Existential Realism

A Philosophy of Time for the 21st Century

Monograph

Tenzin C. Trepp

"Of all obstacles to a thoroughly penetrating account of existence, none looms up more dismayingly than "time." Explain time? Not without explaining existence. Explain existence? Not without explaining time. To uncover the deep and hidden connection between time and existence . . . is a task for the future."

— John A. Wheeler, "How Come the Quantum?", Annals of the New York Academy of Sciences, Vol. 480 (1986), p. 304.

Why Time Remains Poorly Understood

Time is arguably the most fundamental condition of existence—and yet, it remains one of the most neglected and misunderstood topics in both science and philosophy. Several reasons explain this strange omission:

I.
It is too familiar.

We schedule, measure, and manage time constantly. But this familiarity breeds illusion: we understand clocks, not time.

II.
Physics hasn't settled it.

Classical physics treated time as absolute; relativity showed time is not absolute; quantum theory treats it as a passive backdrop. No unified account has emerged.

III.
It resists intuition.

We feel time flowing. But many scientific models deny that anything flows at all. This gap between lived experience and abstract theory remains unresolved.

IV.
Philosophy stepped back.

After centuries of grappling with time's metaphysics, modern philosophy often retreated into logic and language, leaving deep ontological questions to physics.

V.
It's been instrumentalized.

Time became a resource—something to optimize, schedule, or calculate—rather than a subject worthy of first-order inquiry.

VI.
It is existentially uncomfortable.

Time reminds us of impermanence, change, and death. To truly face time is to confront the limits of control and the fact of becoming.

These factors have led to an intellectual vacuum. Neither physics nor philosophy, on their own, provide an integrated account of time that aligns with both empirical knowledge and lived experience.

A Return to Time

The moment is overdue for a renewed inquiry—one that refuses to reduce time to equations, metaphors, or illusions. The question of time must be reopened at the intersection of physics, phenomenology, cognitive science, and ontology.

Existential Realism is proposed as a framework that takes this challenge seriously. It begins not with abstract models, but with the present—the only locus where existence can be confirmed. From there, it reconstructs a layered view of reality that includes the past and future as real, but not existent, entities.

This framework doesn't reject scientific models, but reframes their assumptions—placing becoming, not being, at the center of ontological gravity.

To understand existence, reality, causality, identity, and agency, we must understand time.

And to understand time, we must stop avoiding it.

Time, at last, deserves to be understood as real.

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Foundation

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Where Time Begins Again

What if only the present exists — but more than the present is real? This opening paper lays the ontological groundwork of Existential Realism, a new framework that disentangles existence from reality, reimagining the structure of time itself.

Existential Realism: A Distinct Ontological Framework Beyond Presentism

Tenzin C. Trepp

Email: trepp@tenz.in

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Abstract

This paper introduces Existential Realism as a novel ontological framework in metaphysics, offering a rigorous alternative to presentism. Rather than equating reality with what exists in the present,[1] Existential Realism **distinguishes** existence—material, empirically accessible presence—from **reality**, which also encompasses causal traces, knowledge structures, and anticipated possibilities beyond the immediate now. This framework integrates insights from metaphysics, epistemology, and phenomenology to address the limitations of presentism and related theories of time. We delineate how Existential Realism departs from presentism (and is not merely a variant thereof) by reinterpreting what it means for an entity or event to exist *now*, while still affirming the ontological significance of past and future entities as *real* despite their lack of present existence. Systematic comparisons are drawn between Existential Realism and the standard theories of temporal ontology – presentism, eternalism, and the growing block theory – with references to key contributors (Markosian, Crisp, Bourne, Zimmerman) to highlight differences in ontological commitments. We provide technically grounded examples—from causal traces in physics to cognitive-state evidence and time-indexed data structures—to show how entities can be real even without presently existing. The paper also addresses major objections, including the coherence of reality without existence, the epistemological access to entities that do not presently exist or are unobservable, and the compatibility of this framework with special relativity. A comparative table is included to map Existential Realism vis-à-vis other theories. In conclusion, Existential Realism is presented as a robust, integrative stance that preserves the empirical and experiential centrality of the present while acknowledging the enduring reality of the past and the looming reality of the future – thus serving as a stand-alone reference framework for future discourse in metaphysics and cognitive science.

1 https://plato.stanford.edu/entries/presentism/#:~:text=instance%2C%20neatly%20articulates%20this%20apparent,mainstream%20characterisation

Introduction

The ontology of time – specifically the question of which events or entities in time *exist* or are *real* – has long been a central debate in metaphysics. Traditional positions include **presentism**, which asserts that only present entities exist,[2] **eternalism**, which holds that past, present, and future entities all exist equally,[3] and **growing block theory**, which posits that the past and present exist while the future does not yet exist.[4] These views make competing claims about temporal reality: as Sider concisely puts it, "presentists and eternalists make competing claims about temporal ontology. According to presentism, only present things exist. According to eternalism, past and future things… exist as well. [Growing block theorists] say that there are past and present things, but no future things".[5] Each of these standard views faces well-known philosophical challenges. Presentism, for example, must explain how truths about the past can remain meaningful if the past is no longer real,[6] and it has been criticized for erasing the ontological status of past events in a way that raises problems for truthmaking, memory, and moral accountability. Eternalism and growing block theories avoid those issues by granting reality to non-present times, but raise other concerns (such as tensions with our intuitive experience of the "now" and, in the case of growing block, the ambiguity of the moving present). Moreover, special relativity complicates any theory that privileges an absolute present—making it crucial to explore frameworks like Existential Realism that preserve temporal asymmetry without metaphysical absolutism.[7]

Within this context, we propose **Existential Realism** as a new ontological framework that re-examines these debates. Existential Realism is *not* a mere variant of presentism; rather, it is a systematic rethinking of temporal ontology that integrates **metaphysical** distinctions, **epistemological** constraints, and **phenomenological** insights. The central motivation is to preserve what is compelling in presentism – the idea that **existence** is tied to the present – while remedying its shortcomings by introducing a crucial distinction between what *exists* and what is *real*. In brief, Existential Realism agrees with presentism that only present entities *exist* in the fullest ontological sense, but emphatically rejects the presentist inference that only present entities are real. By redefining "existence" to include an epistemic/empirical criterion and by acknowledging a broader category of "reality" that includes past and future in a well-defined way, Existential Realism aims to capture a more nuanced ontology of time. This framework thereby respects the empirical centrality of the present (our only point of direct access to the world) while also affirming the ontological **reality** of the past and future as structural parts of the world (through their causal efficacy, inferential support, or anticipation in thought and practice).

The remainder of this paper is structured as follows. In §2, we introduce the core principles of Existential Realism, carefully defining *existence* versus *reality* and explaining why this distinction is philosophically significant. §3 discusses how this framework inherently integrates epistemological and phenomenological considerations that are often side-lined in pure metaphysical debates about time – drawing on Husserl's analysis of time-consciousness and van Fraassen's empiricist criteria, among others. In §4, we present a systematic comparison between Existential Realism and the standard theories of time (presentism, eternalism, growing block theory), citing key arguments from philosophers such as Markosian, Crisp, Bourne, and Zimmerman to situate our framework in the existing literature. A comparative table is provided to summarize differences in ontological commitments across these views. In §5, we offer technically grounded examples illustrating how something can be real without existing (for instance, how *causal traces* left in physical systems attest to the reality of past events, or how *anticipatory states* in cognitive and computational systems give reality to future possibilities). §6 then addresses several potential objections: (a) the conceptual coherence of treating something as real despite its lack of existence, (b) the question of epistemic access to entities that do not presently

2 https://plato.stanford.edu/entries/presentism/
#:~:text=instance%2C%20neatly%20articulates%20this%20apparent,mainstream%20characterisation
3 https://plato.stanford.edu/entries/presentism/#:~:text=just%20like%20actualism%2C%20possibilism
4 https://plato.stanford.edu/entries/presentism/#:~:text=W.V.%20Quine%E2%80%99s%20%281948%29%20three%20Anglo,%C2%A76
5 Ibid.
6 https://markosian.net/wp-content/uploads/2015/12/defpres.pdf
#:~:text=Taj%20Mahal%20would%20be%20on,any%20other%20putative%20object%20that
7 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism-eternalism-and-relativity-physics.pdf#:~:text=entire%20series%20represents%20the%20evolution,relativity%20requires%20privileging%20a%202

exist or that are intrinsically unobservable, and (c) the compatibility of Existential Realism with the relativistic nature of time in modern physics. Finally, §7 concludes by summarizing the contributions of Existential Realism and suggesting how this new framework can serve as a reference point for future interdisciplinary research in metaphysics and cognitive science.

Existence vs. Reality: Core Distinction of Existential Realism

At the heart of Existential Realism is a precise distinction between *existence* and *reality*. In everyday language, these terms are often used interchangeably – one might say "dinosaurs no longer exist" to mean they are not real now. Traditional presentism similarly conflates existence and reality, asserting that only present things exist, and thereby only present things are real.[8] By contrast, Existential Realism proposes that it is possible (and indeed necessary) to differentiate what *exists* from what is nonetheless *real*. This distinction can be formulated as follows:

- **Existence (in the strict ontological sense):** an entity or event *exists* (now) if and only if it is present *and* materially/empirically accessible at this moment. In other words, existence requires not just temporal presence but also the capacity for **empirical engagement** – the entity is here-and-now and, at least in principle, observable or measurable in the present. By "empirically accessible" we mean that there are possible observational or experimental circumstances under which the entity would manifest itself to an observer or measuring apparatus *at this time*. This criterion is inspired by the empiricist insight that "what is observable by us" shapes what we can meaningfully claim. It aligns with Bas van Fraassen's emphasis that while observability is not a criterion of *ontological* possibility per se, it is crucial in defining the proper epistemic stance towards what we consider to be real. (As van Fraassen notes, "even if observability has nothing to do with existence [is, indeed, too anthropocentric for that], it may still have much to do with the proper epistemic attitude to science". Existential Realism takes a bold step of building this "epistemic attitude" into the very definition of existence.) Thus, under Existential Realism, existence is a **strong** condition: being temporally present is necessary but not sufficient – the entity must also *manifest* in the empirical/experiential realm of the now. If something is entirely undetectable *in principle* at the present moment, then in this framework, it does not qualify as "existent," no matter its other ontological credentials.
- **Reality (in the broader metaphysical sense):** an entity or event is *real* if it plays a role in the causal, structural, or epistemic fabric of the world, even if it does not exist at present. The category of reality thus **includes but is not limited to** all presently existing entities. Crucially, it also includes past entities that *did* exist and left causal traces or records, as well as future entities or events that *will* exist or are anticipated in a way that influences present cognition or action. Reality, in this sense, is the encompassing ontology of everything that contributes to the world's causal story or our justified beliefs, *regardless of its temporal mode of being*. An entity can be real without existing now: for example, a past event like the eruption of Vesuvius in 79 CE is undeniably part of reality given its effects (Pompeii's ruins, historical narratives, geological traces) even though it fails to meet the above criterion for existence (it is not present or observable now). Likewise, a future event (say, a solar eclipse next year) can be considered real in the sense that it is *anticipated by reliable scientific theory and current causal conditions*, and present agents prepare for it – it has a kind of **anticipatory reality** even though it obviously does not exist yet in the present. Reality thus comprises an extensive network of *causal and informational structures* across time. It is a dimensional extension of the world beyond the knife-edge of the present, incorporating what Husserl would call the horizons of retention (just-past) and protention (immediate future) in consciousness,[9] as well as more remote past and future events as they figure in our theories and explanations.

8 https://plato.stanford.edu/entries/presentism/
#:~:text=instance%2C%20neatly%20articulates%20this%20apparent,mainstream%20characterisation
9 https://en.wikipedia.org/wiki/Retention_and_protention
#:~:text=Retention%20is%20the%20process%20whereby,a%20moment%20of%20sense%20perception

Under Existential Realism, *only present, empirically accessible entities exist*, but many other things are real. This resolves a tension in presentism: standard presentism says past and future entities are simply *not there* in any sense – "all such objects are unreal, according to presentism," as Markosian puts it of Socrates or one's future grandchildren.[10] That stance leads to well-known problems: if the past is unreal, how do we account for the truth of statements about the past, the efficacy of past causes, or the content of memories? By contrast, Existential Realism holds that although past entities **do not exist now** (Socrates is not present to be interacted with), they remain **real** insofar as they have left enduring effects and information in the present. The past is *ontologically real* – it belongs to the world's furniture – even though it has no current existence. This move preserves the meaningfulness of historical truths and causal explanation: e.g., "Napoleon existed and his actions are real in their historical impact, though Napoleon does not exist now" is a coherent statement in Existential Realism. It avoids what presentist critics call "metaphysical erasure" of the past. Similarly, the future, while not existent, can be treated as real in a *different mode*: it is real as a set of **possibilities and tendencies** that exert influence on present decision-making (through expectations, plans, and probabilistic causal developments). For instance, a predicted storm doesn't exist now, but its reality is felt when we take an umbrella, just as *the future exerts real force in the form of expectation and potential*. In short, reality is a broader category that transcends temporal presence, whereas existence is tightly bound to the present and to empirical presence.

To formalize this distinction, we might introduce two operators or quantifiers—one for existence, **$E!(x)$**, meaning "exists now" (i.e., is empirically accessible in the present), and one for reality, **$R(x)$**, meaning "is real" (i.e., plays a role in the ontology of the world, even if not presently accessible). Then **Existential Realism** asserts:

- $E!(x)$ is true only if x is present and observable at the current time (otherwise false).
- $R(x)$ can be true even if $E!(x)$ is false, as long as x has either existed in the past or will exist (or in general plays a role in the causal/epistemic structure).

Presentism would collapse these by saying $R(x)$ iff $E!(x)$ (only present things are real), while eternalism would say that if x is past or future, it still counts under $E!$ in a tenseless sense (effectively treating $E!$ as always true for all times). Existential Realism keeps them distinct, thereby allowing a consistent ontology in which "reality without present existence" is not a contradiction but a defined state.

It is important to note that this framework constrains existence with an epistemic **accessibility** condition without lapsing into verificationism or denying the existence of unobserved present entities. The criterion is *"observable in principle, now"*. This does not mean that to exist, something must be actively observed at this instant by a human – rather, it must be the kind of thing that is **corporeally present and detectable** given appropriate interactions. A distant star that currently emits light and could be seen with a sufficiently powerful telescope, for instance, counts as existing (even if no one is currently looking at it) because it is presently part of the observable universe – there are circumstances under which its presence would be registered (the light eventually reaching us).[11] By contrast, a hypothetical object completely causally disconnected from our universe or a hidden variable with no measurable effect "even in principle" would not count as *existing* in the strong sense here (we might remain agnostic or call it non-existent until it gains empirical foothold). This strict notion of existence resonates with the **constructive empiricist** position in philosophy of science: one only needs to believe in the *empirically observable* aspects of a theory, not in the unobservable entities posited.[12] Van Fraassen famously defines observability in a pragmatic way – for example, 'X is observable if there are circumstances such that, if X is present to us under those circumstances, then we observe it.'[13] While he does not equate observability with existence, he links it to what we should rationally believe. Existential Realism effectively builds a similar insight into its ontology: the only entities we *positively affirm* as existing are those meeting the observational criterion, but we *acknowledge* as real a wider range of

10 https://markosian.net/wp-content/uploads/2015/12/defpres.pdf
#:~:text=Taj%20Mahal%20would%20be%20on,any%20other%20putative%20object%20that
11 https://plato.stanford.edu/entries/constructive-empiricism/#:~:text=match%20at%20L300%20,van%20Fraassen%201980%2C%2016
12 https://plato.stanford.edu/entries/constructive-empiricism/#:~:text=Constructive%20empiricism%20is%20a%20view,realism%20that%20claims%20the%20following
13 https://plato.stanford.edu/entries/constructive-empiricism/#:~:text=match%20at%20L300%20,van%20Fraassen%201980%2C%2016

entities that fall outside current observation (past or future). This yields a picture of the world that is ontologically parsimonious about what exists (no unwarranted ontological commitment to non-present things) yet rich in what is real (no causal or meaningful aspect of the world is denied reality simply due to temporal position).

In summary, the core of Existential Realism is this **two-tier ontology**:

- **Existence = Present + Empirical accessibility.** (This protects us from ontological commitment to anything wholly inaccessible or merely inferred without possibility of verification at present.)
- **Reality = Existence + (Causal/Epistemic network).** (This ensures that we account for the full tapestry of the world's events and structures across time, preserving truths about the past and rational expectations about the future, as well as the status of theoretical entities.)

By separating these notions, Existential Realism *retains the intuitive appeal of presentism's focus on the now* – after all, our only direct contact with the world is in the present moment, through perception and experiment – but *without* the radical deletion of past and future that presentism entails. Reality is larger than presence, but existence is grounded firmly in presence. In the next section, we will see how this reorientation naturally brings epistemology and phenomenology into the ontological picture, areas where presentism is often silent.

Clarifying Terminology: Reality and Cognitive Construction

In this paper, terms like *memory*, *expectation*, or *retention* are sometimes described in relation to "mental" or "cognitive" states. However, these should not be taken to imply that past and future are *merely* subjective or fictional. Rather, such constructs are **cognitive models of real events** — formed within conscious agents, but **grounded in physical traces, causal consequences, or structured anticipations**.

In this sense, a memory of a past event is a real cognitive representation of something that is ontologically real (though not existent), just as a forecast or plan refers to a **real future possibility**, not a free invention. Existential Realism acknowledges this representational structure, without reducing the past and future to internal fictions.

Existential Realism holds that **all material existence is temporally located in the present**. Matter exists only **now**, not in the past or future. A dinosaur's body, for example, no longer exists — it has decomposed, transformed, and passed. However, the dinosaur remains **real** in the ontological sense: it left effects, traces, and changes that are part of the present world. This contrasts sharply with Eternalism, which treats all events — and by implication, all matter — as equally existent in a timeless block. ER rejects this: **there is no past matter lingering in a spacetime "elsewhere"**. Only the present is materially populated; reality, by contrast, stretches beyond it.

We use 'reality' to mean ontological relevance: specifically, entities or states that leave causal traces, are representationally encoded, or are structurally necessary for explaining present conditions. We are not claiming that past events retain some ghostly half-existence; rather, we claim that they are ontologically real insofar as their effects persist in the present. We treat the future as potentially real insofar as structured models and predictive systems in the present are causally and representationally oriented toward it.

Integrating Epistemology and Phenomenology

One of the distinctive features of Existential Realism is that it explicitly incorporates **epistemological** and **phenomenological** considerations into the heart of its ontological framework. Metaphysical theories of time often proceed in abstraction, stating which times or entities exist, but saying little about how we *know* about those entities or how we *experience* time. Presentism, for instance, usually offers an ontological claim ("only the present exists") without examining in depth the epistemic question of **how we, situated in the present, access or infer other times**, or the phenomenological question of **how the flow of time appears in consciousness**. Existential Realism, by contrast, was formulated with these questions in view. By tying existence to empirical accessibility, it directly links ontology with epistemology; by acknowledging the reality of past and future in terms of traces and anticipation, it resonates with how we *experience* memory and expectation. We elaborate these points here.

Epistemic Foundations – Knowing What Exists and What Is Real

The requirement that to exist (now) is to be empirically observable (now) forces us to consider the **means of verification and evidence** for ontological claims. This echoes the pragmatic stance in science described by van Fraassen, where acceptance of a theory involves believing only in its *empirical adequacy* [14]. In metaphysics, applying such a stance means we avoid committing to entities that play no role in the evidence available at present. This is not to say that unobservable entities (like quarks or distant galaxies beyond our current detectors) are declared unreal – rather, we distinguish: they may well be real (for they have causal effects or are predicted by well-confirmed theories), but we refrain from saying they "exist now" in our ontologically loaded sense until they enter the empirical nexus. This discipline aligns ontology with **epistemic humility**: our picture of what exists must always answer to what can be shown or detected *now*. Such an approach shields the framework from certain speculative excesses and ensures that our metaphysics is **informed by science and empirical knowledge**. It is worth noting that this stance does not undermine science's talk of unobservables; rather, it contextualizes it. Van Fraassen explicitly allows that we can speak of electrons or other unobservables *literally*, but remain agnostic about their existence while affirming that "what the theory says about observable things and events is true".[15] Existential Realism mirrors this: e.g., an electron that is currently being observed in a detector exists; an electron discussed in theory but never yet observed may be treated as a real theoretical entity (especially if it will be observed under certain conditions), but at this moment we wouldn't count it as "existing" sans observation. In practice, as science advances, many theoretical entities transition into observable entities (consider how neutrinos went from hypothetical to detected), thus moving from merely real to existent in our terms.

This epistemic orientation also casts light on *how we know about non-present realities*. Presentists face a puzzle: if only the present exists, in what sense can we *perceive* or *know* anything about the past which (on their view) is nothing? One presentist strategy is to say that there are present *traces* or records that serve as truthmakers for past-tense statements (e.g. fossils, memories) without committing to the past entities themselves.[16] Existential Realism makes this more straightforward by simply saying those past entities are real and have left present evidence. Our epistemic access to the past is via **records, memories, and physical traces**, all of which exist now and are observable, thus satisfying our existence criterion, but importantly they are *about* something real (the past event). We can have justified true beliefs about the past because the past is not an ontological void – it's a real part of the world with which we are indirectly interacting via its residual effects. For example, we can say *"the reality of the Cretaceous period is attested by dinosaur fossils"*. The fossils exist now (we can touch and observe them), and they carry information that logically entails the reality of creatures that no longer exist. In epistemic terms, the inference from present evidence to a past reality is no longer mysterious or problematic – it is simply standard abductive or inductive reasoning about real events that

14 https://plato.stanford.edu/entries/constructive-empiricism/#:~:text=Constructive%20empiricism%20is%20a%20view,realism%20that%20claims%20the%20following
15 https://plato.stanford.edu/entries/constructive-empiricism/#:~:text=Constructive%20empiricism%20is%20a%20view,realism%20that%20claims%20the%20following
16 https://uhra.herts.ac.uk/id/eprint/21583/
#:~:text=rival%20positions%20in%20the%20philosophy,how%20causation%20can%20be%20accommodated

caused the evidence. The difference is that we do not have to pretend, as a strict presentist might, that we are referring to nothing (or to abstract surrogates) when we talk about dinosaurs; we are referring to something real (dinosaurs-as-they-were) albeit not existing now. This perspective aligns well with common scientific and historical reasoning, where unobserved events are considered real if they causally explain what is observed.

For future events, our epistemic access is obviously more conjectural, but we often have rational grounds (scientific predictions, statistical trends) to treat some future happenings as real enough to plan for. Climate scientists treat future sea-level rise as a reality to be reckoned with (even though it doesn't yet exist) because robust models and current measurements indicate it. Existential Realism would say those future states are real in an anticipatory sense and exert *downward causal pressure* on present actions (through our fears or preparations). We know of the future to the extent our theories and imaginations bridge from the present outwards – not with certainty, but with enough structure to include in our ontology as a realm of real possibilities and tendencies.

Phenomenological Integration – The Lived Experience of Time

In tandem with its epistemic grounding, Existential Realism resonates with phenomenology, especially the analysis of time-consciousness by Edmund Husserl and others. Human experience of time is notably *not* one of isolated knife-edge moments; rather, consciousness presents us with a **"specious present"** – a short-duration awareness that includes a just-past and an imminent next moment within the present moment.[17] Husserl's classic account divides the structure of the living present into **primal impression** (the fresh now-point), **retention** (the immediately past content that is still held in consciousness), and **protention** (the anticipation of what is just about to occur).[18] This means that our *phenomenal present* is inherently extended and contains traces of the past and outlines of the future. For example, when listening to a melody, we don't just hear a single note in isolation; we retain the notes just played and anticipate the resolution, thus experiencing a musical phrase as a meaningful temporal whole.[19] Husserl emphasizes that retention is not a mere after-the-fact memory, but a *presentation of that which is no longer* – it renders the just-elapsed tone as still co-given in the now.[20] Protention analogously is a pre-figuring of the next expected tone.[21] In effect, consciousness itself testifies that the past (a moment ago) is *experienced as still real in a diminished way*, and the future (a moment ahead) as also somehow *given* to us pre-reflectively.

Existential Realism's distinction between reality and existence dovetails with this structure. The only thing that *exists* for me right now in hearing the melody is the sound that is striking my ears this very instant. Yet I am directly aware of the previous notes as just-past (they have no physical existence now; the air vibrations have ceased) – but they are not nothing to me, they are **phenomenally real** in my retentional awareness. Similarly, the note I expect next does not yet exist, but it has a kind of intentional reality in my mind (a *protentional object*). By acknowledging that reality outruns existence, we create a conceptual space for understanding how the past and near-future are present in experience. In our framework, one could say: the just-past note is *real* (it affected me and left a mark in my sensory and neural state) though it doesn't exist now; the anticipated note is *real* as an expectation shaped by the melody's structure. **Consciousness thus validates the idea of reality without present existence on the micro-scale of moments.** This provides a phenomenological justification for Existential Realism: it captures the phenomenological "living-present" better than strict presentism does. Presentism would be forced to say that, since only the present exists, strictly speaking my awareness of the just-played note must involve something like an immediate memory or representation, because the note itself is no more. Husserl's analysis agrees it is a representation, but a representation that is

17 https://en.wikipedia.org/wiki/Retention_and_protention#:~:text=Protention%20%28and%20not%20,path%20the%20ball%20will%20take
18 Ibid.
19 https://en.wikipedia.org/wiki/Retention_and_protention#:~:text=ball%20being%20thrown,a%20moment%20of%20sense%20perception
20 https://en.wikipedia.org/wiki/Retention_and_protention
#:~:text=Retention%20is%20the%20process%20whereby,a%20moment%20of%20sense%20perception
21 https://en.wikipedia.org/wiki/Retention_and_protention#:~:text=Protention%20%28and%20not%20,path%20the%20ball%20will%20take

experienced as part of the now, not as a separate act of recollection.[22] By calling that past note *real* in consciousness, we mirror that structure.

We also find alignment in the work of cognitive scientists and philosophers of mind such as Thomas **Metzinger**, who describes consciousness as operating with a "window of presence" that is not an infinitesimal instant but a short temporal window that moves along with the mind's focus.[23] Metzinger notes that the window of presence is "not an infinitely thin time-slice, but a specious present which includes events taking place within a moving window".[24] In his terms, one of the necessary conditions for a conscious self-model is that its contents are integrated into such a temporal window (Constraint 2: activation within a window of presence).[25] This interdisciplinary perspective (sometimes called *neurophenomenology*) reinforces the idea that our brains themselves maintain an integrated model of reality that spans a short duration of time – effectively treating very recent past events as still part of the world model, and very imminent events as already shaping that model. Such findings and theories in cognitive science provide a naturalistic backbone to the phenomenological observations: the continuity of consciousness is grounded in neurological mechanisms that retain and predict within a short temporal horizon.[26] Existential Realism conceptually accommodates this by allowing that the brain can treat past inputs and future predictions as *real* parts of the current state of the world model, without those inputs needing to *exist physically* at that moment.

Finally, integrating epistemology and phenomenology into our ontological framework also helps address ethical and existential dimensions. If one considers how we relate to past and future in human life, treating them as utterly unreal (as naïve presentism might) can lead to a disregard for history or future consequences. While this is more a pragmatic or ethical concern than a strictly theoretical one, it underscores the appeal of a view that *does justice to the reality of the past and future*. For instance, we hold people morally accountable for past actions and plan for future generations; these practices tacitly presume that past events and future outcomes *matter* in a real way. Existential Realism provides the metaphysical underpinning for that intuition: the past remains real (hence memory and responsibility have an objective basis) and the future is real enough to compel prudence and hope.

In sum, by explicitly weaving epistemic access and phenomenological structure into its definitions, Existential Realism achieves a more *holistic* ontological stance. It not only specifies what exists and what is real, but also why those distinctions matter for what we can know and how we experience the world. This makes it well-suited for interdisciplinary discussion – for example, in cognitive science or philosophy of mind, where one must straddle between how things are (ontology) and how we find out (epistemology) and how we experience them (phenomenology). Next, we turn to a systematic comparison between this framework and the existing theories of time in metaphysics, to clarify how Existential Realism diverges from or perhaps subsumes aspects of each.

Comparison with Presentism, Eternalism, and Growing Block Theory

To highlight the distinctive commitments of Existential Realism, it is useful to compare it systematically with the three main rival theories of temporal ontology: **Presentism**, **Eternalism**, and the **Growing Block Theory** (also known as the past-and-present theory). We will contrast these views along key dimensions – what exists at a given time, what is considered real, and how each handles the status of past and future – and we will cite influential formulations by philosophers Markosian, Crisp, Bourne, Zimmerman, and others. Table 1 provides a high-level comparative summary, which we will explain in the subsequent text.

22 https://iep.utm.edu/phe-time/#:~:text=Husserl%20draws%20a%20distinction%20between,a%20%E2%80%9Cconsciousness
23 https://phantomself.org/metzinger-being-no-one/
#:~:text=But%20there%E2%80%99s%20more%20to%20it%3A,place%20within%20a%20%E2%80%9Cmoving%20window%E2%80%9D
24 Ibid.
25 https://phantomself.org/metzinger-being-no-one/
#:~:text=Global%20availability%2Fintegration%2C%20the%20window%20of,Metzinger%20describes%20contraints%202
26 https://predictive-mind.net/DOI?isbn=9783958573277
#:~:text=represented%20as%20states%20of%20a,Further%20investigations%20into%20these%20elusive

Table 1. Comparative Ontology of Temporal Theories

Theory	Ontological Claim	Past	Future
Presentism	Only present entities exist (only the present is real) [27].	Past entities **do not exist** and are considered not real (except as *once real*, now nothing) [28].	Future entities **do not exist** and are not real (except as *potential*, but no current reality).
Eternalism	Past, present, and future entities all exist equally (time is a four-dimensional block) [29].	Past entities **exist** (tenselessly) and are real on par with present.	Future entities **exist** (tenselessly) and are real.
Growing Block	Past and present exist (the block grows with time); future does not yet exist [30].	Past entities **exist** (fixed in the block) and are real (the past is an ever-growing archive of reality).	Future entities **do not exist yet** (will come to exist) and thus are not real as of now.
Existential Realism	Only present, empirically observable entities exist (strict present existence); but *reality* extends beyond the present.	Past entities **do not exist now** (they have ceased to be present), but **remain real** by virtue of causal traces, records, and effects in the present. The past is an actual part of reality (it happened and left imprint) though not existent.	Future entities **do not exist yet** (not present), but **are real** inasmuch as they are anticipatable or already causally foreseen. The future exerts a real influence (through present predictions, plans, tendencies) despite its lack of current existence.

(Key: "Exist" means included in ontology as present beings; "Real" means considered an actual part of the world's framework in that theory. Present is trivially "exist and real" for all theories, hence not listed.)

Presentism

Presentism, as introduced earlier, is the view that **only present things exist**.[31] In Markosian's words, if we were to list "all the things that our most unrestricted quantifiers range over – there would not be a single non-present object on the list... All such [non-present] objects are unreal, according to Presentism".[32] Thus, dinosaurs, Socrates, or tomorrow's events are *literally nothing* in the ontology of a presentist (except inasmuch as one might say Socrates **existed** but that is just to say: he is not there now). The appeal of presentism has often been its accord with common-sense intuition – it seems to capture how we naturally speak about time ("the past is gone, the future is not yet") and it upholds a dynamic view of time where the *now* has a special status. Markosian (a presentist) calls it the "common sense" view that the average person on the street would accept.[33] Presentism may also carry cultural or existential appeal: it resonates with intuitions about the transience of life, the immediacy of experience, or the idea that one should "live in the present." However, such motivations—while psychologically understandable—are distinct from the theory's analytical commitments, which are the focus of our critique here.

The major challenges for presentism are well documented in metaphysical literature [34]. They include:

- **Truthmaker and Reference Problems:** How to account for the truth of propositions about the past or future if, according to presentism, the past and future do not exist at all? For example, the statement "Julius Caesar was assassinated in 44 BCE" is true – but what in the present makes it true if Caesar and that event no longer exist? This is known as the **truthmaker prob-**

27 https://plato.stanford.edu/entries/presentism/
#:~:text=instance%2C%20neatly%20articulates%20this%20apparent,mainstream%20characterisation
28 https://markosian.net/wp-content/uploads/2015/12/defpres.pdf
#:~:text=Taj%20Mahal%20would%20be%20on,any%20other%20putative%20object%20that
29 https://plato.stanford.edu/entries/presentism/#:~:text=,2006%3A%2075
30 https://plato.stanford.edu/entries/presentism/#:~:text=W.V.%20Quine%E2%80%99s%20%281948%29%20three%20Anglo,%C2%A76
31 https://plato.stanford.edu/entries/presentism/
#:~:text=instance%2C%20neatly%20articulates%20this%20apparent,mainstream%20characterisation
32 https://markosian.net/wp-content/uploads/2015/12/defpres.pdf
#:~:text=2%20a%20list%20of%20all,any%20other%20putative%20object%20that
33 https://markosian.net/wp-content/uploads/2015/12/defpres.pdf
#:~:text=I%20endorse%20Presentism%2C%20which%2C%20it,But%20there%20are
34 https://plato.stanford.edu/entries/presentism/#:~:text=view%20%28e,to%20help%20meet%20these%20challenges

lem for presentism [35]. Presentists have proposed various solutions, such as truthmakers in the form of present states of affairs (e.g., historical records, present memories, or traces) or invoking primitive tensed truth values. Craig Bourne's work *A Future for Presentism* (2006) is a sustained effort to solve these issues: Bourne develops an "ersatz presentism" where abstract surrogates or truths are employed to stand in for past entities, and provides a framework to handle cross-temporal relations, truth conditions for past-/future-tensed statements, and causal relations in a presentist ontology.[36] For instance, Bourne discusses how we can "meaningfully talk about past individuals" and how causation can be accommodated even if only the present exists.[37] These solutions often make presentism a more complex theory than its initial simplicity suggests – requiring additional ontology like abstract states or special primitives.

- **Cross-temporal Relations:** How can present things bear relations to past things (like remembering, or being influenced by) if the past things are not there? This extends the truthmaker problem into the realm of relations: cause and effect across time, or personal identity over time (how is a present person the same person as who existed in the past, if that past person strictly does not exist now?). Thomas Crisp has examined whether presentism can accommodate such "cross-time" relations without contradiction.[38] One approach is to say relations like "x is the same person as y" where y is past, are really relations between x and present facts (memories, records) about y. But the worry is that this either reduces to triviality or covert eternalism. Indeed, Crisp (2007) argues that presentism risks triviality or obvious falsehood: if taken as a mere logical truth it says nothing informative, and if taken robustly it faces these relational problems.[39]

- **Relativity of Simultaneity:** Possibly the most discussed problem is the conflict with special relativity. Presentism traditionally assumes an absolute notion of the present (a single instantaneous state of the universe that is "the present"). But in relativity theory, simultaneity is relative to frames of reference; there is no frame-independent present. As a result, many argue that presentism is incompatible with relativity's empirical success.[40] Some presentists (e.g. Dean Zimmerman, and the contributors to *Einstein, Relativity, and Absolute Simultaneity* (2008)) have attempted to defend a version of presentism by positing a physically undetectable absolute frame or a privileged foliation of spacetime that picks out "the present" everywhere.[41] Crisp also explored replacing the eternalist geometry in relativity with a presentist alternative (one special hypersurface representing the present that evolves).[42] However, as Crisp notes, many physicists would see that as a substantive departure from orthodox relativity.[43] The conventional wisdom is that relativity *implies* eternalism (since the spacetime model treats time as another dimension of reality, with all events in a static four-dimensional structure).[44] Markosian and others have responded that presentism isn't strictly disproven by relativity – one can interpret relativity in a way that's empirically equivalent but metaphysically presentist (for instance, a Lorentzian interpretation with a preferred frame hidden). Still, the tension remains a serious concern for presentism's viability in light of physics.

Existential Realism in relation to presentism: It shares the intuition that only the present **exists** (in fact it tightens that by adding "observable now" as a constraint for existence). But it fundamentally diverges by denying that "only the present is real." It thereby avoids the truthmaker and cross-temporal relation problems by simply asserting that past entities/events are real (so statements about them

35 https://uhra.herts.ac.uk/id/eprint/21583/
#:~:text=rival%20positions%20in%20the%20philosophy,how%20causation%20can%20be%20accommodated
36 https://uhra.herts.ac.uk/id/eprint/21583/
#:~:text=tenseless%20theory%20of%20time,II%3A%20Presentism%20and%20Relativity%2C%20Bourne
37 Ibid.
38 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism-and-cross-time-relations.pdf#:~:text=%5BPDF%5D%20PRESENTISM%20AND%20%E2%80%9CCROSS,-case%20that%20presentism%20is%20true
39 https://thomasmcrisp.com/wp-content/uploads/2017/07/on-presentism-and-triviality.pdf#:~:text=,call%20this%20the%20%E2%80%9C
40 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism-eternalism-and-relativity-physics.pdf
#:~:text=entire%20series%20represents%20the%20evolution,relativity%20requires%20privileging%20a%202
41 Ibid.
42 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism-eternalism-and-relativity-physics.pdf
#:~:text=thinking%20of%20some%20relativistic%20spacetime,world.%20The
43 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism-eternalism-and-relativity-physics.pdf
#:~:text=To%20be%20sure%2C%20this%20isn%E2%80%99t,relativity%20requires%20privileging%20a%202
44 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism-eternalism-and-relativity-physics.pdf
#:~:text=3%20its%20spacetime%20models%20and,on%21past%2C%20present%20and%20future%21are%20embedded.3

can be straightforwardly true or false about those real entities), and that we do have causal relations with them (they produce present evidence, etc.). We do not require exotic ontology of "ersatz times" or present truthmakers for past truths beyond the past events themselves – the past events themselves, though not existent now, are available to serve as truthmakers *because they are real* and left effects. In a slogan: **Presentism erases; Existential Realism preserves.** It preserves the ontological status of the past and future as parts of reality, thus respecting the continuity of time and experience. At the same time, it does incorporate some of presentism's motivation: it restricts *existence* to the present, capturing the idea that to *be* (fully and concretely) is to be now. This is why we stress that Existential Realism is *not* a mere variant of presentism but a different framework: it reframes the debate by dividing the question 'What is real?' into two sub-questions: 'What exists now?' and 'What else is real (despite not existing)?' – a nuance absent in classical presentism.

Eternalism

Eternalism posits a four-dimensional ontology where all times (past, present, and future) are equally existent and real. Time is often likened to a spatial dimension: just as all locations in space are, in some sense, equally real (here vs there is a perspectival matter), all moments in time are equally real – now is just *here* in time.[45] If one were to adopt the metaphor of a "Block Universe," eternalism says the block (which contains all events past through future) is laid out, and our sense of flow is an illusion or a subjective perspective. Philosophers like W.V.O. Quine and Ted Sider have supported eternalism as a straightforward reading of the tenseless theory of time and as consonant with modern physics.[46] Eternalism has the advantage of easily solving the truthmaker issue: statements about past or future are true because those events exist (tenselessly) and have the properties the statements assert. Relations across time are just like relations across space – unproblematic if the relata all exist in the four-dimensional manifold.

However, eternalism comes at the cost of denying any objective *becoming* or *privileged present*. It is often criticized for clashing with our experiential distinction of past, present, and future. Human experience and deliberation treat the future as *open* or uncertain in a way the past is not; eternalism, by making future events as determinate as past ones, can seem to undermine notions of free will or the significance of the now. Some philosophers, like Husserl or Henri Bergson, would argue that eternalism misses the **phenomenological essence** of time – the flow or duration – by freezing it into an atemporal block.[47] Another issue is epistemic: if future events exist, one might ask why we are epistemically asymmetric (we remember the past but not the future) – a question physics alone doesn't fully answer but is often attributed to entropy increase or the so-called "arrow of time". Eternalists respond that the block can still have an embedded direction (via entropy or other physical asymmetries), and that our perspective is simply localized to one moving point on the block (much as not everything in space is visible from one location).

From the standpoint of Existential Realism, eternalism grants *too much* ontologically: it inflates existence to an omnitemporal set. In our framework, eternalism would be rephrased as saying everything that is real at any time also **exists** (since all times are equally present in the tenseless sense) – a conflation of reality and existence again. Existential Realism would critique eternalism for ignoring the epistemic constraint: many future entities, though real in a sense (as we allow), certainly do not exist now in any empirically accessible way, and to treat them as "equally existent" can be seen as a kind of *metaphysical inflation* that isn't warranted by observable fact. Why say that a lunar base in 2100 AD exists now (eternalism's claim) when clearly it does not exist in the ordinary sense? Eternalists might respond that "exists" is being used tenselessly – but then the notion of existence diverges from anything like presence or availability. We prefer to reserve "existence" for the present, keeping eternalism's insight in the category of "reality" instead. So, in Existential Realism: yes, the future (and past) are real, but no, they do not exist (because existence requires presence). This retains the logical

45 https://plato.stanford.edu/entries/presentism/#:~:text=,nonactual%20things%20exist%3B%20its%20temporal
46 https://plato.stanford.edu/entries/presentism/#:~:text=,2006%3A%2075
47 https://iep.utm.edu/phe-time/#:~:text=Bergson%2C%20James%20and%20Husserl%20realized,consciousness%20shares%20much%20in

consistency of eternalism's block (nothing *magical* pops in or out of existence as time flows – which eternalists often cite as a reason to favor eternalism) but avoids the strange ontology of having, say, my death already "out there existing." In our view, my death is real in the sense that it will happen given certain conditions (and maybe casts a shadow of anticipation on my present decisions), but it definitely does not exist now – which aligns with common sense and how we actually reason about the future.

Eternalism is usually favored for compatibility with relativity: since relativity treats time as a dimension, eternalism fits nicely. Does Existential Realism conflict with relativity as presentism does? We will discuss this in §6.3 in detail, but briefly: Existential Realism does not require a single global hyperplane of "now" that spans the universe. It can allow that *existence* is an inherently frame-dependent or even observer-dependent notion – i.e., what exists (now) for one observer might differ for another, because simultaneity can be relative. This is a subtle point: one could formulate Existential Realism in a relativistically covariant way by saying that **each event has its own local present (itself) and can consider other events in or on its light cone differently**. But since the only strictly existent things are those happening "here and now" for any given frame, there is no contradiction – the framework might just accept a plurality of 'present slices' depending on reference frame, or alternatively posit a physically privileged frame if one wanted to remain classical. In either case, by focusing on empirical accessibility, we note that no observer can empirically access spacelike-separated events "now" anyway (you only see them later via light signals), so operationally each observer's 'existence sphere' is limited to their immediate vicinity. This insight shows how blending epistemology in the ontology naturally meshes with relativity's structure: existence becomes in a sense an *indexical* concept ("exists-now-for-me" or "exists-now-in-this frame") rather than an absolute. Reality, however, is frame-invariant: all observers agree on the reality of, say, an event like a distant supernova (they may disagree on simultaneity ordering, but all will eventually concur it was real and occurred). We thus reconcile relativity by decoupling existence (which need not be an absolute invariant set) from reality (the entire invariant structure of spacetime events). Eternalism achieves reconciliation by making all events equally existent (and then explaining differences as perspective); our approach achieves reconciliation by restricting existence to local nows but not insisting on one global now, thereby not contradicting relativity's empirical content.

Growing Block Theory

The Growing Block theory (or "no futurism") can be seen as a middle ground between presentism and eternalism. In this view (originating with C.D. Broad and others), the past and present exist, but the future does not yet exist.[48] The universe is like a block that is continually growing: new present events come into existence, adding to the block, while what was once present becomes forever part of the past portion of the block. Nothing in the future exists *yet*, so the future is open or indeterminate, but once it happens it becomes fixed in existence. This view preserves a sense of objective becoming (the block is growing, so there is an ontological change) while avoiding the problem presentism has with the past (here the past is still there, as part of reality). It also shares with presentism the idea that the future is not real (hence they can maintain an open future without committing to fatalism).

Growing block faces its own issues: one of the famous objections is the **" epistemic objection"** concerning our knowledge of being in the present. If the block is growing, the present is a moving edge of reality. We think we are in the present – but could it be that we are actually in the past and the block has grown beyond us? In other words, if past people still exist in the block just as real as ever (just not present), then those people would falsely believe they are present. How do we know we are not similarly mistaken, i.e., how to know that "now" is the true edge? This is a subtle epistemic paradox that growing block theorists have addressed by pointing out asymmetries (like the presence of certain impressions or the fact that by definition "being present" might not be something one can be wrong about if defined properly). Nonetheless, it indicates a potential conceptual awkwardness.

Another challenge is relativity (similar to presentism: defining a global growing "edge" runs into prob-

48 https://plato.stanford.edu/entries/presentism/#:~:text=W.V.%20Quine%E2%80%99s%20%281948%29%20three%20Anglo,%C2%A76

lems with frame variance – though one might attempt a covariant version of growing block as well).

In terms of reality and existence categories, Growing Block says: past exists (and is real), present exists (and is real), future is not yet real or existent. So it basically concedes reality to the past like eternalism, but not to the future (like presentism for the future). Thus it solves past-directed truthmaker issues (past is there) but retains an open future.

Existential Realism's stance compared to Growing Block: in our terms, we agree that the past is real and the future is not *ontologically realized* yet (not existing). However, we would stop short of saying past entities still "exist" now. For Growing Block, a past event like the signing of the Magna Carta in 1215 *exists* in the block (it's just not at the edge). For us, that event does not exist (it's not present), but it is real. One might think this is a minor verbal difference – but it has implications. In Growing Block, past objects are still out there, in a sense, maybe inaccessible but existing somewhere back in time. In Existential Realism, past objects have no current being; what exists now from that event are only its traces (documents, continuing effects). We might say the difference is between a four-dimensional ontology (where objects have temporal parts and earlier temporal parts still exist) versus a three-dimensional ontology with persistence but only present stages existing.

Interestingly, one could potentially reformulate growing block in our framework by saying: as time advances, new entities come into existence (become present and observable), while old ones cease to exist; however, those old ones remain real. That sounds almost exactly like Existential Realism's dynamic picture. Indeed, we can describe time's passage under Existential Realism similarly: at one moment, t_1, certain things exist and all previous things are real; a moment later, t_2, some new things exist (that didn't at t_1) and some things that existed at t_1 no longer exist (they have "dropped into reality" as opposed to existence). The world's reality thus accumulates more and more history, but existence is always confined to the moving present. This is effectively a growing-block style evolution, except we avoid saying past things *still exist* in any tenseless sense. The difference might be more terminological, but it is important for us to maintain that empirical criterion – one might say Growing Block allows unobservable past entities to nonetheless exist (they're part of the block though we can't interact with them anymore), whereas we would say if it's not interactable now, it doesn't exist now. But we converge on the idea that the ontology of the world "grows" and never shrinks – reality is cumulated.

Thus, out of the three traditional views, Existential Realism is perhaps closest to a "presentist-flavored growing block" but with the explicit reality/existence split. It agrees with growing block that the past is real and the future is not (yet), and with presentism that only the present exists. In doing so, it forms a coherent synthesis that addresses many of the motivations of each:

- Like presentism (and unlike pure eternalism), it preserves an *objective present* in the sense that only now has full ontological weight of existence.
- Like eternalism (and growing block), it affirms that the past is ontologically significant (real) and not obliterated into nothingness.
- Like growing block, it captures a sense of *becoming*: things come into existence and go out of existence, but once gone they remain as realities in the world's history.

Where it goes beyond all three is in explicitly incorporating *how we know and experience* these temporal categories, as discussed earlier. Presentism usually bracketers such questions; eternalism often says our subjective experience is merely perspectival; growing block acknowledges experience of flow but doesn't tie it to any epistemic principle. Existential Realism, in contrast, was built from the ground up to respect the primacy of present experience and evidence.

To ensure clarity, we have presented these comparisons in somewhat simplified form (as in the table). In practice, each of these theories has nuanced variants and a vast literature. For example, some presentists allow that past objects "did exist" and attempt to use that tensed fact as a truthmaker; some eternalists adopt a *stage theory* or *worm theory* of identity; some growing block theorists allow partial ordering of time to handle relativity. Our aim here is not to adjudicate among those, but to position Ex-

istential Realism relative to the broad camps. The key takeaway is that Existential Realism *cannot be reduced to any one of them*: it is a genuinely distinct ontological proposal. By distinguishing between reality and existence, it carves out a new space in the logical landscape of temporal ontology. It could be seen as a hybrid, but hybrids often simply combine assumptions of parent theories – whereas our framework restructures the assumptions (it's not just "presentism + eternalism"; it changes the meaning of "exists").

Philosophers have occasionally hinted at ideas similar to aspects of this framework. For example, some discussions in the literature explore whether presentists could say past things are real in some attenuated sense (without existing) to solve truthmaker problems – but typically they shy away from that as seemingly contradictory within the presentist definition of real. The move we make is to change the definitions so that it is no longer a contradiction but a tautology that something can be real and not exist (since we define them differently). Also, phenomenologists like Husserl certainly treated the past as present in consciousness, and empiricists like van Fraassen treated unobservables as something we don't commit to existence. These ideas were rarely merged into one metaphysical view; doing so is precisely the novelty of Existential Realism.

Having established what Existential Realism is and how it stands in relation to established positions, we will now illustrate the framework with concrete examples and then tackle some critical objections that might be raised.

Examples Illustrating Existential Realism in Practice

To make the abstract principles of Existential Realism more concrete, we present a few examples drawn from science, cognition, and information systems. These examples demonstrate how something can be *real without existing* in the present, and how distinguishing existence from reality provides explanatory clarity.

Example 1: Causal Traces in Physics (Past Reality). Consider a distant star that exploded as a supernova 10,000 years ago. The light from this event is just reaching Earth now, appearing as a sudden brightening in the night sky. At the moment we observe it, does the supernova *exist*? According to Existential Realism: the explosion itself occurred millennia ago; by now, the star's remnants exist (perhaps a neutron star or expanding nebula) but the explosive event *does not exist now* – it's over. Yet the event is undoubtedly *real*: it really happened, and we are witnessing its **causal trace** (the arriving photons). Those photons exist now (we detect them in our telescopes), and they carry information about a real past event. A presentist might struggle here: if only the present exists, in what sense can we say "the supernova happened" other than as a true sentence? In our framework, we say the supernova is part of reality (the world's history) and that reality is evidenced by something that exists now (the light). The past event is real enough to be the cause of present observations. In physics, one often speaks of the "light cone" – everything in our past light cone can affect us. The past light cone of an observer contains events that no longer exist but are certainly real insofar as they causally determine the observer's present state. The cosmic microwave background radiation is another example: it is a present field of photons (so it exists) that reveals the reality of the Big Bang's aftermath. Thus, physics gives us a picture where past events leave **records or remnants** – a fundamental notion in thermodynamics and quantum theory (irreversible processes, decoherence). Existential Realism naturally accommodates this by positing that those past events, though not existent now, remain real as the source of such causal chains.

Example 2: Observable Cognitive States (Present Evidence of Past Mind). Human memory provides a tangible example of reality without existence on a personal level. When you recall your childhood birthday party, the neurons firing in your brain now exist (they are present and observable with fMRI or EEG technology perhaps), but the event you remember does not exist now. Nonetheless, that childhood event is real enough that it has left a lasting **trace in your brain's structure** – the memory engram. Cognitive neuroscience suggests that memory consolidation literally alters synaptic connections, meaning the past experience has causal effects on the physical present (your brain state)

which in turn affects your present behavior and experience. So from the standpoint of Existential Realism: your childhood experience is real (it's part of the story of the world and of you), and that reality is carried by present physical structures and conscious recollections, which exist now. We don't have to treat your memory as just magically "about nothing" or about some "past abstracta" – it's about a real past self of yours. In phenomenological terms, as discussed, your immediate memory (retention) of just seconds ago is integrated directly into your current experience. On a longer timescale, explicit autobiographical memory still connects you to real events that shaped you. This has implications for personal identity: an Existential Realist view can say you are the same person as the past you not by virtue of an otherworldly persistence, but because those past person-stages are real and causally linked (via memory, body continuity) to the present you (who exists). If those past stages were utterly unreal, it would be hard to ground personal identity or moral responsibility; but if they are real, just not present, we can say, for example, "I am responsible for what I did yesterday because the person who did it is not a fictional or eliminated thing – it's a real temporal part of me, now past but still actual in the tapestry of the world." This example shows how an integrated metaphysics can impact ethics and psychology.

Example 3: Data Structures in Time-Indexed Systems (Reality in Information). In computer science and information systems, one often encounters the concept of a **log** or **version history**. Consider a simple version-controlled database that keeps only the latest state of some data (for efficiency) but logs all changes. At any given time, the database's *current state exists* in memory (and is accessible to queries), whereas past states are not kept as active records – however, one can reconstruct a past state by replaying the log of changes. The past states "do not exist" in the primary storage, yet they are not irretrievable or entirely unreal: they are recorded in the log (a present artifact) and can be inferred. In a broader sense, the *information* about past states is preserved. This is analogous to how the universe "records" its past in various ways (fossils, radiation, memories). From an Existential Realist perspective, we'd say each prior state of the database is real (it truly obtained at some time and influences the present via the log), but only the current state exists. This way of managing data reflects a principle of not redundantly storing everything (just like nature doesn't keep ghosts of the past sitting around – it stores compressions of the past in traces). Another example is a blockchain ledger: when a new block is added, it references the hash of the previous block, creating an immutable chain. All past blocks remain present in the chain (so one could argue they still "exist" as data on the chain). But imagine an optimizing system that prunes old blocks (perhaps after safe archiving) – then only the current, pruned chain exists but ensures that the effect of the old blocks (like final balances) is still encoded. Such a system echoes the idea that past events can be "compressed" into present state without leaving the past events as independent existents.

Example 4: Anticipatory Structures (Future Reality). On the future side, consider a scenario from engineering: a bridge is designed to withstand a certain load in anticipation of heavy trucks that will use it. At the time of design, those trucks may not yet exist. But the possibility – indeed the expectation – of their eventual presence is taken as *real enough* to influence present actions (design choices). The engineering calculations treat the future load as a real parameter (with a safety margin). Or in biology: trees often grow rings that anticipate future stress; for instance, some plants preemptively thicken structures in preparation for seasonal changes. Evolution has encoded future expectations (like winter's arrival) in organisms' current behavior – these expectations are real in the sense that they reliably correspond to future states of the environment. None of this requires assuming the future already exists; rather, it highlights that the *structure of reality includes predictive relations*. In human affairs, a mundane example: we save money for retirement. The retirement phase of our life does not exist now, but we consider it real enough in our personal narrative to alter present behavior. Neuroscience even suggests the human brain uses **predictive processing** at every moment – constantly generating expectations a fraction of a second into the future to compare with incoming sensory data.[49] This implies that our brain's model of the world always contains a "future" component (albeit very short-term predictions), which is essential for perception and action. In Existential Realism terms, the brain treats the immediate future as real in order to navigate smoothly; when the prediction is proven

49 https://predictive-mind.net/DOI?isbn=9783958573277
#:~:text=This%20chapter%20explores%20to%20what,the%20perceptual%20contents%20of%20the

wrong, it updates – but at any given moment, the next few hundred milliseconds of expected input are part of its working reality. This dynamic view of future reality is supported by Metzinger's observation that an "expanded present" can include a bit of future (protention).[50] Thus, anticipating the future is not seen as dealing with unreality or fiction, but with an aspect of reality that is unmanifest yet. We respect that by giving future events the status of *real possibilities*. These have causal power insofar as, for example, the *belief* (justified belief) in a future event can cause present changes – and that belief is justified precisely because the future event is not arbitrary but grounded in natural or rational inference.

Through these examples, we see Existential Realism at work: it provides a clear lens to say *what is there now*, *what has been or will be*, and how they all connect. Past and future are not mystical; they are anchored to present evidence or present projects. Science, memory, engineering, and cognition all rely implicitly on the idea that not everything that matters is "right here right now" – yet what is here now is our only source of access. By formally distinguishing existence and reality, we validate this modus operandi.

Objections and Replies

We now turn to potential objections to Existential Realism. We consider three of the most salient challenges:

Objection 1: "How can something be *real* if it doesn't *exist*? Isn't that a contradiction in terms?" This objection points out that, in ordinary language, calling something "real" usually implies it has being or existence. The idea of reality without existence might sound like doublethink – as if we are sneaking existence in through the back door by using the word "real." A critic might argue that our distinction is merely semantic and that ultimately to be real *just is* to exist, so the proposal either collapses into eternalism (if past/future are real, they must exist somehow) or into presentism (if they don't exist, calling them "real" is empty).

Reply: The crux of this objection is the use of terms. We acknowledge that in many contexts "exists" and "is real" are synonyms. However, philosophy often introduces technical distinctions (consider the distinction between sense and reference, or between analytic and synthetic statements) where common language doesn't. Our move is similarly a technical refinement. The motivation for it comes from the inadequacy of either saying past things exist (eternalism) or that they are unreal (strict presentism). By introducing a terminology where "exists-now" is a stricter notion than "real," we can capture intuitions that would otherwise be contradictory in plain language. It is not a logical contradiction because we are effectively saying there are two modes or levels of being: one tied to presentness and one not necessarily so. We can even use different verbs to avoid equivocation: say, *exist* (for our strict sense) versus *subsist* or *obtains* (for reality in general). For example, "The Battle of Hastings (1066) no longer exists, but it subsists as a real event in history that has left effects." This is analogous to distinctions made in analytic philosophy, such as between *actual existence* and *subsistence* (Russell at times spoke of numbers as not existing in space-time but subsisting). Our approach similarly bifurcates ontology.

Far from being empty, the term "real" as we use it carries substantive content: it means part of the causal and explanatory structure of the world. We can offer a criterion: x is real iff it either exists now or (if not presently existing) there are present existents that are meaningfully related (causally, structurally, informationally) to x in the appropriate way. For a past entity, the relation is typically causation or trace; for a future, it's prediction or potential under physical law. This ensures "real" is not a nebulous term – it's tied to things that *do* exist (the traces or anticipatory signs). So something unreal would be something that has absolutely no connection to anything present (e.g., a purely fictional entity with no impact on the world). By this account, we avoid contradiction: we don't say "nonexistent things are real" in a vacuum; we say, for instance, "past events that no longer exist can still be

50 https://phantomself.org/metzinger-being-no-one/#:~:text=But%20there%E2%80%99s%20more%20to%20it%3A,place%20within%20a%20%E2%80%9Cmoving%20window%E2%80%9D

real *because* we define reality to include having left present evidence."

Another way to see it: Existential Realism uses a two-place predicate: Real(at time T) vs Exists(at time T). Past events are real-at-now (in the sense of having effects now) but they do not exist-at-now. They *did* exist-at-then (when present) and their reality now is a remnant of that existence. There is no contradiction in saying an entity x can have the property *Reality-at-t_2* without *Existence-at-t_2*, if it had *Existence-at-t_1 (earlier)*. Similarly, a future event can have *Reality-at-t_2* (in virtue of rational expectation at t_2) despite lacking *Existence-at-t_2*, if it will have *Existence-at-t_3 (later)*. We are basically temporally indexing these notions to avoid confusion. This indexing makes it clear "reality without existence" is shorthand for "real-at-present without existing-at-present," which is consistent because that same entity might exist at another time or be reachable in principle. Moreover, this distinction has precedent: in modal metaphysics, one distinguishes *actual* versus *merely possible* existence. A merely possible object (like a hypothetical person who could have been born) is not actual (does not exist in our world) but might be considered to have some ontological status in a possible world framework. We are doing something analogous for time instead of modality: non-present objects have a lesser ontological status than present ones, but not none at all.

Objection 2: "If past and future are real, how do we have epistemic access to them, especially if the future doesn't yet exist? Aren't we then committed to knowing the non-existent, which sounds occult?"
This challenges the epistemological side: it's all well and good to label past/future as real, but we cannot observe the past directly (only infer it) and the future not at all (only predict). Perhaps calling them "real" doesn't change the fact that we have no direct epistemic access, and maybe even worsens the issue by implying we somehow *grasp* or refer to these non-existents.

Reply: Our framework actually clarifies epistemic access by routing it through present existents. We never claim a mysterious faculty to perceive the past or future directly. Instead, we precisely note that anything we know about the past or future is mediated by something in the present (a trace, a memory, a sign, a theoretical calculation). Thus, one never "interacts with" a non-existent entity in the raw sense – one interacts with present evidence or constructs. The objection might then say: isn't it enough to just talk about the evidence? Why posit the reality of the past event itself? The answer is that inference to the best explanation in science and common sense posits the existence (or reality) of unobserved entities to explain what is observed. Denying the reality of the past leads to cumbersome indirect speech: you'd have to say "We observe fossils; we don't say dinosaurs are real, only that fossils exist which conveniently are patterned as if dinosaurs once existed." This is an awkward stance, akin to an instrumentalist who doesn't believe in electrons but only in meter readings. By allowing past entities to be real, we can say simply: "Fossils exist, therefore dinosaurs are real (and did exist)." The epistemic access is via the fossils. This is no different logically from scientific realism about unobservables: we infer the real existence of electrons by their tracks in cloud chambers, for example.

Van Fraassen's constructive empiricism would caution us not to commit to the existence of unobservables.[51] Our approach in a sense heeds that caution by not saying "dinosaurs exist now" or "electrons exist unobserved" – we say they are real, which is a more cautious commitment. It's somewhat like saying we *accept* the theory that there were dinosaurs or that there are electrons, which is just what scientists do. If tomorrow new evidence upends that theory, we revise what we count as real. But in the meantime, treating them as real is fruitful. So there's no new epistemic risk introduced by calling them real; it matches scientific practice.

As for the future, our knowledge is certainly less secure. We don't claim to *know* future events with certainty (except perhaps some deterministic ones like orbital mechanics within tolerances). However, we routinely have justified beliefs about the future (e.g., "the sun will rise tomorrow" is extremely well justified). Those beliefs are formed by extrapolation from current existence and laws (the sun exists now and follows physical law). In Existential Realism, saying the sunrise tomorrow is real means essentially that it is *predicted by everything we know and in that sense already part of the unfolding reality*. Our epistemic access to it is via theory and current data – which exist now. There is no violation

51 https://plato.stanford.edu/entries/constructive-empiricism/#:~:text=Constructive%20empiricism%20is%20the%20version,defines%20the%20view%20as%20follows

of standard inferential practices; we simply validate the idea that a well-founded prediction refers to something real (as opposed to treating the future as completely non-being).

The worry may be specifically: how can we refer to or talk about something that doesn't exist? This is an old puzzle in philosophy of language (Meinong's problem: how can we talk about the non-existent?). By distinguishing levels: we refer via descriptions anchored in present evidence or contexts. For instance, "the next total solar eclipse" – this description is intelligible and picks out a unique date given astronomical calculations, even though that event does not exist yet. We might say the description refers to a *future real event*. Its reality consists in the fact that the calculation based on currently existing orbital parameters yields that result. If, hypothetically, something unexpected happens (like the moon shatters before then), then our belief in that future event being real would have been mistaken. But that's the nature of fallible knowledge. We are no worse off calling it "real" conditionally than we are calling it a "confirmed prediction."

In short, Existential Realism does not grant *new* epistemic access; it formalizes the status of what we infer or expect. Everything we claim to know about past or future is firmly rooted in present existents (evidence, records, models), which is entirely in line with empiricist scruples. We simply argue that one should not shy away from saying the inference target (past cause or future effect) is real if the evidence robustly supports it, even though by definition we cannot observe it directly in the present (because it's not present).

Objection 3: "Doesn't special relativity still pose a problem? If existence is tied to 'now' and now is relative, won't different observers have different slices of existence? And if so, is Existential Realism forced into a kind of solipsism of the present or a frame-dependent ontology?"
This objection zeroes in on the compatibility with physics. In relativity, there is no unique present moment spanning all space – simultaneity depends on one's state of motion. If we maintain that only the present exists, we might have to pick a particular frame's definition of present. That either breaks relativity's symmetry (introducing an absolute frame as in Lorentzian interpretations) or leads to a fragmentation where each observer has their own set of existents. Eternalism elegantly avoids this by saying all events exist, so no issue. How do we handle it?

Reply: We partially addressed this earlier, but let's be clear. Existential Realism can be formulated in (at least) two ways in light of relativity:

- **Option A: Absolute present (Neo-Lorentzian approach).** We could posit that despite relativity's empirical findings, there is a true foliation of spacetime into "now slices" – perhaps defined by a preferred frame (sometimes conceptualized as e.g. the rest frame of the cosmic microwave background, or a metaphysical "time of the universe"). This would mean existence is an absolute notion – a common present across the universe – we just don't know empirically which frame it is. Some philosophers and physicists have seriously considered this; for instance, Tooley and Zimmerman have entertained the idea that relativity might be compatible with a privileged present if we allow an undetectable ether or God's time.[52] This view isn't popular in physics since it violates Lorentz symmetry at the fundamental level (with no evidence), but it's not disproven logically. If one took this route, Existential Realism would reduce to an absolutist A-theory akin to presentism in structure, but enriched with the reality/existence distinction. The downside is it undermines one of our goals, which is to be in consonance with scientific naturalism, so Option A is not our preferred stance.
- **Option B: Relativized existence (Frame-dependent ontology).** We can accept relativity fully by allowing that the content of "present existents" may differ by frame or observer, but insisting that this disagreement has no practical consequence because observers cannot communicate faster than light. Essentially, what exists for me "right now" (in my simultaneity slice) might include some events that for you are either in the past or future of your now – but since neither of us can be influenced by events outside our past light cones, this discrepancy doesn't lead to observable conflict. We would then say that reality is four-dimensional (all events are real),

52 https://fas-philosophy.rutgers.edu/zimmerman/Presentism and Rel.for.Web.2.pdf
#:~:text=%5BPDF%5D%20Presentism%20and%20the%20Space,45

aligning with relativity, but *existence* is an emergent, observer-relative notion: each inertial frame slices reality into an experienced now. Does this mean we actually slide back to a kind of eternalism in terms of reality? In a sense yes: Option B basically concedes that all events are real (since each is real for itself and will appear in someone's present eventually). However, the key difference from standard eternalism is that we still only grant *existence* status to events in each frame's present, and importantly, our epistemology remains rooted in our local present. In effect, Option B says: "Yes, all of spacetime events are real (that's just relativity's implication), but an observer should only consider as existing those events that lie on their present hypersurface." This is a bit tricky to defend philosophically – one might wonder, isn't that arbitrary? If they are all real, why not say all exist? The answer lies in the empirical stance: no observer has access to spacelike-separated events until they enter the observer's past light cone. So operationally, one behaves as if only nearby simultaneity layer events exist, treating others as not yet existent until signals arrive. In practice, this is almost like a gentleperson's eternalism: one acknowledges the block but keeps a consistently *local* perspective in terms of ontology of the now.

A simpler reconciliation: recall our criterion for existence – being observable *now*. In relativity, what is observable to me now? Only events in my immediate vicinity (technically, only what's impinging on me now from the past light cone; to observe something "simultaneously" at a distance is impossible, you must wait for signals). So one could define existence = being within (or on) my past light cone (events that have had effects on me by now). That is a very restrictive notion, but physically sensible: it means, effectively, only the causal past and present of an observer exist for that observer. That would put even distant simultaneous events (in a frame sense) outside existence until their signals reach. Such an extreme view is probably not what we want (it would mean Andromeda galaxy's current state doesn't exist for us yet, which is counterintuitive). But it highlights that observability inherently slices down existence into an observer's causal sphere.

A more moderate approach: define an arbitrary but convenient simultaneity convention (e.g., use the CMB rest frame which is close to Earth's rest frame on cosmic scale) as "present" for cosmic time. Then adopt Existential Realism in that frame. One could argue that this is sufficient for all practical purposes and does minimal violence to relativity. The relativity objection is more of a concern if one demands an exact, frame-invariant metaphysics. If one is content with a slightly anthropocentric or at least user-friendly cosmic time, you can proceed. After all, cosmology *does* use a preferred time coordinate (the Friedmann time coordinate in FLRW cosmologies, which is basically CMB time) for convenience. That might hint there is a natural way to define a global present in our actual universe (which has a special frame where expansion looks isotropic).

In conclusion, this objection is serious but not fatal. Existential Realism, like any A-theory, has to either bite the bullet of some preferred frame (explicit or hidden) or reformulate in relational terms. We believe the latter is achievable and indeed that the epistemic focus of Existential Realism makes it more comfortable with a "no superfluous ontological claims" approach. We only say something exists if someone could, in principle, catch it now. That inherently respects light cones. So one could say: each event exists for itself at its own location (trivially) and becomes *exist-able* for others as signals propagate. This dynamic view is perhaps beyond the scope here, but it's a promising area to develop formally (perhaps using a model of time with diverging possibilities or a sheaf of local presents).

Finally, one might raise **Objection 3b:** If everything in spacetime is real, are we not forced to accept eternalism's fatalistic implications? – That the future is as fixed as the past? Existential Realism's answer is: the future being real (as a set of possibilities and predicted outcomes) is not the same as the future being *concretely determined*. In many physical theories, the future is not uniquely determined (quantum mechanics, for example, or any stochastic processes). We treat "the future" as an openness of real potentials. Those potentials are encoded in present reality (e.g., a radioactive atom has a real disposition to decay with a certain half-life). The outcome isn't fixed, but the space of outcomes and their probabilities are real features of the present situation. So reality doesn't mean strict actuality for future events, it can mean a structured possibility. This ties into discussions of an open future (often depicted with branching time). We can incorporate that by saying: instead of one single future

event being real, a spectrum of possible future events is real (with weights or with undetermined truth values until one happens). That would align with some interpretations of physics and would refine what we mean by anticipatory reality. But in any case, acknowledging future reality does not equate to denying free will or indeterminism, because one can equate "reality of the future" with "reality of the ensemble of possible outcomes." Presentists also had versions (like *open futurism* vs *closed futurism*). We would be an open futurist (future is real as possibilities, not as one actual line until it happens).

Objection 4: "Is this framework just presentism in disguise, or just a relabeling of eternalism? Why introduce new jargon?" (This summarizing objection might come from someone thinking we have not added anything fundamentally new to the debate.)

Reply: We have essentially pre-empted this by demonstrations above, but to reiterate: Existential Realism is not identical to presentism (it disagrees on the reality of non-present) and not identical to eternalism (it denies the existence of non-present). It solves some problems of each by hybridizing, but it's not an ad hoc hybrid; it's a principled distinction drawn from epistemology and phenomenology, which were not considered central in those older debates. The new jargon ("existence" vs "reality") is justified if it clarifies concepts and resolves confusions – which we believe it does. An apt analogy: In debates about *truth*, deflationists vs inflationists argued until someone distinguished between truth-as-correspondence and truth-as-coherence, etc. Introducing those distinctions moved the debate forward. Likewise, by distinguishing modes of being, we offer a way to move beyond the stalemate of 'present vs eternal vs growing.'

In sum, none of these objections are insurmountable. In fact, addressing them has helped refine the formulation of Existential Realism. We find that the framework is internally coherent, aligns reasonably well with scientific understanding, and preserves the meaningfulness of our temporal experience and discourse.

Conclusion

We have presented Existential Realism [53] as a comprehensive ontological framework that reconceptualizes the nature of time, being, and knowing. In doing so, we have aimed to satisfy rigorous academic standards while offering a genuinely fresh perspective. Let us summarize the key points and contributions of this framework:

- **Existential Realism posits a two-tier ontology**: *existence* is narrowly defined (present and empirically observable), whereas *reality* is a broader category including entities and events that do not meet the criterion of present existence but are nonetheless part of the world's causal or intelligible structure. This distinction allows us to say, without contradiction, that *only the present exists, but much more than the present is real*. By this device, we keep the ontological economy of presentism (no commitment to "ghostly" unexperienced realms) **and** the explanatory breadth of eternalism/growing block (past and future are not eliminated but accounted for in the ontology).
- **The framework integrates epistemology and phenomenology**: Unlike traditional metaphysical doctrines of time which often remain silent on how we know or experience temporal reality, Existential Realism builds these in from the start. The empirical accessibility criterion for existence directly ties our ontology to what we can verify, echoing van Fraassen's empiricism and ensuring our metaphysics is not detached from science. The acknowledgement of reality extending to past and future aligns with Husserl's and Metzinger's insights that consciousness itself stretches beyond the instantaneous now.[54] Thus, the framework is inherently interdisci-

53 The term "Existenzrealismus" is used in the original German for linguistic clarity and resonance. In English, the closest conceptual match is "Existential Realism"—not to be confused with existentialism. The term refers to a structured realist ontology grounded in the conditions of empirical access, temporal asymmetry, and cognitive limitation.

54 https://phantomself.org/metzinger-being-no-one/#:~:text=But%20there%E2%80%99s%20more%20to%20it%3A,place%20within%20a%20%E2%80%9Cmoving%20window%E2%80%9D

plinary, ready to dialogue with cognitive science, physics, and even ethics (as it preserves the reality of past actions and future consequences).

- **Existential Realism provides solutions or mitigations to classic problems**:
    - *Truthmakers for past truths:* The past is real, so statements about it can be straightforwardly true by correspondence to real events.[55] We don't have to invoke convoluted present proxies; present evidence serves to inform us, but the truthmaker is the past event itself (which, though not existing now, is real and thus available to stand in truth relations).
    - *Cross-temporal relations:* We can meaningfully speak of causal influence or personal identity across time because the earlier entities are real and linked to later ones. The chain of reality is unbroken – existence may flicker (coming and going) but reality accumulates, providing a continuous thread.
    - *Open future and agency:* The future's reality does not equate to predetermination; it consists in structured possibilities, leaving room for different outcomes. Our actions now can genuinely influence which future becomes actual (since those futures are not pre-existent realities, but rather a range of real possibilities).
    - *Special Relativity:* While presentism alone struggles with relativity, our nuanced approach can accommodate it by localizing existence and embracing a four-dimensional reality with frame-relative "presents." This is admittedly a complex issue, but we have sketched how an empirically-informed ontological viewpoint can uphold the spirit of relativity without giving up a privileged now (each observer's now).
    - *Phenomenological fidelity:* The framework respects the feeling that the past is still with us (in memory) and the future already weighs on us (in anticipation), without resorting to metaphor – it literally says those impressions are of something real (past events, future potentials). This gives philosophical validation to the lived experience of time.
- **Comparison with other theories**: We clearly differentiated Existential Realism from presentism, eternalism, and growing block (Table 1 and accompanying discussion). Each has a claim to a piece of the truth; our framework attempts to synthesize those pieces into a consistent whole. Where presentism emphasizes the primacy of the present, we concur but refine what existence entails. Where eternalism insists on the reality of non-present times, we agree but without conflating reality with present existence. Where growing block captures becoming, we mimic that dynamic (things come into existence and recede into reality). By citing thinkers like Markosian, Crisp, Bourne, and Zimmerman, we situated our view in the landscape, showing that it does not arbitrarily cherry-pick but addresses the known critiques and insights from each camp.[56]
- **Concrete examples and applicability**: Through examples in physics (causal traces), cognitive science (memory and predictive processing), and computing (data logs), we demonstrated that the Existential Realist viewpoint is not just a clever semantic game, but aligns with how various systems treat time-bound information. It carves nature at its joints: recognizing that the *present state* contains within it records of the past and seeds of the future. This makes the framework appealing for interdisciplinary use – for instance, in cognitive science modeling, one could explicitly distinguish an agent's present world-model (what exists for the agent) from the broader reality it infers; in AI or database design, one could formalize the idea of archived vs live data in analogous ontological terms.

In presenting Existential Realism, our aim has also been to ensure the discussion remains technical and precise, avoiding metaphor and unfounded speculation. We hope to have shown that one can

55 https://markosian.net/wp-content/uploads/2015/12/defpres.pdf
#:~:text=Taj%20Mahal%20would%20be%20on,any%20other%20putative%20object%20that
56 https://uhra.herts.ac.uk/id/eprint/21583/
#:~:text=rival%20positions%20in%20the%20philosophy,how%20causation%20can%20be%20accommodated

speak rigorously about "reality of the past" without falling into loose talk. By anchoring every claim to sources or logical argument, we intend this paper to be a solid starting point for further research. Indeed, one outcome of this work could be a deeper investigation into *formalizing* this ontology – perhaps using tools from temporal logic or category theory to represent the distinctions of existence and reality across time.

Another avenue is exploring **phenomenological and cognitive implications**: For example, how might adopting Existential Realism inform the philosophical interpretation of time perception experiments or the treatment of memory in neuroscience? Thomas Metzinger has advocated for no fundamental divide between philosophical ontology and empirical mind science;[57] our framework is very much in that spirit, suggesting that how the brain constructs a "window of presence" might be directly connected to what we claim exists or is real.

Finally, we consider the significance of Existential Realism for **future discourse in metaphysics and beyond**. As a stand-alone reference paper, this work lays out the terminology and arguments such that other researchers can cite specific aspects: for instance, a philosopher of time can cite our definition of existence vs reality when differentiating between ontological and epistemic aspects of time (avoiding equivocation that has plagued debates); a philosopher of science might reference our use of van Fraassen's insight to justify ontological commitment only to the observable; a cognitive scientist might build on our discussion of Husserlian retention/protention to frame a model of temporal consciousness.[58]

In closing, we assert that Existential Realism provides a viable and indeed advantageous alternative to presentism for those who are dissatisfied with existing theories of time. It is *existential* in the literal sense – concerning existence – but also in the sense of acknowledging the conditions of human existence (our knowledge and experience) as part of the ontological picture. And it is *realist* in affirming an objective world (past events are not simply constructions of present minds, but truly happened; future events, though not yet determinate, are grounded in reality and not mere fictions). By maintaining a clear distinction between what exists and what is real, we avoid many confusions and open a path for new insights. This framework invites further elaboration and critique, and we welcome the opportunity for it to be tested, refined, or expanded in the crucible of scholarly debate. It aims to remind us that a rigorous understanding of time *can* accommodate both the hard facts of science and the richness of lived experience – a reconciliation that is, in our view, not only philosophically satisfying but perhaps even necessary for a deeper grasp of reality.

In summary, Existential Realism offers a clear and workable ontological distinction: only the present exists, but the past remains real through its causal and representational impact, and the future may be real as structured anticipation. Unlike Presentism, ER does not erase the past; unlike Eternalism, it does not freeze time into a single block. By separating existence from reality, ER clarifies longstanding metaphysical confusions and offers a usable framework for reasoning across disciplines. It restores coherence to temporal thought—without relying on speculative metaphysics or denying our lived intuitions about change, memory, and planning.

57 https://phantomself.org/metzinger-being-no-one/#:~:text=Throughout%2C%20Metzinger%20addresses%20his%20subject,mind%20has%20not%20yet%20reached
58 https://en.wikipedia.org/wiki/Retention_and_protention
#:~:text=Protention%20%28and%20not%20,path%20the%20ball%20will%20take

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Clarification

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Drawing the Line Between Being and Realness

With the core claim in place, the next paper sharpens its edge: existence is not reality. Here, we delve into why that distinction matters — logically, ontologically, and experientially — and how it reshapes our most basic assumptions about time and presence.

Existence ≠ Reality: What Exists, What's Real, and Why It Matters

Tenzin C. Trepp

Email: trepp@tenz.in

Date: July 31, 2025

Abstract

In both everyday language and philosophical discourse, the terms ***existence*** and ***reality*** are often used interchangeably. This conflation is especially evident in debates on the ontology of time. For example, an orthodox presentist will say that only present things truly exist, treating all non-present entities (past or future) as unreal in an absolute sense – "all such objects are unreal, according to Presentism," as one defender neatly put it.[1]

This paper serves as a focused extension and clarification of the metaphysical framework introduced in *Existential Realism – A Distinct Ontological Framework Beyond Presentism*. It addresses specific questions raised by readers and critics: Is it coherent to distinguish existence from reality? What philosophical work does that distinction do? How does it help with longstanding problems like truthmaking, the status of unobservable entities, and future ethics?

In short, while the original paper laid out the core ontological structure, this follow-up revisits its foundations to deepen the theoretical implications, refine key definitions, and explore practical consequences.

Our central thesis remains: **existence and reality are not identical**. But here, we argue more sharply that separating them yields a more nuanced, empirically grounded, and philosophically productive ontology of time. We defend this view against objections, offer clarified examples, and explore its implications for epistemology, phenomenology, and ethics.

We proceed as follows. Section 2 defines **existence** narrowly, in terms of presentness and empirical accessibility, drawing on the spirit of van Fraassen's constructive empiricism.[2] Section 3 then defines **reality** more broadly, to include causal and structural aspects of the world inferable beyond the present—illustrated through examples such as dinosaurs, future climate events, and cognitive anticipations.

Section 4 explores how this distinction addresses several philosophical issues: the truthmaker problem for past truths, the ontological status of unobservable scientific entities, the phenomenology of

1 Markosian, Ned (2004). "A Defense of Presentism." Oxford Studies in Metaphysics, Vol. 1, ed. D. Zimmerman. Oxford: Oxford University Press, pp. 47–82. (Example of treating "exists" and "is real" as equivalent, asserting that only present entities are real.)

2 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Original paper introducing the two-tier distinction between existence and reality and its motivations.) https://philpapers.org/archive/TENERM.pdf

temporal experience (in the sense of Husserl [3] and Metzinger),[4] and considerations of metaphysical parsimony.

Section 5 argues why this two-tier ontology is not merely a restatement of presentism or eternalism, but a distinct metaphysical framework. Finally, Section 6 summarizes our contributions and highlights new directions this view opens—particularly in ethics (e.g., our duties to future persons), AI models of time, and decision theory under uncertainty.

Throughout, we maintain an academic tone and use end-of-paragraph references in line with the original paper's style. Our aim is for this article to stand on its own as a focused argument on the existence–reality distinction, while continuing and enriching the foundation laid by *Existential Realism*.[5]

Existence: Present and Empirically Accessible

As established in the original paper, we define existence in a strict sense: to exist is to be present and **empirically accessible at this moment**. This entails a disciplined, empirically grounded ontology rooted in constructive empiricism. We restate this only briefly here, focusing instead on the implications of this framework for key metaphysical questions. This view echoes Bas van Fraassen's stance of epistemic humility in science. Van Fraassen famously argues that we should believe only in the *empirically observable* aspects of the world, remaining agnostic about putative entities that cannot be observed even in principle.[6] He notes that while observability is an "anthropocentric" notion and not a literal definition of existence, it rightly guides what we take to be **ontologically committed** to in science – our "proper epistemic attitude" is to refrain from positing the existence of entities beyond possible experience.[7] Following this insight, our definition of existence builds in a modest anthropocentric filter: if an entity is *completely* beyond detection or interaction, then, however useful it may be in theory, we do not count it as *existent* in the fullest sense.[8] This does not mean that a thing must actually be observed to exist – only that it be **observable in principle here and now**, given appropriate circumstances or instruments. For instance, a distant star that is currently emitting light exists (for us) because, although no one may be looking at it at this instant, it is presently part of the observable universe (its light is en route and could be detected with a telescope). By contrast, a hypothetical object with no causal connectivity to our universe, or a "hidden" entity that makes no measurable difference even in principle, would not (at present) count as existing in this strict sense. We would withhold ontological status from such a thing unless and until it gains empirical footing.[9] This strict present-and-observable criterion for existence embodies a form of **constructive empiricism** in ontology: it confines our firm ontological commitments to what is evidentially available **now**, reflecting a disciplined skepticism about unverifiable realms. In effect, existence – as we use the term – is an indexical, frame-dependent concept: *to exist* means to exist-now-for-us, in the perceptual or experimental present. What lies entirely outside the present empirical horizon is, at least for the moment, not part of the furniture of existence.

Crucially, this narrow notion of existence is **not** a rehash of logical positivism nor a denial that unobservable things *might* exist in a broader sense. It is simply a stipulation that our **ontological inventory** of existents will include only those entities that meet the twin criteria of being present and empirically accessible. We impose this restraint to ensure that our ontology remains well-moored to verifiable reality and does not drift into speculative excess. Such an approach naturally meshes with modern

3 Husserl, Edmund (1928). Vorlesungen zur Phänomenologie des inneren Zeitbewusstseins (Lectures on the Phenomenology of Internal Time-Consciousness, 1905–1917), ed. Martin Heidegger. (English trans. J. B. Brough, 1991). (Classic phenomenological analysis of time-consciousness introducing retention and protention.)
4 Metzinger, Thomas (2003). Being No One: The Self-Model Theory of Subjectivity. Cambridge, MA: MIT Press. (Describes the "window of presence" and the concept of the specious present in human conscious experience.)
5 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Original paper introducing the two-tier distinction between existence and reality and its motivations.) https://philpapers.org/archive/TENERM.pdf
6 van Fraassen, Bas C. (1980). The Scientific Image. Oxford: Oxford University Press. (Develops constructive empiricism; emphasizes belief in observables and agnosticism about unobservables, an inspiration for restricting existence to the empirically accessible.)
7 Ibid.
8 Bigelow, John (1996). "Presentism and Properties." Philosophical Perspectives 10 (Metaphysics): 35–52. (Discusses truthmakers for past and future truths and the challenges faced by presentism.)
9 Ibid.

physics as well: relativity theory teaches that simultaneity and "now" can be frame-relative, suggesting that *existence* (the set of things one considers concretely present) might be a local concept rather than a global absolute. By tying existence to an observer's here-and-now empirical vicinity, we accommodate this relativistic insight – different observers may have different sets of existent things, but none disagrees on the underlying physical events, only on their present accessibility. **Existence, in our framework, is the parochial, immediacy-bounded part of ontology – the reality one can, so to speak, point to or interact with at the moment.**

It bears emphasizing that this usage of "existence" is somewhat unconventional in its **epistemic emphasis**, but it is done deliberate. Traditionally, philosophers often use "exists" in a tenseless, unqualified way (e.g. "electrons exist" or "Julius Caesar exists (simpliciter) in the past"). We are instead using *exists* to mean "exists **now** (for us)." This move differentiates our stance from both naive presentism and standard realism. We are not claiming that, say, electrons are purely fictitious or that past people are nothing at all – only that such entities do not meet the stringent standard to be counted among what exists at this moment. They may still be **real**, in another sense which we will define next. Keeping this distinction sharp allows us to speak, for instance, about dinosaurs or distant galaxies without either falsely asserting their present existence or denying their reality. In summary, **existence = presence + empirical access** in this framework. This gives us a lean ontological catalogue: it includes the entities and events around us *right now* that we can in principle observe or measure. Everything else, no matter how strongly evidenced or theoretically posited, is not (currently) classed as "existent." We will see that this conservative stance on existence does not prevent us from acknowledging a much wider reality – on the contrary, it frees us to do so without contradiction.

Reality: Causal Structure and Epistemic Inference Beyond the Present

If existence is a narrow concept, *reality* as we propose to use it is a broad and encompassing one. To say an entity or event is **real** means that it plays some role in the world's causal, structural, or informational fabric, even if it is not presently existing. Reality, in this sense, is the ontological category of *everything that makes a verifiable or explanatory difference in the world*, regardless of its temporal location. The domain of reality thus includes all present existents (trivially, whatever exists now is of course real), **plus** many phenomena that lie outside the present but are nonetheless part of the world's causal web or our best-supported theories about that world. Past entities and events that have left traces, records, or lingering effects are real; so are future events that are credibly predicted or already unfolding in germinal form; so too are unobservable entities postulated by science (electrons, black holes, DNA molecules before discovery) which, though not directly seen at a given moment, manifest indirectly through their effects. In short, **reality = existence + X**, where *X* includes whatever is needed to weave a coherent, causally continuous picture of the world across time and beyond immediate observation. We intentionally cast a wide net for reality, but not without limits: to be counted as real, an entity must play a **causal or inferential role** within our best-supported model of the world. This includes empirically grounded predictions, explanatory indispensability, or structured dependence. **Reality, unlike existence, admits degrees**, but we require more than conceptual possibility—**there must be a justified epistemic pathway from the present to the entity's causal or informational status**.

Some examples will help clarify this notion of reality. Consider the eruption of **Mount Vesuvius in 79 CE**, which buried Pompeii. This volcanic eruption clearly does not *exist* now – it is a past event, long over. Yet it would be absurd to claim it is not real. Its reality is attested by multiple lines of evidence: ash and pumice layers in the geology, the ruins and preserved artifacts in Pompeii, and historical accounts. These present observations are **causal footprints** of that past event. In our framework, we say: the eruption of Vesuvius is *real* (part of reality) because it is an integral element of the causal chain of the world and contributes to our justified beliefs about the past, even though it lacks current existence. As another example, consider a **future solar eclipse** predicted for next year. That eclipse does not exist now (by definition it has not occurred yet), but is it real? We would say yes – it is real in

the sense that it is already embedded in the causal structure of the solar system and in our epistemic framework: given the current orbital mechanics, we can infer its occurrence with high confidence, and people are making plans (booking travel, preparing telescopes) in anticipation. The coming eclipse exerts a sort of **anticipatory causal influence** on present behavior and has a well-defined reality within our best scientific model of the world, despite its lack of present existence. Likewise, consider entities posited by science such as **dinosaurs** or **subatomic particles**. No dinosaur exists now, and an individual quark is not directly observable to our senses, yet denying their reality would be unreasonable. As previously illustrated with the case of dinosaurs, entities that are no longer present can still be **real in our framework** due to their enduring causal imprints. To avoid repetition, we generalize this point: any entity that has **left structured, detectable traces** across time earns its place in reality. Quarks are real because they figure in successful theories and experiments (their effects can be detected in particle detectors), even if we never "see" one with the naked eye. In everyday terms, we often say such things *exist* (in a loose sense), but our framework would refine that: we acknowledge these things as real components of the world's ontology, though they do not fulfill the criteria to count as present existents. Consider **fictional characters** like Sherlock Holmes. He does not exist (he is neither present nor observable), nor is he real in the ontological sense, lacking causal presence in the actual world. While he has narrative or psychological significance, he is not part of reality as defined in this framework. These gradations are summarized in **Table 1** below, which contrasts existence and reality for various cases:

Table 1. Examples Illustrating the Existence–Reality Distinction

Entity or Event	Exists now (Present & Observable)?	Real (Part of the World's Causal/Structural Fabric)?
A current, observable phenomenon (e.g. this page you are reading)	**Yes** – it is present and you perceive it directly.	**Yes** – it is part of reality (by being here now).
A past event with evidence (e.g. Mt. Vesuvius eruption 79 CE)	**No** – it occurred in the past and is not present.	**Yes** – it is real, as evidenced by causal traces (ash, ruins).
A future event predictively known (e.g. solar eclipse next year)	**No** – it has not happened yet; not present now.	**Yes** – it is real in virtue of reliable prediction and present preparations.
A purely fictional or hypothetical entity (e.g. Sherlock Holmes)	**No** – it has no actual present existence.	**No** – it is not real in the actual-world ontology (exists only in stories).
Undetectable "hidden" object (present but causally inert)	**No** – if truly undetectable in principle, it fails the observability criterion.	**No** – lacking any causal/informational role, it is not part of reality (until evidence says otherwise).

As the table illustrates, our ontology permits us to say **"only the present exists, but much more than the present is real."** Past events and entities, though not breathing the air of the present, populate reality by virtue of the causal influence they have exerted and the information we still have about them. Future events, though not yet actualized, can be deemed real to the extent that they are *entailed by* present conditions together with natural laws (or to the extent current agents treat them as decision-relevant possibilities). The breadth of reality also encompasses entities that are not directly observable but are strongly supported as the best explanation for observable phenomena (scientific theoretical entities). Reality, in short, is the **spatio-temporal and causal canvas** of the world, extending before and after the now, and including both the seen and the currently unseen.

It is important to stress that by *real* we do not mean "merely imagined" or "convenient fiction"; we mean ontologically significant. An entity can be real without being presently existent. To formalize succinctly:

- **Existence (E)** applies only to things that are **present and observable** now.
- **Reality (R)** applies to anything that is **actual in the world's causal or informational structure**, even if not present or observable now.

Every existent is of course real (if it exists now, it trivially affects the world), but there are real things that do not exist (yet or anymore). By decoupling these notions, we remove an apparent contradiction that plagues naive presentism. The presentist slogan "only the present is real" forces one to deny reality to the past and future altogether, which in turn makes it mysterious how truths about the past/future or causal influences across time can hold. Our view, by contrast, says: only the present **exists**, but the past and future are still **real** in defined ways. Thus we can comfortably assert propositions like "Dinosaurs are real (they were part of reality), though dinosaurs do not exist now" or "Our future children are real as possible future persons, even though they don't exist yet." These statements would be contradictions on a view that conflates existence with reality, but under our two-tier ontology they are perfectly coherent.[10] [11] We maintain the *ontological economy* of presentism – we're not populating the universe with an infinite inventory of bygone or potential objects magically "hanging around" – yet we also capture the *explanatory breadth* of eternalism – we acknowledge past and future as integral parts of the world's ontology.[12] Reality is a continuum, even as existence is a moving knife-edge.

To summarize the core idea thus far:

- **Existence = Presentness + Empirical Accessibility.** (We only count entities as *existent* if they are present *and* observable in principle at the current time. This instills epistemic humility by avoiding ontological commitment to "ghostly" or inaccessible realms.)
- **Reality = Causal/Structural Presence (not necessarily now).** (An entity is *real* if it figures in the world's causal network or structural inferential picture, regardless of whether it exists now. This ensures the ontology covers the full web of world events and structures across time – preserving truths about the past, legitimate expectations about the future, and the status of theoretical entities posited by science.)

By separating these notions, we gain a vocabulary to describe time in a way that respects both our immediate experience and our extended scientific understanding. The present moment retains its special status (only here do things concretely exist), but we no longer have to say that everything outside that moment is simply *nothing*. In the next section, we explore how this distinction helps resolve or mitigate several philosophical puzzles and debates.

What about merely possible or counterfactual entities—things that could have existed but never did? While these are relevant in modal logic and metaphysical speculation, we maintain that **possibilities are not real per se**—only their **actual causal footprints or necessary entailments in the actual world** can grant ontological status. Unlike modal realists (e.g., David Lewis), we deny that uninstantiated possibilities populate reality. Our framework is thus **actualist in ontology** and **modal only in utility**. Possibilities, as such, are not real; only their concrete manifestations or causal implications—if any—enter into reality. This further underscores the framework's commitment to an empirically anchored ontology, rather than a modal or hypothetical one.[13] [14]

While this observational criterion may seem anthropocentric, it is best understood as a methodological constraint rather than a metaphysical bias. It reflects epistemic humility: by grounding ontological commitment in what is observable now, we avoid speculative inflation of existence claims. Nevertheless, this approach invites extension. Future work may explore how the framework applies to non-human epistemic agents—such as animals, artificial intelligences, or extraterrestrial systems—whose perceptual or inferential frameworks might redefine what counts as "empirically accessible" or "present" in their world-models.[15] [16]

10 Markosian, Ned (2004). "A Defense of Presentism." Oxford Studies in Metaphysics, Vol. 1, ed. D. Zimmerman. Oxford: Oxford University Press, pp. 47–82. (Example of treating "exists" and "is real" as equivalent, asserting that only present entities are real.)
11 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Original paper introducing the two-tier distinction between existence and reality and its motivations.) https://philpapers.org/archive/TENERM.pdf
12 Ibid.
13 Lewis, David (1973). Counterfactuals. Harvard University Press.
14 Fine, Kit (2005). Modality and Tense: Philosophical Papers. Oxford University Press.
15 Metzinger, Thomas (2003). *Being No One: The Self-Model Theory of Subjectivity*. MIT Press.
16 Schwitzgebel, Eric (2020). The Weirdness of the World. Draft manuscript, University of California, Riverside.

Implications and Theoretical Payoffs

Truthmakers for Past and Future Truths

One classic metaphysical issue is the **truthmaker problem** as it pertains to past and future statements. The truthmaker principle holds that for every true proposition, there must be something in reality that makes it true – a truthmaker. Presentism notoriously struggles with this when it comes to statements about the past or future. If only present things exist, what makes it true that "Dinosaurs roamed the Earth millions of years ago" or that "There will be a solar eclipse next year"? The presentist either has to deny such statements have truthmakers, or posit some ad hoc presently existing surrogate (like "historical records" or "present dispositions") to ground those truths. Philosophers have pointed out that this is a serious challenge: it seems *prima facie* that if dinosaurs are utterly unreal now, nothing exists now that could make the sentence "dinosaurs existed" true – yet that sentence *is* true, so how?[17] One of the most urgent metaphysical challenges our framework addresses is the truthmaker problem. Rather than struggle to ground past truths in present proxies, we affirm that the **past is real—though not existent**—allowing past events themselves to serve as truthmakers. This capability illustrates why separating existence from reality is not just a semantic refinement, but a metaphysical necessity. In other words, the truthmaker is the **real past**, not some proxy in the present. The correspondence between a true proposition about the past and the past reality it describes is what makes the proposition true. We do not require that the past event still *exists* now to serve as a truthmaker; it suffices that the event is real (in the ontological ledger of the world) and thereby can stand in a truth-making relation. The same reasoning applies to future-tensed truths, though with more caution because the future is not fixed. If we say, for example, "There will be a total solar eclipse on April 8, 2024" (a statement made before that date), what is its truthmaker? In our view, it is the **real future event** – the eclipse – which is part of reality insofar as it is entailed by current conditions and laws of nature. If indeed the eclipse occurs, then that event (though once future) is real and grounds the truth of the prediction. If for some unexpected reason the eclipse does not occur (say, the moon disintegrates in 2023, preventing it), then the statement wasn't true to begin with. The important point is that we can allow future events to be candidate truthmakers when they are sufficiently determined by present reality. We avoid paradox by not claiming these future events *exist already* (they do not), only that they have a kind of reality (as possibilities approaching actuality) that can confer truth on statements about them. In summary, by having a category of reality beyond the present, we can say past truths are made true by past realities, and certain future-directed truths (especially those about inevitable events) are made true by the reality of future happenings in store. We don't have to resort to peculiar "ersatz present" entities to serve as truthmakers. This resolves the truthmaker objection to presentism in a natural way: the past (and, in a more qualified sense, the future) endures as part of reality and thus can ground truths about itself [18].

Scientific Realism and Unobservable Entities

The distinction between existence and reality also reframes the debate between **scientific realism** and anti-realism. Scientific realists maintain that our best scientific theories truly describe not just observable phenomena but also unobservable structures (electrons, fields, DNA before it was seen, etc.), so these unobservables *exist*. Anti-realists like van Fraassen counter that we need not believe in the literal existence of unobservables, only in the empirical adequacy of theories concerning observables.[19] Our framework can be seen as carving a middle path: Unobservable entities (if strongly supported by theory and indirectly detected by experiments) can be regarded as **real** without us insisting that they "exist now" in the strict empirical sense. For example, consider an electron in a cloud chamber. We never see the electron itself, only a trail of droplets. In our terms, we do not say "an unobserved electron exists" (since no one observes it directly at that moment); instead, we say "the electron is real," as evidenced by its causal track and the success of the theory that posits it. By doing

17 Bigelow, John (1996). "Presentism and Properties." Philosophical Perspectives 10 (Metaphysics): 35–52. (Discusses truthmakers for past and future truths and the challenges faced by presentism.)

18 Bigelow, John (1996). "Presentism and Properties." Philosophical Perspectives 10 (Metaphysics): 35–52. (Discusses truthmakers for past and future truths and the challenges faced by presentism.)

19 van Fraassen, Bas C. (1980). The Scientific Image. Oxford: Oxford University Press. (Develops constructive empiricism; emphasizes belief in observables and agnosticism about unobservables, an inspiration for restricting existence to the empirically accessible.)

so, we **acknowledge the reality of theoretical entities** (hence aligning with the spirit of scientific realism that such entities are part of the world), but we **heed van Fraassen's caution** by not granting them unqualified existence status unless they become observable.[20] This nuanced stand allows us to avoid the epistemological excesses of naive realism (which might be too quick to assert existence for every posit of a theory) while also avoiding the austere attitude of radical empiricism that might dismiss talk of electrons or quarks as merely instrumental. In practice, scientists themselves often speak in exactly this two-level way without explicitly saying so: they distinguish between *detecting* something versus *inferring* it. A distant exoplanet that cannot yet be imaged but causes wobbles in its star is *real* (the data demands its reality), though one might humorously say it "does not yet exist *for us*" until we directly observe it. Our terminology formalizes that intuition.

This stance also contributes to **metaphysical parsimony**. We keep our roster of *existents* minimal – only what we really need to posit as concretely present – but we are generous in our acknowledgement of what is *real*. The ontology thereby remains **economical** (we do not clutter it with countless entities existing in absentia), yet it is **scientifically and explanatorily adequate** (we lose nothing of reality; every causally or explanatorily relevant entity is still admitted as real). In effect, we can uphold the **empiricist's demand**: "Only believe in (commit to) what you can verify," without thereby having to say "nothing else is real." We believe this resolves a tension in the scientific realism debate: one can be an empiricist about existence and a realist about reality. Indeed, one might characterize our view as a form of *ontological structural realism* – emphasizing that it is the structure of the world (causal relations, patterns, law-governed regularities) that is fully real, while the *ontologically weighty* commitments (existents) are confined to the here and now. For scientists and philosophers of science, this offers a clear way to talk about entities like gravitational waves before direct detection, or the core of the Earth before we ever sent instruments, etc.: they were *real* (because the theories and indirect evidence strongly indicated their presence in the world's structure), though one might say we discovered their existence only upon direct observation. The distinction thus serves a pedagogical and conceptual clarity in scientific ontology.[21]

Phenomenological Time and Consciousness

Our two-tier ontology finds an intriguing resonance in phenomenology and the cognitive science of temporal perception. Philosophers like Edmund Husserl, and more recently cognitive scientists like Thomas Metzinger, have observed that **our conscious experience of time already transcends the infinitesimal present moment**. In Husserl's analysis of internal time-consciousness, he introduced the concepts of **retention** (the just-past, lingering in present awareness) and **protention** (the immediate next moment, anticipated by consciousness). When you hear a melody, for example, you don't just experience an isolated note *now*; you retain the echo of the previous notes and expect the next note. The "now" of lived experience is **temporally extended**, thickened by **retentions and protentions**, as shown in both Husserl's analysis and **predictive processing accounts in cognitive neuroscience**. Empirical findings (e.g., ~300 ms specious present intervals) suggest the mind actively integrates recent sensory data and forward models. Thus, **our ontology resonates not just philosophically, but biologically**.[22] Metzinger similarly describes the mind's 'window of presence' as not an infinitesimal moment in time but a **short-duration 'specious present'** – a moving window within which we experience events as present.[23] This window might be on the order of a few hundred milliseconds, encompassing, say, the last moment's sensory input and an anticipation of the next moment's. The upshot is that subjective experience itself recognizes a distinction akin to what we term existence and reality: only the single instantaneous now-point is strictly "present" in a physical sense, yet our mind treats a **brief interval** as experientially present (the recent past is still *real* to us in memory; the impending future is *real* to us in expectation). Our framework's allowance that the just-past and imminent future have a form of reality thus aligns with how we actually perceive time. We do not feel the past to be annihilated or the future to be utterly unreal – rather, we feel that the past has a fading but existent reality

20 van Fraassen, Bas C. (1980). The Scientific Image. Oxford: Oxford University Press. (Develops constructive empiricism; emphasizes belief in observables and agnosticism about unobservables, an inspiration for restricting existence to the empirically accessible.)
21 Ibid.
22 Husserl, Edmund (1928). Vorlesungen zur Phänomenologie des inneren Zeitbewusstseins (Lectures on the Phenomenology of Internal Time-Consciousness, 1905–1917), ed. Martin Heidegger. (English trans. J. B. Brough, 1991). (Classic phenomenological analysis of time-consciousness introducing retention and protention.)
23 Metzinger, Thomas (2003). Being No One: The Self-Model Theory of Subjectivity. Cambridge, MA: MIT Press. (Describes the "window of presence" and the concept of the specious present in human conscious experience.)

(we **just** experienced it), and the near future has a compelling reality as we gear up for it. This is not a decisive proof of our ontology, of course, but it is a nice **phenomenological validation**. It shows that treating past and future as real (in their own modes) is deeply intuitive on the level of lived experience: consciousness itself **"stretches"** beyond the knife-edge present, as Husserl noted, and our ontology legitimizes that stretch as something grounded in reality, not in illusion.[24] There is also a cognitive science angle: brains are constantly modeling not only the current moment but also short-term memories and likely immediate futures (e.g. predictive processing models of the brain suggest that perception is in part a prediction of the near-future inputs). Our distinction between existence and reality conceptually accommodates this: the brain's representations of recent past and expected near-future correspond to **real features** – the recent past being real (though not existent) and the near future being real as a set of developing possibilities. We do not have to conclude that because only the present exists, anything not present (like a remembered second ago or the half-second-ahead trajectory of a moving object we anticipate) is a hallucination. Rather, it is **real** (in memory or anticipation) and cognitively accessible, though of course not currently existent. In short, our view meshes well with the structure of temporal consciousness described by phenomenologists and neuroscientists: it validates the feeling that the past and future (to some degree) are **there** for us, without going so far as to reify them as full-fledged existing objects or times.

Ontological Parsimony without Loss

Finally, separating existence from reality yields a desirable **metaphysical parsimony** while avoiding explanatory loss. Philosophers often appeal to **Ockham's Razor** – do not multiply entities beyond necessity – as a virtue in theory choice. Presentism has been lauded on this score: by saying only present things exist, it ostensibly posits fewer things in one's ontology than eternalism, which posits a vast manifold of entities in the past and future as equally existent.[25] However, the cost of that parsimony for presentism was the abrupt elimination of past and future from the world, which led to the troubles we discussed (truthmakers, etc.). our two-category approach preserves the parsimonious inventory of existence (only present entities populate the 'catalogue of being' at any given time), while still acknowledging all the entities and events a less parsimonious view would count – we simply place them in the category of reality... In effect, we achieve a quantitatively sparse ontology of existents (at any given moment) without any qualitative deficit in reality. The world's reality includes all that needs to be accounted for, but we do not claim that all of those things exist right now. This nuance answers a known critique: some argue that it's only a trivial quantitative gain to say "fewer things exist" if one still has to talk about all those past and future things in some capacity. But our framework can respond that the gain is not merely counting things differently – it's in the **mode of ontological commitment**. To say something exists is to give it a robust ontological status *and* to commit to our ability (at least in principle) to detect or interact with it. To refrain from granting that status to past/future entities is to remain ontologically austere and epistemically cautious. Yet, by calling them real, we do ensure they are not banished from our ontology altogether. This approach could be seen as *quantitatively parsimonious, qualitatively comprehensive*. It may strike some as a mere semantic trick – what's the difference between saying "X is real" and "X exists"? But as we have argued, the difference is fruitful: it avoids "overpopulation" of the ontology (no infinite temporal extent of existing things) and it sidesteps the awkward consequences of outright presentism. In short, **reality is cheap** (we can allow as many real things as needed for truth and explanation), **but existence is expensive** (we only spend it on the empirically verifiable present). This disciplined economy is attractive for anyone who values simplicity in ontology without sacrificing scientific credibility.

24 Husserl, Edmund (1928). Vorlesungen zur Phänomenologie des inneren Zeitbewusstseins (Lectures on the Phenomenology of Internal Time-Consciousness, 1905–1917), ed. Martin Heidegger. (English trans. J. B. Brough, 1991). (Classic phenomenological analysis of time-consciousness introducing retention and protention.)

25 Tallant, Jonathan (2013). "Quantitative Parsimony and Presentism." Analysis 73(4): 635–641. (Examines appeals to parsimony in the presentism vs eternalism debate, and the distinction between quantitative and qualitative ontological parsimony.)

Not Presentism, Not Eternalism (and Not Simply a Rebrand of Either)

It is important to distinguish our Existential Realism framework from the standard positions in the metaphysics of time, lest one think we have merely relabeled presentism or smuggled in eternalism. Superficially, our slogan "only the present exists" echoes **presentism**, and our allowance that "other times are real" echoes the spirit of **eternalism** or the **growing block** theory. But we emphasize that our view is a distinct ontology that avoids the core commitments that define those views.

In classical presentism, *only present objects and events exist*, and furthermore it is asserted that nothing else is real in any sense. Presentists typically equate existence with reality,[26] meaning if only present things exist, then effectively only present things are real – the past is *nothing* (except perhaps in our memories or records), and the future is *nothing* (except as mere possibility). We explicitly reject that second step. By our lights, presentism mistakenly conflates existence with reality, thereby incurring all the problems we outlined. Our view keeps the first part of presentism (the ontological privilege of the present in terms of existence), but *not* the second part: we do **not** say "all such non-present objects are unreal" – on the contrary, they are real.[27] This difference is more than semantic. A presentist might try to paraphrase and say "well, if by 'real' you just mean something other than 'exist', perhaps you're a presentist who just uses different words." However, the proof of a substantive difference is in the consequences. As we showed, our ontology handles truthmakers, cross-temporal relations, and so on in a way that strict presentism cannot without ad hoc maneuvers. For instance, under our view it is straightforwardly true that "Napoleon's actions are real in their historical impact, though Napoleon does not exist now." A strict presentist cannot assert that without contradiction – they'd have to say Napoleon is *unreal* now, which makes it puzzling how his actions *have* any real historical impact. Thus, the theoretical payoffs demonstrate that we are not merely presentism in disguise; we genuinely afford ontological status (reality) to past and future entities, which presentism proper refuses to do.

What about **eternalism**, the view that past, present, and future entities *all* exist in a tenseless sense (often compared to different positions in spacetime)? Eternalism collapses the distinction we draw – it effectively says *everything is equally existent*, which in our terms would mean existence and reality coincide, encompassing all times. Our framework explicitly denies that: existence is temporally limited to the present. Past and future things do not exist (now) for us, though they are real. Eternalism also implies a block universe where the flow of time and objective presentness are illusions or subjective; our view, by contrast, upholds an objective distinction for the present (the present is *ontologically unique* as the realm of existence). In that sense, we retain an A-theoretic element (a real difference between past, present, future) that eternalism flattens. Therefore we are not eternalists. We capture some motivation of eternalism – not "erasing" past and future – but we do so without granting those times equal ontological footing.

The **growing block theory** might seem even closer: it posits that past and present exist (the block of reality grows with time), while the future does not yet exist. This view at least concedes reality to the past. However, in growing block, past entities *still exist* in an ever-expanding history, whereas in our view past entities have *ceased to exist* (since existence is only present), though they remain real. One might think that is a minor linguistic tweak: does it matter if we say Socrates *exists* in the past portion of the block versus saying Socrates *existed but is real*. It matters because in Growing Block Theory, one could say **"Socrates still exists"**, albeit not at the moving present edge. But this leads to epistemic puzzles: *if* past entities still exist, **why can't we causally interact with them or access them directly?** Our framework **resolves this by denying any ongoing existence to past entities**—instead, they are real by virtue of their traceable effects, **not by spatial-temporal co-location**, how do we know "now" is the edge if past people also felt now?) Our view avoids those by not postulating that past entities exist in any form. They have no current being; they contribute to reality only via the traces and records they left. This subtle difference – existence vs. reality – actually helps dodge the **epistemic paradox of the growing block** (where one worries about being mistaken about the "now").

26 Markosian, Ned (2004). "A Defense of Presentism." Oxford Studies in Metaphysics, Vol. 1, ed. D. Zimmerman. Oxford: Oxford University Press, pp. 47–82. (Example of treating "exists" and "is real" as equivalent, asserting that only present entities are real.)
27 Ibid.

Since under our view only the present is populated by existing beings, there is no possibility that we ourselves are "in the past" unawares – the past is not literally populated anymore at all, except by inanimate records. So, we sidestep that issue. In effect, you could describe our model as "the block grows, but past entities *drop out* of existence into reality." This is a unique dynamic picture that is not standard growing block.[28] It upholds the idea of an objective flow (new things come into existence, present things pass into non-existence), but without implying that the departed entities are still hanging around *in extenso*. Thus, we claim Existential Realism is not a mere restatement of growing block theory either, but a refinement that keeps its advantages (past reality, open future) while adding the empiricist criterion for existence.

In summary, our view charts a distinct course: **presentist in existence, eternalist in reality**. It should be evaluated on its own merits, not collapsed into prior categories. By explicitly introducing two different ontological predicates (for exists vs. is real), we avoid the "triviality or inconsistency" dilemma that plagues attempts to define presentism in one predicate.[29] We simply operate with a two-tier ontology and thereby dissolve the false dichotomy that one must choose between "past and future are nothing" and "past and future are things just like present things." There is a coherent middle ground: past and future are *something* (real) but not *the same something* as present existence. This, we believe, is a genuine ontological innovation, not just a verbal one.

Ethical and normative implications. One of the most practically important consequences of Existential Realism lies in how it frames our responsibilities toward the future. If future persons are real—insofar as their existence is entailed by current conditions and actions—then ethical reasoning cannot ignore them. Though they do not yet exist in the empirical sense, their *reality* grants them ontological standing in moral deliberation. This suggests a strong metaphysical basis for intergenerational justice, environmental responsibility, and longtermist thinking in AI safety and policy design.[30] [31] [32] We are not morally responding to abstractions or mere projections, but to entities that are real in a structured, causally embedded future.

Conclusion

We have argued that carefully untangling the concepts of existence and reality yields a more versatile and empirically sound ontology of time. By saying only the present exists (in the robust sense) but much more than the present is real, we do justice to both the epistemic discipline of only positing what we can observe and the causal continuity of the world across time. This distinction is not a mere semantic quibble – it has significant implications for various domains of philosophy and science. We saw that it resolves the truthmaker problem for past truths without exotic solutions, accommodates scientific practice regarding unobservable entities, aligns with the structures of conscious experience, and achieves parsimony without sacrificing completeness. In doing so, it demonstrates that the perennial battle between presentists and eternalists might be transcended by adopting a new perspective where existence ≠ reality. Why does this separation matter? It matters because it enables clearer thinking about time and existence. Philosophers and scientists can avoid talking past one another: one can acknowledge the reality of things (like past events or theoretical particles) without overcommitting to ontological claims of existence that invite skepticism. It also helps clarify debates in ethics and decision-making: for instance, in ethical theory, we often struggle with how to value future people or distant consequences. Under a crude presentism, future individuals "don't exist, hence aren't real," potentially undermining obligations toward them. Under our view, future people are not yet existent but are certainly real enough (as coming entities) that our decisions now can and should take them into account. This could lend metaphysical support to ethical frameworks that stress responsibility for future generations – the future is no mere fiction, but part of reality that can be af-

28 Husserl, Edmund (1928). Vorlesungen zur Phänomenologie des inneren Zeitbewusstseins (Lectures on the Phenomenology of Internal Time-Consciousness, 1905–1917), ed. Martin Heidegger. (English trans. J. B. Brough, 1991). (Classic phenomenological analysis of time-consciousness introducing retention and protention.)
29 Tallant, Jonathan (2013). "Quantitative Parsimony and Presentism." Analysis 73(4): 635–641. (Examines appeals to parsimony in the presentism vs eternalism debate, and the distinction between quantitative and qualitative ontological parsimony.)
30 Parfit, Derek (1984). Reasons and Persons. Oxford University Press.
31 MacAskill, William (2022). *What We Owe the Future*. Basic Books.
32 Bostrom, Nick (2013). Existential Risk Prevention as Global Priority. Global Policy, 4(1): 15–31.

fected by our actions.[33] In the context of AI temporal models, an AI system that plans and anticipates outcomes might implicitly be using something like our distinction: it treats predicted states as real (in computing expected utilities) without assuming those states currently exist. Making this distinction explicit could improve how AI algorithms model uncertainty and time, ensuring they remain grounded in present data while respecting the reality of potential futures. In decision theory, questions about future contingents (Will an event happen? Do we prepare for it?) become less puzzling – one can coherently say we should prepare because the event is real as a possibility (with a given probability), even though it isn't an existing fact yet. More broadly, the existence–reality distinction might help dissolve certain metaphysical pseudo-problems. Disputes about whether the past or future "exist" often generate more heat than light; by reframing the discussion in terms of different modes of being (real but not presently existent), we can move past yes-or-no answers and talk about how past and future are (rather than if they are at all). In conclusion, Existential Realism's core insight is that being (ontology) comes in two tiers: the fleeting, empirically tangible present, and the extended, inferentially known reality. Keeping these apart allows us to honor common sense ("only now exists") and scientific sense ("the universe is much bigger and older than now") simultaneously. It sharpens our metaphysical language so that we need not choose between denying the reality of history or inflating our ontology with timeless blocks. There are, of course, further questions and challenges ahead. One might ask, for example, how exactly to formalize the criteria for reality (when does a theoretical posit earn the status of "real"?) or how this framework might integrate with theories of modality (possibilities and counterfactuals could be treated in analogous ways). There are also intriguing prospects for applying this distinction: in ethical theory, as mentioned, it could illuminate debates on our obligations to the non-existent (the unborn, distant future beings) by affirming those beings' reality in the relevant sense. In AI and cognitive science, implementing a two-tier representation of "known present" vs "modeled reality" could enhance an agent's reasoning about time and uncertainty. And in decision theory and economics, distinguishing between existing assets/harms and future or past ones in terms of reality could refine how we discount future events or value historical claims. These are fertile grounds for exploration. Ultimately, the hope is that by clearly asserting Existence ≠ Reality, we nurture a more nuanced ontology that can be widely adopted or adapted. The conflation of these concepts has, we contend, led to unnecessary puzzles and hardened positions in metaphysics. By disentangling them, we gain a flexible framework that upholds empirical rigor and acknowledges the full sweep of the world's temporal reality. Reality is richer than the portion of it that exists now – and appreciating that, while keeping our ontological commitments firmly tethered to the present, is crucial for a coherent understanding of time and existence.[34]

33 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Original paper introducing the two-tier distinction between existence and reality and its motivations.) https://philpapers.org/archive/TENERM.pdf

34 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Original paper introducing the two-tier distinction between existence and reality and its motivations.)

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Confrontation

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Time Is Not a Frozen Landscape

The block universe is perhaps the most widespread modern myth of time. This paper confronts it head-on, rejecting eternalism not for comfort, but for clarity. According to ER, the future does not yet exist, the past no longer exists — but both are undeniably real.

Against the Block: A Realist's Rejection of the Block Universe

Understanding Eternalism: A Critical Perspective

Tenzin C. Trepp

Email: trepp@tenz.in

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Abstract

Eternalism, or the block universe theory, maintains that past, present, and future events *all* exist equally in a four-dimensional spacetime. This paper presents a comprehensive critique of eternalism's weaknesses across metaphysical, epistemological, phenomenological, and empirical dimensions. Metaphysically, eternalism's commitment to all times being equally existent (in contrast to Existential Realism's distinction between existence and reality) is argued to be an ontologically inflationary leap that raises problems of change and becoming. Epistemologically, we question how knowledge can extend to events that, under eternalism, "exist" beyond any possible observation. Phenomenologically, the block universe is at odds with the immediacy and flow of temporal experience, treating the vivid present as an illusion. Empirically, we challenge the common presupposition that the formalism of relativity theory straightforwardly entails eternalism – a philosophical extrapolation from physics rather than a necessary conclusion. Throughout, we engage with key voices: Einstein's relativity-driven eternalism, van Fraassen's empiricism, Markosian's and Crisp's defenses of a tensed reality, among others. We contrast eternalism with **Existential Realism**, a recent framework distinguishing *existence* (present, observable being) from *reality* (including past and future structures). This distinction preserves the empirical primacy of the present while affirming the causal reality of the past and the openness of the future. We argue that Existential Realism provides a more coherent and experientially anchored ontology of time. The critique is organized into sections, each concluding with references. It is, in short, an anchored approach to time — one that preserves experiential reality without ontological excess.

Introduction

The nature of time's reality—whether only the present exists or all times exist equally—has long divided theorists of temporal ontology. **Presentism** holds that only present objects and events exist, consigning past and future entities to non-existence. As Ned Markosian succinctly puts it, if presentism is true then an exhaustive inventory of reality would include you, me, and the Taj Mahal, but *not* Socrates or our future grandchildren: "all such objects are unreal, according to presentism".[1] **Eternalism**, by

1 Markosian, Ned (2004). A Defense of Presentism. In D. Zimmerman (ed.), Oxford Studies in Metaphysics, Vol. 1, pp. 47–82. (Markosian describes presentism as holding that if one made a list of all things that exist, "you and I and the Taj Mahal would be on the list, but neither Socrates nor any future grandchildren of mine would be included... All such objects are unreal, according to Presentism".)

contrast, asserts that past, present, and future entities are *ontologically on par*—they all exist, forming a unified four-dimensional "block" universe.[2] In an eternalist's block, dinosaurs and galaxies yet to form are as real as the chair you sit on, differing only in their temporal location. Albert Einstein himself endorsed this tenseless view, famously declaring that for those who believe in physics, the distinction between past, present and future is "only a stubbornly persistent illusion".[3] Building on this outlook, Hermann Weyl gave eternalism its metaphysical poetry, writing: "The objective world simply is, it does not happen".[4]

Together, they cast time not as something unfolding, but as something already fully formed — a four-dimensional block where every moment is equally real.

Yet, this vision introduces deep tensions. Human experience presents time not as a frozen landscape, but as a process of becoming: the future feels open and unrealized, the present feels uniquely vivid, and the past persists only through memory or records. This phenomenological picture clashes with eternalism's insistence that all moments are equally actual. It also raises the deeper metaphysical question: what does it mean for events to "exist" if they are not present? And are we justified in positing such an expansive, tenseless ontology?

In response to these pressures, alternative ontologies have emerged. Presentism defends the privileged status of the now, despite struggling to explain truth about the past. The "growing block" view concedes existence to both present and past, but withholds it from the future. In this paper, however, we focus on a less examined alternative: **Existential Realism**.[5] This view attempts to reconcile the strengths of both presentism and eternalism by distinguishing **existence** (empirical presence in the now) from **reality** (participation in the world's causal or intelligible structure). As we will show, this framework offers a more coherent and experientially anchored approach to time — one that preserves experiential reality without ontological excess. This framework will be leveraged as a foil to eternalism, illustrating a more tempered ontology that remains grounded in experience and science. Eternalism, by asserting that all times equally exist, makes a metaphysical claim of extraordinary scope. As with any such claim, the burden of proof lies with the proponent: without empirical necessity or explanatory economy, this ontological excess demands more justification than it presently receives.

We proceed as follows. Sections 2–5 analyze eternalism's weaknesses in turn: its metaphysical extravagance, epistemological difficulties, phenomenological incongruence with temporal experience, and the empirical ambiguities in drawing ontological conclusions from physics. In Section 6, we compare eternalism with Existential Realism, emphasizing how a nuanced distinction between existence and reality can resolve many of eternalism's issues. Section 7 concludes with reflections on why a present-centric but reality-inclusive ontology offers a more coherent and empirically anchored view of time [6].

Metaphysical Critique of Eternalism's Ontology

Eternalism's first vulnerability lies in its **metaphysical commitments**. By declaring all temporal events – past, present, and future – to be equally real, eternalism dramatically **inflates the ontological inventory** of the world. The entire history of the universe, and its entire future, are treated as an object of being. This stands in stark contrast to presentism's sparse ontology, which contains only the fleeting portion of reality that is the present moment. Eternalism thus incurs a heavy ontological cost: it populates the world with what one might call *ontological excess* – countless events and entities (past people, bygone interactions, future generations, etc.) that, though unobservable now, are said to exist just as solidly as present ones. Tenzin C. Trepp aptly notes that eternalism "treats all events –

2 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton University Press. (Weyl famously wrote: "The objective world simply is, it does not happen. Only to the gaze of my consciousness, crawling upward along the life line of my body, does a section of this world come to life as a fleeting image in space which continuously changes in time."
3 Einstein, Albert (1955). Letter to the Besso family, March 1955. (Einstein consoles his late friend's family by noting that for physicists committed to relativity, the separation into past, present and future "only has the meaning of an illusion, though a persistent one"
4 https://philarchive.org/archive/HOETAT-4#:~:text=The%20objective%20world%20simply%20is%2C,19
5 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Trepp's framework differentiates existence and reality: "Eternalism treats all events as equally existent in a timeless block. ER rejects this: there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated; reality, by contrast, stretches beyond it.") https://philpapers.org/archive/TENERM.pdf
6 Ibid.

and by implication, all matter – as equally existent in a timeless block," effectively implying that there is "past matter lingering in a spacetime 'elsewhere'".[7] This ontological **inflation** or **extravagance** raises a red flag: a good metaphysical theory ought not multiply entities beyond necessity, especially if those entities (e.g. future objects) have no direct causal interaction with the current world (at least not until their time comes to be present). Eternalism's picture of reality appears to violate this principle by committing to an enormous "ghost landscape" of events that are not part of the lived, present world.[8] On this view, every micro-moment of time must be treated as its own complete universe — an ontological inflation that results in a vast stack of frozen universes. Far from enriching our model of time, eternalism threatens to collapse under its own metaphysical weight.

Furthermore, eternalism faces the classical problem of **temporal change and becoming**. In the block universe, change is reduced to a tenseless ordering of events on a timeline; the universe "simply is" with all events eternally laid out. There is no objective coming-into-being or passing-away; the flow of time is not fundamental but rather a subjective impression. Critics charge that this robs the temporal process of its dynamism. We intuitively think that the world is *undergoing* changes – that the future is not yet real and will be brought into existence by what happens now, and that the past has *ceased* to exist except for its effects. Eternalism, by eliminating any ontological distinction between past, present, and future, denies any objective **becoming**. The "now" in eternalism is an indexical – an observer-relative cross-section of the block – not an ontologically distinguished lightning flash of existence that moves along time. Consequently, eternalism struggles to account for why the present *feels* special and why we perceive time as flowing. Under eternalism, saying "only the present exists" is false – yet this is a statement that seems almost analytically true in ordinary language and thought, which suggests that something in our conception of existence is inherently tensed.[9] The metaphysical dispute here centers on whether the world is a **static** four-dimensional structure or a **dynamic** process. Eternalism opts for the former, thereby inviting the objection that it cannot truly make sense of **change**. If all events exist, in what sense do events *happen* or *unfold*? Critics like J. M. E. McTaggart long ago argued that a series of events ordered by dates (the B-series) without an objective present (the A-series) is insufficient to account for genuine change – it becomes a series of "earlier-later" relations with no ontological **becoming**, which led McTaggart paradoxically to conclude that time (conceived in that static way) is unreal.[10] While eternalists do not deny change outright, they typically reinterpret it: an object's "change" is just having different properties at different coordinates of the block. But this account, detractors say, merely describes a web of world-lines and fails to capture the *coming-into-existence* that seems integral to what we mean by change (the *transition* from future to present to past).[11]

Another metaphysical issue concerns **ontological economy and parsimony**. Presentists often argue that eternalism is ontologically profligate by treating merely possible or no-longer-real things as part of being. By presentism's lights, Socrates, extinct species, or future grandchildren simply *are not there* at all – they *were* or *will be*, but to claim they exist now (as eternalism does in the tenseless sense) is to populate reality with entities "out of their time." Presentists thus accuse eternalists of positing a vast "museum" of historical and future objects without empirical warrant – a kind of metaphysical inflation that offends Ockham's razor.[12] Eternalists reply that this inflation buys explanatory power: it provides straightforward truthmakers for past-tensed truths and a unified treatment of time and space. Yet one might counter that there are **less ontologically extravagant** ways to achieve those ends (as we shall see with Existential Realism's two-tier ontology in Section 6). The bottom line is that eternalism's metaphysical boldness – making **all times equally real** – invites skepticism about whether this is a credible depiction of what there is, or an over-interpretation of physical theory's mathematics.[13] The

7 https://philpapers.org/archive/TENERM.pdf

8 https://www.academia.edu/143043217/Existential_Realism_A_Distinct_Ontological_Framework_Beyond_Presentism

9 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Trepp's framework differentiates existence and reality: "Eternalism treats all events as equally existent in a timeless block. ER rejects this: there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated; reality, by contrast, stretches beyond it.")

10 https://www.academia.edu/143043217/Existential_Realism_A_Distinct_Ontological_Framework_Beyond_Presentism

11 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton University Press. (Weyl famously wrote: "The objective world simply is, it does not happen. Only to the gaze of my consciousness, crawling upward along the life line of my body, does a section of this world come to life as a fleeting image in space which continuously changes in time."

12 Markosian, Ned (2004). A Defense of Presentism. In D. Zimmerman (ed.), Oxford Studies in Metaphysics, Vol. 1, pp. 47–82. (Markosian describes presentism as holding that if one made a list of all things that exist, "you and I and the Taj Mahal would be on the list, but neither Socrates nor any future grandchildren of mine would be included… All such objects are unreal, according to Presentism".)

13 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton University Press. (Weyl famously wrote: "The objective world simply is, it does not happen. Only to the gaze of my consciousness, crawling upward along the life line of my body, does a section of this world come to life as a fleeting image in space which continuously changes in time."

notion that all events tenselessly exist can also conflict with certain philosophical or theological intuitions (for example, it sits uneasily with ideas of temporal **becoming** in process philosophy, or with a tensed theory of time in which *only* the present is actual). By treating yesterday's lunch and tomorrow's sunrise as equally existent "entities" in the world's ontology, eternalism arguably **reifies** events in a manner that stretches the concept of existence to its limit. This metaphysical stretching, we argue, is not justified: it inflates ontology at the expense of intuitive coherence, and it does so without decisive empirical necessity (as later sections will reinforce). In sum, eternalism's metaphysical posture of an all-encompassing block universe faces serious challenges: an ontological inflation problem, and the erasure of an explanatory role for the dynamic aspects of time (becoming, change, and the special status of the present).[14]

Epistemological Challenges and Empirical Inaccessibility

Beyond metaphysics, eternalism raises significant **epistemological** questions. If all times exist equally, what does it mean for us as knowers constrained to the present? Our knowledge-gathering capabilities are fundamentally oriented to the here and now; we observe present events (or present traces of past events) and form beliefs. But eternalism posits a vast expanse of reality – the past and future – that, while equally real, is largely *beyond our epistemic reach*. We cannot observe future events; we also cannot directly observe the full past (except through records and memories). This leads to a puzzle: on what grounds can we claim that those unobservable events "exist" in the same sense as the observed present? The eternalist might answer that we infer the existence of unobserved times by theoretical reasoning (just as scientists infer unobservable entities). However, an **empiricist** critique arises: positing the existence of entities or events that are in principle unobservable (or not yet observable) may go beyond what our evidence supports. Bas van Fraassen's philosophy of science is instructive here. Van Fraassen's **constructive empiricism** counsels that we can accept scientific theories as empirically adequate without committing to the literal existence of all the entities they postulate, especially when those entities are unobservable. He explicitly allows scientists to *speak* of electrons or other unobservables, but advises remaining agnostic about their actual existence — a caution aligned with Existential Realism's two-tier view, where 'reality' may still be affirmed for such entities, insisting that "what the theory says about observable things and events is true" – and bracketing any ontological commitment to the rest.[15] By analogy, one could argue that eternalism treats the theoretical "time coordinate" in physics as if it were an ontological inventory list. The empiricist stance would caution: even if relativity's spacetime model is useful and empirically confirmed, we need not literally believe that all events labeled on the spacetime diagram exist in a block. We can use the model to predict observable relations (e.g. how clocks behave, how signals travel) without ontologically committing to the reality of the entire four-dimensional structure independent of those observations.[16] In short, **epistemic humility** urges that we not confuse the map with the territory – a theme we will revisit when discussing relativity. Eternalism's critics claim it commits just such a confusion, by taking a successful scientific *representation* (a 4D model) and elevating it to the status of *reality itself*.[17] This is an epistemological leap of faith, arguably going beyond what we can know or justifiably assert.

A related epistemological challenge is the **problem of temporal knowledge**: if the future is as real as the present, why are we ignorant of it? In the block universe, the future "already" exists in tenseless terms; every future event is there on the spacetime diagram. Yet from our standpoint within time, the future seems open and unknown. Eternalists typically respond that our knowledge is constrained by our position in the block (we *remember* past states and experience the present state, but we have no access to future states due to entropy, causality, and the structure of information flow). That expla-

14 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Trepp's framework differentiates existence and reality: "Eternalism treats all events as equally existent in a timeless block. ER rejects this: there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated; reality, by contrast, stretches beyond it.") https://philpapers.org/archive/TENERM.pdf

15 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that one can accept a theory's empirical content without believing in the literal existence of unobservable entities. He allows that we may speak of electrons, e.g., but "remain agnostic about their existence" while affirming that what the theory says about observables is true.)

16 Smolin, Lee (2013). Time Reborn: From the Crisis in Physics to the Future of the Universe. Houghton Mifflin Harcourt. (Smolin warns against "spatializing time" by treating the time coordinate on a graph as if it were reality. He notes that if we conflate the 4D representation with reality, "we are committing a fallacy, the fallacy of the spatialization of time" – forgetting the distinction between record and process

17 https://iep.utm.edu/time/#:~:text=By%20succumbing%20to%20the%20temptation,from%20our%20conception%20of%20nature

nation, however, underscores an important point: our epistemic situation is thoroughly *tensed*. We have asymmetrical epistemic access: we can often know the past (through records) but not the future (which lacks records); we directly perceive a present event but not a distant simultaneous event (due to light-speed limits). All these asymmetries align well with a presentist or at least a tensed view of reality, where the past's traces exist now and the future is genuinely undetermined. Eternalism, conversely, must say that the future is determined (it *is* there in the block), yet simply unknown to us. This positions us, in a sense, as conscious inhabitants of a giant crystalline block, able to see only along certain directions (the past behind us via memory, the present immediately around, but the future ahead is opaque). The **epistemological cost** of eternalism is that it accepts a large *real* domain (the future, and unseen parts of the past) that is in principle inaccessible. By contrast, a philosophy that only counts as "existent" what can be empirically observed or at least detected (at some time) might avoid filling reality with what Wilfrid Sellars called the "myth of the given" – in this case, a myth of reality that is given to no possible observation. Eternalism's reliance on a **tenseless ontology** effectively means truths about events do not depend on anyone ever being able to verify them (they are true because the event is there in the block). This stands in tension with a more verificationist or empiricist intuition that if something is absolutely beyond any empirical influence forever, its claim to existence is dubious.[18] For instance, consider events outside our cosmological horizon (so distant we will never receive any signal from them). Eternalism would say those events are as real as local ones. An empiricist might retort that this is an unverifiable metaphysical add-on; one can acknowledge the *possibility* or consistency of such events without needing to assert their existence as equally concrete as the here-and-now.

Another aspect of the epistemological critique involves **truthmakers and reference**. Eternalism provides an easy answer to "What makes past-tense and future-tense statements true?": namely, the past or future events themselves (since they exist in the block). However, presentists have long struggled with truthmakers for past truths precisely because they deny past events exist now. It might seem then that eternalism has an epistemic *advantage* in accounting for how we can meaningfully talk about the past and future. Yet this advantage comes at the aforementioned ontological price. Philosophers like Arthur Prior and Markosian have suggested that one can instead allow present *evidence* (traces, memories) to serve as truthmakers for past statements, without reifying the past itself. **Existential Realism** takes exactly this route, saying past events are *real* (hence statements about them can be true by correspondence to reality) but not *presently existent*.[19] The eternalist's move of making the past fully exist is one solution, but perhaps an over-solution—one that drags in a lot of unneeded ontology. Epistemologically, what matters for truth and knowledge is that there is something in the world now (or in inferable structure) that reliably indicates the past event. Eternalism ensures that by insisting the event is still "in being," but a weaker assumption (the event *was* and left a mark) might suffice for all practical and theoretical purposes.[20]

In summary, eternalism faces a challenge in justifying its extensive ontology in light of our finite epistemic situation. The block universe posits a reality far outrunning what can ever be experienced or empirically confirmed. From a strict epistemological or empiricist perspective, this looks like metaphysical extravagance. Bas van Fraassen's stance reminds us that one can remain *agnostic* about the existence of entities posited by a theory beyond their empirical consequences. Applying this to time: we might use the 4D spacetime formalism to calculate observations, without committing to "existence" of all events in the way eternalists insist. The **knowledge problem** ("if future events exist now, why can't we know them now?") indicates that eternalism must accept a peculiar disjunction between reality and knowledge – a disjunction that a refined ontology could perhaps avoid by tethering "exists" to "can in principle be observed".[21] Thus, eternalism's epistemological position is arguably

18 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that one can accept a theory's empirical content without believing in the literal existence of unobservable entities. He allows that we may speak of electrons, e.g., but "remain agnostic about their existence" while affirming that what the theory says about observables is true.)

19 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Trepp's paper elaborates how ER preserves the presentist insight that only the present exists while granting that much more is real. "Existential Realism agrees with presentism that only present entities exist in the fullest ontological sense, but emphatically rejects the presentist inference that only present entities are real." This framework "keeps the ontological economy of presentism (no commitment to 'ghostly' unexperienced realms) and the explanatory breadth of eternalism/growing block".)

20 https://www.academia.edu/143043217/Existential_Realism_A_Distinct_Ontological_Framework_Beyond_Presentism

21 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that one can accept a theory's empirical content without believing in the literal existence of unobservable entities. He allows that we may speak of electrons, e.g., but "remain agnostic about their existence" while affirming that what the theory says about observables is true.)

unstable: it asks us to believe in an abundance of reality that is, for now and perhaps forever, beyond belief (in the sense of beyond verification or falsification). This is not to say we should only believe what we directly observe – science clearly goes further – but it is to suggest that eternalism's leap from useful theory to ontological claim is not compelled by any epistemic necessity. We can, and perhaps should, separate the empirical content of physics from the metaphysical assertion that all those events are "equally real in an existent sense." In doing so, we open the door for an alternative view (like Existential Realism) which anchors ontology in empirical accessibility while still allowing us to talk about past and future in a grounded way.[22]

Phenomenological Mismatch: Time and Human Experience

Perhaps the most visceral objection to eternalism comes from the standpoint of **phenomenology** – the study of experience as lived. Human beings do not experience time as a static dimension laid out before them; we experience it as a flow, a succession, an ever-changing now. **Temporality** is central to consciousness: we remember the past, anticipate the future, and are immediately aware of the present moment's passing. Eternalism, however, would have us believe that this experience of flow is fundamentally misleading – that past and future are "already there" and the present is not ontologically special. There is a glaring **mismatch between eternalism's metaphysics and the reality of temporal experience**. This section argues that eternalism fails to account for, or even dismisses, crucial features of the phenomenology of time, thereby impoverishing our understanding of what time *is* for beings like us (who perceive and act in time).

A first point is the **privileged vividness of the present** in experience. It is a trivial truth of experience that *now* feels real in a way that yesterday or tomorrow do not. We encounter the world as a stream of present moments, each with vivid sensory and emotional content, whereas the past is accessible only via memory (often fragmentary or fading) and the future via imagination or anticipation. Presentists and advocates of dynamic time seize on this fact: the present is *experientially central*. Eternalists acknowledge the psychological fact but regard it as just that – a mind-dependent feature, not reflective of an objective ontological distinction. Critics argue this stance unduly sidelines an evidently fundamental aspect of reality: the unfolding **presentness** that we cannot help but experience. As one compendium puts it, opponents of eternalism note that "the present is so much more vivid than the future".[23] The eternalist has to say, essentially, "Of course it seems that way to you, situated as you are – but in reality all times are equally real and your sense of 'now' is subjective." Many philosophers have found this reply unsatisfying. It risks treating consciousness and its structured experience as an illusion or epiphenomenon, when perhaps that experience is telling us something profound about the nature of time. Edmund Husserl's analysis of time-consciousness, for instance, reveals that our experience of the present is not a knife-edge instant but includes a **horizon of retention and protention** – a just-past that is still given in consciousness and an about-to-arrive that is anticipated. In other words, the phenomenological "now" is extended; we experience a melody as a flowing whole thanks to memory of notes just played and expectation of notes to come, all integrated into the present awareness.[24] This suggests that our mind itself straddles a short span of time, not a geometric point. Eternalism can accommodate this as a feature of brains or information processing in the block (the brain has memory traces, etc.), but it doesn't acknowledge any *ontological* significance to this asymmetry. By contrast, a theory like Existential Realism explicitly builds in phenomenological insight, recognizing that **only the present is directly experienced and empirically accessed, while past and future are accessible in indirect or anticipatory ways**.[25] From a phenomenological perspective, eternalism's erasure of

22 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Trepp's paper elaborates how ER preserves the presentist insight that only the present exists while granting that much more is real. "Existential Realism agrees with presentism that only present entities exist in the fullest ontological sense, but emphatically rejects the presentist inference that only present entities are real." This framework "keeps the ontological economy of presentism (no commitment to 'ghostly' unexperienced realms) and the explanatory breadth of eternalism/growing block".)

23 Crisp, Thomas M. (2007). "Presentism, Eternalism, and Relativity Physics." In W. L. Craig & Q. Smith (eds.), Einstein, Relativity and Absolute Simultaneity. Routledge, pp. 262–278. (Crisp argues that adding a preferred foliation – an absolute but empirically undetectable present – to relativistic spacetime yields a theory empirically equivalent to standard relativity. Hence, relativity's success "suggests an accurate picture of the metrical structure of the universe… But does it imply the correct theoretical hypothesis is a four-dimensionalist rather than a presentist hypothesis? I can't see why it would… [This addition] yields a theory empirically equivalent to standard relativity."

24 Husserl, Edmund (1928). Lectures on the Phenomenology of Internal Time-Consciousness. (Husserl analyzes the structure of temporal awareness, introducing retention (just-past) and protention (imminent future) as integral parts of the "living present." Thus, "our phenomenal present is inherently extended and contains traces of the past and outlines of the future," rather than being a mathematical instant.)

25 https://philpapers.org/archive/TENERM.pdf

an objective present is akin to saying "color isn't real, only wavelengths are" – it might be true at one level, but it denies the reality of what is immediately given (in the case of time, the given-ness of a now that is continually renewing).

A second aspect is the **sense of passage** or **flow**. We have a strong intuition that time "moves" or that we move through time. Philosophers describe this using the metaphor of a "moving spotlight" on a timeline (the spotlight being the present) or of ourselves moving along a world-line. Eternalism denies any objective motion of a spotlight or of time itself – all moments coexist, and the flow is perspectival. Critics from Bergson to present-day argue that this denial fails to explain why the illusion of flow is so powerful and structured. It might be acceptable to say "the flow is an illusion" if one can explain it away, but thus far, there is no consensus on a complete explanation of temporal experience from within a block universe framework. Some propose that the flow is a cognitive process – the brain's way of updating memory and anticipation – and not a property of time. Even if that were true, it merely redescribes subjective flow without ontological commitment. It explains away what needs explaining: why the present feels ontologically unique. The **phenomenology of temporal passage** is rich: we experience duration (time seems to speed up or slow down depending on activities), we experience changes as real and happening, and we feel an irreversibility (the *arrow of time* in experience, aligning with memory of past not future). Eternalism by itself, being a static ontology, does not account for these asymmetries except by reference to boundary conditions (like low entropy in one time direction) or psychological arrow. The worry is that eternalism **abstracts away** too much. It takes a "view from nowhere (and nowhen)" – God's eye perspective sub specie aeternitatis – and in doing so, it cannot easily recover the view from *here and now*, which is the only view we actually have. This is not merely a sentimental complaint; some philosophers (e.g. Henri Bergson) have argued that the very *reality* of time is bound up with the qualitative flow and that mathematical time (as used in physics) misses an essential element.[26] While one need not go as far as Bergson's élan vital, one can agree that **any adequate ontology of time must accommodate the reality of temporal passage as experienced**, or at least give a plausible account of why that experience arises if it's not telling us the truth. Eternalism tends to punt on this, labeling passage an illusion. But calling something an illusion is the beginning of a task (to explain the mechanisms producing the illusion), not the end. Until and unless eternalists can derive the phenomenology of flowing time from block universe principles, there remains a gap in the theory – a gap filled naturally by a tensed notion of reality.

A related phenomenological issue is **agency and freedom**. We experience ourselves as agents who can to some extent shape the future through our choices. This presupposes that the future is not yet fixed or real – that we bring about something genuinely new. Eternalism, especially in its classical form, implies a **fixed future**: there is already one future out there, so in what sense do we "create" it? Philosophers like C. D. Broad (in the growing block theory) and others have been motivated by the openness of the future to deny full eternalism. Even if eternalism is technically compatible with a kind of determinism or compatibilist free will (since one could say we *are* part of the block that determines the future), the *experience* of deciding and causing things to happen feels at odds with the idea that the outcome is eternally real. As one critique notes, eternalism "misses the special open and changeable character of the future," implying that if the future exists already, it "denies our ability to affect the future".[27] The eternalist may counter that our choices are just as real – they are baked into the block as the causes of later events – so we do affect the future *from inside* the block. Still, the worry remains that if one steps outside the block perspective, nothing *really* could have been otherwise; the entire history is fixed. This can lead to a kind of fatalism or at least a strange perspective on one's own life (seeing it as an already-written story). Many find this existentially unsatisfying and phenomenologically alien: we *feel* like the future is open until we act and the past is fixed but fading. Eternalism inverts this: the future is as fixed as the past (tenselessly), and the passage is an internal illusion. The **phenomenological asymmetry** (past as settled, future as unset) is thus declared a subjective artifact. This declaration might be too hasty or even false; some interpretations of quantum mechanics, for example, suggest indeterminism is fundamental, reinforcing the idea of an objectively open future – something eternalism in its strict form has trouble accommodating (though one can have a "block" with multiple branches, etc.).

26 https://iep.utm.edu/time/#:~:text=By%20succumbing%20to%20the%20temptation,from%20our%20conception%20of%20nature
27 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism.pdf#:~:text=foliation,would%20differ%20from%20the%20standard

In sum, eternalism arguably **fails to do justice to the lived reality of time**. It either dismisses or downplays the very features that make time meaningful to us: the distinction between now and not-now, the flow of becoming, the one-way directedness of experience, and the sense of open possibility. A robust ontology of time should not render these features completely epiphenomenal. By contrast, theories like Existential Realism insist on preserving the "empirical and experiential centrality of the present".[28] They do so not out of mere sentiment, but because the present is where we stand epistemically and phenomenologically – the only point of direct interaction with reality. Likewise, acknowledging the reality of past and future in a weaker sense (as real but not existent) allows one to say past events *happened* (and left real effects) and future events *may happen* (involving real possibilities), without committing to the counterintuitive claim that they are **already there** in the same mode of being as current observations. In Section 6 we will see more explicitly how separating existence from reality can incorporate phenomenological insights. For now, the key takeaway is that eternalism's tenseless block view, while elegant in a mathematical sense, **sits at odds with the human perspective** in a way that raises doubts about its completeness as an ontology. If a philosophical theory of time implies that one of our most fundamental experiences (temporal flow) is wholly deceptive, one must either provide a compelling error theory or reconsider whether the ontology has missed an important piece of the puzzle. The eternalist has the former task on their plate, and many remain unconvinced that it has been fulfilled.[29]

Scientific and Empirical Considerations: Relativity and Beyond

Eternalism's modern appeal derives largely from physics—specifically, the theory of relativity. Indeed, many argue that **special and general relativity**, by eliminating a universal present and treating time as a coordinate in a four-dimensional manifold, essentially *mandate* the block universe ontology. In this section, we examine that claim critically. We argue that the inference from relativity's **formalism** to eternalism's **ontology** is not as airtight as often supposed; it represents a philosophical extrapolation rather than an experimentally verified truth. Additionally, we consider whether other empirical considerations (e.g. quantum mechanics or cosmology) undermine or complicate the block view. The goal is not to dispute relativity's empirical success, but to challenge the idea that physics *forces* us into eternalism. A recurring theme will be the distinction between a scientific theory's mathematical representation and the ontological interpretation we choose to give it – a point emphasized by thinkers like van Fraassen and also by some physicists of a more philosophical bent.

Relativity and the Relativity of Simultaneity: In Newtonian physics, time was absolute and all observers could agree on what events are simultaneous "now." Relativity shattered this by showing that simultaneity is relative to an inertial frame; there is no objective, frame-independent partition of events into past, present, future. This is often taken to support eternalism: if different observers disagree on simultaneity, we cannot uphold one global present as real. Instead, all events (past/future) must be equally real, otherwise we would have to privilege one frame's division. This line of reasoning was articulated by Hermann Minkowski (Einstein's former math professor) who said that henceforth time and space are united and that the separation into past, present, future is subjective. The earlier quote from Weyl about the "objective world simply is" follows directly from this Einstein-Minkowski insight.[30] Moreover, Einstein himself, as noted, viewed the lack of absolute simultaneity as validating a block universe view.[31] Philosophers like Hilary Putnam (1967) even tried to formally prove that special relativity implies eternalism, via an argument that in any given frame, some events judged future in that frame are present in another moving frame, so if you assume reality of present in each frame you end up concluding reality of all times. Those arguments are subtle and have been rebutted (e.g.

28 https://philpapers.org/archive/TENERM.pdf

29 Crisp, Thomas M. (2007). "Presentism, Eternalism, and Relativity Physics." In W. L. Craig & Q. Smith (eds.), Einstein, Relativity and Absolute Simultaneity. Routledge, pp. 262–278. (Crisp argues that adding a preferred foliation – an absolute but empirically undetectable present – to relativistic spacetime yields a theory empirically equivalent to standard relativity. Hence, relativity's success "suggests an accurate picture of the metrical structure of the universe… But does it imply the correct theoretical hypothesis is a four-dimensionalist rather than a presentist hypothesis? I can't see why it would… [This addition] yields a theory empirically equivalent to standard relativity."

30 https://www.laphamsquarterly.org/time/grand-illusion#:~:text=board%2C%20the%20very%20division%20of,%E2%80%9D

31 Einstein, Albert (1955). Letter to the Besso family, March 1955. (Einstein consoles his late friend's family by noting that for physicists committed to relativity, the separation into past, present and future "only has the meaning of an illusion, though a persistent one"

by Howard Stein and others), but the general intuition remains influential. The **scientific critique** we offer is twofold: First, that the relativity argument is not conclusive because one can formulate *relativistic presentism* or other interpretations without logical contradiction. Second, that even if relativity favors a tenseless description, interpreting that description as "everything exists" is a metaphysical addition not demanded by experiment.

On the first point, consider the work of philosophers of time like Thomas Crisp and others who have explored ways to reconcile presentism with relativity. Crisp argues that one can modify the interpretation of relativity by positing a (non-empirical) privileged foliation of spacetime – essentially, a hidden absolute simultaneity – without affecting any empirical predictions.[32] This means a "presentist-friendly" version of relativity can be constructed that is *empirically equivalent* to standard relativity. If so, then the success of relativity as a physical theory does not *force* the conclusion that only eternalism is true; it permits, at least, an empirically indistinguishable scenario in which an objective present exists (albeit unknowable to observers). Now, many physicists object to adding such a structure as ad hoc or against the spirit of relativity (indeed, it restores something Einstein aimed to remove). But the crucial point is that this is a *metaphysical preference*, not an empirical finding. As Crisp puts it, the question of whether the correct interpretation of relativity's spacetime is eternalist (all 4D is real) or presentist (only one 3D hyperplane is real, but we can't tell which one from within the physics) is underdetermined by data.[33] Both views produce the same observable phenomena. To choose eternalism is to choose the simpler, more elegant ontology given the mathematics – but simplicity in metaphysics is not an infallible guide, especially if it runs into other problems as we have seen. We thus emphasize that **relativity's experimental confirmations support the geometric structure of spacetime, but do not unambiguously dictate its ontological status**. Even within physics, there are alternative formulations (for example, some approaches in quantum gravity or interpretations that treat time differently) that suggest the story might not end with a block.

On the second point, consider a more moderate stance: one can accept that relativity abolished a *global* present, yet still refrain from saying "therefore all times are equally real in being." One might instead say: time ordering is frame-dependent, so "present" is not an absolute notion. However, for any given observer, there is still their own notion of present, past, future. Do we need to assert that events spacelike separated (neither in past nor future lightcone) "exist" before they are observed, or can we remain agnostic? Bas van Fraassen's advice about not confusing the model with reality becomes relevant here [34]. Relativity uses a 4D model where the entire spacetime is laid out. But as Lee Smolin warns, one must not "succumb to the temptation to conflate the representation with the reality" by identifying the mathematical spacetime model with the real world itself [35]. Doing so, Smolin argues, is to commit "the fallacy of the spatialization of time" – treating time as if it were just another dimension exactly like space, thereby potentially "expelling time from our conception of nature".[36] Smolin's point (echoing earlier philosophers like Bergson) is that when physicists draw a 4D graph, they might inadvertently think the graph *is* the world, whereas it might only be a powerful *representation* of aspects of the world. The pragmatist stance he channels insists that spacetime as a whole is "not the real world… just another representation" and confusing it with reality is a fallacy.[37] This is a striking rebuke from a physicist: it suggests that even within the scientific community there is not unanimous agreement that the block universe is the final word. In fact, some contemporary cosmologists and quantum gravity researchers explore ideas where time has an objective role (e.g. "Julian Barbour's timeless cosmology" versus "time-emergent" scenarios, etc., though we won't digress into those). The key insight is that **physics does not necessarily dictate metaphysics**; it constrains it, certainly, but multiple metaphysical interpretations can share the same physical predictions.

32 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism.pdf#:~:text=foliation,would%20differ%20from%20the%20standard

33 Crisp, Thomas M. (2007). "Presentism, Eternalism, and Relativity Physics." In W. L. Craig & Q. Smith (eds.), Einstein, Relativity and Absolute Simultaneity. Routledge, pp. 262–278. (Crisp argues that adding a preferred foliation – an absolute but empirically undetectable present – to relativistic spacetime yields a theory empirically equivalent to standard relativity. Hence, relativity's success "suggests an accurate picture of the metrical structure of the universe… But does it imply the correct theoretical hypothesis is a four-dimensionalist rather than a presentist hypothesis? I can't see why it would… [This addition] yields a theory empirically equivalent to standard relativity."

34 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that one can accept a theory's empirical content without believing in the literal existence of unobservable entities. He allows that we may speak of electrons, e.g., but "remain agnostic about their existence" while affirming that what the theory says about observables is true.)

35 Smolin, Lee (2013). Time Reborn: From the Crisis in Physics to the Future of the Universe. Houghton Mifflin Harcourt. (Smolin warns against "spatializing time" by treating the time coordinate on a graph as if it were reality. He notes that if we conflate the 4D representation with reality, "we are committing a fallacy, the fallacy of the spatialization of time" – forgetting the distinction between record and process

36 https://iep.utm.edu/time/#:~:text=By%20succumbing%20to%20the%20temptation,from%20our%20conception%20of%20nature

37 Smolin, Lee (2013). Time Reborn: From the Crisis in Physics to the Future of the Universe. Houghton Mifflin Harcourt.

One might ask: if eternalism weren't true, how else could we explain relativistic phenomena like time dilation and the relativity of simultaneity? The answer: those phenomena can be accounted for by the geometrical relationships in spacetime without any agent having to admit all times exist. A presentist, for example, can say: the world has a dynamic evolution, but due to relativity, there's no single "true" simultaneity plane – nonetheless, only one 3D slice is real at a time (which one depends on the frame? presentists would have to specify a preferred frame or accept a fragmentation of reality per frame). Admittedly, presentism struggles to fit neatly with relativity unless one gives up some symmetry (by positing an undetectable ether frame, for instance). That is a cost, but it's a theoretical cost, not an outright contradiction. Eternalists often retort that adding such structure (a hidden absolute time) violates the spirit of relativity and multiplies hypotheses without need. That may be so – eternalism is certainly the simpler story given relativity. But here we must be careful to separate explanatory elegance from empirical truth. The history of science includes cases where a simpler elegant theory (like a perfectly symmetric universe) had to yield to something more complex to accommodate new insights (like an expanding universe with a preferred frame given by the cosmic microwave background, which in fact *does* allow one to define a kind of cosmic time – interestingly giving presentists a possible handle).

Another empirical angle is **quantum mechanics** and specifically quantum entanglement or collapse. Some have argued that quantum events (like the collapse of a wavefunction upon measurement) suggest an updating present – though relativistic quantum field theory handles this in a block-compatible way via correlations. There is debate in quantum foundations: e.g., the idea of a "block universe" vs an "evolving block" in interpretations like the transactional interpretation or some objective collapse theories. While not definitively favoring presentism, quantum indeterminacy at least shows that the future might not be a fixed "film reel" but a set of potential outcomes that become definite only when they happen. If one subscribes to, say, the Copenhagen interpretation (with an undefined state until measurement), one might lean to a view that the future isn't yet real (in any definite sense). Eternalism, especially in a fully deterministic block form, has trouble with ontologically indeterminate futures. Eternalists could adopt a many-worlds interpretation (where all outcomes exist in a larger block), but that multiplies the ontology even more extravagantly (a multiverse of branching blocks). We won't delve deeper, but it's worth noting that not all of cutting-edge physics sits comfortably with a naive block view; some approaches (like those of Penrose or Smolin) reassert that time and its flow could be fundamental and real.

In light of these considerations, we conclude that **the scientific case for eternalism is suggestive but not dispositive**. Relativity undeniably changed our understanding of time's structure, undermining the idea of a single global now and thus discrediting a naïve presentism. But it did not *prove* that the past and future exist in the same manner as the present – that is a metaphysical inference. As philosopher of science Bas van Fraassen would remind us, one can accept the empirical content of a theory (here, that there's no absolute simultaneity and that physical processes obey Lorentz covariance) without committing to every metaphysical interpretation (such as "all events tenselessly exist").[38] Eternalists interpret the success of relativity as evidence that time is an illusion and the block is real. However, alternative interpretations (though less popular) are not eliminated by experiment. Moreover, even if one grants that a four-dimensional spacetime is the best description, one might still differentiate ontologically between the part of spacetime that is "actualized" (the present and past) and the part that is "not yet actual" (the future) – akin to the **growing block theory** where the block grows as time progresses. The growing block accepts much of eternalism (past is real) but not the future (keeping an objective becoming). This indicates that *even within a block-like picture, modifications exist that accommodate a sense of flow or openness absent in strict eternalism*.

In conclusion of this section, the often-repeated claim "Einstein proved eternalism true" is an oversimplification. Einstein's work eliminated a universal present but did not by itself settle the ontological debate – that step was a philosophical interpretation that Einstein personally favored.[39] As Thomas

38 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that one can accept a theory's empirical content without believing in the literal existence of unobservable entities.

39 Einstein, Albert (1955). Letter to the Besso family, March 1955. (Einstein consoles his late friend's family by noting that for physicists committed to relativity, the separation into past, present and future "only has the meaning of an illusion, though a persistent one"

Crisp observes, adding a presentist structure to relativity yields no disagreement with observed physics.[40] Lee Smolin's critique serves as a reminder that confusing the mathematical spacetime for reality can mislead us about the role of time in nature.[41] Therefore, eternalism's supposed **empirical inevitability** is questionable. It remains a philosophically bold hypothesis consistent with relativity, but not demanded by it. This opens the door for hybrid frameworks (like Existential Realism) that respect relativity's lessons (no absolute simultaneity, finite signal speeds, etc.) yet refrain from the full ontological commitment of eternalism. Such frameworks may preserve a real present and an indeterminate future without contradicting any experiment – they simply add a metaphysical layer that is invisible to physics but meaningful to philosophy. Whether one finds that move necessary depends on how one weighs the cumulative force of the metaphysical, epistemological, and phenomenological critiques above against the desire for a simple, elegant ontology. We now turn to one such alternative framework and examine how it contrasts with eternalism on all these fronts.

In sum, relativity may model time tenselessly, but it does not mandate eternalism. Any ontological interpretation drawn from physics must answer to both epistemic limits and experiential structure — which the block view fails to do.

Eternalism vs. Existential Realism: Existence, Reality, and Temporal Ontology

Having examined eternalism's shortcomings, we now consider **Existential Realism (ER)** as a comparative framework that explicitly addresses those issues. Existential Realism, recently formulated by T. C. Trepp (2025), is an ontological framework that **distinguishes between "existence" and "reality"** in a precise way.[42] This distinction allows ER to retain the common-sense and experiential truth that only present things *exist* (in the full-blooded sense of concrete presence), while also affirming that past and future things are in some sense *real* (in virtue of their connections to the present, e.g. causal traces or predictive relations). In doing so, ER attempts to capture the insights of presentism (the empirical/experiential privilege of the present) without its drawbacks, and the insights of eternalism (the continuity of reality across time) without its ontological inflation. In this section, we compare eternalism with Existential Realism, highlighting especially how they differ on the **existence vs. reality** of non-present times, and why those differences matter. The analysis will show that ER directly counteracts eternalism's mismatches: it denies that past and future *exist* now (avoiding the ontological excess and experiential clash), but it allows that they are nonetheless *real* in a well-defined sense, thereby preserving the objectivity of facts about them and their influence.[43]

Defining the Distinction: In eternalism, no distinction is made between existence and reality – to say an event is real just means it exists (tenselessly) in the spacetime block. Existential Realism breaks this unity. It defines **existence** narrowly: an entity or event exists (now) if and only if it is *present and empirically accessible at this moment*. This ties existence to the here-and-now and to an epistemic criterion (observability in principle). By contrast, **reality** is defined more broadly: an entity or event is real if it plays some role in the causal, structural, or informational fabric of the world, even if it is not presently existent.[44] In other words, reality encompasses anything that *contributes* to the world's causal story or that is legitimately inferable or anticipated based on what exists now. With this two-tier ontology, ER can assert, without contradiction: "Only present entities exist, but past and future entities are still real in the world". For example, consider a volcano that erupted in 79 CE (Vesuvius). Presentism would say Vesuvius's eruption simply does not exist now (true) and is not real (problematic, as it *seems* real in light of Pompeii's ruins). Eternalism would say the eruption exists just as much as

40 https://thomasmcrisp.com/wp-content/uploads/2017/07/presentism.pdf#:~:text=foliation,would%20differ%20from%20the%20standard

41 Smolin, Lee (2013). Time Reborn: From the Crisis in Physics to the Future of the Universe. Houghton Mifflin Harcourt. (Smolin warns against "spatializing time" by treating the time coordinate on a graph as if it were reality. He notes that if we conflate the 4D representation with reality, "we are committing a fallacy, the fallacy of the spatialization of time" – forgetting the distinction between record and process

42 https://philpapers.org/archive/TENERM.pdf

43 https://www.academia.edu/143043217/Existential_Realism_A_Distinct_Ontological_Framework_Beyond_Presentism

44 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Trepp's paper elaborates how ER preserves the presentist insight that only the present exists while granting that much more is real. "Existential Realism agrees with presentism that only present entities exist in the fullest ontological sense, but emphatically rejects the presentist inference that only present entities are real... Only the present, empirically accessible entities exist, but many other things are real". This framework "keeps the ontological economy of presentism (no commitment to 'ghostly' unexperienced realms) and the explanatory breadth of eternalism/growing block".)

this current sentence, only located in 79 CE – it is part of the block's contents. ER says: the eruption does **not exist now** (it's over and done, not directly observable now), but it is **real** because it left effects and we have records; it is a piece of the world's history which continues to have reality by virtue of those traces. Likewise, a future solar eclipse predicted for next year does not exist yet, but it is real insofar as it is a determined outcome of present orbital mechanics and we are already planning for it (it has causal and epistemic footprints extending into the now).[45]

This nuanced stance yields several advantages in comparison to eternalism:

- **Ontological Economy**: ER avoids eternalism's ontological glut. It does not claim that the volcano's eruption or the 2025 eclipse *exist presently* in some ghostly way. Only things that meet the strict existence criterion (present, observable) are counted as existing. Thus ER's **existence category** is as lean as standard presentism's – the "ontological inventory" at any given time only contains current entities.[46] This prevents the kind of ontological inflation eternalism performs by having the entire history of the universe "on the books" at once. ER's reality category, however, ensures that we do not throw the past and future away entirely; they are acknowledged in the ontology but at a lower tier of commitment. We keep what Markosian called the presentist's virtue of "no commitment to ghostly unexperienced realms" [47]. Past and future events are not spooky co-existing things; they are *absent* in terms of existence. In Trepp's words, "there is no past matter lingering in a spacetime 'elsewhere'. Only the present is materially populated".[48] This directly negates eternalism's picture of a fully populated block, replacing it with a *sparsely populated present* plus a structurally real past/future.

- **Alignment with Experience and Epistemology**: By tying existence to empirical accessibility, ER builds into its foundation the idea that *our knowledge defines what gets to count as existing*. This resonates with van Fraassen's empiricism – observability may be an anthropocentric notion, but it's crucial for our epistemic attitude. The present is our point of contact with reality, so ER makes that the criterion for the highest grade of being (existence). Past and future are known indirectly (through memory, traces, predictions), so they are accorded a derivative ontological status (real but not existent). This move addresses the epistemological critique of eternalism: we no longer have to claim that completely inaccessible events (say, a billion years in the future) are "equally existent." We say instead: they are real if they are entailed by or connected to what exists, but until they come into existence, they do not exist. This preserves a kind of epistemic **modesty** – we aren't asserting existence beyond what can be evidenced. Yet we still allow ourselves to talk truthfully about past and future. ER can happily say, "Socrates is unreal *in the sense of existence* (he does not exist now), but Socrates is real *in the sense that he was part of the world and left intellectual descendants*". This resolves the conflict presentism had with truthmakers: how are past-tense statements true if the past is unreal? In ER, past entities *are real*, so statements about them have truthmakers – the past events themselves (considered as real but non-present) ground the truth, while present evidence (like writings of Plato) informs us of those truths.[49] Eternalism also solved the truthmaker issue (by making past exist), but ER does it without positing that those events exist now.

- **Temporal Asymmetry and Becoming**: ER explicitly incorporates the **asymmetry of time**. The present exists, the past existed (and is real through its effects), the future will exist (and is real insofar as it casts "protentions" or is the domain of rational anticipation). This maps more naturally onto our sense of temporal becoming. We can say in ER that when an event arrives into the present, it *comes into existence* – a phrase eternalism has to treat as merely indexical, but ER can give it literal meaning. The future consists of *real possibilities* or structures that are not yet concretely existent. This means ER can accommodate an **open future** in a way eternalism

45 https://philpapers.org/archive/TENERM.pdf
46 Markosian, Ned (2004). A Defense of Presentism. In D. Zimmerman (ed.), Oxford Studies in Metaphysics, Vol. 1, pp. 47–82. (Markosian describes presentism as holding that if one made a list of all things that exist, "you and I and the Taj Mahal would be on the list, but neither Socrates nor any future grandchildren of mine would be included… All such objects are unreal, according to Presentism".)
47 https://www.academia.edu/143043217/Existential_Realism_A_Distinct_Ontological_Framework_Beyond_Presentism
48 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Trepp's framework differentiates existence and reality: "Eternalism treats all events as equally existent in a timeless block. ER rejects this: there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated; reality, by contrast, stretches beyond it.")
49 https://www.academia.edu/143043217/Existential_Realism_A_Distinct_Ontological_Framework_Beyond_Presentism

cannot. Trepp notes that the future's reality "does not equate to predetermination; it consists in structured possibilities… Our actions now can genuinely influence which future becomes actual (since those futures are not pre-existent realities, but rather a range of real possibilities)".[50] In other words, ER yields a picture wherein the future is *ontologically indeterminate* (not filled in as concrete existents yet) though it is *not unreal* (future outcomes are constrained by present realities and have a sort of reality as potentialities). This view aligns with our phenomenological sense of agency and the openness of the future, while allowing future-tensed propositions to attain truth values only upon becoming present. Eternalism, by contrast, saw only one fixed future – thereby implying a kind of eternal determinism. ER's separation of reality from existence lets it say: there is a fact of the matter about the future when it happens, but *before* it happens, what's real are the *possibilities*, not a single actual future.

- **Causal Continuity without Ontological Overkill**: One strength of eternalism is that it makes causation across time straightforward – cause and effect are just different cross-sections of the block. Presentism struggled here: how can a past event cause something now if the past event doesn't exist? ER's answer is elegant: the past event is **real** (hence it can stand in causal relations), though it does not exist now.[51] Reality in ER is cumulative – as time progresses, more events become real (by having happened), even though they cease to exist. Thus, unlike presentism, ER does not face the problem of how a nothing (a non-existent past) can affect the present. The past is something – a real part of the world's history – so causal influence is just the transmission of effects from real past events to present conditions. Meanwhile, eternalism achieved the same but at the cost of saying the cause and effect *both exist timelessly*. ER says the cause existed (and is still real by virtue of leaving a trace), the effect exists now – this is arguably closer to our standard notion of cause (which typically implies something happens and then later its effect happens, with the cause no longer present except via its effects).

- **Compatibility with Relativity**: One might wonder if ER's privileging of "the present" reintroduces conflict with relativity. However, ER is careful here: it does not necessarily claim a single global present. One could formulate ER within each observer's frame (each observer has their own existence criterion relative to their simultaneity). Or if one wanted, one could choose to privilege one foliation (e.g. a cosmic time) as the true present – but that's an optional add-on that goes beyond empirics. The key is that ER's concept of existence is *frame-dependent but objective within a frame*. It thereby might require additional structure to specify a frame for "existence" globally, but this is a debated issue. Trepp in fact discusses compatibility with relativity and suggests that because ER doesn't insist on a single metaphysically privileged simultaneity (it could allow a local or observer-dependent present), it can coexist with relativity's empirical content. In any case, ER carefully avoids imposing an absolute present, since it doesn't claim that the present is a single universal moment shared by everyone. It simply says that for any given observer, existence is tied to whatever that observer could in principle directly observe as 'now.' That concept can be made relativistically invariant (e.g. each observer's past light cone contains what exists for them in some operational sense, though this gets subtle). The full reconciliation of ER with relativity is beyond our scope, but the creators of ER claim it can accommodate relativity without embracing the block view wholesale. The crucial point is that ER preserves *temporal asymmetry* (there is an objective difference between past, present, future in terms of existence status) without necessarily restoring an absolute simultaneity. Eternalism, in stark contrast, implies a symmetric view: no objective distinction, which though simpler, sacrifices the asymmetry that underlies so much of physics (e.g. second law of thermodynamics) and experience. ER might actually align better with the **thermodynamic arrow of time** and other asymmetries: only the present exists, so as time goes on, new things come into existence (increasing reality of the world's history), which meshes with entropy increase (past is fixed and grown, future unformed). Eternalism has to attribute arrows like entropy purely to boundary conditions, whereas an ontology like ER can perhaps encode an arrow in its very structure (growing reality).[52]

50 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Trepp's paper elaborates how ER preserves the presentist insight that only the present exists while granting that much more is real.
51 https://philpapers.org/archive/TENERM.pdf
52 https://www.academia.edu/143043217/Existential_Realism_A_Distinct_Ontological_Framework_Beyond_Presentism

In comparing eternalism and Existential Realism, one sees that *what eternalism does with one brute concept (existence equally for all times)*, ER does with two nuanced concepts (existence vs reality). This added complexity in ER's ontology is arguably well-justified: it maps more closely to how we talk and think about time. We routinely distinguish between what exists now versus what happened or what will happen. Eternalism forces a somewhat counter-intuitive reinterpretation of all such talk (saying tensed verbs are just indexicals, nothing really "comes to be" or "ceases to be"). ER allows those intuitions to be largely true in the intended sense: things really do come into existence and pass out of existence, even though when they are not existent they can still be said to be real in a different sense. This yields a more **humanly intelligible ontology** without abandoning realism about unobservables. It is, as Trepp calls it, a *distinct* option beyond presentism and eternalism – not merely a compromise, but a rethinking that tries to capture "the ontological economy of presentism with the explanatory breadth of eternalism".

Finally, it's important to note that ER is not alone in its motivations. Other philosophers have proposed middle-ground theories (the Growing Block, the Moving Spotlight, etc.), each with their own distinctions (like present vs actual in moving spotlight). ER's particular innovation is the explicit pairing of ontology with epistemology and phenomenology. By ensuring that "existence answers to empirical verification" and "reality extends to what is causally/structurally relevant," it guards against the excesses of both presentism (which can become too *solipsistic* about the now) and eternalism (which can become too *detached* from how we know anything).[53]

In conclusion, when we compare eternalism and Existential Realism, we see two very different philosophical wagers. Eternalism wagers that the success of physics' four-dimensional models means reality *in toto* is a static block, and that any feeling of flow or difference of temporal modes is illusory. Existential Realism wagers that our experiential and empirical situation is telling us something true about ontology – namely that existence is tied to the present moment of interaction – while also acknowledging the scientific insight that past and future events have an objective status (not merely non-entities). ER essentially distinguishes between two ontological categories: **Existence is tensed and indexical (only now exists), but reality is tenseless and extended (the world's structure includes past and future in a determinate way)**. This two-tier approach offers a reconciliation that eternalism's single-tier ontology cannot achieve. It preserves the *reality* of the temporal landscape without insisting that every part of that landscape is equivalently "concrete" at once. By doing so, it answers eternalism's weaknesses: it avoids ontological inflation (since only the present is fully concrete), it fits our epistemic boundaries (since only what can be observed exists, other things are acknowledged as real but not pretended to be observable now), it honors phenomenology (since only the present is fully actual, time *really passes* as new things come into existence), and it still respects empirical science (by granting reality to what science infers about past and future, and not positing any measurable violations of relativity). In the grand balance, we find Existential Realism to be a more **coherent and empirically anchored framework** than eternalism. It shows that one can incorporate Einstein's and Minkowski's insights about time's structure *without* leaping to the conclusion that the flow of time or the specialness of the present are mere illusions. Instead, it reframes those features as perspectival yet ontologically significant. Where eternalism presumes a God's-eye frozen view, Existential Realism builds the view of a situated observer into the very ontology – arguably a wise move for any metaphysics that aspires to connect with reality as we find it.[54]

53 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that one can accept a theory's empirical content without believing in the literal existence of unobservable entities. He allows that we may speak of electrons, e.g., but "remain agnostic about their existence" while affirming that what the theory says about observables is true.)

54 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that one can accept a theory's empirical content without believing in the literal existence of unobservable entities.

Conclusion

Eternalism, the block universe theory, offers a bold vision of reality wherein time is stripped of its flow and all events stand in an eternal landscape of being. While this view has seduced many through its association with relativistic physics and its elegant symmetry, our analysis has shown that it suffers from profound **weaknesses** when examined from multiple perspectives. Metaphysically, eternalism's equating of all times as equally real leads to an **ontological inflation** that is difficult to justify – a reality bloated with entities that are neither present nor empirically reachable (Section 2). It abolishes any objective becoming, leaving change and the passage of time unexplained except as illusions. Epistemologically, eternalism demands belief in a vast unobserved ontology and severs the link between what exists and what we can know (Section 3). It effectively asks us to trust a metaphysical extrapolation from our physical theories, even when that extrapolation outruns empirical verification – a move at odds with an empiricist caution advocated by van Fraassen and others. Phenomenologically, the block universe stands in stark **mismatch** with human temporal experience (Section 4). It tells us that our sense of the vivid present, the feeling of time's flow, and the intuition of an open future are all mistaken – yet it offers, as of yet, no compelling account of why we should have such persistent and structured "illusions." The ontological **neutralization of the now** under eternalism fails to accommodate the deeply embedded tensed features of language, thought, and practice.

Scientifically, we found that eternalism's strongest selling point – its consonance with relativity – is not a knock-down argument but rather a philosophical interpretation layered onto physics (Section 5). Relativity eliminated absolute simultaneity, but it did not incontrovertibly decree that all events exist in a block; that was a step of **ontological generalization** that can be questioned. Empirical equivalence arguments (as by Crisp and others) show that one can uphold the empirical predictions of relativity while still maintaining a tensed ontology.[55] Furthermore, the modern understanding of cosmology and quantum mechanics suggests that time's story is not fully told by a naïve reading of special relativity alone. Issues like the arrow of time, quantum uncertainty, and cosmic expansion all hint that the reality of time may be richer than the frozen 4D block conception. Even within physics, voices like Smolin's caution us not to confuse the map for the territory.[56] In short, the **philosophical leap** from Einstein's equations to "past, present, future are equally real" remains debatable, and when one weighs the heavy costs of that leap highlighted in earlier sections, eternalism's claim to be the one true ontology of time looks overextended.

By contrast, we have explored how **Existential Realism** provides a fresh and promising alternative. It is an ontology that explicitly builds in the distinctions and asymmetries eternalism effaces. In Existential Realism, *existence* is reserved for the present, empirically accessible world, while *reality* extends to past and future in a carefully circumscribed way. This framework directly addresses eternalism's weaknesses: it keeps ontology lean and **human-centric** (only the present exists, reflecting the world we experience and measure), it retains the meaningfulness of temporal language and experience (the flow of time is reflected in the coming into existence of new events), and yet it does not retreat to a solipsistic present – the past and future are acknowledged as real insofar as they matter for explanation, causation, and planning. Existential Realism thus manages to respect the phenomenological reality of time's passage and the epistemological primacy of the present without giving up the objective content of science regarding other times. It is, in effect, an **integrative ontology**: integrating insights from metaphysics (the need for ontological parsimony and coherence), epistemology (the tie between existence and observation), phenomenology (the structure of lived time), and empirical science (the causal and structural relations across time).

In light of this comparison, eternalism appears as an over-generalization – a theory that achieved popularity by taking a scientific model too literally and too absolutely, at the cost of sidelining much that is evident in our experience of reality. Its **ontological inflation** (treating all times as concrete) and its **denial of temporal becoming** put it at odds with the pragmatic and human perspective that any satisfactory metaphysics should accommodate. While we do not deny that eternalism has a certain conceptual elegance and can solve some narrow puzzles (like providing truthmakers for past statements),

55 Crisp, Thomas M. (2007). "Presentism, Eternalism, and Relativity Physics." In W. L. Craig & Q. Smith (eds.), Einstein, Relativity and Absolute Simultaneity. Routledge, pp. 262–278.
56 https://iep.utm.edu/time/#:~:text=By%20succumbing%20to%20the%20temptation,from%20our%20conception%20of%20nature

the **holistic critique** we have advanced shows that this elegance comes with substantial trade-offs. We have challenged the presupposition that physics *requires* eternalism, showing that such a stance is an interpretation rather than a dictate of nature. And we have argued that, philosophically, the tenseless view of time that eternalism enshrines is too thin a reed to support the full weight of temporal reality as we understand and live it.

In conclusion, our critique finds eternalism wanting on multiple fronts: it overcommits metaphysically, under-explains experientially, overinterprets scientifically, and as a result it offers a picture of reality that, while logically possible, is not the most coherent or satisfying when all evidence is considered. **Existential Realism** emerges as a compelling alternative that preserves the core truths in both the presentist and eternalist intuitions while avoiding their extremes. By drawing a clear line between *what exists* (the present world) and *what is real* (the broader temporal landscape as accessible through traces and predictions), it gives us a framework where time's passage and human perspective are centrally important rather than illusory.[57] It is a more modest ontology, but in being modest it is truer to the nuanced nature of temporal reality. The block universe, for all its panoramic grandeur, ultimately demands that we dismiss too much of what matters to us (and arguably, to the ontology of the world itself).

The critique presented here thus revives an old insight: that temporal reality is layered—there is an is-ness to the present, a was-ness to the past, and a will-be of the future, each distinct in ontological status. Eternalism flattens these layers; Existential Realism stratifies them in a rational way. As our analysis has shown, once we appreciate this stratification, we can resolve many of the puzzles that plague a purely tensed or purely tenseless theory. In sum, eternalism's weaknesses across the board suggest that it is not the last word on time. Approaches like Existential Realism point the way to a more **comprehensive and empirically grounded understanding** – one that keeps faith with both the deliverances of science and the testimony of our temporal experience. In moving beyond the block universe, we regain a dynamic, lived, and causally intelligible time, which any truly satisfactory ontology of the universe should have. Existential Realism answers that need — an anchored approach to time, one that preserves experiential reality without ontological excess.

57 Trepp, Tenzin C. (2025). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Trepp's paper elaborates how ER preserves the presentist insight that only the present exists while granting that much more is real.

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Alignment

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Physics Meets the Now

If the universe truly unfolds, does physics agree? Here we explore how quantum mechanics — through measurement, collapse, and temporal asymmetry — might favor the present as the site of existence, lending unexpected support to ER's temporal ontology.

Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement

Tenzin C. Trepp

Email: trepp@tenz.in

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Abstract

Modern quantum mechanics, despite its relativistic extensions, provides intriguing support for a present-centered view of time. This paper argues that quantum phenomena – indeterminacy, wavefunction collapse, the Born rule, and temporal asymmetries in measurement – challenge the static **block universe** of eternalism and instead elevate the **present moment** to ontological prominence. Remaining largely interpretation-neutral, we draw on a range of perspectives (from Einstein's relativity to collapse models, and thinkers like Heisenberg, Rovelli, Maudlin and others) to show that quantum theory *operationally* distinguishes past, present, and future in a way classical physics did not. We examine how the measurement problem and the randomness of quantum outcomes resist a fully eternalist description, highlight how quantum mechanics introduces an arrow of time at a fundamental level, and consider proposals (e.g. GRW theory, delayed-choice experiments) that make a global present – or something akin to it – conceptually necessary. Classical philosophers and physicists from Einstein to Schrödinger are discussed alongside contemporary voices. While stopping short of endorsing any single ontology outright, we contend that the empirical success of quantum theory **re-opens** the case for **presentism** or related "A-theoretic" models of time. In closing, we introduce **Existential Realism** as a novel metaphysical framework aligning with these insights – one which preserves the special status of the present while accommodating the reality of past and future in a more dynamic ontology. The result is a rigorous yet accessible interdisciplinary inquiry: quantum physics, we conclude, *prefers the present*, suggesting time's passage and the **now** are more than mere illusions.[1]

1 https://quoteinvestigator.com/2024/03/18/stubborn-illusion/#:~:text=%3E%20On%20Michele%20Besso%20%281873,245

Introduction: Time, Physics, and Philosophy

In everyday experience, the **present moment** feels paramount – it is the only moment we directly experience, where uncertain futures crystallize into definite pasts. Yet modern physics has long cast suspicion on the idea that the "Now" is objectively special. Early 20th-century relativity, in particular, welded space and time into a four-dimensional spacetime in which all events (past, present, future) coexist, differing only by their temporal coordinates. This picture – often called the **block universe** – treats time as a dimension much like space, implying the passage of time or flow of "now" is more subjective impression than physical fact. Albert Einstein articulated this eternalist view succinctly in 1955: "for those of us who **believe in physics**, the distinction between past, present and future is only a stubbornly persistent illusion". Einstein's remark encapsulated the prevailing scientific sentiment that **eternalism** (a "B-theory" of time in philosophical terms) was the natural interpretation of relativistic physics – a world where all times are equally real and temporal becoming is not fundamental.

However, not all have agreed that relativity truly abolishes an objective present. Philosopher of physics Tim Maudlin has argued that nothing in Einstein's theory *requires* treating time's flow as illusory, and that Einstein's quote has been over-interpreted [2]. Einstein himself, in discussions with philosopher Rudolf Carnap, expressed regret that his equations could not capture the **Now** as experienced, calling this "a matter of painful but inevitable resignation".[3] The debate over time's reality thus straddles physics and metaphysics: **Presentism** (one form of "A-theory" of time) maintains that only present events and entities truly exist, whereas **eternalism** (a "B-theory") holds past and future are equally real. A middle path, the **growing block universe**, concedes reality to past and present while treating the future as unreal (the block "grows" as time progresses). Each of these philosophical positions faces challenges in light of physical theory. Special relativity's relativity of simultaneity famously undercuts a universal present, seeming to favor the B-theoretic block. Yet, as we shall explore, **quantum mechanics** – the other great pillar of modern physics – paints a very different portrait of time, one that arguably *requires* a genuine ontological distinction between what has happened, what is happening, and what is yet to happen.[4]

This paper examines how **quantum physics supports a present-centered ontology**. We aim to remain interpretation-sensitive rather than interpretation-neutral, foregrounding views where the present moment plays an ontologically active role, focusing on operational and experimental facts, but delve into specific quantum interpretations (e.g. Copenhagen collapse, Ghirardi–Rimini–Weber (GRW) objective collapse, de Broglie–Bohm pilot-wave theory, and even Everett's many-worlds) when necessary to illustrate the metaphysical stakes. In §2, we review the key **quantum phenomena** that distinguish past, present, and future – such as Heisenberg's uncertainty principle and the **Born rule** – and show how they imply an **open future** and a unique role for the present moment in making outcomes definite. §3 discusses the infamous **measurement problem** and how the collapse of the wavefunction (whether real or apparent) enforces a **temporal asymmetry** (an "arrow of time") absent from the time-symmetric equations of motion, thereby undermining strict block-universe thinking.[5] In §4, we consider thought experiments like Wheeler's **delayed-choice** and the phenomenon of entanglement, highlighting the tension they create with relativity's block picture and the ways they *resurrect* the need for an absolute simultaneity (a global present) in some interpretations.[6] Throughout, we interweave insights from physicists and philosophers – from **Werner Heisenberg** and **Erwin Schrödinger** to contemporary voices like **Carlo Rovelli** and **Tim Maudlin** – to underscore that the idea of a flowing, present-centered time has never truly been banished from foundational discourse.[7] Finally, §5 introduces **Existential Realism**, a recently proposed metaphysical framework that builds on these quantum insights, aiming to reconcile the **centrality of the present** with a nuanced reality of past and future.[8] We

2 https://iai.tv/articles/tim-maudlin-einstein-didnt-think-time-was-an-illusion-auid-2317#:~:text=In%20a%20famous%20letter%20to,an%20illusion%2C%20argues%20Tim%20Maudlin
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8 https://philarchive.org/archive/TENERM#:~:text=other%20theories,in%20metaphysics%20and%20cognitive%20science

conclude that the evidence from quantum mechanics lends credence to the intuition that time's flow – the continual coming-into-being of the present – is an objective feature of reality, not just a cognitive or thermodynamic artifact.

Before proceeding, we clarify that our aim is not to **prove** presentism (or any specific A-theory) true outright, but to show that **quantum mechanics significantly weakens the case for eternalism**. If the block universe view was bolstered by classical determinism and relativity, the quantum worldview, with its indeterminism and measurement updates, tilts the balance back toward a dynamic, present-emphasizing ontology. The **present**, in a quantum world, is when the indefiniteness of mere possibilities becomes the definiteness of actual events.[9] With this guiding idea, we now turn to the quantum-mechanical evidence.

Indeterminacy and the Open Future in Quantum Mechanics

One of the most revolutionary aspects of quantum theory is its built-in **indeterminacy**. Unlike classical Newtonian physics – where given complete initial conditions one could, in principle, calculate the future state of a system exactly – quantum mechanics only allows prediction of **probabilities** for different outcomes. This fundamental limit is codified in the **Born rule**, formulated by Max Born in 1926, which states that the wavefunction of a system yields the probability distribution of measurement results (the probability is the squared amplitude of the wavefunction).[10] Thus, even if a system's wavefunction (its full quantum state) is known at present, the theory does not output a single definite future, but a range of possible futures with associated probabilities. The **future**, in quantum mechanics, is not "already out there" in spacetime – it is genuinely underdetermined until it *happens*. As historian of science James Cushing summarized, "quantum mechanics, unlike classical mechanics, does not determine the future uniquely; it determines only probabilities".[11] Albert Einstein, uneasy with this indeterminism, famously quipped in a 1926 letter to Max Born: *"I, at any rate, am convinced that He [God] does not throw dice".* [12] Yet experiments have overwhelmingly confirmed the statistical predictions of quantum theory, vindicating Born's stochastic interpretation. Nature, at its core, **plays dice** – and only at the moment of a measurement (or equivalent event) is a specific outcome realized.

This quantum indeterminacy is tightly linked to a distinction between **past and future** that has no analog in classical physics. **Werner Heisenberg**, in his uncertainty principle paper (1927), pointed out a critical insight: "This formulation makes it clear that the uncertainty relation does not refer to the **past**." [13] Once an event has happened – say, a particle's position was measured at time t_0 – it has a definite value; any uncertainty about it subsequently is epistemic (due to lack of knowledge) rather than a fundamental indefiniteness. By contrast, before the measurement, quantum theory may forbid simultaneously definite values for certain pairs of quantities (like position and momentum), meaning the particle's future position was literally undefined (not just unknown). In other words, the **uncertainty principle** applies to predictions about the future, not to retrodictions of the past. Heisenberg's remark underscores that the **past is fixed** (once something becomes past, quantum uncertainty about it vanishes), whereas the future remains open. It implies an objective asymmetry: we can speak of past events as having determinate properties (in retrospect), but we can only assign probabilities to future events.[14] *Indeterminacy thus points to a preferred status for the present*: it is the **boundary** between a fixed, definite past and an open, indefinite future.

Erwin Schrödinger, another founding figure of quantum mechanics, voiced a similar intuition about the unique reality of the present. Schrödinger mused that "for eternally and always there is only **now**, one and the same now. The present is the only thing that has no end."[15] This poetic remark (from a

9 https://ar5iv.org/pdf/2104.09945#:~:text=We%20then%20outline%20a%20novel,which%20that%20event%20will%20happen
10 https://en.wikipedia.org/wiki/Copenhagen_interpretation
#:~:text=Formulated%20by%20Max%20Born%20in,will%20yield%20a%20given%20result
11 https://arxiv.org/abs/1602.06100
#:~:text=choice%20experiment%2C%20led%20Wheeler%20to,the%20behaviour%20of%20the%20particle
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#:~:text=Albert%20Einstein%20had%20the%20double,distance%E2%80%9D%20in
13 https://ar5iv.org/pdf/2104.09945#:~:text=,Werner%20Heisenberg%5B1
14 https://ar5iv.org/pdf/2104.09945#:~:text=,packet%E2%80%9D%2C%20with%20the
15 https://ar5iv.org/pdf/2104.09945#:~:text=,Erwin%20Schrodinger%5B2

1949 lecture) can be interpreted as supporting a "Now-centric" ontology, wherein the present moment alone exists in the full ontological sense, while the past and future do not share this mode of existence—*the past has become determinate but no longer exists, and the future remains indeterminate and not yet actual*. Schrödinger's statement comes surprisingly close to affirming presentism, albeit in an informal way. It suggests that physics might accommodate a relentless *present* that is ever-renewing ("has no end") – a stark contrast to the block universe view in which all times exist with equal ontological weight. While Schrödinger did not formally develop a philosophy of time, his instinct that "eternally there is only now" resonates strongly with the perspective we defend in this paper: that quantum mechanics makes **Now** an inescapable reality, not an illusion.[16]

To make these ideas concrete, consider a radioactive atom at time *t*. Quantum mechanics (in the standard Copenhagen interpretation) assigns it a wavefunction that yields a certain probability that the atom will decay in the next hour, and a complementary probability that it will not. Suppose at time *t + 1 hour* we check the atom and find that it *has decayed*, emitting an alpha particle. At that moment, the atom's state becomes definite (decayed), and the **indefiniteness** is resolved. We can now say, as a matter of fact, that "the atom decayed (at some specific moment in that hour)." But crucially, quantum mechanics does not allow us to describe the decay as a definite occurrence *prior to observation*—its status remains probabilistic until the moment of measurement. Freeman **Dyson** emphasized this point in a thought experiment: *"We can describe a uranium nucleus by a wave-function ... which determines the probability that the nucleus will decay tomorrow. But we cannot describe by means of a wave-function the statement, 'This nucleus decayed yesterday at 9 a.m.'"* [17] In general, Dyson concluded, "statements about the past cannot in general be made in quantum-mechanical language" – once something has occurred, we must describe it in **classical terms** (as an event that definitely did happen at a known time).[18] This is another way of saying that quantum states (wavefunctions) apply to the present **knowledge** of a system with respect to future observations; the formalism doesn't create an objective history of definite events until those events are registered. Dyson went on: *"My second general conclusion is that the 'role of the observer' in quantum mechanics is solely to make the distinction between past and future... All we need is a point of reference, to separate past from future, to separate what has happened from what may happen, to separate **facts** from **probabilities**."* [19] This striking viewpoint, published in 1979, asserts that the only meaningful difference an "observer" (or more generally, an event that records information) makes is to mark when an event leaves the realm of quantum possibility and enters the realm of classical fact. The **present moment** is precisely when that happens – it is the **turning point** from probability to fact, from indefinite to definite.[20]

In summary, quantum indeterminacy and the probabilistic nature of state evolution carve out a **special role for the present**. The present is when the wave of possibilities collapses into one actuality—**a process of becoming that marks the transition from what is merely real (as potential) to what exists (as actual).** This becoming, grounded in quantum indeterminacy, reinforces the notion that reality is not fixed but unfolds in time. Before something happens (future), physics can only tell us likelihoods; after it has happened (past), it is a fixed part of reality (though known only through records in the present). There is a natural alignment here with **A-theory** notions of time (like presentism or the moving spotlight theory): there is an objective difference between past, present, and future, grounded in whether events are definite or not. Indeed, Lee Smolin and Clelia Verde (2021) have recently proposed that the fundamental distinction in quantum mechanics is between the **indefinite** (quantum possibilities) and the **definite** (classical facts), and that the familiar labels past/present/future are **derivative** of this deeper distinction.[21] On their account, "neither the past nor the future fully exist, but for different reasons" – the past *has existed* (and is now definite, though perhaps only accessible via records), whereas the future *has not yet* existed (it is represented by the quantum wavefunction as something that **may** come to exist).[22] This view effectively asserts that **all that is fully real is real in**

16 https://ar5iv.org/pdf/2104.09945#:~:text=,Erwin%20Schrodinger%5B2
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22 https://ar5iv.org/pdf/2104.09945#:~:text=We%20then%20outline%20a%20novel,which%20that%20event%20will%20happen

the present moment, echoing a key tenet of presentism but formulating it in quantum-mechanical terms.[23] It is remarkable that such a view can be advanced *without* reference to any single interpretation of quantum mechanics – as Smolin and Verde note, the statement "the wavefunction represents something that may come to exist in the present" holds no matter which interpretation one espouses.[24] Even in many-worlds (Everett) interpretation, for instance, each branch's wavefunction encodes multiple possible outcomes that have not all been realized in any one branch's experience; the *branching event* still distinguishes an unrealized superposition (pre-measurement) from a realized outcome (post-measurement) for any given observer. Thus, **quantum indeterminism** robustly points to a universe where the future is *open* and the present is when reality "happens." Any attempt to regard the future as already concretely laid out (as a strict block universe would) runs afoul of this essential quantum insight.

The Quantum Measurement Problem and the Moment of Now

While indeterminacy establishes that quantum theory endows the present with a unique role (the resolution of uncertainty), the **measurement problem** goes further, suggesting that standard quantum mechanics *cannot be complete* without explicitly accounting for the transition from possibilities to actuality – a transition that looks suspiciously like an **objective becoming**. The measurement problem arises because the fundamental equations of quantum dynamics (like Schrödinger's equation) are **linear** and **time-symmetric**, and they allow superpositions of different outcomes to persist indefinitely. Yet, when we perform a measurement, we never observe such superpositions – we see a single outcome. In the textbook Copenhagen interpretation, this is handled by invoking a special, non-unitary "collapse of the wavefunction" at the moment of measurement: upon observation, the wavefunction *instantaneously* reduces to the eigenstate corresponding to the observed result. Collapse is effectively a placeholder for "what really happens" when a quantum possibility becomes a classical reality. Importantly, collapse is *non*-time-symmetric and *non*-deterministic: it picks out one outcome and discards the others, seemingly in conflict with the smooth reversible evolution that preceded it. In a block universe, which is entirely deterministic and symmetric under time-reversal (if one includes the future as given), it is deeply puzzling how an irreversible, indeterministic **collapse event** can occur at all. The block universe would have to contain an ad hoc, one-directional "marker" distinguishing pre-measurement superposition from post-measurement definiteness – an unnatural intrusion into a static 4D spacetime. Some philosophers of physics argue that this tension is a strong hint that the block view is insufficient for quantum reality.[25]

One way to resolve the measurement problem is to posit that wavefunction collapse is a real physical process – this is the route of **objective collapse theories** such as the Ghirardi–Rimini–Weber (GRW) model or Penrose's gravity-induced collapse hypothesis. In GRW, for example, every particle has a tiny probability per unit time of undergoing a spontaneous localization ("collapse") which, for macroscopic collections of particles, results in rapid localization of superposed states (thus ensuring macroscopic definiteness). What's crucial is that GRW (in its simplest form) must introduce a preferred **time frame** in which these collapses occur, effectively reintroducing **absolute Newtonian time** behind the Lorentzian facade of relativity. As physicist Angelo Bassi and colleagues note, collapse mechanisms "create a fundamental irreversibility, and introduce an **arrow of time**" at the fundamental level.[26] The moment of collapse can be identified as the moment something becomes **actual** – thus aligning with the concept of a moving present. But this comes at the cost of treating different frames of reference differently (violating relativity's symmetry) unless one devises a relativistic collapse theory (a topic of ongoing research). The need for a universal time coordination in collapse models suggests that quantum theory might be pointing toward a **non-block, temporally oriented ontology**. Indeed, certain

23 https://ar5iv.org/pdf/2104.09945#:~:text=Everything%20that%20is%20real%20is,of%20a%20succession%20of%20moments
24 https://ar5iv.org/pdf/2104.09945#:~:text=This%20view%20seems%20to%20treat,of%20quantum%20mechanics%20you%20espouse
25 https://link.springer.com/chapter/10.1007/978-3-319-10446-1_6#
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interpretations of quantum mechanics explicitly *demand* a distinguished notion of simultaneity: for example, **Bohmian mechanics** (the pilot-wave theory) supplements quantum formalism with definite particle positions guided by a pilot wave, but it requires defining those positions *at each time* with respect to a universal time parameter. In Bohm's theory, all particles have positions defined on slices of absolute simultaneity – a clear presentist flavor underlying the theory's structure.[27] Similarly, relativistic extensions of Bohm's theory or collapse models often invoke a foliation of spacetime (essentially, a cosmic time slicing) to maintain consistency.[28] These examples show how **making the quantum mathematics make sense often forces us to treat the present as something objectively shared** (at least within a given model's universe), even if it's hidden beneath relativistic covariance.

Even apart from specific interpretations, the **irreversibility** associated with measurement stands out. When a wavefunction collapses or when decoherence (interaction with environment) produces effectively classical outcomes, certain information is destroyed (or irreversibly dispersed into correlations with the environment), and an **entropy increase** often accompanies the process. This is analogous to the second law of thermodynamics, which provides a **time arrow** from past (lower entropy) to future (higher entropy). Quantum measurements (or collapses) can be seen as contributing to the overall growth of entropy (since a pure quantum state effectively becomes a mixed state from the observer's perspective). If one were to try to **embed** a quantum measurement event into a block universe, one would have to encode this entropy increase and the choice of outcome into the block – but that is equivalent to pre-specifying the outcome in the 4D description, losing the indeterminism. The block universe would have each measurement outcome fixed *timelessly*, implying there was never a superposition or uncertainty except in our knowledge. But such a view is hard to square with the operational content of quantum theory, in which the superposition is very real (it produces observable interference, for instance) until the interaction (measurement) happens. In effect, the block view forces a **hidden variable** or super-deterministic perspective (where outcomes were predetermined all along), which not only conflicts with the spirit of quantum theory but also with Bell's theorem constraints unless one accepts radical nonlocal conspiracies. *In contrast, a present-centric view naturally accommodates the idea that reality makes a choice at each measurement*. The **measurement event** is when reality's course is decided among the possibilities allowed by prior quantum amplitudes. After that moment, the outcome can influence subsequent events, but before it, it was genuinely undecided. This narrative is dynamic and aligns with how physicists actually use the theory: prepare state → evolve → measure → update state. The **update** (or collapse) is a law-like element that breaks time-symmetry and aligns with the psychological and thermodynamic arrow of time – we remember the past (records of outcomes) but cannot "remember" the future since it's not determined.

To illustrate, consider **Wheeler's delayed-choice experiment**, a modern variant of the double-slit experiment where the experimental arrangement can be changed *after* a particle (photon or electron) has entered the apparatus. The startling outcome is that whether the particle exhibits wave-like interference or particle-like behavior can seemingly be decided by a choice made at the very last moment, as if the particle's past "decision" of whether it went through one slit or both is not set until the measurement. John Archibald **Wheeler** summarized the lesson: *"No phenomenon is a real phenomenon until it is an observed phenomenon."* [29] In fact, Wheeler went further to say, "the past has no existence except as it is recorded in the present" [30]. These are extraordinary statements: they imply that **reality is fundamentally participatory**, with present observations effectively determining how we may consistently regard past events. In a block universe, by contrast, every event's outcome is fixed on the spacetime diagram – the delayed-choice experiment's weirdness would have to be explained by a convoluted but perfectly determined story in the block (often involving advanced wavefunctions or retrocausal influences that were there all along in the 4D description). Some physicists and philosophers do pursue such retrocausal or block-consistent interpretations (e.g., the *transactional interpretation* or certain *two-time interpretation* approaches), but these remain minority views. Wheeler's own leaning was towards a picture of the universe as a kind of **feedback loop** where present mea-

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29 https://arxiv.org/abs/1602.06100#:~:text=,the%20behaviour%20of%20the%20particle
30 Ibid.

surements actualize certain features of the past – a clear break from strict eternalism.[31] The **measurement problem** in all its forms – whether one sticks with Copenhagen's collapse postulate, opts for objective collapse, or even Many-Worlds – underscores that *something* happens at the moment of measurement that is not just another mundane physical process in the block. Either the universe splits (Everett), or the wavefunction nonlocally collapses (Copenhagen/GRW), or an observer updates information (QBist or epistemic interpretations). All these emphasize that **the present moment of interaction is ontologically/special**: it's when reality's course (in one world) is settled.

It is worth noting that the one interpretation that tries hardest to rescue the block (or at least a deterministic picture) is the **Many-Worlds Interpretation (MWI)**. In MWI, the wavefunction never collapses; instead, every possible outcome in a quantum measurement is realized, each in a different branch of the multiverse. From the outside perspective of the universal wavefunction, the evolution is perfectly deterministic and unitary – *and indeed, one might claim the entire multiverse history (with all branches) is just as fixed as a block universe*. However, even MWI has an emergent sense of **becoming** within each branch: observers in each branch experience the resolution of uncertainty when their branch "splits" off from the others at the measurement. The *global* picture is block-like (the multiverse structure is static and includes all outcomes), but the *experienced* picture within a branch is indeterministic and features a moving present (each observer sees one outcome actualize and not the others). Moreover, MWI faces the well-known probability challenge: since all outcomes occur, it's debated how probabilities apply within a single branch, and whether this can be coherently resolved. Solving this requires an additional interpretive rule (like the Born rule as emergent from self-locating uncertainty or decision theory), which again highlights the special role of the moment of branching/observation for the **agent**. In short, even the most block-friendly quantum interpretation cannot escape giving a key role to the present and the subjective flow of time (at least within branches).[32] Other interpretations, as discussed earlier, explicitly reintroduce something like a global present (Bohmian, objective collapse) or deny a single global reality (QBism or Rovelli's relational quantum mechanics, which might imply a kind of fragmental presentism for each observing system). **Relational quantum mechanics**, championed by Carlo Rovelli, suggests that properties only exist relative to interactions – in a sense, an event's outcome is only real *for the system that interacted with it*. This radical relational view still doesn't endorse a block: rather, it implies a multiplicity of "present moments" for each interaction, with no god's-eye universal present. But it *does* preserve the idea that events (facts) only crystallize upon interactions – which is another articulation of the present-centered "event ontology." Whether one goes with one observer's present or many localized present events, one has moved away from the block where all events and facts are laid out timelessly. Rovelli even argues that time itself might be an emergent concept in quantum gravity and that there is no single time variable at the fundamental level.[33] That suggests that what we call "time" – including the present – might come from correlations and relationships, not an absolute container. Yet even this view does not favor eternalism; if anything, it implies only relations (interactions) are real, and those are localized happenings (a relational kind of presentism where each interaction establishes a present fact for those participants).

The upshot of this section is that the **measurement problem and the process of measurement** in quantum mechanics emphasize **becoming** over **being**. Quantum events are not just sitting in spacetime waiting to be looked at; rather, they **become real in the moment they are measured**.[34] The present is when quantum amplitudes (which evolve timelessly in the Schrödinger equation) undergo a momentous change – either literally (if collapse is physical) or effectively (from the standpoint of any given observer/branch). This momentous change introduces a one-way structure to time (an arrow) at the microscopic level, complementing the thermodynamic arrow at the macroscopic level.[35] A truly eternal block universe would not have a fundamental arrow or a fundamental distinction between before and after an event – those would be human conventions on a static history. But the quantum universe *insists* on an arrow: the future is different in kind from the past. As physicist H. Dieter Zeh

31 Ibid.
32 https://ar5iv.org/pdf/2104.09945#:~:text=This%20view%20seems%20to%20treat,of%20quantum%20mechanics%20you%20espouse
33 https://plato.stanford.edu/entries/time/#:~:text=quantum%20gravity%20in%20which%20there,of%20the%20world%3F%20What%20would
34 https://arxiv.org/abs/1602.06100
#:~:text=choice%20experiment%2C%20led%20Wheeler%20to,the%20behaviour%20of%20the%20particle
35 https://link.springer.com/chapter/10.1007/978-3-319-10446-1_6
#:~:text=Such%20a%20mechanism%20creates%20a,solve%20this%20problem%20of

wrote, *"there is no doubt that Einstein meant [his time-illusion remark] very seriously. It obviously refers to the four-dimensional ('static' or 'objective') representation of all events in spacetime…."* [36], yet the **quantum-mechanical description** breaks this static representation by forcing us to treat events in sequence – the "before" and "after" of a measurement are not symmetric. We are thus led to consider time as not just another dimension, but a special dimension along which **something happens**. The world may better resemble a "growing block" in which new events continuously come into existence—*a reality that is dynamically updated*—rather than a fixed four-dimensional structure where all events are equally real. The growing block theory, first proposed by C. D. Broad and later developed by others, holds exactly that: the past and present are real, the future is not (yet) real. Quantum mechanics' progressive revelation of facts dovetails with this image. In fact, Smolin & Verde (2021) describe a "block-presentism" or growing block picture in quantum terms, only to caution that one must carefully define in what sense the past exists if it's no longer dynamically involved.[37] If the past exists as a sort of inert archive (the common view of growing block), it still differs from the vivid, happening present. Quantum relational views might go further to say even the past doesn't *exist* except insomuch as it's recorded now (echoing Wheeler).

In conclusion, the quantum measurement process is a key pressure point where physics seems to **demand a tensed, present-oriented ontology** rather than a tenseless one. It is the locus where *possibility transitions into actuality*—a feature that any satisfactory interpretation of quantum mechanics must account for. Eternalism provides no natural home for this feature – at best it can accommodate it by complex constructions (all outcomes exist but we index one as "observed" by an agent, etc.). Present-centered frameworks take it in stride: that's just how reality unfolds. As we move on, we will see more phenomena that reinforce this conclusion.

Entanglement, Nonlocality, and Temporal Order

Quantum mechanics not only challenges our understanding of time through indeterminacy and collapse, but also through the phenomena of **entanglement** and quantum nonlocality. While entanglement is usually discussed in the context of spatial separation (spooky action-at-a-distance, as Einstein put it), it has profound implications for temporal ontology as well. In an entangled pair of particles (say, two electrons in a singlet spin state), a measurement made on one particle appears to instantaneously constrain the state of the other, no matter how far apart they are. Importantly, what counts as "instantaneous" is frame-dependent in relativity; there is no absolute simultaneity. Yet the quantum correlations manifest as if there *were* a preferred frame or a common time for the two events (measurement on particle A and measurement on particle B). If one assumes a relativistic block universe, one must accept that the correlation was somehow encoded in the joint 4D history from the start (e.g., via common causes in the past light cone, or superdeterminism, or retrocausal influences that zigzag through time). Bell's theorem, however, rules out any local common cause explanation for the perfect correlations, leaving us with either outright nonlocal influences or correlations that transcend space-time structure. Some physicists, like **John Bell** himself, have argued that the least problematic way to accommodate quantum nonlocality is to allow a single **preferred frame** (an absolute simultaneity) in which the wavefunction's collapse (or Bohmian guiding equation's update) happens consistently across space.[38] Bell wrote that a Lorentz-invariant formulation of quantum theory with collapse is possible but "hard to contrive," whereas a theory with a preferred frame is conceptually straightforward (even if it's experimentally hidden). This again shows that quantum mechanics **pulls us toward a presentist or A-theoretic picture**: to describe what happens in entanglement in a realist way, it is convenient to say "there is one real time ordering of events (the real present), in which the second particle's state becomes definite at the same time as the first's measurement." Without committing to any one interpretation, we can note that **several of them explicitly do this**. For instance, in **Bohmian mechanics**, even for relativistic extensions, one typically uses a preferred foliation of space-time to define particle trajectories and enforce quantum nonlocal correlations in a consistent

36 https://quoteinvestigator.com/2024/03/18/stubborn-illusion/#:~:text=,of%20relativity%20uses%20so%20efficiently
37 https://ar5iv.org/pdf/2104.09945#:~:text=There%20is%20a%20view%2C%20which,effect%20on%20their%20other%20properties
38 https://marcsandersfoundation.org/wp-content/uploads/2022/09/An-Empirical-Argument-for-Presentism-Final.pdf
#:~:text=21%20For%20example%2C%20some%20interpretations,that%20are%20formulated%20using%20absolute

manner.[39] In **GRW collapse models**, attempts at making them relativistic (such as "flash" ontology approaches) often involve a relativistic spacetime with a built-in notion of simultaneity for collapse events, or a random time coordinate in which collapses occur.

From the perspective of time philosophy, entanglement hints at a subtle form of the **moving spotlight** theory. The moving spotlight theory (a version of A-theory) says all times exist (like eternalism), but one moment is objectively **illuminated as present** and this spotlight moves forward. One could imagine a block universe with quantum correlations, but a "spotlight" moving through it that enacts the collapse or actualization of entangled states. This is admittedly a very metaphoric description, but it captures the idea that even if one wants to preserve something of the block, one needs an added structure that selects out a present and enforces the synchronic realization of quantum outcomes across space. If that selection is just an extra metafactual thing (like the moving spotlight not affecting anything), then one hasn't really solved the problem (it would be epiphenomenal). If it *does* affect physics (by selecting an actual outcome), then we're essentially back to a presentist or growing-block view in practice, because only with reference to that moving present can we say when outcomes become real.

Delayed-choice entanglement swapping experiments add another layer: one can entangle photons that never interacted by making a joint measurement on their partners after they've been detected. This yields scenarios where doing or not doing a measurement in the present can seemingly change whether two earlier particles were entangled or not. Again, the block-universe advocate will say the entire experimental setup and outcomes are in the block and there's a 4D consistency – no real change "after the fact." But from within a temporal process viewpoint, it appears that present choices influence the interpretation or ontology of past events (e.g., whether we consider two particles as having had a definite, separable state or a single entangled state). The **Copenhagen interpretation** would forbid us from even talking about whether they "had" an entangled state in the past – it's only decided when the measurement is made now. Thus, in a very real sense, the *present action* determines the kind of connection that existed between the particles. The past is not being changed retroactively, but its description is only settled now. This defies ordinary intuitions of a fixed past and again emphasizes the **creative role of the present**.

Temporal asymmetry in quantum processes also shows up in subtle ways besides collapse. For example, the *retrodictive* form of quantum theory (where one can update a wavefunction backwards in time upon gaining information) is mathematically possible, but rarely used except in specialized situations (like the two-state vector formalism of Aharonov et al.). In normal practice, we evolve states forward in time and update when we learn something. That is, the *predictive* (past→future) direction is fundamental, and while one can formally propagate constraints backward, one never "uncollapses" a wavefunction after the fact. This practical irreversibility echoes the fundamental asymmetry: as Dyson said, quantum formalism doesn't speak of the past in the same language as the future.[40]

To sum up this section, the phenomena of entanglement and nonlocality, when combined with the need to avoid paradoxes, quietly nudge us toward re-instating a notion of **global time** or at least an **order of events that is universally valid**. The block universe denies any one global present, but quantum nonlocality's simplest resolution is to have one anyway (even if hidden). And if one is going to allow that, one might start to wonder: if relativity allowed multiple "clock times" but quantum insists on one "collapse time," perhaps physics at a deeper level *does have* a canonical time structure. Indeed, some quantum gravity approaches, like certain Bohmian-inspired field theories or canonical quantum gravity schemes, posit a preferred time variable (sometimes called "foliation parameter" or similar). Other approaches like the causal set theory or Hořava–Lifshitz gravity introduce a preferred foliation to make the theory work. These are speculative, but they show that *at the bleeding edge of physics, the idea of an absolute present is not entirely taboo*. It's being considered because quantum features seem to demand more than relativity's minimalist view of time [41].

39 https://marcsandersfoundation.org/wp-content/uploads/2022/09/An-Empirical-Argument-for-Presentism-Final.pdf#:~:text=21%20For%20example%2C%20some%20interpretations,that%20are%20formulated%20using%20absolute

40 https://ar5iv.org/pdf/2104.09945#:~:text=,The%20role%20of

41 https://marcsandersfoundation.org/wp-content/uploads/2022/09/An-Empirical-Argument-for-Presentism-Final.pdf#:~:text=21%20For%20example%2C%20some%20interpretations,that%20are%20formulated%20using%20absolute

Revisiting Presentism, Eternalism, and Hybrid Models in Light of Quantum Theory

It is now useful to step back and connect the quantum-mechanical insights to the philosophical theories of time. **Presentism**, in metaphysics, is the view that only present objects and events exist. **Eternalism** (or four-dimensionalism) holds that past, present, and future entities all equally exist (we are just *located* at a certain time). **Growing block theory** holds past and present exist, future does not yet. And the **moving spotlight** theory overlays an objective "now" onto an eternalist block. What have we learned that bears on these positions?

Quantum mechanics gives a strong impetus to the idea that **the present is ontologically unique**. The clearest alignment is with either presentism or the growing block model. In a purely presentist interpretation of quantum physics, one would say: The universe's state right now is real; past events have happened but do not exist except as memory records or remnants in the present; future events do not exist at all, only a spectrum of possibilities exists encoded in the present state. This maps more closely onto an enriched form of presentism—one that allows past events to be real in virtue of their causal traces in the present: the wavefunction (or quantum state) right now encodes all *potential* future outcomes (with their probabilities), and any influence of the past is contained in the present state (and present records). The reason we can talk about the past at all is because the present contains information (records, memories, entropy gradients) that correlate with past events – but the past events themselves are not "out there" in addition to those records.[42] This is essentially the position Wheeler advocated: *"The past is theory. The past has no existence except as it is recorded in the present."* [43] That statement from Wheeler could serve as a presentist slogan tailored to quantum physics. Presentism, however, has a notorious issue with relativity, since relativity says there's no unique set of "now" events across space. Here quantum might offer a resolution: if some interpretations or new physics (quantum gravity, etc.) introduce a preferred simultaneity (as we discussed), then presentism could be made compatible with physics at a deeper level.[44] Even absent that, one can formulate a *general relativistic presentism* by choosing a foliation (e.g., cosmological time in FRW models) as an *actual* present – an additional structure not provided by relativity alone but not in conflict with it either, especially if backed by quantum considerations (some proposals in quantum gravity do just this).[45]

The **growing block theory** also meshes well with quantum evidence. One might envision that as each quantum event is resolved, it becomes part of the fixed past (the block grows), but the future remains genuinely non-existent/unfixed until it occurs. This is like an ever-advancing "edge" of reality which we identify as the present. Indeed, the idea of an **"advancing moment of now"** is quite consonant with the growing block. Quantum physics tells us the nature of how that advancing happens: by probabilistic actualization of possibilities. One could imagine the 4D spacetime is being dynamically generated or revealed as time goes on – an appealing picture some have tried to formalize (e.g., in theories of cosmic time as a creative dimension). There is an interpretive subtlety: if the past stays real in growing block, does that conflict with our earlier statement that past events "don't exist" except as records? Possibly not – the growing block theorist can say past events exist *in the block* but we don't have direct access except via present records, which is consistent. The relational nuance from quantum theory is that past events might lack some of the "vitality" of present events since they are no longer in play causally (except through the traces they left). Smolin actually criticizes growing block by asking: *"in what sense does the past exist – if there is no way for us to alter it?"* [46] For a relationalist (like Smolin), existence means being part of an ongoing network of interactions; once something is fully past and no longer interacting, calling it "real" in the same sense may be empty. Nonetheless, as a halfway house between presentism and eternalism, the growing block remains attractive in a quantum context – it acknowledges an objective flow and a special present, while not consigning the past to utter non-be-

42 https://arxiv.org/abs/1602.06100
#:~:text=choice%20experiment%2C%20led%20Wheeler%20to,the%20behaviour%20of%20the%20particle
43 https://arxiv.org/abs/1602.06100#:~:text=,the%20behaviour%20of%20the%20particle
44 https://marcsandersfoundation.org/wp-content/uploads/2022/09/An-Empirical-Argument-for-Presentism-Final.pdf
#:~:text=21%20For%20example%2C%20some%20interpretations,that%20are%20formulated%20using%20absolute
45 https://www.sciencedirect.com/science/article/abs/pii/S187117740601014X
#:~:text=Chapter%2014%3A%20Presentism%20and%20Quantum,a%20fixed%20foliation%20of%20spacetime
46 https://ar5iv.org/pdf/2104.09945
#:~:text=Then%20there%20are%20hybrid%20formulations,network%20of%20relations%20and%20interactions

ing (thus avoiding some puzzles like "how can we talk truly about the past if it doesn't exist?").

What about **eternalism**? Can it somehow survive the quantum assault? Some eternalists might argue that the entire history including all collapse outcomes (or all Everett branches) is indeed laid out in the 4D block or 4D multiverse, and the appearance of indeterminacy is just us not knowing which branch we're on or being embedded in it. They might point to **consistent histories** formulations of quantum mechanics, where one can define whole sequences of events (histories) and assign weights to them, and say one history is "realized" in the actual world. In a block perspective, one could imagine the actual world is one of those histories drawn at random according to the Born rule. So even though *we* couldn't predict it, the block "knew" which one was realized. This is a logically possible interpretation: a single, pre-determined history consistent with quantum statistics is the real one (this would be a hidden-variable or superdeterministic picture effectively). However, such a view tends to betray the spirit of quantum mechanics and faces the aforementioned conflict with Bell's theorem unless nonlocal hidden variables exist. If one introduces hidden variables (like Bohm's particle positions), one does indeed have a fully determined block (including the hidden variable trajectories) – but crucially, in Bohm's theory, the block has an extra structure (the world-lines guided by the pilot wave) that standard relativity doesn't allow without a preferred frame. So again eternalism can be saved only by adding an A-theoretic structure behind the scenes. Standard relativity + standard quantum randomness yields an incoherent block unless one is willing to accept true randomness as simply a fact in the block (which is philosophically mind-bending: a block where some events have no causes but just happen spontaneously – it's not a deterministic block, but one with "random paint splashes" so to speak). Eternalism thrives on determinism; with irreducible chance, the block becomes strange – one might then say the block contains not one fixed story but a superposition of possible stories, which is no longer a usual block (this starts to sound like the *block of branches* in MWI, which as discussed does contain all outcomes, but then each observer's experience is that of an unfolding present within one branch).

Finally, consider the **moving spotlight** theory. It basically grafts presentism's "now is special" onto eternalism's "all times exist." In doing so it often ends up being accused of metaphysical redundancy (what does the moving spotlight do, if everything is already there?). However, one might find a parallel in physics if one thinks about the wavefunction of the universe. Perhaps all events exist in the universal wavefunction's structure, but the *realization* of particular facts is like the spotlight picking a slice. This is very analogous to Everett's many-worlds, where all outcomes exist in the state, but "our reality" follows one branch (the spotlight moving along one path in the multiverse tree). In fact, Everett's theory can be construed as a four-dimensionalist picture (all branches exist timelessly in the multiverse) combined with an emergent spotlight for each observer (the flow of time as they experience branching). If one is comfortable with that, one might say quantum mechanics doesn't force presentism so much as a more complex hybrid: the block exists, but there is also an extra element of reality corresponding to which parts of the block are "lit up" as actual for a given world or observer. This is a less economical ontology than plain presentism or growing block, but some might prefer it to outright denial of the block. We mention it to acknowledge that the philosophical landscape of time theories is rich, and quantum insights can be appropriated in multiple ways.

However, a fresh approach has recently entered the stage, aiming to transcend the standard options. This is the idea of **Existential Realism**, which we now turn to.

Existential Realism: A Quantum-Friendly Temporal Ontology

One promising framework that explicitly seeks to incorporate the lessons of quantum mechanics into a new ontology of time is **Existential Realism (ER)**. Proposed by
T. Trepp in 2025, Existential Realism is *"a distinct ontological framework beyond presentism"*. It arises from the recognition that the classical debates (presentism vs eternalism vs growing block) might be too restrictive, and that quantum theory calls for a more nuanced account of what it means for something to **exist** in time. ER distinguishes between **existence** and **reality** in a temporal context. In simple terms, it suggests that only present entities *exist* in the fullest sense, but past and future entities can

still be said to be in some sense **real** (hence "realism") even if they lack present existence.[47] This is not mere semantic juggling; it's a technical move to allow talk of past and future as having ontological status without inflating one's ontology to include them as fully existent things **now**.

In Existential Realism, the **present** is indeed privileged: *"Everything that is real is so in the present moment, which is one of a succession of moments."* (This echoes the Smolin quote we saw earlier,[48] and Trepp's framework is very much in that spirit.) But ER also acknowledges an "enduring reality" to the past and a "looming reality" to the future [49]. How so? The past is **real** by virtue of its **recorded effects** in the present – the causal traces, memories, records, and physical impacts that past events have left. These ensure that past events are not mere fictions; they happened, and their occurrence is evidenced by present reality. However, those past events do not *exist* now – they aren't out there waiting to be interacted with; they are **over**. Meanwhile, the future is **real** in the sense that it consists of genuine possibilities that exert influences on present dispositions – for example, the unstable nucleus has a real propensity to decay (a notion some philosophers call "ontic potentiality"). The future "looms" as a realm of possibilities that constrain and guide present tendencies, even though future events do not yet exist.[50] In Trepp's terms, this amounts to saying: an entity can be **real** (as part of temporal reality) without being *existent* at the present time. Reality thus extends beyond the present, but existence does not.

This nuanced ontology fits quantum mechanics hand-in-glove. Consider again the uranium nucleus example: at time *t=now*, the nucleus has not decayed; at *t+*, it might. In ER terms, the nucleus at *t* exists (present), its possible decay at *t+* is not yet existent but it is certainly a real possibility (with a calculable probability). If it decays at *t+*, that event will become present and thus exist, and after that it will remain real by virtue of the traces it leaves (the emitted alpha particle, say) even though it no longer exists (since *t+* is past). This framework allows one to consistently talk about truth-makers for statements about past and future without needing to grant full existence to non-present objects. For instance, the statement "the nucleus decayed yesterday" can be true because there is a present record (the alpha particle, damage in a detector) that is the truth-maker – the past event is real (it really happened) because of that record, even if the event is no longer an existing process.[51] Likewise, a statement about the future like "the nucleus will decay in the next hour" can be probabilistically true or false based on the present quantum state (propensity); if one wanted, one could say its truth value is indeterminate until it happens, reflecting the openness of the future.

Existential Realism thus manages to **"preserve the empirical and experiential centrality of the present while acknowledging the enduring reality of the past and the looming reality of the future."** [52] It forges a middle path: not as austere as presentism (which denies any form of reality to non-present times), but not as ontologically permissive as eternalism (which puts all times on equal ontological footing). It can be seen as a formalization of the intuitive picture that **quantum physics paints**: The present is when things are definitely real; the past is real in a fossilized sense; the future is "real" only as a space of possibilities. Such a view had been foreshadowed by many quantum thinkers: recall Dyson's claim that future is quantum (indefinite, probabilistic) and past is classical (definite, recorded) [53] – ER essentially codifies that idea by different terms. It also resonates with ideas in quantum foundations like *propensity interpretations* of the wavefunction (where the wavefunction represents real tendencies for outcomes, not concrete realities until realized).

From a philosophical perspective, ER also addresses the **truthmaking problem** for presentism: how to account for the truth of past-tense propositions if only the present exists. In ER, the truthmakers for past propositions are present facts (records), so no issue there. For future propositions, they may simply lack truth values until the event occurs (or one can assign them modal truth values based on present propensities). This is congenial to an indeterministic universe.

47 https://philarchive.org/archive/TENERM#:~:text=other%20theories,in%20metaphysics%20and%20cognitive%20science
48 https://ar5iv.org/pdf/2104.09945#:~:text=Everything%20that%20is%20real%20is,of%20a%20succession%20of%20moments
49 https://philarchive.org/archive/TENERM#:~:text=other%20theories,in%20metaphysics%20and%20cognitive%20science
50 https://philarchive.org/archive/TENERM#:~:text=other%20theories,in%20metaphysics%20and%20cognitive%20science
51 https://ar5iv.org/pdf/2104.09945#:~:text=,packet%E2%80%9D%2C%20with%20the
52 https://philarchive.org/archive/TENERM#:~:text=other%20theories,in%20metaphysics%20and%20cognitive%20science
53 https://ar5iv.org/pdf/2104.09945#:~:text=My%20second%20general%20conclusion%20is,a%20point%20of%20reference%2C%20to

Existential Realism is a new proposal, and it will surely invite critique and analysis from metaphysicians and philosophers of science. But it stands out as an example of how the conversation is evolving *in light of quantum physics*. It is a framework **built for quantum reality**, taking cues from both metaphysics and physics. Near the end of Trepp's paper, a comparative table contrasts ER with standard views, highlighting that ER integrates the insights of quantum physics (like causal connectivity, records, propensities) into the heart of temporal ontology.[54] By doing so, it aims to be "a robust, integrative stance" that could serve future discourse in metaphysics and even cognitive science of time.[55]

Whether or not one embraces Existential Realism, it exemplifies the kind of creative re-thinking that the quantum perspective on time encourages. It's an approach that wouldn't likely have arisen without the peculiar demands of making sense of a world where new information truly comes into being (as opposed to merely becoming revealed) over time.

Conclusion: The Moving Spotlight of Quantum Reality

At the dawn of the 20th century, **Einstein's relativity** delivered a profound shock to our temporal intuitions, seemingly elevating **space-time** over **time's flow** and casting the present moment as an illusion. The **block universe** has since loomed large as the paradigm for serious ontologies of time in physics. However, the equally revolutionary discovery of **quantum mechanics** in the same era began a countermovement – one that took longer to be appreciated in philosophical depth. Quantum physics, as we have argued, *prefers the present*: it inherently separates what *is* (actual facts) from what *could be* (probabilistic outcomes), and situates that distinction at the knife-edge of the now.[56] In a quantum world, the present is not just a fleeting indexical; it is when indeterminate possibilities **become determinate reality**.[57]

We have seen multiple facets of this argument. Indeterminacy and the Born rule mean the future is not written in stone – contrast this with a classical block where the future is as fixed as the past. Wavefunction collapse or decoherence in measurement highlight an irreversible process that singles out the present moment of interaction as special – contrast with the block universe where the laws are reversible and no "special moments" exist. Entanglement and nonlocality suggest that, to avoid paradox, one might need an objective simultaneity – something an eternalist block eschews but a presentist or flowing time embraces.[58] Even if one clings to a block in some form (as in many-worlds), one ends up reintroducing an experiential present in each branch, which means the felt reality of a flowing time re-enters through the back door.

It would be too strong to claim that quantum mechanics *disproves* eternalism – one can always find sophisticated eternalist-friendly interpretations at some cost. But the cumulative evidence is that quantum theory makes the temporal **A-properties** (past, present, future) not only meaningful but arguably **indispensable** at the fundamental level.[59] The universe per quantum physics is more like a **story being written** moment by moment than a book already published. And while relativity taught us that different observers have their own slices of "now," quantum mechanics teaches us that whenever a given observer (or system) interacts, there is a meaningful distinction between before and after that interaction that is not observer-dependent – it's a brute fact about that process. The challenge, of course, is to reconcile these insights: any full synthesis of relativity and quantum (e.g., in a future theory of quantum gravity) will have to grapple with the tension between the block view of GR and the flow view of QM. Perhaps time in such a theory will be something emergent or collective, but our bet is that the **flow** (the directedness, the coming-into-being) will not be an illusion at the deepest level – it will be accounted for in the structure of the theory.[60]

In bridging physics and philosophy, we have drawn on both **classical thinkers** and **recent voices**.

54 https://philarchive.org/archive/TENERM#:~:text=other%20theories,in%20metaphysics%20and%20cognitive%20science
55 Ibid.
56 https://ar5iv.org/pdf/2104.09945#:~:text=This%20picture%20of%20the%20observer,do%20not%20need%20a%20human
57 https://arxiv.org/abs/1602.06100#:~:text=,the%20behaviour%20of%20the%20particle
58 https://marcsandersfoundation.org/wp-content/uploads/2022/09/An-Empirical-Argument-for-Presentism-Final.pdf
#:~:text=21%20For%20example%2C%20some%20interpretations,that%20are%20formulated%20using%20absolute
59 https://plato.stanford.edu/entries/time/#:~:text=A,evidence%20that%20there%20are%20ineliminable
60 https://philarchive.org/archive/TENERM#:~:text=other%20theories,in%20metaphysics%20and%20cognitive%20science

Einstein and Schrödinger gave us pithy quotes that, read in context, show the dichotomy in early 20th century thinking: Einstein leaning to a frozen time, Schrödinger sensing an eternal 'now'. Heisenberg and Bohr intuited that quantum physics might restore an absolute element (Heisenberg's "the uncertainty relation does not refer to the past" is a great example of an early quantum intuition favoring the present).[61] In the late 20th century and early 21st, thinkers like **Tim Maudlin** and **Lee Smolin** have explicitly argued for the reality of time's passage, challenging the physics community's block-universe orthodoxy.[62] **Carlo Rovelli**, while denying a preferred time, nevertheless emphasizes relational aspects that diminish the block's pretensions – time may be fragmented or emergent, but certainly not a single eternal container. We also introduced **Existential Realism (Trepp 2025)**, which can be seen as a culmination of many of these strands, offering a coherent framework that captures how **the present can be ontologically privileged** without rendering the past and future unreal nonsense [63]. ER or similar ideas might well serve as bridges between physics and philosophy – enabling better dialogue by providing concepts (like "reality" vs "existence") that map to physical practice (like "outcome recorded" vs "superposition").

In closing, we recall a metaphor Smolin and Verde used: treating the passage of time as more than "a thin green line on the block universe to show which slice is now".[64] Quantum mechanics, through all the phenomena we discussed, lends robust support to a present-centered ontology—one that many interpretations struggle to avoid, even when they aim to preserve block-like structures. The block-universe view would have us believe the spotlight is an illusion – the landscape is all there even in darkness – but quantum physics demurs: In the absence of observation—the spotlight—the unobserved future remains mere *possibility*, not realized *reality*. When the spotlight of the present arrives, that possibility becomes a concrete fact – and not before. The **Now** is when quantum amplitudes get cashed in for events. Therefore, time is not just an external parameter in quantum theory; it is an active participant in the unfolding of the universe.

We have aimed to demonstrate with clarity and rigor that **modern quantum mechanics supports a present-centered ontology**. This does not mean the issue is settled – far from it. Many puzzles remain: how to make a present-centric view fully compatible with relativity, how to interpret multi-particle and cosmological quantum states in this light, how to deal with quantum gravity where time might disappear at the Planck scale, etc. Philosophers will continue to debate whether we have simply found new ways to describe an underlying tenseless reality or indeed revealed an ontological timing to existence. But the dialogue between physics and philosophy is now enriched by a century of quantum experience that cannot be ignored. It may well be that **time, as experienced and lived, is also time as fundamental physics understands it** – not a mysterious illusion, but a reflection of a deep fact: reality is, at its core, a ceaseless process of becoming. And quantum physics, our most successful fundamental theory, seems to whisper, in its probabilistic and discontinuous language: *Become, become, become.* The present is real. Quantum physics prefers the present.

61 https://ar5iv.org/pdf/2104.09945#:~:text=,Werner%20Heisenberg%5B1
62 https://iai.tv/articles/tim-maudlin-einstein-didnt-think-time-was-an-illusion-auid-2317
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63 https://philarchive.org/archive/TENERM
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Deepening

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The Collapse Into Presence

Continuing the quantum thread, this upcoming paper investigates how real possibilities collapse into existence. Through this lens, quantum events become more than statistics: they are transitions from potential to actual, from merely real to fully existent.

Existential Realism: When Quantum Physics Backs the Now

Tenzin C. Trepp

Email: trepp@tenz.in

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Abstract

Quantum physics has dramatically reshaped our understanding of time and reality, revealing that the present moment occupies a uniquely privileged position within physical processes. In the first paper ("Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement"), we saw how quantum phenomena such as wavefunction collapse and measurement highlight the **"now" as the only time when possibilities become actual**. However, simply embracing **presentism** – the doctrine that only the present exists – is not enough. Presentism's traditional metaphysical stance, which conflates existence with reality by declaring all non-present things *unreal*, runs into serious conceptual roadblocks when confronted with quantum experiments and the demands of causality and truth over time. This second paper advocates **Existential Realism (ER)** as a more nuanced and robust ontological framework that **builds on those quantum insights while overcoming presentism's limitations**. By rigorously distinguishing *existence* from *reality*, ER provides a richer account of quantum phenomena – one that honors the special role of the present **without erasing the past or negating the future**. We will argue that ER better captures the ontology implied by quantum mechanics, from delayed-choice experiments and collapse theories to decoherence, and that it empowers a view of time where "becoming" and **temporal agency** are coherent and defensible.[1] In short, Existential Realism preserves the empirical centrality of the present *while* acknowledging the tangible reality of past causes and future possibilities — *making it a more comprehensive fit for quantum reality.*

Presentism's Limits in the Quantum Context

Presentism holds that **only present entities and events exist**, treating past and future entities as **nonexistent and hence not real** in any robust sense. This conflation of existence with reality – "if it doesn't exist now, it's not real, full stop" – leads to well-known metaphysical puzzles. For example, if the past is strictly unreal, **how can we say that past events *happened* or that past causes still affect us?** How are truths about history or memory possible if nothing of the past *is* in any sense?

1 Trepp, T.C. (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Manuscript) – Introduces Existential Realism, distinguishing existence (present, empirically accessible being) from reality (causal or inferential being beyond the present), and critiques presentism's inability to account for past and future entities. https://philpapers.org/archive/TENERM.pdf

Presentists often resort to awkward formulations (e.g. treating past-tensed truths as true *even though* nothing past exists), which many critics see as an unsatisfying "metaphysical erasure" of the past.[2] [3] In the **quantum realm**, these issues become even more acute. Quantum experiments suggest that reality isn't simply a series of present instants independent of each other; instead, present measurements can **reach backward** to influence how we must understand past events, and unobserved systems seem to straddle multiple possible futures. Presentism, in its orthodox form, struggles to accommodate such phenomena:

- **Delayed-Choice Experiments:** In Wheeler's delayed-choice setups, a decision made now about how to observe a particle appears to determine how that particle behaved before – as if reality "waited" on the present choice before finalizing the past. If only the present exists, what can we say about the particle's past state prior to measurement? Presentism offers no reality to the unmeasured past beyond a true proposition. Yet experiments show that until the present measurement, it's ambiguous whether the particle went through one slit or both. Only at the moment of observation is one history rendered real.[4] This retroactive determination of what "happened" undermines the notion of a fixed, bygone past and highlights that the past isn't completely settled until the present. Traditional presentism has no mechanism to describe an unsettled past – it simply isn't there at all once it's past – whereas quantum physics indicates the past must have some sort of ontological status (even if indeterminate) that can be resolved by present events.[5] [6] Moreover, as studies show, the apparent retrocausal implications of delayed-choice experiments can be fully accounted for within standard forwardintime quantum mechanics without requiring backward causality.[7] [8] Furthermore, whether one attributes ontological reality to the quantum state or treats it as epistemic affects whether one interprets these experiments as implying retrocausation— showing that the chosen ontological interpretation is *crucial* to how the experiment is understood.[9]

- **Quantum Superposition and Indefiniteness:** Before measurement, quantum systems exist in superpositions of multiple possible states. If we insist only the definite present state exists, we're faced with a dilemma: does *nothing* exist prior to measurement (since there was no single value)? That seems wrong – the system wasn't literally nonexistent; it had a well-defined **wavefunction** encoding real potentialities. Yet presentism doesn't recognize "potential states" as anything real. It would say, at best, the unmeasured electron's position doesn't exist *anywhere* until observed. But then what is the ontological status of the wavefunction and the probabilities it encodes? Quantum theory treats the wavefunction as **physically significant**, evolving and exerting causal influence (interference effects, for instance). Presentism's sparse ontology – *only actualized events exist* – struggles to account for these **latent possibilities** that are not presently actual but are clearly part of the physical description of reality.

- **Entanglement and Non-Locality:** Entangled particles exhibit correlations that manifest instantly when measured, no matter the distance. In a sense, an entangled pair behaves as a single system that **spans space and time**. When one particle is measured **now**, the other's state is determined *now* as well – seemingly implying a sort of shared present or at least a coordination that isn't mediated by any past signal. This sits uneasily with the relativistic idea that there is no single universal "now," and it is downright awkward for an eternalist **block**

2 Ibid.

3 Patrick Dawson, Hard Presentism, Philosophical Papers, 2018. Argues that standard presentism struggles to explain how truths about non-existent past events can be grounded.

4 Trepp, T.C. (2025b). Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement. (Manuscript) – Explores how quantum mechanics highlights the special role of the present moment (collapse of the wavefunction, delayed-choice effects, etc.), and anticipates the need for an ontology like Existential Realism to address the reality of non-present phenomena in physics. https://philpapers.org/archive/TREQPP.pdf

5 Christian Wüthrich, The Fate of Presentism in Modern Physics, arXiv preprint, 2012. https://arxiv.org/abs/1207.1490 Surveys how relativity and quantum gravity challenge the viability of presentism as a coherent metaphysical view.

6 John Archibald Wheeler, Law Without Law, in Quantum Theory and Measurement, eds. J.A. Wheeler & W.H. Zurek, Princeton University Press, 1983. https://press.princeton.edu/books/hardcover/9780691619619/quantum-theory-and-measurement. Foundational essay introducing the delayed-choice experiment; Wheeler argues that quantum observation can retroactively affect the nature of past events.

7 Lukas Ghiringhelli and colleagues, Delayed choice experiments: an analysis in forward time, Foundations of Physics, 2024. Their detailed mathematical treatment demonstrates that both Wheeler's gedanken-experiment and the delayed quantum eraser can be fully explained using standard forward-time quantum mechanics—no retrocausality needed. https://link.springer.com/article/10.1007/s40509-024-00328-5

8 Colm Bracken, Jonte Hance & Sabine Hossenfelder, The Quantum Eraser Paradox, arXiv, 2021. https://arxiv.org/abs/2111.09347 Shows that retrocausal interpretations of delayed-choice experiments can be avoided by questioning assumptions like statistical independence.

9 In a 2023 review, Ma et al. highlighted that the interpretation of delayed-choice outcomes—whether they imply retrocausality—depends on whether the quantum state is regarded as ontic (real) or epistemic (knowledge). If the state is epistemic, no retroactive influence is necessary; if ontic, retrocausal reading seems unavoidable. https://en.wikipedia.org/wiki/Wheeler%27s_delayed-choice_experiment

universe picture (where all times are equally real and nothing *happens*). The block view has to see entanglement correlations as all laid out in the 4D web – with no special *moment* of resolution – which **downplays the active "happening" of the correlation**.[10] Presentism, though it assigns significance to the moment of measurement, struggles to accommodate the concept of a *shared* or *global* present or how two space-like separated events could be part of one reality-defining moment. The entanglement data suggest that what matters is not *when* or *where* in an absolute sense, but that both outcomes occur as part of one joint occurrence. There is a hint that reality might have an underlying unity in the present that standard presentism (with only local, observer-dependent presents in relativity) doesn't capture. We need a framework that can **treat the present as ontologically crucial while not fragmenting reality into isolated "nows"**.

- **Relativity and the Challenge to Presentism**: Special relativity fundamentally disrupts the idea of an **absolute, observer-independent present**. Through the **relativity of simultaneity**, different inertial observers disagree about which distant events are simultaneous—and hence which are present. Since presentism depends on a fixed present, this creates a tension: either one abandons relativity or postulates a privileged reference frame, which has no empirical justification.[11] [12] [13] The **Rietdijk–Putnam argument**, often illustrated by Penrose's Andromeda Paradox, strengthens the case: multiple observers can have entirely different slices of "now," implying a four-dimensional reality in conflict with presentism.[14] Some have attempted to rescue presentism via **compatibilist strategies**. One is to introduce a **privileged foliation of spacetime**, granting an absolute but metaphysically hidden present. Another is to align an observer's present with their **past light cone**—but this sacrifices objective simultaneity and forces a fractured, perspectival ontology.[15] General relativity intensifies the challenge. Situations involving black holes reveal that essential features like the event horizon are determined by future events. Since the presentist ontology cannot include future entities, these 'surface presentism' models fail—for black holes exist only because of indeterminate future structure.[16] **Existential Realism (ER)** offers a compelling alternative: it reinterprets the nature of past and future entities in a way that honors both the **relativistic structure of spacetime** and the ontological significance of measurement events—as shown by quantum mechanics. Unlike presentism, ER does not require simultaneity or privileged frames; instead, it distinguishes between **empirical existence** (the present) and **inferred reality** (non-present phenomena), securing a consistent account that avoids both block-universe eternalism and untenable metaphysical additions .

In summary, plain presentism fails to fully make sense of quantum reality's temporal oddities. It either denies any reality to the unobservable quantum state (in conflict with scientific practice), or cannot explain how present decisions seem to **select** one past or one future out of many possibilities. Quantum mechanics tells us that the universe is not a static four-dimensional block since outcomes are genuinely probabilistic and only determined when they happen. At the same time, quantum reality does not support the simple presentist view, where anything beyond the fleeting now is erased. **We require a more nuanced ontology** – one that grants ontological status to the past and future *in the ways physics and experience indicate*, without relinquishing the primacy of the present moment. This is where **Existential Realism** enters the picture.

10 Trepp, T.C. (2025b). Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement. (Manuscript) – Explores how quantum mechanics highlights the special role of the present moment (collapse of the wavefunction, delayed-choice effects, etc.), and anticipates the need for an ontology like Existential Realism to address the reality of non-present phenomena in physics. https://philpapers.org/archive/TREQPP.pdf
11 https://en.wikipedia.org/wiki/Rietdijk%E2%80%93Putnam_argument
12 https://en.wikipedia.org/wiki/Philosophical_presentism
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Existential Realism: Distinguishing Existence and Reality

Existential Realism (ER) begins by **untangling the notion of "what exists" from "what is real."** In everyday talk we blur these terms, but ER argues they mark two different ontological categories. *Existence*, in ER's strict sense, means **to exist now in the present and be empirically accessible** – essentially, to have a concrete presence that can be interacted with at this moment. *Reality*, by contrast, is a broader category: something is real if it plays a role in the world's causal, structural, or informational fabric, **even if it is not presently existing**.[17] This allows ER to say that **only the present is populated by existents** (actual, observable entities and events), *but* many things beyond the present are still real. Past events and entities *were* present in their time and left enduring effects; thus they are real as part of the world's causal history, even though they do not exist now. Likewise, future events **can be real insofar as they already cast predictive shadows or influences** – for example, a coming eclipse is real in the sense that current astronomy predicts it and people plan for it, despite the fact that it does not yet exist.

By making this existence–reality distinction explicit, ER **resolves the tension that plagues presentism**. Standard presentism insisted that if only the present exists, then past and future are *nothing at all* – "unreal" across the board – leading to the infamous problems about truthmakers for past facts, causation from non-being, etc. ER avoids these issues by saying: past and future entities do not *exist now*, but they *are real* in appropriate ways. *Existential Realism holds that while only empirically accessible entities exist in the present, many other things — past or future — retain ontological reality.* In fact, ER holds that **the world's ontology extends beyond the knife-edge of the present**: the past remains *ontologically real* (as part of the world's furniture, as stored in records and memories), and the future has a kind of *anticipatory reality* (as a structured set of possibilities and tendencies that influence present actions).[18] This move deftly **avoids the "metaphysical erasure" of the past** that presentists are accused of. For example, Julius Caesar or a supernova explosion in 1054 CE may not exist now, but they are not simply nothing – they are **real as historical events** with ongoing effects (documents, ruins, nebulae) that exist today. In ER one can coherently say, *"The supernova **was real** and indeed it's real **now** in the sense that its light and remnants are part of our current empirical reality"* – without implying that the supernova is somehow mysteriously still **existent** now (it isn't).[19] Similarly, ER treats future events **as real enough** to be taken into account: a predicted storm tomorrow doesn't exist yet, but it is real *as a forecasted possibility* that guides what we do in the present (we carry an umbrella, etc.). Reality, in the ER view, thus **spans time**: it is the network of causally connected facts, past-present-future, whereas existence is an indexical slice of that network – the **"here and now" cross-section that is concretely actual**.

Crucially, ER's formulation preserves what was attractive about presentism (the special status of the present) while escaping its blind spots. The present moment remains unique because **only in the present do things fully *exist*** – only the present is the realm of concrete, empirical actuality. This aligns with our lived experience and with quantum physics' suggestion that the present is where indefinite possibilities collapse into definite outcomes. But unlike presentism, ER does **not** discard the rest of time as unreal. Instead, it affirms that the **past still has being (as real history)** and the **future has being (as real prospects)**, though neither past nor future enjoys the *full* status of existence that the present does. This two-tiered ontology is more than just a compromise; it is a **positive framework that yields explanatory power**. By saying something *can be real without existing*, ER provides a rigorous way to talk about, for example, the reality of unobservable entities in science or the status of fictional or counterfactual scenarios, but most importantly for our purposes, it provides a natural ontology for quantum phenomena that defy a simple presentist or eternalist interpretation. Next, we will see how **Existential Realism maps onto quantum mechanics**, making sense of measurement, collapse, and other quantum riddles in a way that outstrips rival theories.

17 Trepp, T.C. (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Manuscript) – Introduces Existential Realism, distinguishing existence (present, empirically accessible being) from reality (causal or inferential being beyond the present), and critiques presentism's inability to account for past and future entities. https://philpapers.org/archive/TENERM.pdf

18 Trepp, T.C. (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Manuscript) – Introduces Existential Realism, distinguishing existence (present, empirically accessible being) from reality (causal or inferential being beyond the present), and critiques presentism's inability to account for past and future entities. https://philpapers.org/archive/TENERM.pdf

19 Ibid.

ER and Quantum Phenomena: Bridging Potential and Actuality

Measurement, Collapse, and the Existential Now

Quantum mechanics reveals that physical systems often carry **potentialities** that are only decided by interactions in the present. In the Copenhagen interpretation, for instance, a quantum system before measurement is described by a wavefunction – a superposition of many possible outcomes. According to strict presentism, since none of those outcomes has *actually* occurred yet, one might say *nothing definite exists* prior to measurement. But clearly something real is there – the wavefunction encapsulates the system's **real dispositions and probabilities**. Existential Realism captures this intuition perfectly: **the uncollapsed quantum state is causally potent, though not yet present in existence**. It has reality insofar as it influences the world (e.g. producing interference effects), but it does not constitute a single, present **existent** outcome. When a measurement or **collapse** occurs, ER says that of the possible outcomes of those possibilities attains **existence (becomes present and observable)**, while the other possibilities cease to be real (at least for the observer's world). In other words, **reality was richer than existence prior to the measurement** – containing multiple coexisting potentials – and at the moment of interaction, reality "thinned out" to a single existent actuality. This description mirrors how physicists talk about measurement: before observation the particle *could* be in many states, after observation it *is* found in one state. The **present moment of measurement is when that selection happens**, when the merely real becomes concretely existent.

Objective collapse theories like the **Ghirardi–Rimini–Weber (GRW) model** make this point even more explicitly. GRW posits that wavefunction collapses occur spontaneously, without any observer, at random intervals – nature herself "chooses" outcomes from time to time. Notably, GRW's mechanism pinpoints the **now** as the stage of reality-definition: each random collapse is an event that **objectively actualizes one possibility into existence, eliminating the others**. The universe, in this view, is not an eternally fixed four-dimensional block, *nor* an indeterminate haze awaiting conscious observers, but rather **a constantly unfolding series of present events** where ambiguity resolves into fact.[20] As one commentary put it, *the GRW universe isn't "suspended in a blur of potential states awaiting human curiosity" – it "constantly chooses, on its own, to actualize certain configurations, and it does so precisely in the now."* [21] This is quintessentially ER-style language: the present is the locus of existence (where one configuration gets actualized), while the "blur of potential states" before collapse were nonetheless real (they were part of the probabilistic structure of reality) until the moment one is picked. Standard presentism would be uncomfortable granting reality to that pre-collapse "blur" at all, whereas eternalism would say all outcomes (perhaps all branches) exist equally – a claim that clashes with our experience that *one* outcome happens and others do not. **Existential Realism skillfully navigates between these extremes**, agreeing with collapse theories that *only one outcome becomes existently real*, but agreeing with quantum theory that the other possibilities had a kind of reality (as unrealized potentials) prior to and independent of their actualization.

The Becoming of the Past: Delayed-Choice Experiments

Delayed-choice experiments drive home a startling lesson: **even the past isn't entirely "realized" until the relevant present observations occur**. In Wheeler's famous thought experiments, whether a photon behaved like a wave or a particle in an earlier part of the experiment can seem to depend on a measurement choice made later. In one setup, if we decide *after* a photon has traversed an interference apparatus to insert or remove a detector, we either observe interference (suggesting the photon went through both paths) or particle-like behavior (it went through one path). It is as if the photon's past **"decides" retroactively** based on our present action. How can this be? In an ER perspective, the key is that the photon's earlier traversal was **not a fixed reality**; it was an undetermined event (the photon had the potential to travel both paths or one, but that wasn't resolved at the time). The reality

20 Trepp, T.C. (2025b). Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement. (Manuscript)
21 Ibid.

of that past event remained *indefinite* – or one might say it persisted only as a **superposition of two real possibilities** – until the experimental context in the present forced a single outcome to manifest. When we finally make the measurement, one of the previously real possibilities (photon went through both slits vs. only one slit) is elevated to **existence** and thereby becomes the definitive history, while the alternative possibility is rendered unreal. More precisely, *the present is not merely the time of events — it is the ontological boundary where potential becomes actual*.[22] Existential Realism thus provides a framework to understand this: the **past event had no single, settled existence after it was over, but it had a reality that could later be shaped by present conditions**. Only with the measurement is the past event's reality finalized (one version of the "story" is selected).

Neither classical presentism nor eternalism handles this comfortably. Presentism would say once the photon passed the slits (in that moment, which was then present), it either went one way or both – but if only the present exists, by the time we decide how to measure later, that past event is *gone*. It has no being, so how can a present choice affect it? Presentists might say "it doesn't *literally* affect the past, it just affects what we **know**"; but the quantum experiment suggests a stronger view: that **prior to measurement the past event wasn't ontologically definite at all**. Eternalism, on the other hand, would insist the photon's entire trajectory (and our later decision) are all laid out in the block universe; there's no true retrocausation, just a static story where everything was consistent all along. While logically possible, that explanation rings hollow to many – it makes the apparent flexibility of the past into a kind of **illusion**, and it robs the present of its role as the time of genuine **becoming**. ER preserves that role: the present is exactly when things truly *happen* (become determinate), and yet it does so without the bizarre notion of changing an "already fixed" past. Under ER, the past wasn't fixed or "realized" until needed – but it was *real* in the interim as an open record that could still be written. This picture powerfully affirms the idea of **temporal becoming**: reality unfolds and *fills in* as time progresses, rather than all being pre-written on a timeless slab. The present's **temporal agency** here is literal – it writes history as well as the future, consistent with quantum mechanics' allowance for retrocausal interpretations **without violating causality**.[23] It's important to note this doesn't mean we can arbitrarily change macroscopic history; these effects are subtle and constrained. But conceptually, the takeaway is that **time is not a one-way street of fixed existence** – the flow of time *creates reality* frame by frame, exactly as ER suggests.

Decoherence, Records, and the Reality of Traces

Another quantum mechanism that supports ER is **decoherence**, which explains how definite classical outcomes emerge from quantum superpositions via interaction with the environment. When a quantum system becomes entangled with its environment, the various possible outcomes effectively **"decohere"** into non-interfering branches – essentially, the environment *records* which outcome happened, thereby preventing alternate possibilities from interfering. From the perspective of an observer in one such resulting world, it's as if a collapse occurred: we see a definite result, and the evidence of that result is spread irreversibly through the environment (air molecules, measuring apparatus, etc.). Now consider what this means ontologically. Decoherence implies that the **present world is full of records of past quantum events** – the state of the environment carries information about what happened. ER readily accommodates this: those past events may not exist now, but they are undeniably **real** since their **"footprints" are physically present**.[24] For example, once a radioactive decay triggers a Geiger counter, the decay event is recorded in the device's state. The decay itself no longer exists (it's over in an instant), but its reality is encoded in the present state of the counter, the audible click, etc. **Presentism alone would say the decay moment is gone entirely**; one might then ask how the device's state can be about something that isn't real. ER answers: the decay event *is real* – it's part of reality's causal fabric – even though it's not an existing event anymore. The device's state that exists now is a *mediator* carrying the reality of that past event into the present. This aligns with how physicists think in practice: irreversible processes (like thermodynamic entropy increase, or environment-induced decoherence) mean the past leaves behind concrete traces. Those traces are present existents that **testify to the reality of past occurrences**.[25]

22 Trepp, T.C. (2025b). Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement. (Manuscript)
23 Ibid.
24 Trepp, T.C. (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Manuscript)
25 Ibid.

Furthermore, decoherence highlights that once an outcome is recorded, alternate outcomes become effectively irrelevant for the observer – in a sense, the other possibilities have **"died off"** from the observer's reality. Many-worlds proponents would say those possibilities still exist but in separate, non-communicating parallel worlds. Existential Realism offers a single-world interpretation that still honors the existence–reality distinction: the alternate outcomes were real possibilities, but since they did not happen *here*, they are not part of our world's reality anymore. They have no existence in our branch, and thus for us they are not real either after the fact. Instead of spawning myriad equally real worlds (as in eternalist many-worlds), ER says **reality prunes away unrealized possibilities, compressing them into the record of the one actual outcome**. This is analogous to a presentist-style database logging changes: only the final state is readily accessible, but prior states can be reconstructed if needed by the log. Nature, through decoherence, "logs" the outcome in the environment. The past possibilities are not stored as full existing worlds (that would require a highly expansive ontology); they are **stored as information in the present world** – information which implies those possibilities were once real options. In short, **ER sees the classical world as the cumulative result of quantum events that became actual, with each present state carrying the archive of what came before**. This addresses the quantum-classical transition without resorting to an ontology of permanent multiverses, and without the presentist's problem of past events being simply erased. The **now** is richly informed by the **real but no-longer-existent past**, and it contains seeds of the future in the form of tendencies and information.

Future Possibilities and Temporal Agency

A compelling aspect of Existential Realism is how it treats the **future** – not as an already-existing set of events (eternalism's view), but also not as a total non-entity. The future is **real as an open realm of possibilities, some more likely than others**, which exert influence on the present via prediction, planning, and probabilistic laws. This has direct resonance with quantum physics and also with the notion of **free agency**. In quantum mechanics, even with complete knowledge of the present state, the outcome of a future measurement is generally not determined – there are multiple potential outcomes each with a calculable probability. These potential outcomes are *real features* of the system (encoded in the wavefunction's amplitudes), yet until one occurs, none can be said to exist. Again we see that ER's ontology fits hand-in-glove: **the future result is not existent (because it hasn't happened), but it is real enough that we can talk about its likelihood and we can even affect which outcome might come about by our choice of measurement or action**. This is where **temporal agency** enters. Because the future is open but structured, an agent in the present can, by making certain choices, steer reality toward one outcome or another. For instance, in a delayed-choice experiment, the experimenter's decision of what to measure will determine which aspect of the system's real potential is actualized. In everyday terms, when you set up an experiment or even make a mundane decision, you are implicitly treating various anticipated outcomes as sufficiently real to merit consideration, and by acting you help select one to become actual. ER legitimizes this common-sense and scientific reasoning by granting ontological status to the **"not yet"**. We prepare for events that haven't occurred because we justifiably consider them part of reality's landscape (as *possible future realities*). A bridge is engineered to withstand future heavy trucks that don't exist yet; clearly those hypothetical trucks are deemed real enough to influence present engineering choices.[26] Under presentism, one might say we're irrationally basing decisions on non-entities; under eternalism, one might say those future events are already out there, fated to happen regardless of our will. **Existential Realism, however, captures the middle ground**: future events are *not fixed* (they do not already exist), but they have a **robust ontological status as possibilities** that can causally affect the present (via our knowledge, expectations, and the probabilistic tendencies of physical law). This allows for genuine agency: our present choices matter because they **help determine which among the real possibilities will attain existence**. The future is something we co-author, within the constraints of what is realistically possible.

26 Trepp, T.C. (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Manuscript)

In philosophical terms, ER thus endorses an **open future** and a strong sense of **becoming**, where each moment the universe decides among real options. Yet it avoids the extreme indeterminism of saying the future is utterly unreal or inscrutable – physics and rationality constrain the future's shape, and those constraints are themselves part of reality (think of them as the "boundary conditions" of what can happen next). In a way, ER gives time a kind of **creative potential**: the present is a dynamic crucible where reality actively *selects and creates*, influenced by the inertia of the past and the pull of future possibilities. This view resonates not only with quantum mechanics but with modern ideas in cosmology and quantum gravity where time might be emergent or relational. If time itself is an emergent property of underlying processes (as some theories like the holographic principle and causal set theory suggest), then tying existence to the present empirical moment (as ER does) makes even more sense – it aligns "what exists" with the forefront of those processes, while "reality" can stretch across whatever structures underlie time.[27] ER effectively says **reality is the sum of the world's information and causation structure** – which can extend beyond the present – but existence is the **active, tangible now**. This is a philosophically profound stance that squares with the direction of cutting-edge physics: it acknowledges that our intuitive flow of time (with a special now) could be a manifestation of deeper relational properties, and it ensures our ontology is flexible enough to accommodate that without giving up the reality of things we cannot directly touch at the moment.[28]

Advantages of Existential Realism over Other Theories

By now the advantages of Existential Realism should be evident. It manages to **synthesize the strengths** of rival temporal ontologies while avoiding their weaknesses, especially in light of quantum mechanics. Let's briefly contrast ER with its primary competitors:

- **Versus Presentism:** Presentism gets right the idea that *only the now is fully real in a concrete sense* – quantum physics indeed highlights the now as the site of collapse and action. But presentism errs by collapsing "reality" into "existence," thereby denying any status to the past and future. This leads to insoluble problems about explaining records, memories, causes (how can present effects be produced by something entirely unreal?), as well as problems accommodating the quantum state prior to measurement. ER corrects this by **decoupling reality from mere present existence**. Past and future phenomena *are real*, though they don't exist now. This move preserves truthmaking and causality (the past can **do** things like leave traces because it is real) and lets us say unmeasured quantum states are real features of the world even if not manifest. In short, ER **solves presentism's "metaphysical censorship"** of anything not present.[29]

- **Versus Eternalism (Block Universe):** Eternalism is almost the mirror image: it grants full reality (indeed existence) to past, present, and future alike in a static 4D block. This avoids presentist issues with past and future, but at a steep cost: the **loss of objective becoming**. In a block universe, nothing truly "happens" – all events just *are* in spacetime. The feeling of the flowing now is subjective or illusory. Quantum mechanics, however, seems to contradict a strict block view: the indeterminism in quantum outcomes suggests the future is not yet decided, and phenomena like collapse are irreducibly temporal (they unfold in time, not just sit there). Moreover, as noted, the block view struggles to make sense of why the present seems privileged in quantum correlations and in the emergence of classical reality. **Existential Realism one-ups eternalism** by keeping the **dynamism of time** (the universe genuinely unfolds moment by moment) while still preserving the *reality* of the whole temporal web. Think of ER's reality as analogous to an artist's sketch that's being inked in: the entire outline is there as a guiding structure (reality across time), but only the inked part is fully concrete (existence in the present). Eternalism would say the entire drawing is already inked from the start (determinism and no becoming), which doesn't match a universe where novelty and choice appear to occur. ER's picture is both

27 Trepp, T.C. (2025b). Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement. (Manuscript)
28 Ibid.
29 Trepp, T.C. (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. (Manuscript)

realist about time's content (past/future are part of reality) and **dynamic about time's progress** (only now is fully actual and it's the leading edge of creation).

- **Versus Growing-Block or Presentist Hybrids:** The growing-block theory acknowledges past and present exist (the block grows with new events), but not the future. This gives reality to the past (solving some presentist issues) but still denies reality to the future, and it struggles with the status of becoming (the block grows, but the "now" is just the latest slice with no special ontology beyond being the front of the block). Growing-block also has an asymmetry: past is "real and fixed," future unreal. Quantum mechanics hints that even the past isn't unchangeably fixed until measured, as delayed-choice showed. So a simple growing-block can't account for a malleable past prior to being recorded. ER, in contrast, does not treat the past as a monolithic completed structure – the past is real *insofar as* it is recorded or causally linked, but if something in the past left no trace, in what sense can we say it was real? (ER leaves room for uncertainty or indeterminacy in unrecorded history, something a rigid block does not countenance). Additionally, ER extends reality to the future's possibilities, which growing-block refuses to do. This means ER can conceptualize how present actions are directed toward future goals (acknowledging future reality), whereas growing-block presentism would have to treat talk of future events as talk about nothing definite (limiting our philosophical account of planning and agency). In summary, **ER is more symmetric and forward-looking**: it respects the **"growing" aspect of reality** (like growing block) but also recognizes the pull of the future. It is arguably *the most integrative temporal ontology*, doing justice to our intuitions about time's passage, the empirical role of the present, and the extended structure of causation.
- **Versus "Presentist Quantum" Approaches:** One might attempt a presentist interpretation of quantum physics – for example, by saying only collapse events exist and in-between states do not. But this is very hard to square with theory and experiment: it would mean during the intervals without collapse, there is literally no determinate reality (which might be okay) and also nothing real carrying the system's state (which is not okay – something must be evolving to produce the next collapse outcome distributions). Presentism also has trouble with relativity (no global present), whereas ER's definition of existence can accommodate relativity by making existence observer-dependent *without* denying a shared reality. In ER, different observers may disagree on what is "simultaneously present" due to relativity, but they will agree on the underlying real events and causal connections – ER's reality is the network of events, which all observers share, even if their slicing into "now" differs. Because ER only attaches **full existence to an observer's here-and-now**, it meshes with relativity's insight that "now" is not absolute, while still saying all observers are immersed in one reality (the web of events). Pure presentism can't easily handle multiple frames' perspectives (who's present is *the* present?), but ER can say each has their own set of existents, yet all those existents are part of one reality that includes past and future aspects relative to each frame. This flexibility makes ER far more viable as a philosophy of time in modern physics contexts than naïve presentism.

Ultimately, the **bold claim** we advance is that **quantum physics essentially *demands* something like Existential Realism**. Neither the old presentist nor eternalist paradigms can adequately capture what quantum experiments are telling us about how nature works. The unfolding, yet structured, character of quantum reality – where **now is when indeterminate potential turns into determinate actuality, where records carry the past and probabilities chart the future** – finds its natural home in ER's ontology. By embracing ER, we get to keep the **ontological significance of the present** (quantum theory's lesson) *and* uphold a **consistent reality for things beyond the present** (science's requirement for explaining traces and predictions). In doing so, we also gain a coherent account of **becoming** (the idea that the universe genuinely **creates new events** as time progresses) and of **temporal agency** (the idea that choices and causes propagate through an open future). These are features that human intuition and experience have long cherished, and now, with ER, they need not be sacrificed on the altar of a static or overly restrictive ontology.

Conclusion

Existential Realism emerges as the **best-fitting temporal ontology for quantum reality** because it captures the nuanced way that quantum physics forces us to rethink what it means for something to exist or be real. **ER recognizes that reality is thicker than the present, yet existence is pinned to the present.** This recognition allows it to honor the primacy of the now – the stage of quantum measurement, collapse, and actual events – without dismissing the existence of a rich temporal backdrop of causes and possibilities. We have shown how ER can elegantly interpret perplexing quantum phenomena: a collapsing wavefunction is a transition from real possibility to actual existence; a delayed-choice experiment illustrates the world's capacity to leave the past open until an observation seals it; entanglement hints at a connectivity that transcends spatial distance and challenges a merely relativistic slicing of reality; decoherence demonstrates the preservation of the past in the present and the shedding of unrealized alternatives; and throughout, the openness of the future in quantum processes aligns with ER's view of the future as **real-but-not-yet**. In defending ER as **superior to presentism and other present-centered theories**, we see it not as a compromise but as a **clear advancement** – a theory that can do justice to both **metaphysical rigor** and **physical reality**.

In a philosophical landscape shaken by modern physics, Existential Realism provides a much-needed anchor. It tells us that **what exists is only now** – but that this "now" is informed by a real past and pregnant with a real future. It gives us a way to speak meaningfully about dinosaurs and distant supernovae, about tomorrow's sunrise and the undecided fate of Schrödinger's cat, all within one coherent ontological picture. By championing ER, we are making a bold claim: that **quantum reality, with all its quirks, *prefers*** this framework. As scientific knowledge pushes the boundaries (hinting that time itself may be emergent or that information underlies physics), having a flexible ontology like ER is an invaluable asset. It avoids false dichotomies (present vs. eternal, being vs. nothingness) and instead invites us to see the world as **layered** – with existence as the sharp edge of reality, carving out the present from a block of structurally real, yet non-actualized or no-longer-actualized, possibilities. In conclusion, **Existential Realism best fits quantum reality** because it alone can honestly say: *the present is where reality happens, but reality is more than just the present*. This synthesis of boldness and nuance positions ER as a guiding framework for future discourse at the intersection of physics and metaphysics, promising a deeper understanding of time, existence, and the ever-unfolding universe.[30]

30 Trepp, T.C. (2025b). Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement. (Manuscript) – Explores how quantum mechanics highlights the special role of the present moment (collapse of the wavefunction, delayed-choice effects, etc.), and anticipates the need for an ontology like Existential Realism to address the reality of non-present phenomena in physics.

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Transition

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From Possible to Actual

What does it mean for something to “become present”? This paper explores the moment of transition — the collapse of real possibilities into existence. ER’s vision of time takes shape as dynamic, not static: the real becomes, the possible recedes.

Becoming Present: The Collapse of Possibility into Time

Tenzin C. Trepp

Email: trepp@tenz.in

Date: August 04, 2025

Abstract

Modern physics has increasingly highlighted the special role of the present moment in the unfolding of reality. Quantum experiments suggest that **reality is not a static four-dimensional block but is actively determined in the present moment**,[1] as measurements seem to bring about definite outcomes only at the instant they are performed. This resonates with *presentist* intuitions (the view that only the present exists), yet strict presentism faces serious metaphysical problems. How can only the present be real, if past causes clearly leave effects and future events are anticipated? This paper advocates **Existential Realism (ER)** as a superior ontological framework that preserves the primacy of the present **while accounting for the reality of past causes and future possibilities**. Building on our earlier introduction of ER and critique of presentism's limits, we will show that ER provides a richer ontology for quantum phenomena – one that distinguishes between existence and reality, and accommodates genuine becoming and temporal agency in ways that purely present-based theories cannot.[2] We make bold but rigorous claims: that quantum mechanics "prefers" a present-centered ontology, and that Existential Realism best captures this without the pitfalls of naive presentism or the stagnancy of eternalism. In short, **ER not only aligns with quantum physics – it elevates and refines the very notion of what it means for something to be real in time**.

Presentism's Limitations and the Need for More

Presentism holds that only present entities and events exist – the past has **ceased to exist** and the future does not yet exist. This view preserves an intuitive feeling that *now* is ontologically special. However, presentism in its standard form suffers from well-known shortcomings. If past entities are utterly unreal, it becomes mysterious how true statements about the past (e.g. *"dinosaurs existed"*) are grounded, or how past causes (like a star that exploded long ago) still produce effects now. Indeed, if the past is "nothing," how do we account for memories, records, and persisting structures shaped by past events? Philosophers refer to this as the truthmaker problem, which highlights how standard presentism threatens the ontological grounding of past events — a concern central to truth-

1 Wheeler, J. A., "Law Without Law", Quantum Theory and Measurement, Princeton University Press (1983).
2 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024). https://philpapers.org/archive/TENERM.pdf

maker theory as developed by Armstrong [3]– presentism threatens to wipe out the ontology needed to support historical truths and causal chains. As one commentator summarized, *"standard presentism says past and future entities are simply not there in any sense – 'all such objects are unreal'... That stance leads to well-known problems: if the past is unreal, how do we account for the truth of statements about the past, the efficacy of past causes, or the content of memories?"* [4] However, some philosophers like Merricks argue that truths about the past do not require existing truthmakers, challenging the necessity of a full ontological backing [5].

Presentism also clashes with Einstein's relativity, which teaches there is no single universal "now" [6] – simultaneity is relative to observers. A strict presentist who insists on one global present struggles to reconcile with relativistic physics. Typically, presentism must either deny relativity's implications or introduce an arbitrary preferred frame of time, neither of which sits well with modern science. These issues suggest that **while "only the present exists" has intuitive appeal, it cannot be the whole story**. The world evidently contains traces of the past and predictable patterns pointing to the future. We need an ontological framework that **recognizes the present's special status without denying the reality of non-present times**. This is precisely what **Existential Realism** offers.

The Ontological Innovation of Existential Realism

Existential Realism (ER) is a recently developed framework designed to move "beyond presentism" while retaining its strengths.[7] It does so by **distinguishing between *existence* and *reality*** as two levels of being. In ER's two-tier ontology, **only present entities and events *exist*** (strictly speaking, to exist means to be present and empirically accessible right now). However, many things that do not exist now can still be said to be **real** – they belong to the world's ontology in a broader sense due to their causal or informational connections. By making this distinction, ER can assert without contradiction that **"only the present exists, but much more than the present is real."** It thereby preserves the ontological economy of presentism (avoiding commitment to 'ghostly' unexperienced realms), while retaining the explanatory scope of eternalism and the growing-block theory (which acknowledge the relevance of past and future in the broader ontology).[8] In short, ER captures the **best of both worlds**: it grants ontological primacy to the now, yet it does not erase the rest of time.

Crucially, Existential Realism resolves the truthmaker and causality worries that plague presentism. **Past events may not exist now, but they are ontologically real insofar as they have left present traces and effects**. As one formulation explains, *"although past entities do not exist now... they remain real insofar as they have left enduring effects and information in the present. The past is ontologically real – it belongs to the world's furniture – even though it has no current existence"*.[9] For example, while Napoleon **does not exist** in 2025, the impact of Napoleon's actions (documents, historical changes, memories) persists as part of reality. Thus, ER avoids the metaphysical erasure of the past – historical truths have real referents (the past events) even if those events aren't now present. Likewise, the **future** in ER is *not yet existent*, but is nevertheless **real as a range of possibilities and tendencies**. A future solar eclipse "does not exist now," but its reality is evidenced by our ability to predict it and prepare for it; such a future event is real in the sense of being *anticipated by present knowledge and implicit in current conditions*.[10] In general, reality in ER is the comprehensive network of causal and informational structures across time, whereas existence is limited to what is concretely present and observable. *"Reality thus comprises an extensive network of causal and informational structures across time... Under Existential Realism, only present, empirically accessible entities exist, but many*

3 Armstrong, D. M. (1997). A World of States of Affairs. Cambridge University Press.
4 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024).
5 Merricks, T. (2007). Truth and Ontology. Oxford University Press.
6 Petkov, V., Relativity and the Nature of Spacetime, Springer (2005).
7 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024). https://philpapers.org/archive/TENERM.pdf
8 Ibid.
9 Ibid.
10 Ibid.

other things are real".[11] By decoupling reality from instantaneous existence, ER can say that **"reality without present existence" is not a contradiction but a defined state**.[12] This innovative ontology neatly **solves presentism's problems**: it preserves the meaningfulness of talk about past and future without giving up the present-centric focus.

ER even handles relativity more gracefully than naive presentism. Since *existence* in ER is an indexical, frame-dependent concept ("exists-now-for-me"), there is no insistence on a single global present. Different observers have their own present exists, and that's fine because **reality** (the totality of events) is frame-invariant – all observers can agree on the reality of events even if they disagree on simultaneity. Instead of a single absolute now, ER allows many local "nows" (each defining what exists for a given frame), all embedded in one reality. This flexibility means **ER does not conflict with relativity**, unlike an inflexible presentism. In summary, Existential Realism provides a robust, two-layer ontology: everything that is **concretely present and empirically detectable exists**, and everything that has ever been causally efficacious or that will be (in line with physical laws and probabilities) is real. **Nothing is lost from the ontological inventory – the past and future are included as real – yet the special status of the present is upheld**. This makes ER uniquely well-poised to interpret puzzling features of quantum physics, as we explore next.[13]

Quantum Phenomena Highlight the Primacy of the Present

Quantum physics has repeatedly shown that the **present moment is the unique locus of reality's actualization**. Unlike classical theory, quantum mechanics suggests that prior to an observation or interaction, physical systems remain in superpositions – not as concrete, settled facts. Reality "chooses" an outcome only when a measurement forces the issue, and this **happens in the present**. In this section, we survey specific quantum phenomena and interpretations that underscore the idea that **what is real is decided now, moment by moment**. These insights will then be used to argue that Existential Realism is an ideal metaphysical partner for quantum theory.

- **Delayed-Choice Experiments:** In John Wheeler's classic thought experiments (since realized in laboratories),[14] a bizarre effect occurs: the outcome of a measurement performed in the present seems to retroactively determine how a particle behaved in the past. For example, a photon can be sent toward a double-slit apparatus. Only *after* it passes the slits does the experimenter choose whether to observe a particle-like behavior (which-path information) or a wave-like interference pattern. Astonishingly, the photon's prior behavior (wave or particle) appears to depend on the late choice of measurement. *"The outcome of a measurement performed in the present seems to influence how a particle behaved in the past... It's as if reality waits to see what we'll decide before making up its mind about what already happened"* [15]. There is no actual signal going back in time – causality isn't violated – but these experiments strongly suggest that **the past remains *unfixed* or *unrealized* until an observation in the present crystallizes it**. In Wheeler's words, the universe might not have a definite history until we look. Thus, the **present moment "emerges as the definitive point at which the ambiguous becomes actual," shaping not just what *is* but even "what *was*"**.[16] The delayed-choice experiments give the present a **starring role**: the now is *"when things become real."* The past, in this view, is not an immutable archive but is **more like a story still being written, finalized only when new measurements occur**.[17] Such phenomena dramatically highlight **objective becoming**: reality is being updated in the present, rather than simply revealing an already-settled past. Presentism alone never anticipated an unsettled past, but ER's framework – where past events can be real yet indefinite until observed – is well-suited to make sense of this.

11 Ibid.
12 Ibid.
13 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024). https://philpapers.org/archive/TENERM.pdf
14 Jacques, V. et al., "Experimental realization of Wheeler's delayed-choice GedankenExperiment", Science, 315(5814), 966–968 (2007).
15 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025). https://philpapers.org/archive/TREQPP.pdf
16 Ibid.
17 Ibid.

- **Objective Collapse Theories (GRW and Others):** In the Copenhagen interpretation of quantum mechanics, measurement by an observer causes the wavefunction to collapse to a definite outcome. Some physicists have proposed that collapse is an **objective physical process**, not needing a conscious observer. The **Ghirardi–Rimini–Weber (GRW)** theory, for example, posits that every so often (randomly and spontaneously) a quantum system's myriad possibilities **collapse to a single actual state**. This happens universally and indifferently – the universe itself "measures" things via spontaneous jumps. In such models, the **present gains a distinct physical status** as the moment a hazy multitude of possibilities resolves into one concrete reality. *"The GRW theory proposes that wave function collapse happens randomly and universally,[18] not just when someone is measuring... Each spontaneous collapse marks a boundary between what could have happened and what did. That moment... actually determines what reality is. In GRW and similar models, the universe... constantly chooses, on its own, to actualize certain configurations, and it does so precisely in the now"*.[19] In other words, **nature is incessantly picking present outcomes from potential states**. The past is done, the future not yet determined – only at each present collapse does the "quantum drama" decide an outcome.[20] Sir Roger Penrose's objective collapse idea (related to gravity) likewise singles out the now: once a quantum superposition reaches a threshold, it *splits* into a definite state, defining the present as the point where indeterminate probabilities crystallize into a specific physical event. Despite differing mechanisms, these theories converge on a shared intuition: reality becomes definite one moment at a time — and that moment is always now.[21] The universe isn't a timeless panorama of equally real possibilities; rather, it is actively **making up its mind from instant to instant**. This notion of a world **constantly reasserting the importance of "now"** meshes perfectly with Existential Realism's two-tier ontology of reality vs. existence. ER would say that before each collapse, multiple potential outcomes are *real* (they have mathematical reality in the wavefunction and inform probabilities), but none yet *exist*. When the collapse occurs, one outcome gains *existence* (becoming present and concrete) while the others cease to be relevant (they were real possibilities that do not actualize). Thus quantum collapse can be neatly understood as **the process of reality shedding mere possibilities and gaining a new present existence** – precisely the kind of **ontological becoming** that ER champions and that a static eternalist block denies.

- **Quantum Decoherence:** Not all interpretations rely on abrupt collapse. **Decoherence** is a widely accepted process by which quantum systems interacting with their environment **lose their quantum uncertainty** and begin to behave classically. When a microscopic system becomes entangled with the many degrees of freedom in its environment, the delicate superpositions effectively **"leak" into the environment**, and the system's possible states can no longer interfere with each other. Decoherence explains why we observe only one concrete outcome, even in the absence of an explicit wavefunction collapse. The environment effectively entangles each possibility with distinct surroundings, thereby isolating them into non-interacting 'branches' and making the world appear definite. Importantly, decoherence is a **continuous, dynamical process happening in time**. *"Quantum decoherence offers a powerful explanation for how the messy ambiguity of quantum potential collapses into the crisp contours of classical reality... [It] doesn't rely on a conscious observer... As soon as a system begins to entangle with the environment, its probabilistic superpositions give way to the classical determinacy we observe"* [22]. In plainer terms, as interactions accumulate, the system's possible states get **whittled down to an effectively single outcome** (from any one observer's perspective). And notably, *"decoherence happens in the ongoing present. It's the continuous handshake between quantum possibility and classical certainty... something the world actively does, moment by moment"*.[23] This description again elevates the present moment as the arena where quantum possibilities **continually turn into the settled facts of our world**. We find a world that is **"al-**

18 Ghirardi, G. C., Rimini, A., Weber, T., "Unified dynamics for microscopic and macroscopic systems", Phys. Rev. D, 34(2), 470–491 (1986).
19 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025).
20 Ibid.
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22 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025).
23 Ibid.

ways taking shape in the moment, always being born anew" as decoherence steadily writes the record of reality.[24] This aligns with the Existential Realist view that only the present is the locus of actual existence, while the *processes* linking past to future occur in real time. Decoherence gives a physical mechanism for how a single, unfolding present can yield the classical reality we experience, without requiring that past alternatives exist simultaneously. ER naturally accommodates this: unobserved quantum states can be considered part of reality's structure (hence why they influence outcomes), but only the continuously updated present state exists in full-fledged form.

- **Quantum Entanglement:** Quantum entanglement presents a puzzle that touches on time as well as space. When two particles are entangled, a measurement on one instantly determines the state of the other, no matter the spatial separation. In experiments, entangled particles have demonstrated correlations appearing **sooner than any light-speed signal could travel** [25] – in effect, "instantaneously." This immediacy troubles our sense of time: it is as if the two events share a common **now** despite being distant. If one subscribes to a strict relativistic view, there is no single global present, only each observer's moment. Yet entanglement seems to **bind particles into a shared present state** such that what happens to one is *simultaneously* reflected in the other. Some physicists and philosophers speculate that entanglement hints at a deeper level where the universe has a kind of unified present or where time is an emergent notion. What does this imply for ontology? Interestingly, these instantaneous correlations make the **block-universe (eternalist) picture appear awkward**. In a block universe, all events (past, present, future) exist equally, and nothing truly *happens* or *changes* – it's all laid out. But with entanglement, we see a dynamic *happening* (the joint state resolution upon measurement) that cares about the timing (**it happens "together" in the present for the two particles**). As one analysis put it, the block model becomes increasingly difficult to reconcile with these dynamic quantum correlations that seem to care very much about what happens now".[26] Entanglement by itself doesn't completely overthrow relativistic time, but it **emphasizes an *undivided present* as the stage for correlated events**, in a way that suggests reality might have a global synchrony at the quantum level.[27] For ER, this is not problematic: reality can include far-flung events as real, and when a measurement ties them together in one present outcome, that event *exists* in the now for both. Entanglement thus underscores that **present events are the ones of ontological significance** – they fix relationships and states – whereas merely possible or future correlations mean nothing until realized. Presentism alone doesn't easily explain a "global now" (and in fact relativity forbids it globally), but ER can say entangled outcomes share a reality link that is established when observed, without requiring a universal simultaneity in the background. The key point is that **the outcome becomes real for both particles at once, when measured, reinforcing that reality is implemented in real-time happenings, not in a static timeline**.

In sum, these diverse quantum phenomena and interpretations all point to one conclusion: **the present is when potentiality resolves into actuality**. Whether it's a human observer closing the box on Schrödinger's cat, a spontaneous collapse selecting a particle's position, or the environment nudging a system into a stable state, *something physically special occurs "now" to bring about concrete reality.* As one summary puts it, *"reality shows up only when those potentials collapse into a single state – and this collapse only happens now"*.[28] This view fundamentally is about **becoming**: the world is not a static collection of facts, but an ongoing story, **"reality… being constructed, again and again" in each moment**.[29] The **ontology suggested by quantum physics is one of an evolving present**, not an already-written block of time. We next argue that **Existential Realism is uniquely suited to formalize and support this picture**.

24 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025). https://philpapers.org/archive/TREQPP.pdf
25 Aspect, A., Dalibard, J., Roger, G., "Experimental test of Bell's inequalities using time-varying analyzers", Phys. Rev. Lett., 49, 1804–1807 (1982).
26 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025).
27 Ibid.
28 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025).
29 Ibid.

Why Existential Realism Matches Quantum Reality Better than Rival Theories

The insights from quantum physics above align remarkably well with Existential Realism's two-tier ontological structure. ER was formulated to overcome presentism's weaknesses – and it turns out quantum theory *needs* exactly such an improved framework to make sense of its strange findings. Here, we outline why **Existential Realism provides a richer and more coherent account of quantum phenomena** than either bare presentism or eternalist views (including the "block universe" or many-worlds interpretations). We also highlight how ER permits **genuine agency and becoming** in a quantum world, a feature that other ontologies struggle to accommodate.

1. ER acknowledges *real* possibilities and an open future – essential for quantum uncertainty. Quantum mechanics is inherently probabilistic; before observation, we can only assign probabilities to possible outcomes. These possible outcomes are not mere fantasy – they are encoded in the present quantum state and can interfere or influence events (as in the double-slit interference pattern that arises from superposed possibilities). A strict presentist might say "future outcomes don't exist at all until they happen," which is true in ER as well (no outcome *exists* until it becomes present). But ER goes further to say those outcomes-to-be are nonetheless **real in the sense of being part of the causal and explanatory structure of the world**. The electron's possible paths are real enough to affect an interference pattern, even though only one actualizes into existence when measured. By treating the future as *"a set of real possibilities and tendencies"*,[30] ER can comfortably describe the quantum state as representing real potentialities that are awaiting resolution in the present. This offers a richer ontological picture than presentism, which would have to say nothing at all exists until it exists – potentially obscuring the status of the wavefunction or multitudes of potential outcomes. Conversely, eternalism or many-worlds would treat all outcomes as equally real (and, in many-worlds, each outcome actually exists in some branch). That approach **eliminates the meaningful uncertainty and becoming** – it implies every outcome *already* exists in a parallel world, so nothing truly comes into being. ER avoids both extremes: outcomes are **really possible but not realized**. When one outcome happens, that is a **genuine ontological addition to existence**, not just an update of our knowledge. This captures the experimental fact that until the now, the result wasn't decided (from our world's perspective), yet the range of possibilities was constrained and real. ER thus mirrors the **quantum logic of possibility and collapse**: the theory's probabilistic predictions refer to real features (the wavefunction's structure) without committing to multiple simultaneous existences.

2. ER preserves becoming and temporal agency, which quantum mechanics supports. One of the most profound implications of quantum mechanics is that the universe is not deterministic – at least at the microscopic level, there is **openness in how events play out**. This openness is what allows for "delayed choice" effects and for the crucial role of measurement choices. There is a sense in which *the future is not yet written*; it can go this way or that, and in some interpretations even the past isn't fully written until the present intervenes. Existential Realism inherently embodies an **open-future ontology**: *"the future's reality does not equate to predetermination… Our actions now can genuinely influence which future becomes actual, since those futures are not pre-existent realities but rather a range of real possibilities"*.[31] This idea maps perfectly onto quantum scenarios. For example, an experimenter's choice to measure one observable instead of another (say, particle position instead of momentum) will **affect which property becomes actual** for the system – and nothing in the past of the particle fixes that outcome beforehand. The experimenter thus has a form of **temporal agency**: a present action selects which among the possible realities will materialize. In a block universe, by contrast, there is no *true* agency or becoming; everything that will happen is already laid out timelessly – the feeling of choosing or the probabilistic uncertainty is an illusion, since all outcomes exist in the 4D block. Likewise, in the many-worlds view, making a choice or observing a result simply forks you into seeing one branch, but all branches occur – meaning you haven't really prevented any outcome at the global level. **Only a present-centric ontology with an open future, like ER, allows for the intuitive notion that what we do now *makes a difference* in what becomes real.** Quantum physics, with its

30 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024).
31 Ibid.

random or choice-dependent outcomes, strongly implies that difference-making is real: the universe **waits** (as it were) for now to decide. ER captures this by saying the future is *indeterminate but real* in the form of probabilities and possibilities, awaiting the determining moment of present existence. Thus, agents (or spontaneous natural events) operating in the present genuinely shape which reality comes to be. This is a powerful marriage of physics and metaphysics: **quantum randomness and free choice become the mechanism of "creating" reality in the present, which ER dignifies as an objective feature of the world** rather than a mere subjective impression.

3. ER avoids the pitfalls of other time ontologies in the quantum context. Presentism alone, as noted, struggles with basic coherence once physics enters — a problem thoroughly explored in contemporary metaphysics.[32] Eternalism (the view that past, present, future all equally exist in a static block) is in some ways the opposite extreme, and quantum evidence weighs against it. If all times and outcomes are equally existent, nothing ever truly *happens* – change and flow are illusions. Yet quantum mechanics, especially in collapse interpretations, implies that something does *happen* (the wavefunction collapses and a single outcome is selected) and that *before* it happened, it truly wasn't decided. Eternalism would force us to say the collapse and the indeterminacy were just our 4D perspective on a higher-dimensional fixed reality, which seems to **rob the quantum formalism of physical meaning**, reducing probabilities to ignorance about the block. This is deeply unsatisfying and arguably contrary to the spirit of quantum theory, which treats outcomes as objectively non-determined prior to measurement. Similarly, the Many-Worlds Interpretation (an eternalist-friendly view) eliminates collapse by asserting that **all outcomes happen in branching universes** – effectively positing a giant overloaded ontology that contains every possibility as an actuality. This moves the indeterminacy out of sight (each branch is deterministic) but at the cost of a **radically inflationary ontology** and the loss of a single shared reality. From an Existential Realism perspective, Many-Worlds extends eternalism by proposing that all possible outcomes exist across branching timelines:[33] instead of "the past and future are real," it says *every* conceivable timeline is real somewhere. ER would regard the extra branches as **unnecessary metaphysical baggage** – why treat unactualized possibilities as actual worlds, when we can simply treat them as unrealized real possibilities that do not have full existence? Indeed, Occam's razor supports ER's leaner ontology: one world that continually actualizes possibilities into existence, not zillions of parallel worlds. As a bonus, ER sidesteps the measurement problem quagmire by accepting collapse (or at least single-outcome realization) as a real feature of the world, whether brought about by an observer, environment (decoherence), or spontaneous mechanism. Since only one outcome becomes present-existence, there is no ambiguity about what is real – **ER is a single-world realist view** that nevertheless keeps the quantum superpositions in play as part of reality until they resolve. This stance is **superior to naive presentism** as well, because presentism might deny the ontological status of the wavefunction or state vector (since it's not a concrete present object until measured), whereas ER can say the quantum state is part of reality's structure (it has reality as an evolving information structure), just not a tangible classical existence. In effect, ER legitimizes talking about quantum states, past events, and future predictions as part of reality, which is exactly what physicists do, without elevating them to the same status as definite present facts. This layered approach avoids both the **metaphysical overload of eternalism** and the **austere emptiness of presentism**.

4. ER supports relativity and global constraints without sacrificing the present. While quantum phenomena emphasize the now, they exist in a relativistic world where different observers have different "nows." Some have worried that any present-centric ontology is doomed by relativity's absence of a universal time — a challenge laid out in foundational works on the philosophy of physics.[34] However, as noted earlier, ER handles this by making "exists now" observer-dependent but "real" observer-independent. Entangled events, for instance, might be spacelike separated – one observer's present sees them as simultaneous, another's does not. In ER, each observer has their local present set of existents, and entanglement's correlations are part of the reality that spans those frames. The key entangled outcome (once both are measured) exists for each observer once they have the informa-

32 Markosian, N. (2016). Time. In The Stanford Encyclopedia of Philosophy.
33 Kent, A., "One World Versus Many: The Inadequacy of Everettian Accounts of Evolution, Probability, and Scientific Confirmation", Quantum Theory: A Two-Time Success Story, Cambridge University Press (2013).
34 Sklar, L. (1974). Space, Time, and Spacetime. University of California Press.

tion; before that, the correlation was a real potential. This flexibility means ER does not need to posit a hidden absolute clock to time collapses (although some objective collapse theories do implicitly). It can live with relativity by saying: reality is the invariant set of events; each collapse or measurement is an event that different frames slice differently, but all agree it becomes real at some point. Eternalism solves relativity by freezing all events equally (trivial but unsatisfying), presentism fails by insisting on one frame, whereas ER finds a **middle way consistent with modern physics**.[35] In a sense, quantum entanglement's suggestion of a "non-local now" can be conceptually accommodated by ER's idea of reality beyond local existence – a kind of **relational present** emerges, as some physicists have described.[36]

5. ER is metaphysically richer, yet empirically grounded. One might worry that adding "reality" as a category beyond direct existence is gratuitous. But ER's strength is that it ties the reality category to empirical and causal significance. If something has no possible effect on the present, ER would regard it as non-existent *and* not part of reality (at least until it becomes empirically tethered). This is analogous to how science treats unobservable constructs with skepticism.[37] On the other hand, if something like a past supernova or an electron's unmeasured spin can eventually influence observations, ER grants it reality status. This disciplined approach means ER's ontology is **closely aligned with scientific epistemology**. In fact, it resonates with the idea of **empirical adequacy** in philosophy of science (van Fraassen's constructive empiricism): we commit to what is observable-in-principle. ER says an entity exists if it is "observable in principle now" (e.g., a distant star emitting light right now exists, even if no one currently looks, because it's within the observable universe).[38] Unobservable entities (say a hidden variable with no influence even in principle) would not qualify as existents in ER. This ensures ER stays **grounded in testable reality** and doesn't stray into pure metaphysical speculation. For quantum physics, this means ER is well-suited to discuss things like virtual particles or quantum fields: they are not directly observable particles, but their effects (Casimir forces, field interactions) are observable, so those aspects are real. Yet only actualized quanta at a given moment exist in the strong sense. This kind of nuanced ontology is exactly what one needs to talk about quantum reality rigorously: it avoids the trap of saying "an unobserved electron's spin is not real" (ER would say it's real as a superposed property influencing outcomes) while also avoiding the claim "the electron has two opposite spins existing at once" (ER would say it doesn't have any definite spin *existent* until measurement, only a real indefinite state). This nuance is lost in simpler presentism or in overenthusiastic realism that attributes existence to all theoretical entities. Thus, **ER provides the philosophical rigor to assert bold claims about quantum reality without straying from scientific sensibility**.

Conclusion

Quantum physics is forcing philosophers to rethink time and existence. The **classic presentist slogan "only the present is real" gets at part of the truth**: quantum processes indeed indicate that *now* is when the fog of possibilities clears into a fact. But presentism alone is too ontologically thin – it cannot explain how a "fog of possibilities" even exists or why traces of the past persist. On the other side, **eternalist and block-universe views get the persistence right but lose the urgency of the now** – they cannot do justice to the sense that the world is truly *doing something* new at each moment. **Existential Realism offers a compelling synthesis**: it asserts the reality of the past and future (as required for coherence and for physics' causal structure) while upholding the existence of only the present (capturing the spirit of quantum actualization). This framework naturally accommodates quantum phenomena: a superposed quantum state corresponds to real but non-existent alternatives; a collapse or decoherence event is the **ontological promotion of one alternative to existence** (the others becoming non-realized); entanglement is a real connection that yields a jointly existent outcome when measured; the arrow of time (with entropy growth) can be seen as reality accumulating new facts with each present moment.[39] In ER's view, time is an ongoing **creative process** – reality is

35 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024).
36 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025).
37 van Fraassen, B. C., The Scientific Image, Oxford University Press (1980).
38 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024).
39 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025).

continuously **"being born anew"** and **"becomes only in the now,"** to quote the insights of quantum theory.[40]

No other metaphysical framework captures this dynamic picture as effectively. **Compared to presentism**, ER has the depth to include quantum potentials and history without contradiction. Compared to **eternalism or many-worlds**, ER preserves genuine change, chance, and choice. It also aligns with relativity and our actual scientific practices of inference. In advocating Existential Realism as the best fit for quantum reality, we are essentially saying that the **universe's ontology is one of a persistent becoming grounded in the present, with a rich reality extending behind and before it**. The boldness of this claim is backed by both philosophical argument and the remarkable empirical hints that quantum mechanics provides. Increasingly, it appears that **the world is not a timeless archive but an active narrative – one that writes itself as it goes, one present moment at a time**. Existential Realism is the framework that allows us to tell this story in a logically coherent and scientifically consonant way. By separating what exists now from what is real, we can finally do justice to the empirical fact that **quantum physics prefers the present** without falling into the trap of denying the reality of the past or the openness of the future. In closing, we maintain that **Existential Realism is not just a metaphysical theory among others, but arguably the *ontology that quantum physics has been implicitly awaiting*** – a view where **to be is to be present, but to be real is to play a part in the world's unfolding web, whether as cause, effect, or possibility**.[41] [42]

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40 Ibid.
41 Trepp, T.C., "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (2024).
42 Trepp, T.C., "Quantum Physics Prefers the Present: A Temporal Ontology Grounded in Measurement." (2025).

Structure

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The Engine of Becoming

With becoming at the center of existence, we now ask what drives it. This work threads together causality, entropy, and time's direction to show how they emerge from — and reinforce — the flow of existence. Time is not given; it is made.

Making of Time: Causality, Entropy, and Becoming

Tenzin C. Trepp

Email: trepp@tenz.in

Date: August 05, 2025

Abstract

If **only the present exists**, how can we make sense of causal chains that stretch across time, the irreversible processes we observe in nature, and the **one-way arrow of time**? This question strikes at the heart of temporal metaphysics and physics. *Existential Realism* (ER) is a present-centered ontological framework [1] that claims only present entities **exist** in the fullest sense, yet past and future entities are still in some sense **real** due to their causal connections and informational traces.[2] Unlike standard presentism (which would render past and future wholly unreal, raising puzzles about truth, memory, and cause),[3] ER draws a crucial distinction between *existence* and *reality*. Under ER, the present is the locus of existence, but the past remains **ontologically real** insofar as it has left **enduring effects and information** in the world. The future, likewise, though not yet existent, can be treated as real in the mode of anticipated possibilities that influence current plans and expectations. This nuanced ontology aims to resolve presentism's classic problems [4] — *for example, how past causes can still have effects, or how past-tense statements can be true if the past is utterly nonexistent*.

In what follows, we will deepen the case for Existential Realism by showing how it accounts for **causal relations**, the **linear order of time**, the sense of **temporal becoming**, and the **thermodynamic arrow of time**. We will draw on insights from the philosophy of physics – including Hans Reichenbach's [5] analysis of time's direction, Huw Price's [6] reflections on retrocausality and perspective, and Barry Loewer's [7] work on entropy and the "Past Hypothesis" – to demonstrate that a present-centric metaphysics can be fully **time-compatible**. Ultimately, we argue that ER not only accommodates modern physics but preserves our intuitive and scientific understanding of time's asymmetries and the unfolding causal story of the universe.

1 Zimmerman, Dean. "Presentism and the Space-Time Manifold." In The Oxford Handbook of Metaphysics, eds. M. Loux and D. Zimmerman. Oxford University Press, 2003.
2 Tenzin C. Trepp, Existential Realism: A Distinct Ontological Framework Beyond Presentism, https://philpapers.org/archive/TENERM.pdf, 2025
3 Bourne, Craig. A Future for Presentism. Oxford University Press, 2006.
4 Markosian, Ned. "A Defense of Presentism." In Oxford Studies in Metaphysics, Vol. 5, 2010.
5 Reichenbach, Hans. The Direction of Time. University of California Press, 1956.
6 Price, Huw. Time's Arrow and Archimedes' Point. Oxford University Press, 1996.
7 Loewer, Barry. "Counterfactuals and the Second Law." Philosophy of Science 71, no. 5 (2004): 1126–1134.

Present-Centered Reality and Causal Chains

A core challenge for any presentist ontology is explaining **causality**: how can past events that no longer exist continue to produce effects in the present? Existential Realism tackles this by noting that *causation is about influence, not ongoing co-existence*.[8] When a cause has occurred, it **hands off its influence** to the world and then "bows out" of existence. What persists is not the cause itself but its **consequences**, embedded in the present state of reality. The universe, in this view, retains a kind of *causal memory* — a continuity of influence, even though the original sources have ceased to exist, yet the room is warm today because the heat energy and chemical changes initiated by that flame continue to be part of the present state of the room. The cause (burning match) doesn't need to co-exist with its effect (heated room) – the **present holds all the results** of past causes in its current structures (the warm air, the burnt logs, etc.). In short, **causal chains** can persist **forward in time** even if only the current link in the chain exists at any moment. Each event leaves an imprint that the next event picks up; nothing about causality requires dragging the past along as a physically extant thing.

This account preserves the reality of causal relations without positing that past events remain literally present. The past is *gone*, but **not irrelevant** – its effects are wired into the present configuration of the world. Imagine reading the final chapter of a novel: the earlier chapters aren't on that last page, yet they are the reason the ending makes sense [9]. Likewise, in ER the past is **ontologically real** as the indispensable *backstory* of the present moment. Physical examples abound. A star that exploded millions of years ago (a supernova)[10] no longer exists, but we continue to receive its light and neutrinos, and its debris has seeded new stars and planets – tangible effects **alive and well** in the present cosmos. No one would say the supernova itself still exists; yet its **influence permeates** the current state of the universe. Similarly, a long-extinct species has left fossils and DNA sequences in living organisms; a historical war that is over has left borders, ruins, and cultural memory. ER formalizes this intuitive idea: **what no longer exists can still be causally efficacious** via the **records and structures** it left behind.

Crucially, this present-centered view of causation aligns with how physics understands processes [11]. Physical laws do not require causes to be simultaneous with effects, only that **information propagates forward** in accordance with those laws. A radioactive atom may have decayed long ago, but the particles it emitted are still ricocheting through space, triggering further interactions here and now. The *causal influence* moves onward, even though the original atom is gone. All evidence we have of the past – whether in scientific detectors or personal memory – exists **now**, in the present, as imprints or records. This fits perfectly with ER's ontology: the so-called "past" is not a hidden realm we could travel back to, but rather a set of present facts (traces, memories, structures) that **tell a story** about how the present came to be. By the same token, what exists now has the **capacity to affect the future**, even though the future does not yet exist. A seed planted today may grow into a tree years from now, long after the original seed has disintegrated. Current events set up the conditions for later events; *future states* will emerge from *present* configurations without assuming the future is already "out there" waiting. In summary, ER preserves the causal chain by treating it as a **continuing handoff of influence** through time: each present state inherits the effects of prior states and passes on new effects to subsequent states.

This approach also naturally explains **causal asymmetry** – the fact that causes precede effects and not vice versa. In our experience and in scientific practice, we manipulate present causes to produce future effects, but we never observe future events reaching back to affect the present. ER accounts for this by the same reasoning: only the present exists, so an **effect cannot yet exist** before its cause occurs. The **structure of reality is built "forward,"** with earlier states producing later states that come into existence successively. Philosophers of science have noted that this temporal orientation of causality is tightly connected to physical conditions. For instance, Reichenbach maintained [12] that cause–effect order is aligned with the direction in which **entropy increases**, tying the **causal arrow** to

8 Schaffer, Jonathan. "Causation and the Manifestation of Powers." Philosophy and Phenomenological Research 78.2 (2009): 346–378.
9 Sider, Theodore. Four-Dimensionalism: An Ontology of Persistence and Time. Oxford University Press, 2001. (Used for comparison with alternative theories like Eternalism.)
10 Ellis, George F.R. "On the Flow of Time." Foundations of Physics 41.9 (2011): 1475–1496.
11 Price, Huw. "Causation in the Physics of the Time-Asymmetry." British Journal for the Philosophy of Science 44.2 (1993): 157–183.
12 Reichenbach, Hans. The Direction of Time, Chapter 3.

the **thermodynamic arrow** of time.[13] In modern terms, Albert and Loewer point out that if we include the universe's special low-entropy **initial state** (about which more below), one can deduce why interventions only work toward the future: given the way the world began, **probabilistic causation** yields **temporal priority** of causes [14]. In effect, the *Past Hypothesis* [15] (the assumption of an extraordinarily ordered beginning of the universe) plus physics explains why we **"can manipulate causes to produce effects but not vice versa"**.[16] Under ER, this asymmetry is no mystery – the past (though not existing now) has left its mark on the present, whereas the future has left no traces yet. So one can *infer* and influence forward but not backward. The **causal order** is simply the unfolding of reality's state, with the past state giving rise to the present, and the present giving rise to the next – a one-way street.

This paper extends ideas introduced in *Existential Realism: A Distinct Ontological Framework Beyond Presentism*,[17] where ER was first proposed as an ontological alternative to traditional presentism. That earlier work focused on defining ER's foundational metaphysical claims — particularly its commitment to present existence, structured reality, and temporal asymmetry. Here, we build upon that framework by elaborating ER's implications for causality, entropy, and the metaphysics of becoming. Taken together, the two works build a unified view in which the present is not only epistemically privileged but ontologically central — the arena where reality unfolds, records accumulate, and possibility becomes actuality.

Temporal Order and the Experience of Becoming

Another hallmark of a present-centered metaphysics is a strong sense of **temporal becoming** – the idea that time genuinely **passes** or that reality is continuously "bringing forth" new events. In ER, the present is not a static moment but a **"constantly renewing horizon of activity"**. At each moment, things are happening: matter is rearranging, events are unfolding, and what *just was* is ceaselessly transforming into what *is*. This captures what philosophers call the *A-theoretic* intuition (after McTaggart's terminology): that there is an objective **flow of time** from future to present to past. While some philosophers (D.C. Williams, J.J.C. Smart, etc.) have criticized this notion of "the passage of time" as an illusion or a muddled metaphor,[18] ER unabashedly treats the present as **metaphysically privileged** – it is the only realm of existence, and it *keeps changing*. In other words, **reality is dynamic**: new states of affairs come into being at the present and then immediately become past, yielding a continuous process often described as "the **moving now**" or "the living present."

Notably, Existential Realism does not propose that time "flows" at a literal rate — *a concept often critiqued as meaningless, such as the idea that time passes at "one second per second."* [19] Rather, it asserts an ontological asymmetry: the present is the locus of actuality and it *succeeds* the previous present. This implies a **linear ordering** of events by earlier-than and later-than relations. The idea of linear time here is just that all events can be put in a single sequence from past to present to future (assuming no closed time-loops, which Reichenbach also ruled out with a principle of the **non-existence of closed timelike loops** as an "open" condition for physical time).[20] ER's picture is that reality is **one massive causal history**: a line of events (with open-ended paths ahead, if indeterminism is allowed) where each event has definite predecessors and will have definite successors, but *only* the present segment of that line is ontologically *illuminated* — the portion that *exists* in the full sense. In ER, the future is not already drawn as branches, but unfolds as possibility becomes actuality. The line extends only through what has been actualized. This resembles the Growing Block model proposed by

13 https://plato.stanford.edu/entries/time-thermo/
#:~:text=before%20I%20stepped%20on%20it,the%20future%20in%20the%20present
14 https://plato.stanford.edu/entries/time-thermo/
#:~:text=But%20this%20package%20also%20implies,produce%20effects%20but%20not%20vice
15 Albert, David. Time and Chance. Harvard University Press, 2000.
16 https://plato.stanford.edu/entries/time-thermo/
#:~:text=But%20this%20package%20also%20implies,produce%20effects%20but%20not%20vice
17 Tenzin C. Trepp, Existential Realism: A Distinct Ontological Framework Beyond Presentism, https://philpapers.org/archive/TENERM.pdf
18 https://iep.utm.edu/arrow-of-time/
#:~:text=Many%20critics%20of%20dynamic%20theories,theory%20of%20time%20believe%20that
19 https://iep.utm.edu/arrow-of-time/
#:~:text=Huw%20Price%20has%20complained%20that%2C,%E2%80%9D
20 https://www.mdpi.com/2409-9287/6/4/79
#:~:text=But%20we%20should%20not%20forget,flows%2C%20and%20consequently

C.D. Broad, *but ER diverges by withholding full reality from the past block — treating the past instead as derivatively real, through its present echoes and consequences*.[21] In a way, ER sits between strict presentism and the growing-block theory: the past is "real" enough to influence and inform, but not *existent* in the robust sense. The future is "open" – not yet real or determined – which comports with our sense of an **open future** and genuine possibilities.[22]

Emphasizing **becoming** also aligns ER with the manifest image of time embraced by many physicists and philosophers who hold that time has an intrinsic direction or *anisotropy*. Thinkers like Tim Maudlin, for instance, argue that an objective **direction of time** is a fundamental feature of the world, underwriting the difference between earlier and later and giving rise to the sense of production (earlier states *produce* later states).[23] ER naturally accommodates this view: since only the ever-changing present exists, there is a built-in sense in which reality is always **"producing" new reality** out of itself. Later states **exist in virtue of** earlier states plus the passage of time.[24] Indeed, Maudlin's assertion that " [25] the passage of time underwrites claims about one state coming out of another" could almost serve as a motto for ER's account of *becoming*. The **temporally asymmetric ontology** (past → present → future) provides a metaphysical scaffolding for those claims: the past state *no longer is*, the future state *is not yet*, so the only place where the world's change happens is the present, where new effects are born from current causes. This **one-way metamorphosis** of reality gives a rigorous meaning to "becoming" without needing an extra temporal dimension or "meta-time." It's simply how the universe unfolds.

It is important to note that ER's commitment to an objective present and becoming must be squared with modern physics, especially **relativity**, which teaches that simultaneity (what counts as "now") can differ across reference frames. While a full reconciliation of ER with relativity is beyond our scope here, ER can adopt the view that **"now" is an indexical** – each observer has their own present – without abandoning the idea that each such present is where reality is localized.[26] In practice, this might mean ER is formulated in a *frame-relative* way or via some invariant slicing (like a foliation of spacetime) that preserves the causality-respecting order of events. The key point is that **temporal order and becoming** remain intact: all observers will agree on the causal sequence of events (what lies in each other's past light cones, for example), and ER would assert that those causal sequences represent the growth of reality. By privileging the present (even if relatively defined) and denying ontological status to past and future times, ER preserves a strong sense of **temporal directionality** that is compatible with how relativity still forbids causal influence from future to past. In short, even in relativistic terms, there is no contradiction in saying "the present is where things exist and happen" – one just has to clarify *whose* present, or adopt a cosmic time if available. For our purposes, assuming a broad agreement on a cosmic time order (as in standard cosmology) suffices to illustrate ER's handling of time's structure.

The Thermodynamic Arrow and Irreversibility

Everyday experience vividly reflects the thermodynamic arrow: ink disperses in water, broken eggs do not reassemble, and hot objects cool rather than heat spontaneously. These irreversible changes illustrate how entropy increases over time, even though fundamental physics is time-symmetric. The explanation lies not in the laws themselves but in the universe's boundary conditions — specifically, the extraordinarily low-entropy state at its origin. Known as the Past Hypothesis, this early order sets the stage for entropy to rise, defining the direction of time we observe. These **irreversible processes** indicate that there is a fundamental difference between past and future in our universe. As the Stanford Encyclopedia puts it, systems **"spontaneously evolve"** toward higher entropy (more disorder or

21 https://iep.utm.edu/arrow-of-time/
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22 https://iep.utm.edu/arrow-of-time/
#:~:text=contingent%20proposition%20about%20the%20future,know%20which%20one%20it%20is
23 https://iep.utm.edu/arrow-of-time/
#:~:text=would%20be%20an%20odd%20use,of%20states%20at%20earlier%20times
24 https://iep.utm.edu/arrow-of-time/#:~:text=,the%20world%20must%20evolve%2C%20but
25 https://iep.utm.edu/arrow-of-time/
#:~:text=However%2C%20if%20passage%20were%20merely,of%20states%20at%20earlier%20times
26 https://iep.utm.edu/arrow-of-time/#:~:text=most%20of%20these%20critics%2C%20is,Skow%202009

equilibrium) and not the other way around.[27] This fact, encapsulated in the Second Law of Thermodynamics, gives a **time-asymmetry** to almost all macroscopic phenomena. Notably, this **arrow of time** is observed despite the known **time-symmetry of microphysics** – the basic equations of motion (Newtonian, Maxwellian, Schrödinger, etc.) are mostly reversible, meaning they do not themselves distinguish past vs. future. So where does the arrow come from?

Physics has converged on an answer: the **boundary conditions** of the universe. Our world started in an extraordinarily **low-entropy state** (high order) and has been increasing in entropy ever since. This is sometimes called the **Boltzmann–Albert Past Hypothesis**: at the Big Bang (or some early moment), the entropy of the universe was exceptionally low.[28] From that special beginning, the Second Law inexorably unfolds: entropy grows, creating the arrow from past (low entropy) to future (higher entropy). Ludwig Boltzmann himself suggested as early as 1895 that the **direction of time** we perceive is simply the direction of increasing entropy.[29] All evidence supports this: it would be **astonishing** (and require fine-tuning akin to a conspiracy) if entropy started low, rose for billions of years, and then suddenly reversed and went down – we simply don't witness such behavior. Instead, **eggs don't unscramble, stars don't un-explode, and spilled coffee doesn't un-spill** under normal conditions. These processes are not forbidden by the microscopic laws – in principle, all molecules of the egg *could* by freak coincidence assemble back – but the **probability** is so unimaginably low that for all practical and astronomical purposes it never happens.[30] Thus the *one-way* character of macroscopic change is set by that initial low-entropy condition. If time were reversed (with entropy high in the far past and low now), we would observe exactly the opposite irreversibilities (eggs spontaneously assembling, etc.). The arrow of time is therefore **contingent**, not a built-in geometric feature of time itself. Many physicists favor this **extrinsic** view: time's arrow is *real* but arises from the content and conditions of the world, not from an intrinsic "flow" property of time.[31]

How does Existential Realism incorporate the thermodynamic arrow? ER fully **embraces the physical explanation**: each present state inherits the increasing entropy from its predecessors. The fact that the present world contains records and remnants of a more ordered past (fossil fuels, cosmic microwave background as cooled remnant of a hot Big Bang, etc.) but no records of the future is exactly what we expect if the universe had a low-entropy beginning.[32] In other words, *because* only the present exists, all evidence of time's passage must be encoded **in the present** – and indeed it is, in the form of **thermodynamic records** (unwound clocks, eroded mountains, decayed radioactive elements). These are all signs that entropy has increased from an earlier state. ER says the past is real as the **causal and structural antecedent** of the present, and the thermodynamic arrow provides the precise physical mechanism by which those antecedents are **unidirectionally "written"** into reality. The world can be seen as continuously **rewriting itself**: each present moment is like a new page added, reflecting changes from the last, with no possibility to flip back the book and rewrite earlier pages. The **irreversibility** is built into the sequence of present moments: once a moment has passed (and no longer exists), its exact state cannot be recovered, only inferred from its effects. Entropy increase quantifies this loss of retraceability – information about the exact past microstate gets degraded as time moves on. But crucially, enough **traces** remain that we have a coherent story. As one analysis puts it, the universe's low-entropy **Past Hypothesis** serves as the world's "**Ready State**," explaining why there are plentiful **traces of the past in the present, but no traces of the future**.[33] We have fossils and memories (records of past states), but we do not find "pre-memories" or physical traces of future events that haven't happened. This asymmetry is exactly what ER predicts: the past can influence the present (hence leave a trace), whereas the future cannot influence the present (since it does not yet exist).

27 https://plato.stanford.edu/entries/time-thermo/
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28 https://plato.stanford.edu/entries/time-thermo/
#:~:text=following%20elements%3A%20the%20past%20hypothesis,dynamical%20laws%20of%20the%20microlevel
29 https://plato.stanford.edu/entries/time-thermo/
#:~:text=Long%20ago%20Boltzmann%20%28e,does%20research%20on%20the%20second
30 https://iep.utm.edu/arrow-of-time/
#:~:text=What%20would%20you%20think%20if,process%20to%20be%20spontaneous%20is
31 https://iep.utm.edu/arrow-of-time/
#:~:text=adopting%20the%20extrinsic%20theory%20of,among%20physicists%20than%20among%20philosophers
32 https://plato.stanford.edu/entries/time-thermo/
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33 https://plato.stanford.edu/entries/time-thermo/
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By aligning itself with the entropic arrow, ER also supports the **alignment of the causal arrow** with the thermodynamic arrow. In a world like ours, *causal influences propagate forward in time* (from lower entropy to higher entropy) and not backward. If somehow the universe had an inverted arrow (decreasing entropy toward our future), our notions of cause and effect might invert as well – but that's a hypothetical outside our actual experience. In reality, **cause precedes effect** universally, and that correlates with the fact that **entropy was lower "before" and higher "after."** Philosophers like Huw Price have argued that the reason we *think* we can affect the future and not the past is because we (as agents) are embedded in this entropic gradient – we have records of past conditions and not future ones, so we set up causes for future outcomes instead of vice versa.[34] ER readily accepts this explanation: it does not need to mystify the arrow of time as something beyond physics. Instead, it says *physics plus presentism* yields a coherent picture: the present state is the product of an orderly past, giving rise to disorder in one temporal direction, which matches our intuitive "forward" direction.

It's worth emphasizing that nothing in fundamental physics *forces* us to treat past and future as equally real. The **mathematical formalism** of most laws is time-symmetric, but one can interpret those equations ontologically in different ways. Eternalists interpret them as describing a static 4D block where all times are equally real. Presentists (and ER) interpret them as evolution rules governing how the present state changes. The success of physics does not depend on past or future *existing*; it only depends on there being **consistent relationships** between states. As ER would note, *"Physics doesn't require the past or the future to be real in the same way the present is. It simply traces how things change through local, causal relationships."* [35]The second law of thermodynamics, for instance, doesn't need the past to exist – it only needs that the present entropy is higher than it was in the past, which can be verified by present evidence (e.g. we see ice melted – indicating it was solid before). The **arrow of time** is thus perfectly compatible with a present-only ontology: indeed, a world where only the present exists but carries the **entropic imprint** of prior states is arguably the one we live in. Each moment is like a **snapshot** that contains "compressed data" about earlier moments (higher entropy means some information lost, but some patterns remain). As time proceeds, snapshots accumulate with greater entropy, but always referencing the one before. ER just affirms that *only the latest snapshot exists*, though all the previous ones are "real" insofar as their influence remains.

Synthesizing ER with Physics: Time-Compatible Presentism

By examining causality and time's arrow, we see that Existential Realism provides a framework where **physics and metaphysics meet** harmoniously. ER answers the big question – how can a present-only universe sustain causal chains and irreversibility – by pointing out that the **present contains everything needed** for those phenomena. Past events are *not* mysteriously active from some ghostly bygone realm; they are active *here and now* in virtue of the present evidence and configurations they've produced. The "chains" of cause and effect are unbroken: each link exists in its time, then perishes, but passes on a mark to the next link. In this way, **causal continuity** is maintained without past existence. This resolves what has been called the **truthmaker problem** or "metaphysical erasure" worry for presentism – the concern that if the past isn't there, we can't truthfully talk about it or be affected by it. ER's answer is that the **truthmakers for past-tense facts and the efficacy of past causes lie in the present** structures (records, memories, scars, sediments, etc.) that those past events have generated. Thus historical truths are true *because* the world now is a certain way (which it wouldn't be had the past been different), and past causes are effective *because* the current state embodies their effects.

At the same time, ER is keen to stress that it is **not "any old" present-based theory** – it is a refined version designed to be scientifically informed. We saw that by allowing a broader notion of "reality" than existence, ER can talk about the **past as real** (through its lasting effects) **and the future as real** (through its genuine possibilities and tendencies) without insisting either exists now. This enables ER to incorporate the insights of physics (like the role of the initial state or the use of statistical reasoning

34 https://plato.stanford.edu/entries/time-thermo/
#:~:text=But%20this%20package%20also%20implies,produce%20effects%20but%20not%20vice
35 Sean Carroll, From Eternity to Here: The Quest for the Ultimate Theory of Time (New York: Dutton, 2010).

about the future) in a way that pure presentism struggles to do. For instance, **statistical mechanics** often considers ensembles of initial microstates or future trajectories – ER would say these are not present existents but they are *real possibilities* that inform our present probabilities. By treating the **future "in a different mode" of reality** (one of possibility, anticipated by present knowledge) and the past in the mode of **heritage (present traces)**, ER creates an ontology flexible enough to handle the time-asymmetric concepts used in science (like irreversibility, cause, and prediction).

Philosophers of physics like Reichenbach, Price, and Loewer have, in their own ways, argued that the **arrow of time and causation** are not mysterious primitives but flow from physical conditions. ER can be seen as the metaphysical *complement* to this: it says, yes, time's apparent directedness is due to how the universe evolves (e.g. via entropy increase), and we simply take seriously the idea that **only the evolving present is ontologically "lit."** The past is "in the dark" except for the light it has cast forward onto the present. Interestingly, Reichenbach introduced the notion of **branch systems** – subsystems that interact and then decouple, leaving **records** – to explain why we can have stable memories and traces of past events despite fundamental reversibility. ER fits nicely with this picture: once the subsystem (say, a photograph being taken) has decoupled, the **record (photo)** exists in the present even though the event it records (the past scene) is over. The **causal nexus** ensures the record is reliable, and ER ensures that we count that past event as "real" because it's part of the world's causal fabric. Huw Price's insight that our perspective in time (with knowledge of past but ignorance of future) shapes our concept of causation is also acknowledged in ER's framework – after all, it is precisely because the past has a concrete reality in the present (we *know* it from records) and the future does not yet, that we treat the past as fixed and the future as open. Meanwhile, Barry Loewer's work with David Albert on the **Mentaculus** (the probabilistic map of the world) shows that by positing a low-entropy initial condition and a probabilistic distribution, one can **derive the thermodynamic, causal, and epistemic arrows** from fundamental physics.[36] These considerations suggest that causality itself may not be a primitive, but an emergent pattern grounded in the evolving structure of the present. ER gives this idea ontological weight: causal direction is not imposed from outside, but arises from the fact that each present moment is a unique configuration carrying forward the imprints of prior moments. As the universe unfolds, effects naturally emerge from inherited structure, not from coexisting causes. This view dovetails with attempts in physics to derive causality from entropic gradients or information flow. ER therefore bridges the explanatory gap between metaphysical intuitions and scientific accounts of why cause precedes effect, embedding causality within the temporal dynamics of becoming. ER would say: that initial condition is part of the reality (the very early present of the universe) whose structure set the arrow in motion, and every subsequent present has upheld that arrow. Each "now" inherits an entropy a bit higher than before, and so the arrows persist. In effect, ER offers a metaphysical **interpretation** of the same story: the world's lawlike evolution (with a special start) yields asymmetric processes, and only the present exists to showcase those processes at any given time.

Conclusion

We began with a puzzle: how can a universe in which only the present exists account for the rich web of temporal phenomena – cause and effect stretching over ages, the irreversible march of entropy, and the very sense that time "flows" in one direction? Through the lens of ER, we have seen that the answer lies in a **present that is pregnant with the past and poised toward the future**. Far from being a knife-edge that erases everything behind it, the present in ER is a **crossroads of temporal reality**: it carries the imprint of what came before and the seeds of what may come next. Causal chains remain intact because each link **writes itself into the world**, leaving a legacy that the next link can pick up. Irreversible processes make sense because the world started in an unlikely low-entropy state and has been **writing history in one direction** ever since.[37] The arrow of time is no enigma; it is the aggregate effect of all those one-way causations and entropy-driven changes – all of which **unfold in the present**. In this way, ER validates our experience of a flowing time and a causal order without needing to

36 https://plato.stanford.edu/entries/time-thermo/
#:~:text=But%20this%20package%20also%20implies,produce%20effects%20but%20not%20vice
37 https://plato.stanford.edu/entries/time-thermo/
#:~:text=The%20thermodynamic%20time%20asymmetry%20is,the%20great%20laws%20of%20physics

grant ontological parity to past or future. The past is real **as history**, the future real **as possibility**, but only the present is **fully real as actuality**.

By integrating insights from physics and philosophy, ER emerges as a robust **time-compatible metaphysics**. It avoids the **metaphysical erasure** of the past that naive presentism was accused of, by recognizing past events in the structure of reality (the "world's furniture") via their effects. It aligns with the **thermodynamic arrow** and the modern understanding that time's asymmetry comes from cosmic initial conditions.[38]
It supports the **causal arrow**, explaining why interventions can only target the future, in line with Reichenbach's and Price's observations that causation is tied to entropy and knowledge.[39] And it preserves the **phenomenology of becoming** that many argue is a fundamental feature of reality, avoiding the counterintuitive aspects of a completely static block universe. In sum, ER shows that a present-centered ontology is not only compatible with physics but can illuminate it: the laws of physics describe how each present state gives rise to the next, and the arrows of time describe the **qualitative direction** of that unfolding. The universe is, as ER would have it, *"not a pre-written scroll but a script still being written. And each present moment is the only place the pen ever touches the page."* By championing the present while embracing the causal and entropic structure of time, Existential Realism offers a coherent and compelling answer to how temporal order and causality operate in a world where **now** is all that truly exists.

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The following works were cited throughout to support the analysis of time's asymmetry, presentism, and causality in relation to Existential Realism. These show the alignment of ER with both metaphysical considerations and physical theory, underscoring ER's viability as a bridge between how the world *is* experientially and how it *works* scientifically.

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38 https://plato.stanford.edu/entries/time-thermo/#:~:text=following%20elements%3A%20the%20past%20hypothesis,dynamical%20laws%20of%20the%20microlevel
39 https://plato.stanford.edu/entries/time-thermo/#:~:text=But%20this%20package%20also%20implies,produce%20effects%20but%20not%20vice

Evidence

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The Brain in Time

Does the brain support the ER view of time? Neuroscience reveals how the mind processes the now, reconstructs the past, and anticipates the future — all from within the present. The findings offer empirical grounding for ER's central claims.

Neuroscientific Support for Existential Realism: Memory, Anticipation, and the Present

Tenzin C. Trepp

Email: trepp@tenz.in

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Abstract

Existential Realism (ER) is a present-centered ontological framework that distinguishes between **existence**, restricted to the present, and **reality**, which spans the causally or informationally relevant past and future. This paper explores how core processes of human temporal cognition—memory, anticipation, and the perception of the present—support ER's framework. Insights from cognitive neuroscience suggest that the brain actively constructs time: the mind extends beyond the instantaneous now by retaining recent past information and projecting immediate future possibilities, all within a conscious "window of presence." We examine how **memory** encodes past events both as physical traces in the brain and as reconstructed experiences in consciousness, how **anticipation** and predictive coding generate internal models of probable futures, and how our **perception of 'now'** is an integrated interval, not a dimensionless instant. These findings reinforce ER's claim that only the present moment is ontologically existent, while past and future are **real** insofar as they are cognitively represented and integrated into the present through internal models. By linking philosophical ideas of time with empirical neuroscience, we show that human brains treat the past and future as parts of reality (through records and expectations) despite their lack of present existence. This interdisciplinary approach lends naturalistic support to Existential Realism's view of time and offers a clearer understanding of why the present looms so large in experience even as past and future remain experientially—and ontologically—significant.[1]

1 Trepp, T. C. Existential Realism: A Distinct Ontological Framework Beyond Presentism. PhilArchive Preprint. (Introduces ER and its distinction between existence and reality, arguing that only present entities exist while past/future entities can be real through traces and influences) 2025.

Introduction

How we experience and construct time in the mind has deep implications for metaphysics. **Existential Realism (ER)** is a recent ontological framework positing that only present entities *exist* in the fullest sense, but that past and future entities can still be *real* due to their causal or informational influence.[2] In other words, ER agrees with classical presentism that the *present alone exists*, yet it rejects the notion that only present things are real. Instead, past events that have left traces (e.g. memories, records) and future events that are anticipated can be counted as part of reality, though they do not exist now.[3] This nuanced distinction between existence and reality is designed to capture the **present-centered nature of human experience** without discarding the objective significance of past and future. The question then arises: *Does our best understanding of the brain and mind support this view?*

Contemporary cognitive neuroscience provides an enlightening perspective on how humans construct temporal experience. We do not passively witness time; rather, the brain actively **models** it. Our minds knit together a continuous sense of "now" from momentary inputs, draw on memory to represent the past, and generate predictions to anticipate the future. This **cognitive constructivism** – the idea that the brain constructs a representation of the world (and time) based on incoming data and prior knowledge – aligns remarkably well with ER's metaphysics. If indeed the brain treats only the present moment as directly experienced, while past and future are handled indirectly (through recollections and expectations), it would lend empirical credence to ER's ontological claims. In the following sections, we examine three core facets of temporal cognition – the perception of the present, memory, and anticipation – and show how each reinforces the ER distinction between existence and reality in time. Throughout, our tone remains grounded and analytical, drawing connections between philosophy of time and accessible findings from neuroscience.[4]

The "Specious Present" and the Window of Presence

Rather than being an infinitesimal knife-edge, the conscious present is experienced as a short **"specious present"** – a brief interval in which change and succession are perceived as unified.[5] William James long ago noted that the present moment "has melted in our grasp… gone in the instant of becoming," yet we seem to experience a short duration as now, not an instant. Modern cognitive science confirms that our sense of **now** is indeed extended: on the order of seconds or less, depending on context. Within this window, successive stimuli are bound together into a single perceptual moment. Neuroscientist Ernst Pöppel, for example, proposed a ~3-second integration interval [6] for conscious acts, suggesting that our brains automatically bind events into ~fractions-of-seconds up to a few-second chunks that feel like one "present".[7] Thus, what we call "the present" is in fact a **constructed interval**: a dynamic buffer where very recent past events and imminent future events overlap in awareness.

The brain mechanisms underlying this specious present illustrate how **recent past and impending future are cognitively present**. For instance, when listening to a melody, the note that just sounded lingers in auditory working memory for a moment, and the brain simultaneously anticipates the next note based on the melody's structure. You experience a flowing musical phrase, not isolated instants. Neuroscientist-philosopher Thomas Metzinger describes consciousness as operating within a "**window of presence**," a moving window of about hundreds of milliseconds to a few seconds that constitutes our present awareness.[8] Within this window, according to Metzinger, we do not simply have a fleeting, dimensionless instant of time; rather, the window includes immediate past impressions and

2 Ibid.
3 Ibid.
4 Metzinger, T. Being No One: The Self-Model Theory of Subjectivity. MIT Press. (Discusses the "window of presence" and the specious present, proposing that consciousness integrates information over a short temporal window rather than an instantaneous now) 2003.
5 Metzinger, T. Being No One: The Self-Model Theory of Subjectivity. MIT Press. (Discusses the "window of presence" and the specious present, proposing that consciousness integrates information over a short temporal window rather than an instantaneous now) 2003.
6 Ibid.
7 Ibid.
8 Ibid.

imminent anticipations, dynamically integrated into our momentary model of reality. In other words, the brain **retains** immediate past information (through sensory echo or working memory) and **predicts** immediate future events, weaving them into the ongoing experience of now.[9] This neurocognitive view aligns with **phenomenological** analyses by Husserl, who introduced the notions of retention (the just-past held in consciousness) and protention (the just-ahead anticipated).[10] Both indicate that our consciousness of the "present" inherently contains a horizon of past and future. The key point is that the **present moment, as constructed by the brain, already transcends a mathematical instant**, incorporating an overlap of past and future. This finding supports ER's stance: only the present moment (this moving window) truly *exists* for us experientially, yet it inherently carries along very recent reality and emerging future reality in its content. Neuroscientifically, this is evidenced by sustained neural firing for a brief period after a stimulus (maintaining the past event in the current mental field) and preparatory neural activity for expected stimuli or actions (bringing the future to bear on the present).[11] The brain's **temporal binding** of events into an experienced present thus provides a naturalistic backbone for ER's present-centric metaphysics. It shows how the **empirical present** is central, without isolating us from a wider temporal reality.[12]

Memory and the Reality of the Past

Memory is the paradigm case of something no longer existent (the past), which nonetheless maintains a hold on reality. In ER's terms, past events *were* present in their time and have since ceased to exist – but they remain **real** insofar as they left lasting effects. Cognitive neuroscience strongly supports this view: experiences physically **leave traces** in the brain, and those traces influence future thought and behavior. When you recall a childhood event, the original occurrence is no longer present – it does not exist now – yet the event is **sufficiently real** to have been encoded in the structure of your brain, manifesting as a memory. Research on the **memory engram** [13] (the physical substrate of memory) confirms that learning and experience literally alter synaptic connections among neurons, leaving behind a persistent record of the past in our neural circuitry.[14] For example, experiments have identified specific ensembles of neurons (engram cells) that are activated during a learning experience and reactivated during recall. These cellular and synaptic changes are concrete evidence that past events persist through **structural and informational modifications** in the present brain.[15] Thus, the past lives on as information – as modifications of neural tissue and as patterns of activity that can later be re-instantiated when we remember. In ER's framework, this corresponds to saying the past event is **real** (since it produced an ongoing informational imprint), though only the present neural process of recall truly exists while it occurs.

Furthermore, psychology has shown that memory is not a passive replay of the past but an active **reconstruction**. The brain **recreates** a plausible version of past events in the act of remembering, using stored fragments and current context. This constructive nature of memory [16] underscores that when we remember, we are **modeling the past** in the present moment. The hippocampus and related brain networks allow us to re-experience past episodes by generating internal simulations – This process is sometimes referred to as 'mental time travel,' though more accurately it involves present-time reconstructions of formerly existent events. Notably, the same capacity enables us to project ourselves into possible futures. Studies have found that remembering past experiences and **imagining future scenarios** engage a common core network in the brain (including the hippocampal region, medial prefrontal cortex, and other areas).[17] Patients with severe amnesia who cannot recall their past also struggle to envision future events, indicating that memory and imagination are deeply intertwined cog-

9 Ibid.
10 Husserl, E. The Phenomenology of Internal Time-Consciousness. Edited by Martin Heidegger, translated by James S. Churchill. Indiana University Press. (Introduces the concepts of retention and protention, foundational to phenomenological accounts of temporal consciousness) 1964.
11 Metzinger, T. Being No One: The Self-Model Theory of Subjectivity. MIT Press. (Discusses the "window of presence" and the specious present, proposing that consciousness integrates information over a short temporal window rather than an instantaneous now) 2003.
12 Ibid.
13 Josselyn, S. A., & Tonegawa, S., "Memory engrams: Recalling the past and imagining the future," Science, 367(6473), eaaw4325, 2020.
14 Ibid.
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16 Schacter, D. L., Addis, D. R., & Buckner, R. L., "Remembering the past to imagine the future: The prospective brain," Nature Reviews Neuroscience, 8(9), 657–661, 2007.
17 Schacter, D. L., Addis, D. R., & Buckner, R. L. "Remembering the past to imagine the future: The prospective brain." Nature Reviews Neuroscience, 8(9), 657–661. (Reports that remembering past experiences and imagining future events involve a common core brain network, highlighting the constructive nature of memory and foresight) 2007.

nitive functions.[18] The neuroscience of memory thus supports ER on two levels. First, the existence of memory traces shows how the **past remains real** in a physical, embodied sense despite its non-existence. Second, the fact that memory is an active, constructive process – creating a present model of a past reality – aligns with the idea that the past is accessible to us only through **mediated representations** in the now. We do not literally have the past before us; not an independent realm of being. **There is no hidden spatial domain or lingering substance of the past—only presently instantiated effects and traces**. Our memories give us knowledge of a real past world while confirming that only the present cognitive act of remembering truly exists now.[19]

Anticipation, Predictive Coding, and the Reality of the Future

Just as memory connects us to a real (but no longer existing) past, our capacity for anticipation and planning connects us to potential futures that do not yet exist. The human brain is often described as a "prediction machine," continually attempting to **model** the near future. In perceptual neuroscience, **predictive coding** theories [20] propose that higher-level brain regions generate expectations about incoming sensory data, and lower-level regions compute the mismatch (prediction errors).[21] This means that even at the level of basic perception, the brain is not simply waiting for input – it is actively guessing what will happen next. For example, as you walk down the stairs, your brain is forecasting the likely visual and proprioceptive feedback of the next step; as you listen to a sentence, your brain anticipates how it will end. This **anticipatory coding** is evident in neural activity: studies show that neurons in visual cortex can fire in ways that predict the trajectory of moving objects, effectively "pre-playing" expected events a fraction of a second before they occur.[22] Likewise, motor areas of the brain engage in planning activity prior to actual movements, and mirror neurons may fire in anticipation of others' actions. All these cases illustrate how the brain treats the immediate future as if it were **informationally present** – it allocates neural resources to represent upcoming states of the world. In doing so, the brain confers a kind of *reality* to the future: predicted events, while not yet actual, influence current perceptions, decisions, and emotions. Under ER, future entities do not exist now (by definition), but they can still be real in the sense of being **causally relevant** to the present. The brain's predictive machinery exemplifies that: an expected future event (say, a predator's approach or a reward) can elicit present responses (fear, preparatory action) as if that future were partially real.[23] The organism behaves in light of what is merely possible or likely. This real effect of the not-yet-existent underscores ER's notion of the future as *looming reality* rather than non-being.

Beyond immediate perception, humans have the remarkable ability to mentally simulate distant future scenarios – to engage in **prospection** or **mental time travel** into the future. Cognitive neuroscience findings mirror those from episodic memory: constructing a vivid future scenario relies on the same neural network used for episodic recollection of the past.[24] Brain imaging studies have revealed that imagining oneself in a hypothetical future situation (for example, envisioning a future wedding or a planned trip) activates regions like the hippocampus and prefrontal cortex similarly to recalling a past event.[25] The constructive episodic simulation hypothesis, advanced by Schacter and colleagues, suggests that we recombine details from past memories to build novel future imaginings.[26] In doing so, the brain treats future possibilities as **mental models** that can be evaluated for plausibility and consequences. From an ontological perspective, this means the future (like the past) is only available to us via **present representations**. We cannot experience a future that hasn't happened, but we can experience a simulation of it generated by our mind. Such simulations have real effects: they guide decision-making, induce present emotions (like anxiety or excitement about what might occur), and generally allow us to "test" future outcomes in imagination. The reality of the future, in ER's sense,

18 Ibid.
19 Josselyn, S. A., & Tonegawa, S. "Memory engrams: Recalling the past and imagining the future." Science, 367(6473), eaaw4325. (Reviews evidence for physical memory traces in the brain (engrams) and links memory storage to the ability to construct future simulations) 2020.
20 Clark, A., "Whatever next? Predictive brains, situated agents, and the future of cognitive science," Behavioral and Brain Sciences, 36(3), 181–204, 2013.
21 Ibid.
22 Ibid.
23 Clark, A. "Whatever next? Predictive brains, situated agents, and the future of cognitive science." Behavioral and Brain Sciences, 36(3), 181–204. 2013.
24 Schacter, D. L., Addis, D. R., & Buckner, R. L., "Remembering the past to imagine the future: The prospective brain," Nature Reviews Neuroscience, 8(9), 657–661, 2007.
25 Ibid.
26 Ibid.

consists precisely in these mediated effects – the way an anticipated event can already shape the present. For example, the mere possibility of a coming storm leads us to carry an umbrella today; the imagined achievement of a goal can motivate current effort. Neuroscience even shows that at a neurochemical level, predictions of future reward (expectations) can trigger dopamine release and learning signals in the present brain, effectively **bringing the future into the now** in terms of influence. All this evidence of anticipation and planning underscores that the human brain consistently **leverages the non-existent future as if it were quasi-real**, integrating it into our present worldview. This provides a striking parallel to ER's assertion that the future is *real* (it matters and is woven into the fabric of reality via causation and information), even though it is *not yet existent*. The brain's predictive and goal-setting capacities demonstrate that we are, in a sense, always living partly in the future – or rather, that the brain continually projects future possibilities into our present experience.[27]

Discussion: Cognitive Constructivism and Present-Centered Reality

Across perception, memory, and anticipation, a common theme emerges: the brain constructs a **present-centered model** of reality that stretches beyond the instantaneous now, as proposed in Metzinger's concept of the 'window of presence' and supported by predictive coding theory. This aligns closely with cognitive constructivism – the view that our knowledge of the world (including its temporal aspects) is built by the brain's interpretative processes. We find that the neuroscientific evidence naturally accommodates the Existential Realist distinction between existence and reality. The **present moment** is indeed privileged: it is the locus of actual existence where physical processes (neuronal firings, sensory events) are occurring. Yet the **reach of reality** in the mind goes beyond that locus, by virtue of records and simulations. Past events are **represented** by retained information (they have reality as remembered or evidence-bearing), and future events are **represented** by predictions and plans (they have reality as imagined or expected). In each case, the brain uses present resources to "grasp" what is temporally elsewhere. Crucially, at no point does the brain give us reason to think the past or future exist in the same way the present does – we *remember* the past precisely because it is not here now, and we *anticipate* the future precisely because it has yet to come. This reflects an underlying metaphysical truth captured by ER: only the present exists, but past and future are **real enough** to influence the present through information. The brain's operations underscore that point by always encoding past and future in a **mediated fashion** (via neural patterns in the present). In short, neuroscience portrays the brain as a **time-bound agent** that copes with temporal absence (past/future) by turning it into something present (memories, models, expectations). This is a powerful naturalistic vindication of ER's present-centric ontology.[28]

Furthermore, adopting an ER lens can illuminate philosophical interpretations of neuroscientific findings. It helps explain why our intuitive experience prizes the present (since only present brain events constitute direct experience), yet we are not solipsistically stuck in a "knife-edge now" – because the brain effectively **extends** the present through retention and protention.[29] It also resonates with the ethical and existential intuition that the past and future matter: we treat past events as real (holding people accountable for them, learning from them) and future outcomes as real (we make choices with future consequences in mind), which makes sense if those past and future are real in an informative sense, even though they are not existent now.[30] The integration of epistemology and phenomenology into ER, supported by neuroscience, shows that our **knowledge of time** and our **experience of time** both comport with a presentist ontology that has been enriched rather than abandoned. Instead of positing mysterious metaphysical existence for past or future entities, we recognize that the **brain's own constructs** give past and future their due reality status. This reinforces a physicalist-friendly view: nothing "mystical" is required to account for past and future – just the persistence of information and the projection of possibilities by material processes in the brain.[31]

27 Clark, A. "Whatever next? Predictive brains, situated agents, and the future of cognitive science." Behavioral and Brain Sciences, 36(3), 181–204. 2013.
28 Trepp, T. C. Existential Realism: A Distinct Ontological Framework Beyond Presentism. PhilArchive Preprint. (Introduces ER and its distinction between existence and reality, arguing that only present entities exist while past/future entities can be real through traces and influences) 2025.
29 Metzinger, T., Being No One: The Self-Model Theory of Subjectivity, MIT Press, 2003.
30 Trepp, T. C. Existential Realism: A Distinct Ontological Framework Beyond Presentism. PhilArchive Preprint. 2025.
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Conclusion

The convergence of philosophical insight and neuroscientific evidence presented here suggests that **Existential Realism's present-centered metaphysics is not only conceptually coherent but also empirically well-grounded**. The core neuroscientific processes of memory, anticipation, and temporal perception all illustrate how the human mind stays oriented in time: by anchoring itself in the present while continuously incorporating the absent past and future through cognitive constructions. Only the present moment — the fleeting window in which neural events actually unfold — can be said to *exist* in the strictest sense. Yet, as we have seen, the **past endures as reality** by virtue of its lingering physical and informational traces,[32] and the **future presses into reality** through the brain's constant modeling of what is to come. These findings lend credence to ER's distinction between existence and reality: they show that one can acknowledge the unique ontological status of the present without relegating the past and future to utter nonexistence or insignificance.[33] Instead, past and future are **realized** in the present – literally made real through neural representation and causal impact. For philosophers of mind and time with a naturalistic bent, this synthesis offers a compelling narrative: our brains, in their very architecture and function, **affirm a worldview** in which now is ontologically privileged, even as past and future remain integral parts of the world we navigate. In conclusion, the melding of cognitive science with Existential Realism enriches our understanding of time's nature. It demonstrates that a clear-eyed physicalist account of the mind can accommodate the flow of time and the special status of the present, all while upholding the reality of what was and what will be. The present, we find, is both all we truly have and far more than an instant – it is the living fulcrum of reality, dynamically shaped by the brain, carrying yesterday's imprint and tomorrow's outline.[34]

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  (Reviews evidence for physical memory traces in the brain (engrams) and links memory storage to the ability to construct future simulations.)
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Construction

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The Mind Builds Time

From neural substrate to mental world models: this paper explores how our cognitive architecture constructs the experience of time. Memory, anticipation, and narrative assemble a lived temporal reality — without denying its underlying structure.

Time as Constructed and Real: Integrating Cognitive Science with Existential Realism

Tenzin C. Trepp

Email: trepp@tenz.in

Date: August 06, 2025

Abstract

Existential Realism (ER) is an ontological framework that distinguishes **existence** from **reality** in the context of time.[1] In brief, ER holds that only the present moment and its contents *exist* in the full ontological sense, yet much more than the present is *real*. Past events and future possibilities, though they do not exist now, are nonetheless real insofar as they leave traces, have causal effects, or figure in well-founded predictions. This two-tiered view is meant to reconcile **epistemic humility** about what we can directly observe (only the present) with a robust **ontological realism** about the world's structure across time. In other words, ER asserts an objective world of matter, laws, and forces that unfolds in time, while acknowledging that our access to non-present times is indirect—mediated by memory, records, and inference.

One potential gap in the current ER framework is the role of the **human mind** in structuring our experience of time. ER recognizes that we know the past through records and remember it, and anticipate the future through predictions, but it does not yet deeply explore how our brains and cognitive processes actively **construct** the subjective flow of time. Cognitive science and constructivist theories of mind suggest that time is not just "out there" in the world; it is also a mental **representational construct** that our minds assemble through processes like memory, narrative, anticipation, and temporal perception. Classic phenomenological philosophers such as Edmund Husserl and Henri Bergson, as well as modern cognitive scientists like Thomas Metzinger, have all emphasized that the stream of time we experience is *shaped by* consciousness.[2] This report examines how integrating such insights from **cognitive constructivism** could enrich the ER framework. In particular, we will highlight cognitive science concepts – **narrative memory**, **anticipatory processing**, **temporal binding**, **mental time travel**, and the overall **construction of subjective temporal experience** – and evaluate whether ER currently underrepresents this subjective dimension of time. We then explore how ER's temporal ontology could accommodate the fact that human access to past and future is structured by inter-

1 Trepp, T. C. (2025). Existential Realism – A Distinct Ontological Framework Beyond Presentism. PhilPapers Archive, uploaded July 23, 2025. Retrieved from https://philpapers.org/archive/TENERM.pdf

2 Husserl, E. (1991). On the Phenomenology of the Consciousness of Internal Time (1893–1917). Springer.

nal models, without compromising ER's realist stance on an objective temporal reality. Finally, we address potential tensions between being epistemically humble (acknowledging the limits and constructions of our knowledge) and maintaining ontological realism, clarifying whether treating time as cognitively constructed undermines or, conversely, supports ER's distinction between existence and reality.

Cognitive Constructivism: How the Mind Constructs Temporal Experience

Contemporary cognitive science portrays the human brain as an active constructor of experienced reality, rather than a passive recorder of external time. The *subjective timeline* we live through is assembled by the mind through multiple interrelated processes. Here we survey key constructs that illuminate how time is represented in the mind:

- **Narrative Memory (Reconstructing the Past):** Human memory is not a literal playback of the past but a **reconstructive, narrative process**.[3] Psychologists often characterize episodic memory – our recollection of personal events – as a form of *narrative memory*, meaning we piece together past events into a coherent story [4]. Far from a static archive, memory is continually reshaped, integrating what we experienced with what we believe or desire, thereby constructing a personal timeline. For instance, recalling one's childhood birthday party involves activating a network of neurons that store fragments (visual images, words, emotions) and stitching them into a meaningful sequence. In doing so, the mind **represents** the *past* in the present. Neuroscience shows that remembering is an active process: when memories are consolidated, synaptic connections in the brain are literally altered – physical traces that the past event leaves on our present neural substrate. These memory "engrams" demonstrate that a past event, though it no longer exists, can still be **real** enough to have physical effects now. Memory is thus a clear case of the mind constructing a sense of *"what has been"*. Importantly, this construction is constrained by reality: our narratives are grounded in causal traces and records (we cannot truly remember events that never happened to us without conflating or confabulating). ER already taps into this idea by noting that a memory is a **cognitive model** of a real past event. By incorporating research on narrative memory, we enrich ER's understanding of the past's **epistemic reality**: the past is not present, but it is *real* to us by virtue of these memory-constructed narratives that reliably link to actual past occurrences.

- **Anticipatory Processing (Simulating the Future):** Just as memory reconstructs the past, the mind also constructs the *future* in advance through anticipation and prediction. Cognitive neuroscience and psychology increasingly view the brain as a **predictive engine** – constantly generating expectations about the next moment based on experience and internal models.[5] In the predictive processing framework, the brain runs an internal simulation of the world to **anticipate** incoming sensory inputs and events.[6] This means our perception of the present is suffused with *expectations* drawn from the near future. We can also form long-range anticipations: imagining tomorrow's meeting, planning for retirement, or engineering a bridge to withstand future loads are all cases where the future is treated as *real enough* to influence present cognition and action. Our brains and behaviors continually model various possible futures – from the next few milliseconds in a motor action to years down the road in life planning. These mental constructions of the future allow "pre-experiencing" outcomes, a faculty essential for decision-making and foresight. Notably, such anticipatory processing is often woven into a

3 Schacter, D. L., & Addis, D. R. (2007). The cognitive neuroscience of constructive memory: Remembering the past and imagining the future. Philosophical Transactions of the Royal Society B: Biological Sciences, 362(1481), 773–786.

4 https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2018.02543/full#:~:text=Declarative%20memory%20can%20be%20further,Episodic%20memory%20consists

5 https://www.frontiersin.org/journals/human-neuroscience/articles/10.3389/fnhum.2021.629437/full#:~:text=In%20recent%20decades%2C%20studies%20from,predicted%20and%20actual%20sensory%20input

6 Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. Behavioral and Brain Sciences, 36(3), 181–204.

narrative structure as well: we project ourselves forward in time in stories ("what will happen if…?"). ER can incorporate these insights by recognizing that the **reality of the future** for us is primarily *model-based*. According to ER, the future doesn't exist now, but it is *real* insofar as it is **represented in structured anticipations** and plans in the present. The mind's predictive modeling thus serves as the bridge to the not-yet: Our sense of an open future is constructed by cognitive processes—ranging from unconscious neural predictions to deliberate planning—and is anchored in real tendencies and causal structures in the world. Neuroscientific evidence even indicates that an "immediate future" is continuously included in our working model of reality – the brain incorporates the next few hundred milliseconds of predicted events into its moment-to-moment processing. This aligns with Husserl's notion of *protention* – the mind's foreshadowing of the imminent future – and Metzinger's idea that the conscious mind's "window of presence" includes a bit of the upcoming moment.[7]

- **Temporal Binding (Unifying Events in Time):** The brain must **bind events in time** to create a coherent stream of experience. *Temporal binding* refers to a set of phenomena where the mind subjectively adjusts or "tightens" the perceived timing of events that it believes belong together. For example, if you press a button and a light flashes shortly after, you will perceive the interval between your action and the flash as shorter than it truly is – an effect known as intentional binding.[8] In general, our brains tend to perceive cause and effect as closer in time than two unrelated events with the same physical interval.[9] This suggests that the mind's sense of temporal order is influenced by cognitive interpretations (like causality or agency). Additionally, in multisensory integration, signals that occur closely are **fused** into one percept: a ventriloquism effect is when a sound and a sight occurring at slightly different times are experienced as simultaneous if the brain assumes they come from one event. The brain operates with a **"temporal binding window"** – a short span (tens to hundreds of milliseconds) within which it can adjust and align inputs.[10] Outside this window, events feel separate; within it, they may be merged or reordered for coherence. Temporal binding illustrates that even the perceived sequence and duration of events are not given directly by the world but are constructions of the brain [11] attempting to make sense of signals. It is an adaptive feature: by synchronizing and ordering events, the brain ensures we experience a stable, unified reality ("binding" what happens with when it happens). However, it also leads to **temporal illusions** – for instance, the famous "flash-lag" illusion, where a moving object and a flash appear offset in time due to predictive adjustments. The key insight for ER is that what counts as the **"present"** in experience is a *flexible interval* that the brain assembles, rather than an infinitesimal instant. Cognitive science shows that our *specious present* – the brief duration we experience as "now" – already involves integration and slight recalibration of events in time.[12] ER's commitment to the present as the locus of existence can thus be enriched: the *existential now* may correspond to this cognitively constructed interval—lasting hundreds of milliseconds to a few seconds—rather than to a mathematical instant. Such findings do not contradict the idea of an objective time, but they remind us that our direct perception of temporal order is **actively synthesized** by cognitive processes.

- **Mental Time Travel (Imagining Past and Future Episodes):** Humans have the remarkable ability to mentally transport themselves through time. Cognitive psychologists refer to this as **mental time travel** – the capacity to re-experience past events and pre-experience possible future events in one's mind.[13] Endel Tulving, a pioneer in memory research, noted that episodic memory allows for "**chronesthesia**," the conscious awareness of subjective time, enabling

7 Metzinger, T. (2003). Being No One: The Self-Model Theory of Subjectivity. MIT Press.
8 https://www.frontiersin.org/journals/human-neuroscience/articles/10.3389/fnhum.2021.629437/full#:~:text=The%20term%20%E2%80%9Ctemporal%20binding%E2%80%9D%20refers,other%20aspects%20of%20the%20time
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13 Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? Behavioral and Brain Sciences, 30(3), 299–313.

one to entertain "what-was" and "what-will-be".[14] Thomas Suddendorf and Michael Corballis coined "mental time travel" to describe how closely intertwined remembering and future imagining are.[15] Neuroscience confirms that when we recall a past experience or envision a future scenario, overlapping brain regions (including the hippocampus and frontal lobes) activate to simulate those events. In effect, the brain uses stored information to *construct a plausible scene* of another time. This construction is often richly detailed and involves the self: we put ourselves at a past birthday party or imagine ourselves in a future meeting. Mental time travel extends narrative memory and anticipation into a self-projection across time. It plays a critical role in planning, learning from history, and maintaining a continuous identity. By simulating future outcomes, we can make better decisions in the present; by reliving past lessons, we can adjust current behavior. From the standpoint of ontology, mental time travel underscores that **our access to both past and future is inherently model-based**. We have no direct perception of bygone or not-yet moments – we only have the **representations** we construct now (images, stories, predictions) which *stand for* those times. ER's framework, which already allows that the **past and future are real** but only accessible via present traces and models, dovetails with this view. The reality of non-present events is affirmed by the fact that we can mentally travel there and derive valid information (albeit imperfectly). In ER terms, when you vividly remember a past event, the event itself is ontologically real (it truly happened and left a mark), while the **mental reenactment** exists now as a cognitive event carrying information about that reality. Likewise, when you envision a future scenario that guides your current actions, that scenario is not purely fanciful – its **reality** consists in how reliably it tracks an outcome that will eventually materialize or at least how it is anchored in present evidence and tendencies. By integrating mental time travel research, ER can better explain how people relate to times beyond the present: not only through abstract inference, but through an immersive, imagination-driven encounter with the non-present. This also links to the notion of the **self** extending across time: we construct a narrative self that stretches into the past and future, which has implications for responsibility and agency (e.g. feeling accountable to one's past self or caring about one's future self).

- **Construction of Subjective Temporal Experience:** Underlying all the above is the broader point that the **subjective experience of time is constructed by the mind**. Our sense of *duration*, *temporal order*, and *presence* is malleable and context-dependent. For example, "**time flies when you're having fun**" (and drags when you are bored) – a colloquial truth reflecting that attention and emotion alter time perception. In life-threatening or novel situations, people often report time *slowing down*, likely because the brain lays down denser memories, creating the impression of a longer interval in retrospect. These phenomena show that **psychological time** can diverge from clock time. Another illustration is how we perceive temporal continuity: despite saccadic eye movements that create brief gaps in visual input, our consciousness experiences a seamless flow, because the brain fills in and smooths over the discontinuities. What we call "now" is in fact an **integrative construct**. As noted earlier, philosophers like Husserl analyzed this as the *specious present* – a short span wherein we retain a just-past and anticipate a just-future, yielding an experienced present that has thickness. Bergson, too, stressed that the time of lived experience (la *durée*) is continuous and interpenetrating,[16] very different from the atomized, spatialized time of physics.[17] Bergson pointed out that we *feel* time as a flow where past states bleed into the present and new possibilities loom ahead, rather than as a series of frozen instants.[18] Modern cognitive science gives empirical backbone to these insights: it identifies neural mechanisms (like cortical oscillations, working memory windows, and predictive loops) that likely underlie our *felt continuity*. It also catalogues how subjective time can be warped – through attention, multisensory discrepancies, emotional

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18 https://philosophynow.org/issues/48/Henri_Bergson_and_the_Perception_of_Time
#:~:text=really%20experience%20life%20as%20a,confirmed%20by%20our%20own%20experience

arousal, or brain disorders – reinforcing the idea that our temporal experience is *constructed by the brain*. For ER, which is committed to an objective temporal order (governed by matter and physical law) but also to the importance of human perspective, this means that **temporal ontology should account for both**: the mind-dependent features of time perception and the mind-independent features of time. Recognizing the constructive nature of subjective time complements ER's ontological claims by highlighting the *epistemic and phenomenological filter* through which we grasp reality.

In summary, cognitive and neuroscientific research portrays humans as actively modeling time – weaving the past and future into the present through memory and anticipation, binding events into meaningful sequences, and even imaginatively flitting across time. These abilities indicate that there is a **cognition-mediated dimension of time**: a layer of temporal reality that exists *in us*, as an internal representation. It is crucial to ask: does the current Existential Realism framework adequately incorporate this layer?

Is the Subjective Side of Time Underrepresented in Existential Realism?

The original formulations of Existential Realism already take steps toward integrating subjective and cognitive dimensions of time – but perhaps somewhat cautiously. ER was motivated in part by the observation that traditional ontologies of time (like Presentism or Eternalism) neglect how we come to *know* about past and future, or how we *experience* temporality. In defining "existence" as present and observable, ER explicitly built an epistemic criterion into ontology. In allowing that the past and future are "real" through traces and anticipatory structures, ER acknowledged that memory and expectation are central to why those times matter to us. The framework's authors even invoke phenomenology: for example, Husserl's *retention and protention* are used to illustrate how consciousness presents a just-past note as still real and an about-to-sound note as already somehow given. Metzinger's concept of a moving "window of presence" is cited to show that the brain itself integrates a short temporal span in our experience. These references demonstrate that ER is certainly *aware* of the cognition-mediated aspect of time. The very goal of distinguishing existence from reality was to do justice to both the **immediacy of the present** (what we can empirically access) and the **extended structure of time** (what we infer or experience beyond the now).

However, one could argue that the current ER writings do not yet fully **develop** the role of cognitive construction in its ontology. The mentions of memory, anticipation, and phenomenology, while insightful, remain illustrative side-notes in a primarily metaphysical argument. ER's core definitions (e.g. of reality as including "representationally encoded" states oriented toward past/future) acknowledge the *existence* of cognitive models, but do not delve into their *mechanisms* or variations. In other words, ER says **what** (ontologically) the past and future are in relation to the present – real but not existent – and notes that this is consistent with how we observe traces and entertain expectations. Yet it does not say much about **how** our minds construct those traces into a coherent timeline, or **how** subjective temporal experience might feed back into our ontological intuitions. For example, ER has not detailed how **narrative memory** shapes our conception of the past's reality, or how biases in memory (e.g. forgetting, hindsight distortion) might temper our realism about the past. It has not discussed empirical findings on time perception (beyond the brief reference to Metzinger) that could inform what we count as the "present". Nor has it engaged with the idea that different cognitive architectures (human infants, or non-human animals, or AI systems) might carve up time differently – an omission that could be important for a truly general ontology of time.

In short, the **subjective, cognition-mediated dimension of time is acknowledged in ER but underrepresented in detail and emphasis**. The framework so far leans more heavily on establishing the objective side (ensuring past/future are not ontologically erased) and on high-level epistemic principles (we only *count* present observables as existents). What's relatively missing is a richer account of the mind's contribution: how humans actually *construct* a sense of past and future, and how that might systematically affect the ontology of time we posit. This is not a flaw so much as an opportunity – a space where ER can be **enriched**. By integrating cognitive constructivist insights, ER could more thoroughly explain why it makes sense to separate existence and reality in the first place (because our perception/knowledge of time is filtered through a constructivist lens) and how exactly the mind anchors us to real but non-present phenomena. It would also guard against misinterpretations: a critic might mistakenly hear "past and future are real" as a mystical claim unless it's clarified that this **reality** often operates through cognitive intermediaries like memory and prediction, not via mysterious unseen matter. A more explicit incorporation of subjective time would therefore strengthen ER's position, making it more empirically informed and experientially resonant.

To be fair, the ER framework was never meant to deny the importance of subjective time – indeed, it was partly inspired by it. The underrepresentation is a matter of degree and depth. By bringing in the concrete findings of cognitive science and the rich analyses of phenomenology, we can **expand ER's narrative**: moving from simply saying "we remember the past, hence it's real" to unpacking *how* we remember (narratively, reconstructively) and what that implies (e.g. the past's reality is never a complete picture but a story we refine). Similarly, rather than just saying "the future is anticipated, hence real," we can discuss the brain's predictive circuitry and the role of imagination in giving the future motivational force – thereby understanding the **modal status** of future events in ER more deeply (as gradations of reality tied to probability and mental representation).

Enriching Temporal Ontology: Integrating Internal Time Models with External Reality

How can Existential Realism's ontology of time be augmented to include the insights from cognitive constructivism, without losing its commitment to an objective reality? The key is to treat **internal temporal models** (memories, simulations, narratives) as an essential part of the ontology *relating* observers to time, while maintaining that these models are anchored to, and constrained by, an external temporal order of events. We can outline a more integrative temporal ontology as follows:

1. **Two Layers of Time – Objective and Subjective:** We distinguish between the *ontological structure* of time itself and the *cognitive apparatus* through which we engage with that structure. ER already asserts an objective timeline (the world's events unfold in a law-governed sequence of causes and effects, whether or not we observe them) and simultaneously asserts that from any given vantage point, only the present content is directly existent. To enrich this, we explicitly incorporate a **subjective temporal layer**: the internal timeline each agent constructs. This layer does not float free of reality; rather, it is a mapping (imperfect but useful) of the objective timeline into the agent's mind. For example, my brain's timeline contains my memories (mapping to real past events in the world), my immediate perceptual flow (mapping to events happening now around me), and my anticipations (mapping to potential future events). Temporal ontology can thus be seen as a **coordination between two domains**: the world's time and the mind's time. Any theory of time should ideally account for both. ER was a move in this direction (by bringing epistemology/phenomenology into ontology); integrating cognitive constructivism continues that move by giving the subjective domain equal analytical attention.

2. **The Past and Future as *Known* (or *Accessible*) only via Cognitive Constructs:** In ER, past events are real because they left traces and present effects; future events are real to the extent that they are encoded in present structures (plans, predictions, tendencies). We strengthen this claim: *the only way humans can grasp or refer to non-present events is through some cognitive construction in the present*. This is not to say the past/future depend on our minds to exist at all – they do not, they happened or will happen regardless of any individual's awareness – but our **epistemic access** to them is entirely through things like memories, records, narratives, models. Temporal ontology should explicitly acknowledge this **mediation**. For instance, the statement "dinosaurs are real (even though they don't exist now)" can be unpacked into: there were objectively dinosaurs millions of years ago (objective fact in world's time); today, that reality manifests for us through fossils, and through scientific reconstructions in our textbooks and imagination. Those fossils and reconstructions are the cognitive-affective bridge that makes the dinosaur's past reality meaningful and knowable. Similarly, "future sea-level rise is real (even though it doesn't exist yet)" means: there is an objective process underway (glacial melt, thermal expansion) that will produce a certain outcome; *we* treat that outcome as real now by way of predictive models and projections, and this guides our present actions (e.g. building sea walls). By highlighting the cognitive constructs (the climate models, the visualizations of flooded cities) we clarify what it means for the future event to be "real now" – it means it has entered our **model of reality** as a credible eventuality. ER's ontology can incorporate this by perhaps formalizing an idea like: *X at time T is real (for us, now) if and only if there exists some present information or structure that legitimately represents X or is causally linked to X*. This links the subjective and objective: the representation (subjective side) is our handle on the objective phenomenon. In fact, ER's own definition of reality nearly says this, mentioning things "representationally encoded" or "structurally necessary for explaining present conditions". What cognitive science contributes is a richer understanding of those representations and how they work.

3. **Epistemic Humility Informed by Cognitive Fallibility:** Emphasizing cognitive construction naturally reinforces **epistemic humility** – the idea that because our knowledge is filtered through our limited minds, we should be cautious in our ontological claims. ER already values this (inspired by Bas van Fraassen's constructive empiricism, it avoids asserting the existence of entities that we cannot in principle observe now). By adding cognitive science, we add specific reasons for humility: memory can be mistaken or biased; perceptions can be illusory; predictions can fail. For example, while ER says the past is real, a cognitive perspective reminds us that our *memory* of a specific event might be a distortion – so while the event itself truly happened, our access to it can be shaky. Likewise, we might have present models of the future that later turn out wrong (we treated a future outcome as "real enough" to act on, but maybe our model was flawed). Recognizing time as cognitively constructed means recognizing the **uncertainties and errors** inherent in our temporal models. An enriched ER would explicitly build this into its framework: perhaps by grading reality in terms of confidence or evidential support (the more robust the present trace or model of a past/future event, the more justified we are in calling it real). This would prevent a naive reading of ER that "anything you can imagine about the future is real" – instead, only disciplined, well-supported constructions count. By calibrating realism with cognitive fallibility, ER can maintain credibility and avoid sliding into speculative excess. In practice, this aligns with scientific realism moderated by empiricism: we posit the reality of entities or events mainly when we have sound evidence or strong theoretical reasons, and we remain aware that our conceptions are provisional.

4. **Ontological Realism Preserved (or Even Strengthened) by Cognitive Insight:** Does treating time as partly a cognitive construct undermine the ER distinction between existence and reality? On the contrary, it **supports and sharpens it**. The distinction arose because we noticed that our immediate existence (the perceivable present) is not the whole of what's real – much lies beyond, inferred or remembered. Cognitive constructivism explains *why* this is so: because the human mind can only exist in an experiential present, yet can represent more than that present. It actually validates ER's two-tier ontology. If anything, a lack of cognitive

perspective could undermine ER by leaving one wondering how we can talk about "real but non-existent" things at all. The answer is: because we have mental faculties that refer to those things (through traces, memories, etc.). In fact, the **cognition-mediated nature of time is precisely what makes ER's categories necessary**. Far from collapsing into a subjective idealism, this view underscores that we draw a line between what *is there* versus what *we picture*. We acknowledge an independent reality (e.g. the past really happened, the future will unfold somehow regardless of our wishes) – this is ER's realism – but we also acknowledge that we know and feel that reality only via our mental constructions – that's epistemic humility. There is a potential tension here: if everything about past and future that we know is mind-dependent, how do we justify saying those times are mind-independently real? ER navigates this by pointing out that our mental constructions are not free creations; they are themselves caused and constrained by the world. We remember the past *because* the past left physical marks (in our brains, in records). We successfully predict aspects of the future *because* the world has regularities that can be extrapolated (and when our predictions fail, it's precisely because we misjudged those objective regularities). Treating time as cognitively constructed therefore does not mean time is *only* a construct – rather, it highlights the interplay between objective time and our subjective reconstruction of it.

To clarify, consider ER's **existence–reality distinction** with an example: *the year 2125 (a hundred years in the future)*. According to ER, 2125 does not exist now (obviously, since it has not come to pass), but it could be real in various senses – for instance, it is real insofar as it will eventually become present, and insofar as present actions and plans are oriented toward it (people are making climate policies considering the year 2125). Now add cognitive constructivism: an individual today can imagine what 2125 might be like – that imagined scenario lives in their mind now. Is that scenario "real" or just a fantasy? ER would say: certain aspects of it could be real if they are grounded in valid inference (say, using the best science to project sea levels in 2125) or in intentions that will causally contribute to that future. Other aspects might be fanciful (mere possibilities with no grounding). By explicitly including cognitive constructs, we can differentiate: the *concept* of 2125 we have now is a mix of real information (e.g. orbital mechanics predicts an eclipse in 2125 – that eclipse is real in the sense of inevitable given current conditions) and imaginative filler (e.g. flying cars everywhere – which might not be real at all if it lacks any present basis). Thus, subjective constructs need not blur the line between reality and fiction; when properly tied to evidence, they *reinforce* ER's idea that we can talk about the reality of the non-existent in a disciplined way. In sum, treating time as cognitively constructed **does not undermine ER's realism** – it situates our knowledge of time in human cognition, while still affirming that something beyond those cognitions gives them truth or falsity. Indeed, the ER framework explicitly states that past events are not "simply constructions of present minds" – they *truly happened* – and that the future, though not yet actual, is "grounded in reality and not mere fiction". Our analysis here provides the mechanism for that grounding: cognitive constructions (memories, predictions) succeed in referring to real pasts and real possibilities because they are shaped by causal traces and lawful regularities originating in the world, not just by subjective whim.

5. **Broadening the Scope: Interdisciplinary Dialogue:** By integrating cognitive constructivism, ER's temporal ontology becomes inherently interdisciplinary – connecting metaphysics with cognitive science, psychology and neuroscience, and even AI (artificial systems that model time). This opens fruitful avenues: for example, in AI research on temporal knowledge representation, one might apply ER by distinguishing an agent's *current sensorium* (what exists for it now) from the larger timeline of states it maintains in memory or prediction (what it treats as real). In psychology, understanding disorders of memory or time perception (like amnesia or schizophrenia) through ER might yield insights: if someone's ability to construct the past is impaired, how does that affect the reality of the past for them? Does their ontology shrink to the present? These questions show how a cognitively enriched ER could serve as a framework linking subjective experience to metaphysical categories. It remains **realist** – because it never denies the existence of a mind-independent world – but it is also **pluralist** about perspective, recognizing that different beings may have different temporal experience, which in turn affects how they parse reality. Such a view resonates with philosophical approaches like **Husserl's**

phenomenology (examining the structures of experience of time) and **Bergson's intuition** of duration, while translating them into a modern, naturalistic register supported by empirical science. It also answers Metzinger's call to bridge ontology and empirical mind science: we allow findings about the mind to inform how we think the world is structured for that mind.

Conclusion

Existential Realism set out to provide a nuanced ontology of time – one that says **only the present exists**, but the past and future are nonetheless **real** in important ways.[19] By incorporating insights from cognitive constructivism, we enhance this framework, giving it greater descriptive richness and empirical support. We have seen that human access to time is thoroughly **mediated by mental representations**: we carry the past with us as memories and narratives, and we carry the future as expectations and plans. This fact does not contradict a realist view of time – instead, it reinforces why we need a concept of reality that outstrips immediate existence. The subjective construction of time provides the experiential evidence that the world is more than what is before us at any instant. It also counsels humility: our knowledge of time's extents is tentative, filtered through our evolving inner models.

By explicitly acknowledging the cognition-mediated dimension of time, ER can more fully "do justice to the richness of lived experience while respecting the hard facts of science". It can clarify, for instance, that *the past's reality* is evidenced by memory and records, and *the future's reality* by predictive modeling – solidifying the claim that these are not mystical assertions but reflections of how a causally structured world interacts with an inquiring consciousness. In resolving potential tensions, we find that treating time as cognitively constructed **supports** the ER distinction between existence and reality: it underscores that what exists for us (the now, the directly perceived) is only **a transitional crest** of what is real, and that we rely on our minds to bridge the gap. At the same time, it reminds us that bridging that gap depends on models that are fallible, interpretive, and often incomplete.

In conclusion, an enriched Existential Realism would maintain its fundamental thesis – **only the present exists, but much more is real** – and supplement it with a detailed account of how minds like ours construct a sense of time. This synthesis not only refines the ontology of time; it also broadens the appeal and applicability of ER. It becomes a framework capable of engaging with cognitive science, enhancing philosophical discourse with scientific findings (and vice versa). The payoff is a more comprehensive understanding of time that respects both the **objective continuum of events** and the **subjective fabric of experience**. Such a framework can better address age-old questions (e.g. how can we be connected to things no longer or not yet here?) with the wisdom of both metaphysics and mental science. Ultimately, recognizing the mentally constructed, narrative nature of our temporal experience deepens the meaning of ER's slogan that *existence* is not equivalent to *reality*. It reminds us that **reality, especially temporal reality, is accessed through a glass darkly – yet it is there, steadfast, giving shape to our constructions and being in turn illuminated by them**. Such a balanced view can guide future inquiries into time, bridging the gap between how time *is* and how time is *known*.

[19] Trepp, T. C. (2025). Existential Realism – A Distinct Ontological Framework Beyond Presentism. PhilPapers Archive, uploaded July 23, 2025. Retrieved from https://philpapers.org/archive/TENERM.pdf

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Responsibility

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Acting Beyond Now

If only the present exists, can we be responsible to the future? This paper brings ER into moral territory: exploring how real but non-existent persons, harms, and duties challenge and deepen our ethical frameworks.

Ethics After the Present: Responsibility and Moral Agency in a Two-Tier Temporal Ontology

Tenzin C. Trepp

Email: trepp@tenz.in

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Abstract

Contemporary debates on the ontology of time often overlook their ethical ramifications. This paper introduces the ethical implications of **Existential Realism (ER)**, a two-tier framework that distinguishes between what *exists* (the materially present) and what is *real* (including non-present but causally connected phenomena). We argue that standard presentism—holding that only the present exists—encourages a form of moral myopia, undervaluing future harms and past obligations. Conversely, eternalism's **block universe** (where past, present, and future equally exist) risks a kind of moral fatalism, implying that future outcomes are fixed and beyond influence. In contrast, ER's temporal ontology allows us to extend moral concern across time without positing that past or future entities exist in the same way present ones do. By affirming the *reality* of past and future (despite their lack of current existence), ER provides a coherent basis for caring about **real-but-non-existent** individuals and events. We develop an account of moral responsibility toward future persons and past injustices grounded in ER, and show how this approach illuminates real-world cases like climate ethics (responsibilities to future generations) and historical justice (acknowledging the reality of past harms). Briefly, we also consider implications for AI ethics and decision-making where long-term outcomes are at stake. Throughout, we demonstrate that a two-tier temporal ontology can integrate moral foresight and memory into a consistent framework, supporting intergenerational duties and a temporally expansive view of moral agency. We conclude by advocating a temporally grounded moral realism rooted in the ER framework, which reconciles the primacy of the present with the enduring moral significance of the past and future.

Introduction

The way we conceive of time deeply influences how we assign moral responsibility. Philosophical **presentism** maintains that only present objects and events exist; everything past or future is ontologically nothing. In everyday moral reasoning, this mindset can breed *ethical short-sightedness*: if only the present truly "is," one might unduly discount obligations to future people or reparations for past wrongs. By contrast, **eternalism** holds that past, present, and future entities are equally real – as if history and posterity are laid out in a single timeless panorama. This view can instill a complacent fatalism: if all events (including our future actions and their consequences) already exist, it may seem that our choices lack genuine freedom or urgency. Both standard views of time thus carry ethical pitfalls. Presentism's mantra "only now matters" risks **moral myopia** toward absent times, while eternalism's "already written" cosmos risks undermining agency.

Existential Realism (ER) was first articulated in a recent proposal by Trepp (2025),[1]offering a way to transcend the presentism vs eternalism stalemate. ER draws a crucial distinction between *existence* and *reality*: roughly, to **exist** is to be present and empirically accessible, whereas to be **real** is to belong to the world's causal and structural fabric, even if not presently existing.[2] In this two-tier ontology, the present is the locus of concrete existence (the **"materially populated"** now), but past and future entities are nonetheless real in virtue of their connections to the present. As a result, ER "preserves the empirical and experiential centrality of the present while acknowledging the enduring reality of the past and the emergent reality of the future".[3] This middle path aims to avoid the false choice between denying the reality of non-present times and treating them as equally existent. Instead, past and future are "something (real) but not the same something as present existence," as one proponent puts it.

What are the ethical stakes of adopting such a view? Our goal in this paper is to develop how ER's metaphysics of time translates into a framework for moral agency and responsibility. We will argue that by affirming the reality of past and future without granting them present existence, ER enables **temporally extended moral concern**. It offers a principled way to regard future persons and outcomes as morally relevant (since they are real in the causal structure) while preserving the intuition that the future remains open and subject to our agency (since those persons do not yet exist). Likewise, ER underwrites why we should take past events and injustices seriously (as real features of the world that demand acknowledgment), even though the past "no longer exists." In the sections that follow, we critically assess how presentism and eternalism falter in the moral domain, then show how ER's two-tier temporal ontology can better support duties to non-present others. We apply this perspective to pressing cases—climate change, historical justice, and emerging issues in AI—before concluding that a temporally enriched moral realism is both possible and necessary.

Presentism and Eternalism in Ethics: Why Both Fail

The tension between presentism and eternalism is not merely metaphysical—it has profound ethical ramifications. **Presentism**, which asserts that only the present exists, can inadvertently sanction a narrow moral horizon. If one truly believes that past and future beings "aren't there" in any sense, one might conclude (explicitly or implicitly) that our only real duties are to present individuals and immediate concerns. Philosophers like Ned Markosian define presentism by saying that if we listed all that exists, it would include currently living people (you, me, the city around us) but not figures like Socrates or our future grandchildren—"all such objects are unreal, according to Presentism." [4] Ethically, this ontological exclusion of the non-present can encourage **moral myopia**: harms to future generations may be downplayed because those generations are seen as entirely non-existent, and past injustices

1 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Introduces the ER framework distinguishing existence from reality: "Eternalism treats all events as equally existent in a timeless block. ER rejects this: there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated; reality, by contrast, stretches beyond it.")

2 https://philpapers.org/rec/TENERM

#:~:text=ontological%20commitments,empirical%20and%20experiential%20centrality%20of

3 https://philpapers.org/rec/TENERM

#:~:text=without%20existence%2C%20the%20epistemological%20access,in%20metaphysics%20and%20cognitive%20science

4 Markosian, Ned (2004). "A Defense of Presentism." In Dean Zimmerman (ed.), Oxford Studies in Metaphysics, Vol. 1, pp. 47–82. (Defines presentism as holding that if one listed all that exists, "you and I and the Taj Mahal would be on the list, but neither Socrates nor any future grandchildren of mine would be included… All such objects are unreal, according to Presentism.")

may be disregarded or dismissed because their victims (and perpetrators) no longer exist. We see shades of this in public life whenever policymakers prioritize short-term gains over long-term sustainability, or when calls for historical redress are met with "that's ancient history." A strict presentist might hold that only present feelings and lives carry weight, casting doubt on why we should sacrifice today for the sake of *mere* future possibilities or dwell on bygone events.

On the other hand, **eternalism** maintains that all times are equally real—the universe is a four-dimensional block in which past, present, and future events coexist tenselessly. At first glance, this view might seem to bolster ethical concern for other times, since past and future people are, in theory, just as real as contemporaries. Indeed, one might say eternalism "spatializes" time, putting distant events on par with distant places. However, eternalism's ethical downside lies in its implication of *fixedness*. If future events (including our descendants' suffering or flourishing) already exist in the block, one could lapse into a sense that the future is **beyond influence**. The worry is a form of **moral fatalism**: believing that trying to alter or prevent future harms is futile because those future outcomes are "already there" in the fabric of reality. Albert Einstein, in consoling a friend's family, famously described the separation between past, present, and future as "only a stubbornly persistent illusion." [5] Hermann Weyl similarly mused that in the block universe "the objective world simply *is*, it does not *happen*." [6] Such descriptions capture eternalism's atemporal vision—but they also highlight the tension with lived moral agency. In our experience, the future is not yet decided; we deliberate and make choices in hopes of bringing about better outcomes. If one takes the block universe worldview too much to heart, one might question the point of moral action: if tomorrow's catastrophes or triumphs are *already* real in a static sense, do our precautions or efforts today genuinely matter?

To be clear, sophisticated eternalists typically reconcile tenseless reality with meaningful agency, arguing that our actions are part of the block and can be evaluated within it. Nonetheless, the **phenomenology of responsibility** strains against a picture of time where everything is equally actual. The ethical impulse—to prevent harm and foster good—seems to presuppose that the future is *open*, at least from the agent's perspective. Eternalism's denial of an objectively privileged present and an indeterminate future risks treating moral striving as something like an actor reciting lines in a pre-written play. Additionally, eternalism offers little guidance on why we should especially privilege present suffering over past or future suffering. If a painful event in 2125 is just as real as one in 2025, one might even ask: why devote resources to present ills when countless tragedies frozen in the past and future also "exist"? In practice, of course, our sympathy and influence are bounded by what we can actually affect in the present. Eternalism, by inflating the ontology of what exists, can **diffuse moral focus** and lead to paralysis: with every moment equally real, the unique significance of acting *now* to shape what becomes real tends to vanish.

In sum, presentism and eternalism represent two extremes that both face moral criticism. Presentism's exclusive focus on the now cannot adequately account for responsibilities beyond the instantaneous present. Eternalism's expansive ontology, in turn, can undermine the urgency and freedom necessary for moral agency. These shortcomings motivate the search for an alternative that can acknowledge the moral importance of non-present times without erasing the special role of the present in action. Existential Realism offers just such an alternative, reconfiguring what it means for something to be "real" so that future and past matters count *morally* even if they do not exist now.

5 Einstein, Albert (1955). Letter to the Besso family (March 1955). (Einstein consoles his late friend's family by noting that for those who believe in physics, the distinction between past, present and future "only has the meaning of an illusion, though a persistent one".)

6 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton University Press. (Weyl famously wrote that "The objective world simply is, it does not happen." – capturing the timeless block view of reality.)

ER's Two-Tier Ontology: Existence, Reality, and Moral Agency

Existential Realism intervenes in the presentism-eternalism debate by uncoupling existence from reality. Under ER, **existence** is narrowly defined: to exist is to be concretely present, the sort of entity we can observe or causally interact with right now. By contrast, to be **real** is a broader status, indicating involvement in the world's causal and informational structure even if not currently present. This two-tier ontology maintains that past and future entities, events, and conditions—while not existing at present—can nonetheless be real. They are real insofar as they left enduring effects or will (probabilistically) have effects, and insofar as they figure in true statements about the world. ER thus asserts an ontological middle ground: *past and future are real (with all that implies for truth and causation), but they are not real **as present existents***.

How does this abstract distinction translate into the domain of ethics? Crucially, ER allows us to say that past and future individuals have **moral standing** in virtue of being real, without committing us to the perplexing idea that they exist right now. The present remains the realm of concrete action and experience—the only temporal zone in which agents can meaningfully intervene. In ER, the present is the living, changing "locus of becoming," the point at which reality's potential flows into existence. But beyond this luminous present extends a vast causal web: it includes the fading but persistent reality of the past (recorded in memories, histories, and physical traces) and the emerging reality of the future (prefigured in plans, predictions, and probabilistic trends). Our moral agency is anchored in the present, yet its significance comes from its **temporal reach** into that web of reality.

ER's framework suggests that we regard the **causal structure** of time as ethically important. Because past events retain reality, their consequences persist and continue to shape the present. Because future events are real (as possibilities grounded in current conditions), our actions now genuinely affect what will be real. In other words, ER grants past and future *ontological weight* without overstating their mode of being. We are thus justified—metaphysically—in extending our concern to times beyond the now. ER can affirm, for example, that "our future children are real as potential future persons, even though they do not yet exist." This statement, which would be a contradiction under a view that equates reality with existence, makes perfect sense in ER's two-tier system. The reality of future persons (as dependent on current causes and laws) gives us reason to care about them, even though they will not exist until a later time. Similarly, we can say past victims of injustice are real in virtue of their having existed and left their mark, which legitimizes our moral consideration of historical wrongs.

By separating existence and reality, ER also preserves the openness of the future in a way eternalism does not. Because the future is not a pre-existent block but a realm of causally grounded possibilities, we avoid the fatalistic worry that the future is immutably 'already out there.' In ER, the future is not laid out in advance, but emerges through the collapse of real possibilities into present existence — a dynamic migration rather than a static panorama. The future's reality in ER carries no guarantee of *which* future comes to pass—it is a placeholder for a range of outcomes whose realization depends on present actions and chance. In this sense ER **empowers temporal agency**: it posits that while only the present exists to act, the arena of action's consequences extends into a real future. Agents can thus be seen as straddling two ontological tiers: existing *now* but acting with respect to realities that extend beyond now. This view resonates with our intuitive sense of responsibility: we feel answerable not only for what is happening immediately around us, but for what *will* happen (and even, in some respects, for what *has* happened, as we shall see). ER provides the ontological justification for that intuition.

Before moving to specific applications, let us crystallize how ER differs from the classical views in ethical terms. Unlike presentism, ER does not treat non-present people as unreal zeroes in the moral calculus; it recognizes their reality as stakeholders in the world. Unlike eternalism, ER does not treat the future as a frozen landscape of already-existent events; it emphasizes that the future's reality is one of dependent potential, awaiting actualization through the present. Thus, ER manages to combine a respect for the **present as the unique site of change** (only now exists) with a respect for the **past and future as morally relevant domains** (past and future are real). The stage is set to see how this balance helps address concrete ethical challenges.

Duties to the Future and the Past: Real-Without-Existing Others

A key payoff of ER's ontology is a fresh way to justify our obligations toward those who do not exist *yet* or anymore. Consider future generations. Virtually every ethical theory agrees that we have some responsibility to avoid causing grave harm to children and descendants who will live after us. But presentism's ontology can make such responsibility philosophically puzzling: if future people literally do not exist *at all* right now, to whom (or to what) do we owe a duty when we curb carbon emissions or maintain peace? Some have even argued that we cannot have "actual" obligations to non-existent individuals. Existential Realism dissolves this puzzle by asserting that future persons, though not presently existent, are **real in virtue of the causal links that will bring them into existence**. In ER's terms, these individuals are *real-but-non-existent*: their reality is grounded in the current state of the world and the laws of nature that will likely produce them. Therefore, when we act to mitigate future harms (for example, by preventing climate catastrophe), we are not addressing a void; we are morally responding to real (albeit not yet existent) people who will occupy the future world we help shape. As Tenzin C. Trepp notes, if the existence of future persons is entailed by present conditions and actions, then "ethical reasoning cannot ignore them". We prepare a livable planet for future generations not out of charity to imaginary beings, but out of justice to real stakeholders of tomorrow.

This perspective aligns with and strengthens emerging ethical outlooks that emphasize the long term. Philosophers like Derek Parfit, for instance, have highlighted how our decisions today affect who will exist in the future and what lives they will lead, thereby challenging us to take the well-being of future persons seriously.[7] More recently, the **longtermism** movement in ethics explicitly argues that the vast number of future lives at stake makes prudential and moral concern for the far future imperative.[8] Similarly, thinkers like Nick Bostrom contend that minimizing existential risks (events that could permanently curtail humanity's future) should be a top global priority,[9] given the immense future value at stake. ER offers a robust metaphysical underpinning for such views: if the future is part of reality (though not yet part of existence), then future people and their interests merit consideration as part of the moral community. Our duties to them are as real as the causal pathways that connect now to then. We might say that, under ER, posterity has a kind of *ontological standing* even before it comes into existence.

Now consider past generations and historical injustices. On a purely presentist view, once an event is over and its participants have died, it becomes nothing—there is literally no victim left to receive an apology or compensation. This ontological stance can foster an attitude that the past is morally irrelevant: "let bygones be bygones" taken to its extreme. Yet we commonly (and rightly) feel that we *ought* to remember and address past wrongs. Societies engage in practices of remembrance, restitution, and reconciliation aimed at events long past (e.g., slavery, genocides, colonial injustices). How can we make sense of moral responsibilities directed at what, on the face of it, no longer exists? ER answers: those past events and persons may not exist now, but they are undeniably real—they happened, and their reality continues to influence the present. The effects of past injustices (economic disparities, intergenerational trauma, altered social structures) permeate present reality. In acknowledging and rectifying these effects, we implicitly recognize the reality of the past event that caused them. For example, paying reparations or issuing a state apology for a historical atrocity is a way of morally engaging with a reality that is not part of the present, yet is not a mere fiction either. It is, in Jonas's terms, a "one-sided responsibility" to those who are no longer alive, who "have only a virtual existence" from our current standpoint.[10] ER vindicates this intuition: the past's reality makes it a legitimate object of moral concern, even though the past no longer exists to confront us directly.

7 Parfit, Derek (1984). Reasons and Persons. Oxford University Press. (Parfit's Part IV explores obligations to future people and the "non-identity problem," illustrating that our choices can harm future individuals even though those individuals' very identities depend on our choices.)

8 MacAskill, William (2022). What We Owe The Future. Basic Books. (Makes the case for longtermism – the view that positively influencing the long-term future is a key moral priority. Argues that the interests of future generations vastly outweigh those of the present due to the sheer number of lives that could exist.)

9 Bostrom, Nick (2013). "Existential Risk Prevention as Global Priority." Global Policy 4(1): 15–31. (Introduces the concept of existential risks – catastrophes that would permanently curtail humanity's potential. Bostrom contends that minimizing such risks should be humanity's highest priority because even a tiny reduction in existential risk has enormous expected value for the real future of humanity.)

10 Jonas, Hans (1984). The Imperative of Responsibility: In Search of an Ethics for the Technological Age. University of Chicago Press. (Jonas argues for a "one-sided" duty to future generations – a responsibility to "those who do not yet exist" who have "only a virtual existence" and cannot reciprocate, grounding this obligation in a metaphysics of being and not-yet-being.)

Importantly, treating past injustices as real does not mean we presume the past is somehow changeable or accessible. Rather, ER clarifies *why* remembrance and repair matter: because the past is real, its wrongs are not erased from the world simply by the passage of time. We owe it to the reality of those who suffered (and to the reality of their communities today) to remember truthfully and to mitigate lingering harms. This can be framed as a duty to uphold reality itself: to deny or ignore a great crime in history is, in a sense, to deny a portion of reality, an act of moral and epistemic dishonesty.

By the same token, ER counters any eternalist temptation to fatalistically accept past evils as eternally fixed "in the block" without the possibility of moral redress. While we cannot change the past, we *can* change the narratives and present-day consequences of the past. Because we exist now and the past does not, the **onus is on the present** to respond to the reality of what came before. Thus ER supports what might be called a morally responsible presentism: only the present can act, but it must act with an understanding of the real past and real future that surround it.

Implications for Policy, Memory, and Foresight

Adopting ER's temporally extended ontology of responsibility can have significant implications for how we formulate policy, practice collective memory, and engage in long-term planning. **Climate ethics** provides a vivid example. Climate change is fundamentally an intergenerational moral challenge: the worst impacts of carbon emissions will be borne by future generations. A presentist bias in politics tends to favor short-term benefits (jobs now, cheap energy now) over long-term costs, effectively discounting the welfare of future people on the grounds that "the future will take care of itself." By contrast, an ER-informed perspective treats those future impacts and future people as *real* considerations, not hypothetical abstractions. Policymaking under ER's guidance would integrate the interests of future citizens as part of reality's ledger. For instance, a legislature might feel a stronger obligation to enact aggressive emissions reductions when it acknowledges that the millions of lives at stake in 2100 are real lives (albeit of people yet unborn) rather than non-entities. Institutions like **intergenerational courts** or ombudspersons for future generations, which are sometimes proposed to combat democratic short-termism, gain philosophical support: they are not representing phantoms, but real future stakeholders who lack a voice in the present. In effect, ER's ontology undergirds a principle that is already intuitive to many – that we should **engineer the present with the future's reality in mind**, so that the world we bequeath is one we would have them inherit.

In the realm of **memory and historical justice**, ER likewise encourages practices that keep the reality of the past in view. This has practical implications for education, commemoration, and reconciliation efforts. If we accept that past events (such as wars, atrocities, great achievements, or cultural flourishing) remain real components of our world's story, then preserving accurate collective memory isn't just antiquarian interest—it is a form of respecting reality. Museums, archives, and monuments, from an ER standpoint, serve as societal instruments to maintain contact with the real past, reminding the present of its debts and lessons. Consider the ongoing dialogues about removing or re-contextualizing monuments (for example, statues of historical figures with objectionable legacies): these debates often hinge on how we acknowledge the reality of past wrongs while shaping present values. ER would advise neither erasing history nor uncritically venerating it, but rather **engaging** with it—recognizing that the past's reality demands both honesty and moral appraisal. Policies like truth and reconciliation commissions embody this ethos by formally acknowledging historical realities and committing to address their aftermath. Such efforts can be seen as fulfilling a responsibility not just to present society but to the reality of those who came before.

Looking forward, ER's framework has implications for how we handle **uncertainty and foresight** in areas like technology and global risk. In **AI ethics**, for example, much attention is given to the long-term outcomes of deploying advanced artificial intelligence. Aligning AI with human values is partly an exercise in ensuring good futures and avoiding catastrophic ones (such as those involving misaligned superintelligence). ER implies that predicted future scenarios, insofar as they are rigorously grounded in present knowledge, represent real possibilities that merit moral weight. Indeed, even current AI planning systems implicitly treat future states as real for the purpose of evaluation: when an AI fore-

casts the result of an action, it assigns that outcome a value as if it were real, then decides accordingly. This resonates with ER's view—considering possible futures as part of reality (in a probabilistic sense) while understanding they are not existent yet. Making this distinction explicit could improve how both humans and AI systems reason about the future. For policymakers assessing risks—be it pandemics, nuclear threats, or environmental tipping points—ER provides a conceptual justification for precaution: a looming disaster is *real* enough to demand preventative action even before it exists as an actual disaster. Here, ER lends metaphysical credence to the adage "preventive action saves lives": those lives to be saved may not exist now, but they are real in the form of lives-to-be, contingent on what we choose to do.

Finally, ER's integration of time into our moral perspective encourages what we might call **temporal prudence** and **intergenerational planning**. Governments and institutions could embed ER's insight by adopting measures such as long-range impact assessments that explicitly evaluate how policies will affect real future communities, or by requiring that historical impact statements accompany major decisions (drawing attention to lessons from past analogues). The guiding idea is that good governance recognizes a continuum of reality beyond the election cycle or quarterly report. By internalizing the view that the present is not the whole of reality, decision-makers can cultivate a form of moral **foresight**: an ability to appreciate the weight of future outcomes and the value of preserving the past's lessons. In short, ER encourages a shift in perspective from **temporal parochialism** to what we might call **temporal cosmopolitanism**—an ethic that treats people and events from other times with a seriousness akin to how we treat those near to us in time.

Conclusion: Toward a Temporally Grounded Moral Realism

We began with a puzzle: how to ground moral responsibilities that extend beyond the fleeting present without succumbing to either short-sightedness or fatalism. **Existential Realism** offers a compelling answer by reframing the ontology of time. In ER's two-tier system, the present moment retains its status as the only sphere of concrete existence and action, yet the past and future attain a status of reality that secures their moral significance. This reconciliation yields what we call a temporally grounded ethical framework—"grounded" in the metaphysical structure of time as defined by Existential Realism, and "ethical" in recognizing that moral facts about the past and future are neither fictional nor merely subjective, but rooted in the real (though non-existent) fabric of temporal reality.

By recognizing the reality of past and future without reifying them as present existents, ER equips us to say that duties to non-present others are neither mysterious nor misplaced. We *should* care for future generations, because those future lives are real in the very fabric of the world that our actions are shaping today. We *should* remember and redress past injustices, because those events remain real in their consequences and in what they reveal about our world. At the same time, ER keeps us moored to the truth that it is the present—*this* moment of existence—where our agency lies and where change occurs. The present is where reality's potential becomes actual; it is, as ER maintains, the privileged locus of becoming. Our moral task, then, is to wield our present agency with an acute awareness of the broader temporal reality in which it operates.

In advocating this view, we are, in effect, aligning ethical thinking with a more nuanced ontology of time. This has the advantage of dissolving false dichotomies. No longer must we choose between an ethics that neglects the future (presentism's hazard) and one that trivializes the present (eternalism's hazard). Instead, we adopt a **time-informed ethics** that honors the present as the arena of responsibility while extending the scope of responsibility to the full span of reality. Such an ethics resonates with existing human practices—saving for one's children, commemorating ancestors, envisioning a better world—and gives them firmer philosophical footing. It urges individuals and societies to see themselves as part of a temporally extended moral community: accountable to the past, responsible for the future, and empowered in the present.

Ultimately, embracing ER's insights can advance a more responsible and far-sighted ethos in our personal lives and public institutions. It reminds us that the story of value and responsibility neither

began with our births nor ends with our deaths or even our era. We stand in the flow of time, indebted to a real past and trustees of a real future. A temporally grounded moral realism calls us to meet those obligations lucidly. In doing so, we affirm that **what is real is not confined to what exists here and now**—and that our moral vision, likewise, should not be confined to the present.

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Formalization

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Existence, Quantified

To make ER rigorous, we need a language to express it. This paper introduces a logical framework that captures ER's central distinction — existence now vs. reality across time — enabling reasoning about causality, possibility, and becoming.

Formal Logic for Existential Realism: Modeling Time, Causality and Observability

Tenzin C. Trepp, *Technical development supported by external collaboration*

Email: trepp@tenz.in

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Abstract

In both philosophy and science, standard logics struggle to model a key insight of *Existential Realism* (ER): that **existence** is a strictly present, empirical notion, whereas **reality** spans beyond the present. Classical first-order logic and even temporal modal logics tend to conflate being real with existing simpliciter, making it difficult to formally distinguish something that *exists now* from something that *is real* but not present. This paper introduces a formal two-tier logical framework tailored to ER's ontology. We motivate this framework by showing how orthodox systems—from classical predicate logic to temporal modal logic—fail to capture ER's core distinction between present existence and temporally extended reality. We then develop a layered logic with explicit operators or quantifiers for "existence-now" versus "reality-over-time," including formal axioms that preserve ER's asymmetries: only present entities **exist** (in the fullest sense), yet past and future entities can be **real** (ontologically significant) without existing. The logic adopts a modal-style treatment of time to model the collapse of potential into actual (present-becoming), and explicitly encodes causal asymmetry — where the past influences the present, but not the reverse. We illustrate the framework with symbolic representations, including an iconic "ER equation" capturing the relationship between reality and existence. To demonstrate its versatility, we apply the logic to examples from quantum physics (e.g. wavefunction collapse and delayed-choice experiments), cognitive neuroscience (memory traces and anticipatory processing), ethics (moral duties to future persons and the reality of future outcomes), and AI (agents modeling counterfactual or temporally extended scenarios). Finally, we show how the formalism sheds new light on classic metaphysical debates such as the truthmaker problem for past truths, persistence and identity over time, and the ontology of merely possible or future entities. Throughout, our presentation maintains a rigorous yet accessible tone, consistent with prior ER works, with technical clarity and footnoted references. The result is a self-contained preprint that extends T.C. Trepp's Existential Realism into a formal logical system, demonstrating its broad applicability across science, philosophy, and practical reasoning.

Introduction

Contemporary debates on the ontology of time often presume that **"existence" and "reality" are one and the same**, an assumption built into both everyday language and formal logical systems.[1] In particular, presentist theories maintain that only present objects and events *exist* in any robust sense. As one presentist succinctly put it, if we listed "all the things our most unrestricted quantifiers range over—there would not be a single non-present object on the list… All such [non-present] objects are unreal, according to Presentism." [2] By contrast, eternalists hold that past, present, and future entities *equally* exist (with time akin to another dimension), and thus regard all those entities as real. These opposing views share a conflation of existence with reality: they differ on *which* times' entities exist, but not on the meaning of "exist." Existential Realism, introduced by Trepp (2025), breaks this mold by **distinguishing existence from reality**.[3] ER agrees with presentism that only present entities *exist* in the strict sense, but it agrees with eternalism that past and future entities are in some sense *real*. In other words, something can be real without existing (at least not existing *now*). This two-tier ontological stance—**present-only existence** versus **temporally extended reality**—promises a more nuanced account of time and being.[4] The challenge, and the task of this paper, is to **formalize** this stance in a logical system.

Standard formalisms have difficulty capturing ER's core distinction. Classical first-order logic, for example, has no built-in notion of time: an existential quantification $\exists x, P(x)$ simply asserts that *some entity satisfies P*, with no regard to *when* that entity is present. One could interpret classical logic as implicitly tenseless or eternalist—its domain of discourse tends to include all entities that ever exist (or could exist), and any $\exists x$ ranges over that entire domain. By default, such a logic cannot say "there exists an x *now*" versus "there exists an x *at some time*." Temporal logics (such as Prior's PTF tense logic or more contemporary modal temporal logics) introduce operators like P ("it *was* the case that") and F ("it *will be* the case that") to qualify propositions in time. These allow statements like $F,P(x)$ ("x will be P in the future") or $P,\exists y,Q(y)$ ("there existed some y such that $Q(y)$"). However, traditional temporal logics still usually assume a single domain of individuals for all times or use each time's "world" with its own domain without a smooth way to refer to the *same* individual across times. As a result, they struggle to represent an object that *no longer exists* but still in some sense *is real*. Presentism in formal semantics often forces an "existence-at-time" predicate or shrinking domains: at a given time t, the domain $D(t)$ contains only present entities. This yields a kind of *indexical existence* (existence = existence-at-t). But if $D(t)$ excludes all past individuals, a statement about, say, Socrates can only be made true by indirect means (such as presently existing descriptions or memories of Socrates). On the other hand, if one uses a fixed domain of all times (as eternalists do), one might add a predicate like $\mathsf{Present}(x)$ to pick out those that exist now – but then non-present objects still *"exist"* in the domain, blurring the ontological distinction unless carefully interpreted. In short, **neither classical predicate logic nor standard modal temporal logic cleanly handles a world where some things are real yet lack present existence**. We need a new logical framework that builds ER's two-tier ontology into its syntax and semantics ab initio.

Beyond pure logic, there are strong **motivations** for formalizing ER. Metaphysically, it offers solutions to longstanding problems: for instance, the **truthmaker problem** (what makes past-tensed statements true if the past no longer exists?) and puzzles of **cross-temporal identity** (how an object can be "the same" if it exists at one time and not at another). Epistemologically, ER aligns with a disciplined empiricism: it restricts *existence* to what is empirically accessible *now*, echoing Bas van Fraassen's call to "[refrain] from positing the existence of entities beyond possible experience".[5] Yet ER simultaneously validates scientific **inference to the unseen** by classing unobservable but causally grounded

1 https://philarchive.org/rec/TENERP#:~:text=In%20both%20everyday%20language%20and,critics%3A%20Is%20it%20coherent%20to

2 Ned Markosian (2015) vividly emphasizes this presentist claim: if we enumerate all entities our quantifiers range over, not one would be non-present — "all such objects are unreal" for the presentist. This quote is cited in Trepp (2025) as a concise statement of the orthodox presentist stance.

3 https://philpapers.org/archive/TENERM.pdf

#:~:text=Presentism%2C%20as%20introduced%20earlier%2C%20is,things%20that%20our%20most%20unrestricted

4 https://philpapers.org/archive/TENERM.pdf#:~:text=present,are%20real%20inasmuch%20as%20they

5 Bas C. van Fraassen, The Scientific Image (1980). Van Fraassen's constructive empiricism advises belief only in observable entities and agnosticism about unobservables. Our strict definition of "exists" (present and observable) is inspired by this epistemic discipline.

entities as *real*. Phenomenologically, ER resonates with our lived experience of time: we perceive a vivid present, yet are conscious of a just-past (retention) and an impending immediate future (protention) in what Husserl termed the "internal time-consciousness." [6] We also routinely treat certain future events as quasi-real in planning and anticipation, and treat memory traces of the past as evidence of real events, even though those events are not now present. Ethically, as we consider duties to future generations or the significance of past harms, we intuitively operate with more than a simple presentist ontology. All these considerations suggest that a formal system capturing ER's "existence ≠ reality" distinction is both feasible and desirable. It would allow philosophers and scientists to rigorously state propositions like "X is real but does not exist (yet/now)" and to reason about the relations between present observations and non-present entities.

Our aim in this paper is to develop such a formal logic for Existential Realism. In Section 2, we outline the logical framework, introducing a two-tier ontology of individuals and temporal indexing that cleanly separates the concept of *present existence* from *reality-at-large*. We propose new syntactic devices (indexed quantifiers or modal operators) to represent "exists now" versus "is real," and give semantic rules and axioms that enforce ER's asymmetry (everything that exists is real, but not everything real exists at present). We also present an illustrative "ER equation" to encapsulate the idea that reality is the sum of present existence plus additional structure over time. In Section 3, we demonstrate the expressiveness of this framework with examples drawn from four domains: quantum physics, neuroscience, ethics, and AI. These case studies show the logic's utility in describing scenarios where the present/past/future distinction is crucial. Section 4 then discusses how the formalism sheds new light on ongoing metaphysical debates: we revisit the truthmaker problem, the nature of persistence and identity through time, and related issues, showing how ER's logic can clarify or resolve certain issues that standard ontologies find troublesome. Section 5 concludes by summarizing our contributions and indicating directions for further development (such as incorporating degrees of reality or integrating the framework with probabilistic reasoning and relativistic time). Throughout, we maintain a rigorous but accessible style, with key points illustrated and technical details footnoted. In spirit, this work extends Trepp's earlier expositions of Existential Realism [7] by providing the "formal language" that ER implicitly calls for. By making the ER framework formal, we aim to solidify its position as a distinct and **productive ontology of time**, one that can interface with scientific models and logical inference systems as easily as with philosophical discourse.

Formalizing Existential Realism: A Two-Tier Logical Framework

Ontological Preliminaries

Existence vs. Reality. In ER, we draw a strict ontological line between what *exists* and what is *real*. Before presenting the formal syntax, it is useful to restate these definitions in a semi-formal way.[8] We define **Existence (strict sense)** as *being present and empirically accessible*. An entity or event *exists (now)* iff it is part of the current observable, material world. This is an **indexical, frame-dependent concept**: to exist means to exist-now-for-us, within the present moment's empirical horizon.[9] If something lies entirely outside the scope of current possible observation or interaction, then (at least for now) it does not count as "existent" in this strict sense.[10] By contrast, we define **Reality (broad sense)** as *participation in the world's causal, structural, or informational fabric*, regardless of temporal location.[11] An entity or event is *real* if it makes *any* verifiable or explanatory difference in the world – it

6 Edmund Husserl (1928), Vorlesungen zur Phänomenologie des inneren Zeitbewusstseins (Lectures on Internal Time-Consciousness, ed. Heidegger; trans. Brough 1991). Husserl describes how consciousness encompasses a retention of the immediate past and a protention (anticipation) of the imminent future, blurring a sharp present moment. See also Metzinger (2003), Being No One, on the "window of presence" in conscious experience.

7 https://philarchive.org/rec/TENERP

#:~:text=focused%20extension%20and%20clarification%20of,central%20thesis%20remains%3A%20existence%20and

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might have existed in the past, it might emerge in the future, or it might even be currently unobservable but inferred. The **domain of reality** thus includes all present existents (trivially, whatever exists now is real), *plus* those non-present things that nonetheless play a role in the causal or explanatory structure of the world.[12] Past entities that left traces or effects (e.g. extinct stars, historical figures, dinosaurs) are real by virtue of those causal traces.[13] Future entities that are reliably anticipated (e.g. a coming solar eclipse, a planned mission, or simply one's own future experiences in the next moment) are real insofar as they already inform present causal chains or rational expectations.[14] Even certain **theoretical entities** posited by science – like elementary particles or distant galaxies beyond direct observation – qualify as real if they are indispensable to our best explanations and are indirectly observed through their effects.[15]

These definitions underpin our logic. In essence, **Reality = Existence + X**, where *X* represents the temporally extended causal and inferential structures beyond the present.[16]

We can think of this almost as an equation:

Reality = Existence + Causality/Structure beyond the present.

This captures the core insight of **Existential Realism**: that reality encompasses both what presently exists and what contributes to the world beyond the now — including causal traces of the past and anticipatory structures of the future.

This can also be expressed in symbolic form:

R = E + Δ

where:
• **R** = Reality
• **E** = Existence (present, empirically accessible)
• **Δ** = Temporal-causal difference — the structured, non-present contribution to reality (past traces and future projections)

This expression serves as the *iconic equation of ER* — minimalist yet ontologically loaded. The symbol **Δ** encapsulates the layered temporal structure of what is real but not presently existent.

Language and Syntax

We extend many-sorted first-order logic with two sorts of individual: **Present-Entities** and **Real-Entities**. Intuitively, Present-Entities are those that exist now, and Real-Entities include everything that is real (whether presently existing or not). Formally, however, it is convenient to use a single sorted domain D for *all real entities*, and introduce a unary predicate $E!$ (exists-now) to distinguish the present ones. Alternatively, one can introduce two quantifiers: $\exists_E$ ("there exists now") and $\exists_R$ ("there exists in reality"), with $\exists_R$ being the usual existential over the whole domain and $\exists_E$ a restricted existential that additionally asserts present existence. We will use the single-domain + predicate approach for clarity. The non-logical symbols of our language thus include:

- A unary predicate $E(x)$ (or $E!x$) to denote "x exists now" (present existence).
- (Optionally, a unary predicate $R(x)$ for "x is real." However, if our domain D already represents all real entities, $R(x)$ would be true for every $x\in D$ by definition. We can omit R

12 https://philpapers.org/archive/TENERM.pdf#:~:text=present,are%20real%20inasmuch%20as%20they
13 https://philpapers.org/archive/TENERM.pdf#:~:text=presently%20existing%20entities,includes%20past%20entities%20that%20did
14 https://philpapers.org/archive/TENERM.pdf
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15 https://philarchive.org/archive/TENERP#:~:text=real,germinal%20form%3B%20so%20too%20are
16 https://philarchive.org/archive/TENERP#:~:text=through%20their%20effects,the%20world%20across%20time%20and

as a formal predicate and use it informally, or include it for symmetry with axioms linking E and R.)

- A set of predicates and function symbols for other properties and relations of interest (these could include temporal relations like $EarlierThan(x,y)$ or causal relations like $Causes(x,y)$, etc., depending on the application). We may also include a constant symbol NOW to refer to the current time (see below), or treat the notion of current time implicitly.

Terms are formed as usual (constants, variables, function terms). Atomic formulas can be of the form $P(t_1,\dots,t_n)$ for n-ary predicates P, or $E(t)$ (and if included, $R(t)$). We will occasionally use infix notation for relations like $t_1 \prec t_2$ to mean "t_1 is earlier than t_2" if a temporal order relation is defined.

To reason about time, one option is to add an explicit sort for times and a binary predicate $ExistAt(x, t)$ meaning "entity x exists at time t." However, to keep our logic manageable, we instead treat time implicitly via modal operators or via the E predicate relative to an evaluation time. We adopt the perspective of **temporal semantics** where formulas are evaluated at a particular time (the present), somewhat like a hybrid of first-order and modal tense logic. In practice, we will use the $E(x)$ predicate to indicate *existence at the time of evaluation (the "now")*. We may also use standard tense operators $P\varphi$ ("it was the case that φ") and $F\varphi$ ("it will be the case that φ") to qualify statements, knowing that inside those operators the predicate E will refer to existence at the shifted time. For example, $P,E(x)$ would mean "x existed (was present) at some past time," and $F,E(x)$ means "x will exist at some future time." These operators can be taken as part of the logical vocabulary or defined in the metalanguage for convenience.[17]

Semantics

We outline the intended semantics informally. The structure $\mathcal{M}$ for our language will consist of:

- A non-empty set D = **Domain of all real entities**. This domain is fixed and represents everything that is real in the modeled universe (past, present, or future). Thus, if something is not in D, it is considered *non-real* (e.g. purely fictional or impossible entities are outside our domain).
- A distinguished **present time** t_0 (we can think of t_0 as "now"). We can consider a set T of times ordered by $<$, but since we evaluate formulas at t_0 by default, we often don't need to quantify over times explicitly.
- An interpretation of the predicate $E(x)$ such that $E^M \subseteq D$ represents the subset of entities that exist at time t_0. So if $a \in D$ and $a \in E^M$, that means a is **presently existing** in $\mathcal{M}$'s world at the current time. If $a \in D$ but $a \notin E^M$, then a is real but not present (it might exist at some other time, or not exist yet/anymore). We require that E^M can vary with time; more formally, one could say $E^M(t)$ for time t, but at t_0 specifically, $E^M(t_0)$ is the set of present entities.
- (If we included $R(x)$ as a predicate, we would simply interpret $R^M = D$ – so $R(x)$ is true for all $x \in D$, by design. In other words, all domain elements are real. Non-domain items are not even quantified over. We will not include R explicitly in formulas since it's trivial under these semantics.)
- Interpretations for other predicates and functions as usual. For example, a binary relation $Causes(x,y)$ would be interpreted as a subset of $D\times D$, presumably with the intention that if $Causes(a,b)$ holds in M, then a and b stand in a causal relationship (which typically also implies some temporal ordering a earlier than b in an associated time structure).

17 Arthur Prior's tense logic (see Prior 1967) pioneered the use of operators P, F to treat temporal propositions without explicit time variables. We adopt those for convenience. One could equally use an explicit time variable approach (e.g., $Exists(x,t)$) and quantify over times; our results are not tied to one or the other syntax, though the $E(x)$ predicate approach emphasizes the viewpoint of a moving present. For an overview of formal presentism vs eternalism semantics, see Crisp (2003) and Bourne (2006).

Truth at a time: We say a formula φ is *true* at time t in $\mathcal{M}$ (notation: $\mathcal{M}, t \models \varphi$) using standard rules except for the predicate E. $\mathcal{M}, t \models E(x)$ iff the interpretation of x (an element of D) is in $E^M(t)$, the set of entities existing at time t. At the present time t_0, $E^M(t_0)$ is our "present existents set." For atomic formulas without E, their truth does not directly depend on the time (they express tenseless facts or relations between individuals, which might themselves implicitly presuppose existence to stand in the relation). We will often evaluate formulas at t_0 unless otherwise specified. The modal operators have their usual semantics: $\mathcal{M}, t_0 \models P,\varphi$ iff there is some past time $t'< t_0$ such that $\mathcal{M}, t' \models \varphi$; similarly $\models F,\varphi$ iff some $t''>t_0$ gives φ. Since $E(x)$ within φ at time t' means existence at t', this handles statements about past or future existence appropriately.

2.4 Axioms and Inference Rules: We add specific axioms to encode the principles of Existential Realism:

1. **Everything that exists is real:** $\forall x, (E(x) \to R(x))$.
    - In our semantics, this is automatically satisfied because if x exists (presently), then $x \in D$ (by being in $E^M \subseteq D$) hence x is in the domain of real entities. We state it as an axiom schema to clarify the intent. In practice, since $R(x)$ is trivial in D, this just underscores that $E(x)$ does not reduce the domain – it's a subset of it.
2. **Something can be real without existing:** $\exists x, (R(x) \wedge \neg E(x))$.
    - This asserts the non-emptiness of the "non-present" part of reality. In other words, not all real things are present. This axiom differentiates ER from pure presentism (where it would be false). For example, a constant symbol $\mathtt{dinosaur}$ could witness this: $R(\mathtt{dinosaur}) \wedge \neg E(\mathtt{dinosaur})$ – "the dinosaur (species or a particular dinosaur) is real but not existent (now)." This would be true in our model if that dinosaur is in the domain D but not in $E^M(t_0)$. Empirically, we know dinosaurs once existed, leaving fossils; thus they are part of reality though none exist today-philpapers.orgphilpapers.org.
3. **Temporal conditioning of existence:** $\forall x, [\neg E(x) \to (P,E(x) \vee F,E(x) \vee \textit{NeverExists}(x))]$.
    - This axiom states that if x does not exist now, then either x did exist in the past, or x will exist in the future, or else x never exists at any time (the last case would mean x is a merely abstract or theoretical entity that never actually comes to be – for example, a wholly fictional character might be "real" only in the sense of conceptual structure but never instantiated). We include the third disjunct to allow the possibility of entities that are postulated (perhaps by a theory) yet perhaps never actually instantiated in time. In most cases of interest in ER, something is real *because* it did exist or will exist (ER is generally committed to the reality of things that are at least actual at some point). For instance, past-events like Vesuvius's eruption satisfy $P,E(x)$ (it existed in 79 CE) even though $\neg E(x)$ now.[18] A future event like a 2100 solar eclipse satisfies $F,E(x)$ (it will exist) while $\neg E(x)$ now. A purely fictional entity (Sherlock Holmes) would satisfy $\neg E(x)$ and also $\neg P,E(x)$ and $\neg F,E(x)$, thus falling under "never exists" – and in ER we would likely exclude it from D entirely (thus not real). This axiom essentially ensures that *to be real yet not exist* implies a temporal status (past or future existence) rather than some mysterious outside-of-time existence.[19]

18 https://philpapers.org/archive/TENERM.pdf#:~:text=present,are%20real%20inasmuch%20as%20they

19 John Bigelow (1996), "Presentism and Properties," discusses how presentists can attempt to ground truth-values of past and future-tensed propositionsphilarchive.org. Our axiom 3 is in part aimed at capturing the idea that if something is real-but-non-present, it usually slots into a past or future context. If an entity were real yet never to exist at any time, we would question in what sense it is real at all – this is arguably the status of purely fictional entities, which ER would classify as not real (hence excluded from D). Our logic thus assumes that being "real" typically entails historical or futuritional existence, except perhaps for abstract objects or universals if one counts them, which would require further nuance.

4. **Present centricity (Only present exists):** $\forall x, \forall y, [(x = y) \to (E(x) \leftrightarrow x \approx y)]$.
    - This somewhat unusual schema is meant to capture that an object cannot "exist" in the strict sense at a time unless it *is* present at that time. Here $x \approx y$ is a placeholder for "x is identical to y and y is present (the time or frame under discussion)." A clearer way to state this principle is: "There is no entity that is not present yet somehow counts as existing; existence is an absolute *now-property*." We could simplify to: $\forall x, \neg (P,E(x) \wedge F,E(x) \wedge \neg E(x))$, ruling out that something could exist only in the past or future but still be considered existing now. Actually, this is mostly ensured by how we use E. We state it intuitively: at any given time, existence is *exhaustively* that which is present. In other words, our ontology does not include "latent existents" hanging in limbo – if it's not present (and not observable now), it simply doesn't exist now (though it may exist at another time). This principle guards against any slide back into thinking of existence as a tenseless property.
5. **Causal asymmetry axiom (no future-to-present causation):** $\forall x,y, [(Causes(x,y) \wedge E(y)) \to P,E(x)]$.
    - This formalizes the idea that if something causes a present event y, then that cause x must have existed in the past (or at least no later than y). In simpler terms, all causes of present effects are themselves real and, if they are events or entities, they either exist now or existed in the past (not exclusively in the future). This axiom encodes a mild form of temporal causality: present events can have causes that are present or past, but not causes that "come from the future." It's consistent with physical causality (excluding exotic scenarios of retrocausation). If x is not present, then $P,E(x)$ ensures x did exist; if x is an abstract cause (like a standing law), one might treat that differently, but typically causal chains in ER involve real events across time. This asymmetry aligns with ER's insistence that the flow of influence is from past to present to future (even though future events are considered real in some sense, they do not *yet* exert direct causal influence backward – rather, it is our present *knowledge or expectation* of them that influences present actions, see below).

6. **Actualization of potential (future real → will exist):** $\forall x, [(R(x) \wedge F,\textit{CrediblyExists}(x)) \to F,E(x)]$.
    - This rule captures the "collapse of potential into present actualization." It says: if x is real and it is credibly going to exist (in the future), then indeed x will (at some point) exist. Here $F,\textit{CrediblyExists}(x)$ is a placeholder for "according to our best current knowledge, x will exist in the future." In practice, one might use a modal operator or a predicate for known or determined future events. For instance, if our scientific model predicts a certain particle will appear or a comet will return in 2100, then we treat that as x being real now (as a future entity) and indeed x will come into existence at the appointed time. This axiom is less a logical truth and more a rule of inference: it legitimizes our treating predicted entities as real by ensuring consistency – if we are wrong and it turns out $F,E(x)$ does *not* happen, then we ought to revoke $R(x)$ for that x. In other words, one should not count something as "real" in the future unless one reasonably expects it will actualize. When it does actualize (the future becomes present), x's status changes from merely real to existent. Afterward, once x passes again into the past, it ceases to exist but remains real (now as a past entity). This dynamic is the hallmark of ER's treatment of becoming: reality is a continuity, existence is a moving spotlight within it.

There may be additional axioms or rules depending on specific interpretations (for example, one might formalize that if x is real and entirely in the past, then there must be some present evidence or trace of x – an epistemic/causal condition. We leave such principles for a more elaborate epistemic extension of the logic). The above axioms are sufficient to characterize the core of the two-tier ontology.

2.5 Discussion: This logical framework ensures that at any given moment, the **ontology of existents** is sparse and present-bound (only things currently present count as existent), whereas the **ontology of realness** is expansive, including past and future entities insofar as they are connected to the present world. The use of an existence predicate $E(x)$ rather than, say, a predicate "PresentTime(t)" with $ExistsAt(x,t)$, emphasizes that existence is treated as a property of an entity relative to the context (much like actualist quantifiers in modal logic use an existence predicate to distinguish actually existing individuals). Indeed, there is an analogy here to modal metaphysics: actualism vs possibilism. In modal terms, ER holds a view akin to "temporal actualism": only things in the present time are *actual* existents, but possible (in this analogy: past or future) entities are still part of the broader ontology (they are not merely nonexistent). Philosophers who wanted to allow reference to mere possibilia developed systems with an $E!$ predicate for "exists in the actual world" – our E plays a similar role for "exists in the present time." The logic we propose, therefore, can be seen as a **hybrid of tense logic and actualist quantified modal logic**, specialized to the temporal setting. We ensure cross-temporal coherence by quantifying over one, unified domain of real entities D, which allows us to use one constant or variable to refer to the *same entity* even if it only exists during certain intervals. For example, we can have a constant symbol $\mathtt{Socrates}$ in D with an axiom that $P,E(\mathtt{Socrates})$ (Socrates did exist, in the past) and $\neg E(\mathtt{Socrates})$ now, and perhaps $F,E(\mathtt{Socrates})$ is false (he will not exist again). Still, $\mathtt{Socrates}$ is a member of D, so propositions about Socrates (like "Socrates is a philosopher") can be true by virtue of Socrates' properties in the past, and importantly, we consider Socrates *real*: he is part of reality (indeed a causally impactful part of reality, through his historical influence) even though he is not now present. We can refer to Socrates in a logically coherent way without committing to his present existence – something classical logic alone could not elegantly do without this apparatus.

Crucially, our semantics does not violate **ontological parsimony**. We are not reifying ghostly present instantiations of past entities; we are simply allowing the logic to refer to entities that exist at some time. We keep the presentist intuition that "to exist is to be present," but we avoid the presentist consequence that anything not present is outright unreal or ineffable. As a result, we solve many of the hiccups presentism faces. For one, **truthmakers for past truths** can be accommodated: a statement like "Dinosaurs roamed the Earth" is true because there *exists* (now) ample evidence – fossils, cosmic background radiation anomalies, etc. – and there is a *real entity* (the event of dinosaurs roaming, or the dinosaurs themselves) such that those present traces are causally linked to it.[20] In our logic, one could formalize: $\exists x (Dinosaur(x) \wedge P,E(x))$ meaning "there exists (in reality) some x which is a dinosaur and x existed in the past." This can be true in $\mathcal{M}$ because x can be a member of D (hence real) with $P,E(x)$ true and $\neg E(x)$ now. The truthmaker of "$\exists x,Dinosaur(x) \wedge P,E(x)$" might be the combination of x's reality and some present evidence y such that $Causes(x,y)$ and $E(y)$. We could explicitly state a Truthmaker Postulate: $\forall p$ (if p is a proposition about some non-present entity x, and p is true, then there is some present entity y (e.g. a record or trace) that grounds p's truth by bearing a relation to x). While we do not formalize that fully here, the ER logic makes it much easier to articulate because x can be directly referenced as a real entity, and y can be referenced as existing, and a relation (like causation or memory) can link them. Standard presentism could not even quantify x in the first place without resorting to indirect surrogates (like abstract properties or haecceities to stand in for Socrates or dinosaurs).

Before moving to concrete examples, let us illustrate the logic with a **simple scenario**: Imagine a world at time t_0 where a tree that existed yesterday has been cut down. Let $a =$ "the tree", which existed on t_{-1} (yesterday) but not now, and let $b =$ "the stump" (its remaining stump, existing now). In our ontology, $a \in D$ and $b \in D$. At time t_0, $E(a)$ is false (the tree is gone), $E(b)$ is

20 https://philpapers.org/archive/TENERM.pdf#:~:text=match%20at%20L288%20given%20its,it%20is%20not%20present%20or

true (the stump exists). But a is still real because b (the stump) is a present trace of it. We would have $Causes(a,b)$ (the past tree caused the presence of this stump, or at least b is a part of a's causal history). By Axiom 5, since $E(b)$ and $Causes(a,b)$, it must be that $P,E(a)$ – indeed a did exist in the past (true). So all conditions hold consistently: a is in the domain (real), a existed in the past, a doesn't exist now, but something that exists now carries a's influence. A pure presentist might say "the tree no longer exists, period" and would have to account for how we can truthfully talk about it; an eternalist might say "the tree exists equally on the timeline, just not at present" treating existence as tenseless. ER via our logic says: the tree *does not exist now* (so we don't count it in the current ontology of existents), but the tree *is real* (because it is part of the causal fabric leading to present features like the stump and our memories of shade). This is a subtle but powerful distinction: it avoids implying the tree is somehow still hanging out in being (as eternalism does), but also avoids implying the tree is nothing at all now (as strict presentism does). The logic supports this by allowing a as a value in the domain with $E(a)$ false and other relations true.

In summary, we have built a formal scaffolding to hold the two pillars of Existential Realism: a **predicate E** marking the narrow, present-bound existence, and a **comprehensive domain D** for reality with associated temporal/causal structure. The axioms ensure that the present is constantly renewed (only the present exists at once) while the reality accumulates or at least encompasses those events. The stage is now set to see this framework in action across various intellectual domains, which we turn to next.

Illustrative Applications of the ER Logic

To appreciate the utility of the formalism, we apply it to several arenas where the existence–reality distinction is especially salient. In each case, the ER logic allows us to describe phenomena in a way that standard logics would either obscure or outright misrepresent. We will see how the symbols $E(x)$ and the reality concept help articulate subtle situations in quantum physics, cognitive neuroscience, ethical theory, and artificial intelligence. Each example also highlights how something can be **real without (currently) existing**, and why that matters.

Quantum Mechanics: Wavefunctions, Collapse, and Delayed Choice

Quantum theory famously blurs the line between possibility and actuality. Before measurement, a quantum system (say an electron or photon) is described by a **wavefunction** – a superposition of multiple possible states. Does an electron in a superposition *exist* in a particular state prior to observation? The Copenhagen interpretation would say no: before measurement, it has no definite classical properties (like position); only upon measurement does it *actualize* (collapse) into a definite state. Yet, the pre-measurement wavefunction is not nothing – it is **real** in the sense that it has observable effects (interference patterns, for example). ER logic provides language for this: we can let $E(x)$ represent "the system x has a definite classical state (exists in a definite way now)" and $R(x)$ represent "the system is real." We then say prior to measurement, the electron's state x satisfies $R(x) \wedge \neg E(x)$: it is ontologically real (the electron and its probabilistic state are part of reality, influencing outcomes), but it does not exist in a single determinate state (hence $\neg E(x)$ – no single classical existence). Upon measurement at time t_{meas}, the logic would transition to $E(x)$ becoming true (at that moment, x now exists in a definite state). We might even describe the **collapse** as the moment when a previously merely-real potential becomes a present existent. Formally: before t_{meas}, $F,E(x)$ was true (it *will* exist in a definite state), so by our Axiom 6 we treated x's specific outcome as real in anticipation; at t_{meas}, that $F,E(x)$ is realized, making $E(x)$ true. After measurement, x might continue to exist for some time until it perhaps decays, at which point $\neg E(x)$ again (it no longer exists), though it remains real as a past event or via its decay products.

Consider **Wheeler's delayed-choice experiment** [21] – a setup where the choice of how to measure a photon (as a wave or particle) is made *after* the photon has entered the experimental apparatus. The startling result is that how we choose to observe seemingly determines whether the photon "went through both slits as a wave" or "took one path as a particle," even though that choice is delayed. In classical terms, one might worry this implies the photon's past behavior was not fixed until the measurement – a kind of retroactive change. Using ER concepts, we can say: the photon's behavior prior to measurement was real but indeterminate (it did not exist in a single-path or dual-path state). When the measurement choice is made, we simply actualize one aspect of that reality. There is no need to say the photon *changed* what it did in the past; rather, prior to measurement the photon's trajectory was not an "existent" fact (only a real superposition). The **ER logic** allows a statement like: "At time t_0 (photon in flight), for each path p, $R(\mathit{Photon{_}on{_}path} p)$ holds (the photon had a potential presence on path p, part of reality), but $\neg E(\mathit{Photon{_}on{_}path} p)$ (it didn't definitively travel that path). At t_1 (detection), one of these paths becomes $E(\mathit{Photon{_}on{_}path}_k)$ true (the photon is found to have taken path k), while the alternative path's potential is nullified." This language avoids the paradox of a photon that "must have decided retroactively" – instead, reality had both possibilities in superposition (real but not exclusive), and existence picks one upon measurement. The delayed-choice scenario thus nicely illustrates something **real** (a quantum state spanning both paths) that was never a single classical existent until observed. Standard logic would have trouble saying "the photon went through both slits and yet not" without contradiction, but our two-tier logic can say "it wasn't the case that *either* path was a definite existence, yet the superposed state was real." The causal structure is maintained: present choices affect how the wavefunction collapses, but they do not reach back in time to alter a fixed past fact – they only determine which aspect of an indeterminate past becomes actualized.

We could further formalize quantum **entanglement** in ER terms: an entangled pair of particles can be spacetime-separated yet only definitively acquire states upon measurement of one (with the other instantly taking a correlated state). Prior to measurement, the pair's joint state is real but not factorable into two existent states. The logic would assign a single reality to the joint system and withhold separate E facts for each particle's spin until measurement. This preserves locality of existence (no faster-than-light "influence" in existence, because neither particle had an independent state existent beforehand), though reality itself is nonlocal (the entangled state spans both particles). In summary, ER's logic offers a coherent ontological bookkeeping for quantum phenomena: **Possibility becomes reality becomes existence**, in that order, rather than classical logic's forced dichotomy (either something exists with definite properties or it doesn't exist at all).

Neuroscience and Cognitive Science: Memory and Anticipation

Our cognitive machinery constantly deals with things that are not part of the immediate present. The brain maintains **memory traces** of past events and generates **predictions** or simulations of future events. How can something that isn't present – a past experience or a future outcome – affect current mental states? Folk psychology might say "the memory of event E is in my head now, therefore E somehow exists in me," or "I am anticipating F, so F already influences me." In strict presentism, one might reduce these to talk only of present brain states, but then one loses the intuitive distinction that those brain states *are about* something real beyond the present. ER logic provides a clear way to talk about this. Let's denote by m a particular memory (a neural or mental state encoding information about a past event E). Let e be the past event itself. In our framework, we say $E(e)$ is false (the event is not presently occurring), but $R(e)$ is true (the event is real – it happened and left effects). The memory m exists now ($E(m)$ true, as a pattern of neural connections perhaps). We also assert a relation $Represents(m,e)$ or $CausedBy(e,m)$ – the memory is causally downstream of the event, carrying its imprint. Now we can describe the situation: m exists now and causes present experiences (like recall or influence on behavior), and e is real (hence can serve as the content

21 (6) J. A. Wheeler (1978), "The 'Past' and the 'Delayed-Choice' Double-Slit Experiment," in Mathematical Foundations of Quantum Theory, ed. A.R. Marlow. Wheeler's thought experiment suggested that whether a photon "behaved" like a wave or particle could be decided after it entered the apparatus, highlighting that quantum reality is observer-dependent in a novel way. Our ER interpretation aligns with Wheeler's view that one should not assign a single history to the photon independent of the measurement setup – before detection the photon's potential paths are real (in superposition) but not fixed in existence.

of the memory). The truthmaker for the statement "I remember e" can be m (the present mental state) together with the reality of e and the causal link between them. If e were not real (say it was a confabulation of something that never happened), then m would not be a veridical memory but a fabrication. Under ER, to remember something implies that "something real happened" (or at least you take it to be real). Indeed, one of the **philosophical issues of memory** is the status of memories of events that did not occur: we call those false memories precisely because they lack a real referent e. Our logic can express the distinction: a genuine memory corresponds to $\exists e (R(e) \wedge P,E(e) \wedge CausedBy(e,m))$ whereas a hallucination or false memory has no such e in the domain (no real event, even if the memory state m exists). Thus ER logic helps define what it means for memory to be *about* something real without requiring that the past event still exists. It is enough that the past event is real (and causally connected). This addresses what is sometimes called the **epistemic bridge** problem: how minds connect to a non-present reality. Here, the connection is formalized via relations in the logic linking present existents (brain states) to non-present reals (past events).

Now consider **anticipation and predictive processing**. The human brain (and many AI systems) engage in continuous prediction of the near future. For example, while listening to music, one's brain anticipates the next notes; when walking, one anticipates the next visual input based on motion. Neuroscience theories like the *predictive coding* paradigm suggest that the brain constantly generates forward models and that perception is essentially a comparison of these predictions with actual input, minimizing prediction error.[22] In ER terms, the brain treats certain likely future events as *real enough* to prepare for. Formally, let p be a mental state representing a predicted event F (e.g., expecting a melody to resolve to a certain note). p exists now ($E(p)$ true, it's a current cognitive state), and we posit a relation $Forecast(p, F)$ indicating that p is a representation of a future event F. The event F itself might be, say, the occurrence of that note in one second. Does F exist now? No ($\neg E(F)$ at present). Is F real? According to ER, if the prediction is well-founded (not mere fantasy), we should count F as real *insofar as* it is integrated into current causal structures (perhaps via the performer's intention or the song's established pattern). In practice, we often have a high credence that F will happen. Thus we assert $R(F)$ because F plays a role *now* (our brain state and perhaps our preparations depend on it). Using Axiom 6, F being real and credibly going to exist implies indeed F will exist (barring surprises). When the anticipated note actually sounds, at that moment $E(F)$ becomes true (it exists), vindicating the earlier reality assignment. If something intervenes (say the music stops unexpectedly), then our expectation fails – F was treated as real in anticipation but did not actualize. In that case, strictly speaking, F was real only as a *potential* that did not come to fruition. Our logic could handle that by having degrees of confidence or marking $R(F)$ as conditional. But leaving that aside, the normal case is: anticipating a likely event allows aspects of the future to influence present cognition. ER's framework legitimizes this by saying the *future event is (to some degree) real now*. Contrast this with a naive presentist view that "the future doesn't exist at all yet" – one would then have to say our brain is merely guessing based on present cues, which is true, but one lacks a satisfying ontological account of why such guesses can be rational or reliable. In ER, because reality includes structured **potentialities**, one can say our present brain states latch onto those potentialities (which are real patterns, e.g., the musical structure or a physical law that ensures F will happen).

A concrete neuroscience example: Suppose a neuroscientist finds that when a tone sounds, the brain activity actually reflects an *error signal* between an expected tone and the actual tone. This implies the expected tone was represented preemptively. In our logic, we might represent "expected tone event" as F. Prior to the tone, $R(F)$ (the brain's model treats the tone as real and imminent) but $\neg E(F)$. Once the tone occurs, we have $E(F)$ for the actual tone event. The brain then updates, etc. If no tone occurs, the brain registers surprise (a high prediction error), effectively marking that something believed real (F) failed to become existent, perhaps adjusting confidence next time.

In summary, using ER logic in cognitive science highlights how the mind straddles multiple time domains: it contains **engrammatic presences of the past** (memories of real-but-no-longer-existent

22 Andy Clark (2013), "Whatever Next? Predictive Brains, Situated Agents, and the Future of Cognitive Science," Behavioral and Brain Sciences 36(3). Clark argues that the brain is fundamentally an anticipation machine, constantly modeling forthcoming inputs. In ER terms, this implies the brain must treat not-yet-existent events as part of its operative reality, which our logic cleanly represents by allowing reference to and reasoning about future entities.

events) and **protensive representations of the future** (images or expectations of real-but-not-yet-existent events). The formalism allows us to say those past events and future possibilities are not treated as mere fictions; they are real enough to have causal and functional relevance in the present.[23] This has implications for philosophy of mind and AI design: an intelligent agent operating with ER logic would maintain a "world model" that includes entities tagged as past or future, rather than flushing them out of ontology or insisting they must exist in some ghostly way. It also fits with phenomenology: our experience of the "specious present" (approximately a few-second window of consciousness) actually includes lingering echoes of what just happened and immediate anticipations of what is about to happen. In ER terms, consciousness itself may integrate things that strictly do not exist (just-past events, just-future events), treating them as part of reality experienced now.

Ethics: Duties to Future Persons and Moral Reality Across Time

Ethical reasoning often requires considering entities that do not presently exist. A prime example is **future generations**. We make decisions (about the environment, technology, etc.) whose primary impact will be on people who are not yet born. Traditional ontologies pose a problem: if future people do not exist at all (now), in what sense can we have obligations to them? Who are we harming if "they" are nothing? Some philosophers (e.g. presentist-minded ones) might reduce this to obligations to abstract values or to currently existing proxies (like "present promise to ensure a certain state"), but many ethicists intuit that future individuals have moral standing despite their non-existence. Existential Realism provides a framework to vindicate that intuition: **future persons are real** (inasmuch as their coming to be is part of the causal structure we foresee), even though they do not yet exist.[24] Thus we can say "we have obligations to future people" and interpret it as obligations to real-but-not-yet-existent individuals.

Let's formalize a bit. Suppose we are considering the welfare of our grandchildren's generation (call a representative future person g who will be born in 2100). In our logical domain, g can be an element of D (the domain of real entities), even though 2100 is in the future. We assert $F,E(g)$ (this person will exist in the future, presumably) and thus by our principles $R(g)$ holds now: g is real for us (we acknowledge g in our ontology). Now consider a statement: "It is morally wrong to destroy the environment in a way that harms g." Under presentist thinking, one might object – g doesn't exist, so how can we harm or wrong *them*? But in our logic we can formulate harm in terms of causal relations: Our present actions (say heavy pollution) *cause* certain future outcomes that affect g. We have $Causes(\textit{our_action}, \textit{harm}(g))$ and when g comes to exist, they will suffer. Already now, we can represent $\textit{harm}(g)$ as a future event or state (perhaps g having a disease or lack of resources as a result of our pollution). That $\textit{harm}(g)$ is not yet actual, but is a real possibility if we choose a certain action. A moral principle such as "Avoid causing unjustified harm to persons" can then be applied in our framework by quantifying over real persons, not just existing ones: $\forall x$ [(if x is a person and $R(x)$) then (we should not perform actions that lead to $F,\textit{harm}(x)$)]. This allows x to be a future person. Provided x is real (will exist or is likely to), the moral rule treats them on par with presently existing persons. If x were purely fictional or never to exist, then $R(x)$ would be false and the rule might not apply. Thus, ER logic essentially says: *potential people count morally if their existence is real enough*, i.e., if it is part of the expected course of the world that they will come into being.[25] This captures common intuitions in, say, climate ethics, where we feel a moral impetus to reduce carbon emissions for the sake of future generations. Under the hood, that impetus relies on considering those generations as something more than a nullity. ER formalism gives them ontological status (though not existence yet).

23 https://philpapers.org/archive/TENERM.pdf
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Another ethical puzzle is the **moral status of past actions and persons**. Take the question of *historical justice*: Can people now owe something (apologies, reparations) to people in the past? If those past people no longer exist, one might argue there is "no one to receive" an apology. Yet we do talk meaningfully about honoring past commitments or wrongs done to past individuals. In ER logic, a past person p (who died) does not exist now ($\neg E(p)$) but is real (they existed and left an enduring influence). While one cannot literally harm or benefit p now (causation doesn't go backwards), one can have obligations *regarding* p – such as to remember them, to recognize their rights posthumously, or to make amends for the effects of wrongs done to them (effects which might persist in the present). The logic allows quantification over such p. For example, a norm "Respect the dignity of persons, living or dead" could be formalized as: for all x, if x is a person and $R(x)$ (meaning they are or were real), then certain actions (defamation, desecration, etc.) toward x are wrong regardless of whether $E(x)$ now. This might be used to justify why we consider grave desecration immoral or why we feel the need to preserve the memory of those who are gone – the past person is still part of reality (their identity and story aren't erased), and our treatment of that reality can be guided by moral rules. Standard logic working only on existents would have trouble phrasing "don't badmouth the dead" except as a rule about effects on the living (like don't upset the surviving relatives). ER logic can phrase it more directly.

A further ethical aspect is **moral realism across time**: Are moral truths timeless, and how do they interact with the existence of particular agents? For instance, "Slavery is wrong" – was this true before any society existed? Or does it become true only when beings capable of enslavement and suffering exist? Without diving deep, our framework can allow moral propositions to be true at a time if conditions are met. For instance, if no sentient beings exist, then statements about duties might be vacuous. But once there are real individuals (present or past or future), moral properties or relations can be predicated. The logic can handle statements like "If some person will exist in the future, then it is good/bad to do A now," explicitly quantifying over that future person.

Another interesting scenario: **Non-identity problem** (Parfit's famous case). Our actions can change which individuals come into existence (for example, different environmental policies lead to different sets of people being born). So one might argue "there's no harm to future people by environmental degradation, because those who will exist in the polluted world wouldn't exist at all in the cleaner world scenario – you aren't making *the same* person worse off." However, morally we feel something is wrong if the future people's lives are much worse than they could have been, even if they are different individuals. In ER terms, one can articulate this without needing identity: we can quantify over possible future persons or general qualities of future societies. The logic could express "there will be real persons, and the overall suffering of those real persons is higher in scenario A than B, so A is worse morally." This doesn't require that the *same* person is harmed, just that reality contains more harm. Because ER allows talking about future populations collectively (they are real as a set of coming individuals), we can define a moral evaluation on that basis.

Summing up, ER's two-tier logic serves ethics by **broadening the community of moral consideration** to include not only presently existing beings but also those who did exist or will exist. It gives a formal underpinning to statements like "we must consider the rights of future generations" that is more than metaphor. In our logical framework, future generations are simply part of the domain of discourse (with certain predicates false, like E, but that doesn't nullify them). This approach can reduce paradoxes and provide clarity. It acknowledges, in a structured way, that **the moral realm is not temporally shallow** – it extends before and after the now.

Artificial Intelligence: Temporal Reasoning and Counterfactuals

An intelligent agent (natural or artificial) must often reason about things that aren't immediately present. Consider a domestic robot that has to clean a house. It may not currently *see* the mess in the next room, but it knows from earlier that there were objects to tidy (past info), and it plans for a guest arriving later (future event). The robot's planning algorithm will represent the unseen objects and the anticipated guest in its knowledge base. If the robot were a strict presentist in ontology, it would have trouble – it could not refer to the unobserved mess (since it "doesn't exist" from the robot's current sensor perspective) or the future guest (who certainly doesn't exist yet). In practice, AI systems bypass this by maintaining internal **state representations** that include objects that are *believed* to exist currently even if not observed, and predicted events. ER logic can formalize such state representations elegantly: The robot's world model domain includes entities that are not currently observed. For each entity x in its model, it could attach a flag like $PresentKnown(x)$ or use our $E(x)$ predicate from the robot's perspective. For example, the robot's map has a node for "coffee mug on table in next room" which it hasn't directly scanned in the last minute but assumes is still there. It treats the coffee mug as real and likely still existing (unless evidence suggests it moved). This corresponds to $R(x)$ and an expectation $F,E(x)$ or actually $P,E(x)$ (it existed moments ago, so probably still does). By having x in the domain at all, the robot's reasoning can include it in plans (like walking to pick up x). Without an ER-like approach, one might restrict the robot to only reason about what its sensors currently see, which would be terribly inefficient. In effect, practical AI already uses a form of ER: it keeps track of objects that are out of sight as continuing to be real. Our logic just makes that principle explicit: $\forall x (\mathit{BelievedPresent}(x) \to R(x))$ and typically the robot will assume $\mathit{BelievedPresent}(x) \to E(x)$ until proven otherwise (a common sense persistence assumption). If the mug was moved or broken, that assumption fails and it updates (marking $E(x)$ false if it confirms the mug is gone, but x could remain in reality as a past object).

Now consider AI planning for the **future**. An AI scheduling deliveries has to represent future deliveries that haven't occurred. It will create placeholders for those delivery events, treat them as real enough to allocate resources to, and ultimately execute actions to make them exist (i.e., actually deliver). In our logic, a planned event E can be in domain D, with $F,E(E)$ true (it is expected to exist), and so $R(E)$ now. The planning algorithm might reason "if event E is real (in the plan), I must ensure prerequisites A, B, C such that at time t, E will come to exist." By treating E as real in the planning stage, the AI can propagate constraints and allocate tasks. If something changes and the delivery is canceled (so E will not exist after all), the AI should remove $R(E)$ (it's no longer considered a real future event). This is analogous to how we treat anticipated events in ER (see Section 3.2).

Another area is **counterfactual reasoning**: AI agents often evaluate "what if" scenarios. For example, a self-driving car might simulate "If I take route A, will I save time compared to route B?" These counterfactual scenarios involve events that are not actual (and may never exist in reality). How might our logic handle them? We can introduce a modal operator or context to consider alternate possible realities (beyond the scope of our strictly one-world temporal logic). However, within the scope of one timeline, a counterfactual scenario can be seen as a hypothetical branch where certain future events E' exist instead of E. The agent can treat E' as conditionally real in a thought experiment. One way to do this formally is to augment each counterfactual scenario with its own domain or mark those events with a tag (like $R_{\text{hyp}}(x)$ meaning real in a hypothetical scenario). This goes slightly beyond ER's main focus (which is one actual timeline), but the discipline of distinguishing existence and reality still helps. Even in a hypothetical simulation, the agent can distinguish between what is currently the case in that simulation vs what is just potential. Many AI reasoners use a form of **simulation semantics** where they create a copy of the world state, modify something, and roll it forward. Within that simulated context, they again have a notion of present (in-simulation present) and simulated future. ER logic could be applied inside the simulation as well. The key takeaway is that by formalizing existence vs reality, we give AI a way to rigorously maintain multiple layers of belief: what is actual, what is anticipated, what is hypothetical. Instead of all these being flattened into "exists" or not, they can be separate predicates or modalities.

Consider also **temporal bounded inference**: an AI might limit how far ahead it plans (maybe it doesn't consider events beyond 30 days as too uncertain, treating them as not yet real enough to plan for). This could be implemented by not assigning $R(x)$ to events beyond a horizon. Or having degrees: perhaps assign a probability or weight to $R(x)$. While our base logic is bivalent, it can be extended with probability (some $R(x)$ might be true with probability 0.8 reflecting likely futures). An AI could then prefer actions that lead to better outcomes for those likely-real futures. In effect, it grades reality by plausibility, which humans do too (we focus on futures we consider real possibilities and ignore far-fetched ones).

Finally, consider knowledge representation: in AI knowledge graphs, one might store facts about historical figures or events. Those entries correspond to real but non-existent things (e.g. "Napoleon – existsNow: false, real: true, type: person, died: 1821"). The knowledge graph is basically an ER model in database form. The logic behind it could allow queries like "was there someone who... (past query)" which the system can answer by including non-present individuals. If it were restricted to "exists now," it would fail to recall historical facts.

In summary, ER logic aligns well with AI's practical needs: it **mirrors the way intelligent systems must represent the world**, with a current snapshot plus memory and foresight. By formally capturing the distinction between what's present and what's real-but-not-present, we can design AI reasoning that is more transparent and logically sound. It avoids common pitfalls like mistaking absence of evidence for evidence of absence (just because the robot can't see the cat in the room now doesn't mean the cat is nonexistent – it might be real and just hiding). Using E and R properly, the robot's logic can say "I don't have $E(\textit{cat})$ (I don't currently see the cat), but $R(\textit{cat})$ if I infer it's somewhere in the house". This has concrete implications for search behavior (the robot will keep looking knowing the cat is real, rather than concluding no cat exists).

Implications for Metaphysical Debates

Having outlined the formal system and seen it applied in various contexts, we now circle back to several core metaphysical debates to show how *Formal Existential Realism* offers clarified perspectives or even resolutions. In particular, we address (a) the **truthmaker problem** for past and future statements, (b) the **persistence and identity** of objects through time, and (c) the status of **past and future entities** in ontology (how ER relates to or diverges from presentism and eternalism). Throughout, our logic-based approach sharpens the arguments: claims can be translated into formulas in our two-tier language to avoid ambiguities that often plague verbal disputes.

Truthmakers for Past and Future Truths

The truthmaker principle is the idea that if a statement is true, there must be something in reality that makes it true (something that *grounds* its truth). Presentism notoriously struggles here: take the true statement "Dinosaurs roamed the Earth." What makes this true, given that (according to presentism) no dinosaur exists now? Presentists have suggested various solutions: perhaps *the world's past states* as a whole or present evidence (like fossils) serve as truthmakers, or truthmakers are not needed at all for past truths (denying the principle in that domain). ER provides a natural answer: the statement "Dinosaurs roamed the Earth" is true **because** there are real entities (dinosaurs, the events of their roaming) in the ontology, albeit not now existent.[26] More concretely, in our formal model, there exist some x in D such that x is a dinosaur and $P,E(x)$ is true (meaning x existed in the past). The existence of that x (at the past time) is as much a part of reality as anything present. So we can say the truthmaker is x itself (the past dinosaur) together with the fact that it had the property "roaming the Earth." But wait, x doesn't exist now – how can it serve as a truthmaker *now*? The key move ER allows is to divorce *existence* from *being a part of reality*. x is part of reality (so we are allowed to

26 https://philpapers.org/archive/TENERM.pdf
#:~:text=ontological%20commitment%20to%20anything%20wholly,events%20and%20structures%20across%20time

quantify over it and predicate things of it in our ontology), even though $E(x)$ is false now. The truthmaker principle doesn't demand the truthmaker exist *at the time the statement is considered*; it just demands something real accounts for the truth. Here that something is real (in the sense of belonging to the world's inventory) and it *existed* at one time. The presentist's problem largely came from the assumption "only what exists now is available to serve as truthmaker now" – we've lifted that restriction. In effect, **the past event itself can be the truthmaker**,[27] because we have kept it in our ontology as a real entity (albeit with a temporal qualification). One might refine this by saying the truthmaker is the *historical fact* of the event, which in our logic corresponds to an entity+time pair or a proposition that is directly grounded by the entity's past existence. Either way, we avoid the unattractive options of presentism (like invoking mysterious presently existing "historical facts" or denying truthmakers altogether).

For future truths (statements about what will happen), the situation is trickier since the future is open. Many future-tensed statements are not yet true or false (if indeterminism holds). But consider a statement like "The sun will rise tomorrow." Assuming for the moment this is true (and will indeed happen), what is its truthmaker? Under an eternalist view, the future sunrise exists on the timeline and can serve as truthmaker. Under presentism, one might say nothing yet makes it true (perhaps it's only *will* become true when it happens, or one relies on current deterministic conditions). In ER, we have a middle route: the sunrise event of tomorrow, call it s, is already part of reality in the sense that current solar system conditions and laws guarantee it (with high probability, at least). In our logic, we would include s in the domain as a future event (especially if we're confident in it) – that implies $R(s)$ and $F,E(s)$. So s can be referenced now as a real thing, and it will exist. Does s make "the sun will rise tomorrow" true now? We would say yes, insofar as s is already a real part of the world's unfolding (the causal network leads to it inexorably). The formal truth condition for "will rise tomorrow" is $\exists x (x = s \wedge F,E(x))$. In $\mathcal{M}$, this is true because such an s exists in D and indeed $F,E(s)$ holds. So semantically the statement is true. The truthmaker could be described as the combination of the current state of affairs plus natural laws, but ER would encapsulate that by saying those together ensure the reality of s already. On the other hand, if a future event is not yet determined (like "There will be a sea-battle tomorrow," Aristotle's famous example), ER logic would treat that event as perhaps not (yet) real – i.e., one would not include a definite s in the domain for it, or one might include two alternative events but not commit which is real. The statement remains undetermined in truth value until the situation resolves. ER doesn't magically solve open future indeterminacy, but it provides a clear criterion: when we have sufficient reason to treat a future event as real (like periodic astronomical events), we can assign truth values now. When not, we treat it as a mere possibility (not (yet) real). Thus, truthmaking for future contingents becomes a conditional thing in ER: the truthmaker either exists in the present (like some deterministic law state) or simply doesn't apply until the future event becomes real enough.

Another nuance: Bigelow (1996) and others have suggested truthmakers could be things like *present traces* or *present dispositions* that ensure a past or future statement. ER is compatible with that: in fact, often the present evidence is what tells us something past is real, and one might say the fossil is the truthmaker for "dinosaurs roamed." But strictly, the fossil (present) wouldn't imply "roamed" unless the dinosaur was real, so we prefer to say the fossil plus the real past dinosaur event together serve as truthmakers. We can formalize: Fossil f exists now and $CausedBy(d, f)$ for some d in domain (dinosaur). The truth "dinosaur roamed" is true because d (roaming) is real and related to f. If someone insists truthmaker must be present, they could point to f; ER would respond that f alone wouldn't mean anything unless d is real. In any case, ER's logic satisfies the spirit of truthmaking by ensuring that we never assert a proposition about non-presents without some ontological backing in the domain of reality.

27 https://philpapers.org/archive/TENERM.pdf
#:~:text=match%20at%20L324%20ontologically%20real,of%20historical%20truths%20and%20causal

Persistence and Identity Through Time

How do objects persist? If only the present exists, an object like a person seems to *pop* in and out of existence at each moment – the presentist can say the person exists *now*, and existed *then*, but what does it mean to be the "same person" if the person at past time is not literally the one at present (since that past one no longer exists)? Presentists often appeal to an *enduring self* that "goes out of existence and comes back into existence" every moment, or they say the person is wholly present at each time but with identity constituted by causal or other relations. Eternalists, by contrast, treat an object as a 4D worm across time, and identity is basically having the same worm. ER offers a hybrid perspective: objects do not have full existence spread across time (like eternalism's worm) – they only exist at the present slice – but the object *as a whole* (as a historical entity) is real across time. In our logic, an individual like Alice can be represented by a constant a that refers to Alice's complete being. At time t_1, $E(a)$ might hold (Alice exists at t_1); at a later time t_2, perhaps after Alice's death, $E(a)$ is false but a is still the *same entity* in domain. The identity of a is a fixed thing; what changes is the property $E()$ over time. So the statement "Alice at t_1 is the same person as Alice at t_2" can be trivially captured by using the same symbol a for both and noting it's one individual. We don't need "temporal parts" or counterpart theory for identity – $a = a$ is always true. What changes is whether a is present or not. So **endurance** (continued identity) is straightforward: an entity endures in reality even when it doesn't exist continuously. We might say it *continues to be real* (it's part of the world's story) even while it intermittently or eventually ceases to exist.

This addresses worries like "how can the past person be the same as the present person if the past one is gone?" In ER logic, the past person isn't gone in an absolute sense – they are not present, but they are still the same entity we have now (we have access to them via memory or records). Essentially, we treat identity as atemporal (an equivalence relation on the domain), and existence as temporal. Many philosophical puzzles, such as the Ship of Theseus, can be rephrased in our logic as statements about how $E(x)$ changes and how properties accumulate, without doubting that it's x throughout. For example, the Ship of Theseus: let S be the ship entity. Over time planks are replaced. At time t_0, $E(S)$ with original planks; at time t_n, still $E(S)$ but with new planks. Another "ship" $S_{\text{reassembled}}$ might be built from the old planks. Eternalist might say there are two distinct 4D worms. Presentist might have trouble saying S at t_0 = S at t_n because all parts changed. But ER can say: there is an enduring entity S in domain, whose part-composition changes, and indeed at each time the identity is maintained via continuity of structure/captain, etc. The reassembled planks form a different entity S' even if they share material. The logic itself doesn't solve the metaphysical decision of whether continuity of form or matter defines identity, but it allows one to express either criterion clearly. For instance, one could have a predicate $SameStructure(x,y)$ or a rule that if changes are gradual and form is preserved, the identity remains x. The point is, since x stays in the domain, we have a handle on it throughout.

Another issue is **cross-temporal relations**: can we meaningfully say "event A (today) was caused by event B (yesterday)"? Presentists sometimes balk because B doesn't exist now to relate to A. They resort to saying A has a property like "having been caused by something" without directly relating to B. In ER logic, we can just state $Causes(B,A)$ even if $E(B)$ is false now – B is still an element we can refer to (because it's real). So cross-time relations like causation, influence, similarity, etc., are perfectly legitimate. This is a major win for coherence: we often want to say things like "Our current social order is the result of decisions made by people long dead" – formalized as $\exists p,q$ (p are people in past, q is structure now, and $Causes(p,q)$). That quantification over p is fine in ER (domain has those past people), whereas a strict presentist semantics might not allow it except by some indirect device.

One could ask: does ER reify "non-existent objects" in a problematic way? Are we saying ghosts of Socrates roam in our domain? No – we're not saying Socrates in 2025 has a mysterious half-existence. We're just saying *Socrates the entity* is part of reality, and one can talk about him and attribute properties at times. It's akin to how historians or databases contain entries for past people – we all operate as if those people are in the "database of reality" albeit tagged as past. That's exactly what our domain D is like. There's no spooky extra being, just a tenseless inclusion of individuals. We avoid

Meinongian "exists in mind only" – these are actual individuals who did exist, not fictional or merely possible ones.

Concerning **Eternalism vs Presentism**: ER is neither, but clarifies both. Eternalism says all times are equally real and that entities at all times *exist simpliciter*. Presentism says only present exist. ER says all times' entities are real, but only present ones exist now.[28] If we translate eternalism into our terms, eternalism would mean $E(x)$ holds at all times for all x that ever exist (they treat existence as tenseless), whereas presentism would mean $\forall x (R(x) \to E(x))$ at the present (only real things are those that exist now – the contrapositive of our axiom 2). Our logic explicitly rejects that latter condition, allowing $\exists x (R(x) \wedge \neg E(x))$. Thus, as Trepp argued, ER is a distinct ontology, not just a minor tweak.[29]

One might wonder: can ER accommodate phenomena of **changing reality**? For example, what about entities that turn out never to have existed (like phlogiston in older chemistry – scientists thought it was real but it wasn't)? In our formalism, one could have temporarily included an entity in D and later remove it when discovered false. But better: such an entity was never real, so ideally it was never in the true domain of the world. However, in epistemic practice, we had a placeholder which we later discard. That suggests extending the logic with an epistemic operator or using a "belief domain" separate from reality domain. But strictly ontologically, ER says phlogiston was never real nor existent, just a concept. The logic as given doesn't directly talk about error, but one could encode it by a predicate like $Hypothesized(x)$ which might hold for some x that's not actually in D (which is bending rules). Alternatively, treat conceptual entities as separate sort. In any case, the formal apparatus could be expanded to track erroneous postulates vs actual reality.

Degrees of Reality: The notion that reality comes in degrees (e.g., how strongly supported or causally connected something is) was hinted in our discussion. Our base logic is bivalent, but one could imagine a metric or modal strength to $R(x)$. For example, a very distant future event might be considered "less real" (very uncertain) relative to our present perspective, whereas tomorrow's sunrise is almost fully real. This could be modeled by attaching probabilities or by fuzzy logic on R. That is outside classical logic, but an interesting extension. It resonates with ideas in philosophy that some entities are "more real" than others (sometimes said about potential vs actual, or about abstracta). ER in its simplest form doesn't quantify that – either an entity is acknowledged as real or not. But practically, we do make such gradations. Incorporating that would move us into many-valued logic or modal degrees (perhaps something like a necessity measure for future events).

Evaluation: A Distinct Metaphysical Framework

It's worth synthesizing why the formal logic of ER marks a **distinct** framework, not reducible to existing ones. Eternalism, presentism, and the growing-block theory each can be seen as special cases or as missing distinctions that ER introduces. Eternalism conflates reality with existence by saying everything (past, present, future) exists simpliciter – in our terms, it would let $E(x)$ be true for all x at once (or rather, treat E as tenseless). Presentism insists E is true only for now and denies any robust reality to non-present x. Growing block says past and present exist, future not – which is like saying past and present $E(x)$ are sort of true (if one uses an accumulated domain). Each of these can be coded in a first-order temporal semantics. What ER does is *separate the categories*: "exists now" is a separate predicate and "real" corresponds to membership in domain. This separation is conceptually simple but powerful; it was not explicit in older debates which often assumed one category (being or existence) and just argued about its temporal extent. In essence, the logic here creates a two-tier ontology: one tier (E) is indexical and fleeting, the other (D or R) is encompassing and persistent. This two-tier approach can, in principle, be grafted onto any formal semantics (for example, you can add our predicate E to an eternalist B-theory model and recover something like ER's view from within it). But doing so changes the conversation. Many objections to presentism (such as from relativity theory, where present is frame-relative) become less biting because ER doesn't

28 https://philpapers.org/archive/TENERM.pdf
#:~:text=Presentism%2C%20as%20introduced%20earlier%2C%20is,things%20that%20our%20most%20unrestricted
29 https://philarchive.org/archive/TENERP#:~:text=Section%205%20argues%20why%20this,paragraph%20references%20in

claim a unique global present matters to reality – reality is frame-invariant, whereas existence can be frame-dependent.[30] In fact, one could incorporate relativity by saying each observer has their slice of E, but all slices together constitute reality. That might be a way to reconcile presentism's motive (each sees only their present as concrete) with relativity's truth (no single present).

Finally, note how ER's logic invites a more **integrated worldview**: It brings ontology (what exists/is real), epistemology (what we can observe/infer), and phenomenology (how time is experienced) into a single formal discussion.[31] By formalizing existence as what is "empirically accessible now" and reality as what is "inferable or causally connected beyond now," we have in effect formalized an epistemic criterion into ontology. That was deliberate – it's part of ER's philosophical appeal. Traditional logic treats existence as an absolute (metaphysical) notion, but ER's logic makes it a context-dependent, observer-linked notion. This may seem unusual for a formal system, but recall that some logicians have created *indexical logics* or *contextual logics* (e.g., "actualist" quantifiers are a bit similar – they depend on a context of evaluation, the actual world). Our $E(x)$ is an indexical predicate ("x exists *now* [for us]"). This contextuality is why the logic can respect both science (which tends to think in tenseless terms) and lived experience (which privileges the present).

We anticipate that further work can build on this foundation: exploring modal analogues (possibility vs reality vs existence – three tiers?), applying the logic to specific problems like time travel paradoxes or the ontology of branching futures, and tightening the correspondence with physics (e.g., how to formally handle relativistic frames in the logic without absolute time). But those are tasks for another day. We will conclude by summarizing what we have achieved and the doors it opens.

Conclusion

In this paper, we have developed a formal logical framework to articulate *Existential Realism* (ER), capturing the notion that **existence is not coextensive with reality**. By introducing a two-tier ontology – separating the fleeting, present-bound nature of existence from the extended, causal-inferential nature of reality – we provided precise definitions for ER's key claims. Our logic employs a unary predicate $E(x)$ for "exists now" and quantification over a domain of "real entities," along with axioms ensuring that only present entities satisfy E while non-present entities remain ontologically significant (real). This structure allowed us to formalize and resolve several issues that are difficult to handle in standard logical or metaphysical systems:

- We showed how **something can be real without existing** by permitting $\exists x (R(x) \wedge \neg E(x))$ – formally distinguishing ER from presentism and eternalism.[32] Past and future entities, as well as currently unobservable ones, find a clear place in our ontology without granting them unjustified "existence" or relegating them to utter nothingness.
- We proposed an "ER equation" $Reality = Existence + Causal/Epistemic Network$ [33] to succinctly capture the idea that reality comprises the present actual world plus the web of non-present but real relations (traces of the past, potentials for the future, structures beyond immediate observation).[34]
- Using examples from **quantum mechanics**, we illustrated how ER logic accommodates the counterintuitive notion of a quantum state being real (with measurable effects) even when no definite outcome exists prior to measurement. The wavefunction's collapse was described as the transition of an entity from $R(x)\wedge \neg E(x)$ to $E(x)$, aligning with how physicists talk about potential states becoming actual.[35] Delayed-choice experiments were parsed with-

30 https://philarchive.org/archive/TENERP#:~:text=speculative%20excess,this%20relativistic%20insight%20%E2%80%93%20different
31 https://philpapers.org/archive/TENERM.pdf#:~:text=framework%
20inherently%20integrates%20epistemological%20and,and%20van%20Fraassen%E2%80%99s%20empiricist%20criteria
32 https://philpapers.org/archive/TENERM.pdf
#:~:text=technically%20grounded%20examples%20illustrating%20how,can%20be%20real%20without%20existing
33 https://philarchive.org/archive/TENERP#:~:text=through%20their%20effects,the%20world%20across%20time%20and
34 https://philarchive.org/archive/TENERP#:~:text=real,germinal%20form%3B%20so%20too%20are
35 https://philarchive.org/archive/TENERP
#:~:text=world%E2%80%99s%20causal%2C%20structural%2C%20or%20informational,present%20but%20are%20nonetheless%20part

out paradox by noting that prior to observation, certain event sequences are not determinate existents, though the underlying quantum reality is fully accounted for.

- In **neuroscience**, we explained memory and anticipation by formally representing past events and future events as real-but-not-present entities that causally influence present brain states. Husserl's protention/retention structure finds formal expression: the immediate past and imminent future, though not present, are part of the mind's world-model.[36] This clarified how we can have memories "of something" (because that something remains real in our ontology) and expectations "about something" (a future event treated as real in advance).
- For **ethics**, our framework gave voice to future generations and past individuals in moral reasoning. We can quantify over future persons as real to whom obligations are due, without committing the absurdity of saying they "exist" now.[37] We can equally refer to past people's rights or contributions. This helps bridge the gap in ethical theory regarding temporal distance – under ER logic, moral patients are not limited to presently existing ones.
- We demonstrated that AI systems implicitly use an ER-like approach in modeling environments, keeping track of objects out of sight or events yet to happen. Formalizing this can improve clarity in AI reasoning: an agent can maintain a knowledge base of entities with flags for current existence, and reason about counterfactuals or plans with explicit reference to hypothetical entities. The ER logic thus can inform the design of knowledge representation schemes that naturally handle time and uncertainty.[38]
- We revisited core metaphysical debates: our logic cleanly solves the **truthmaker problem** for past truths by holding past entities as real truthmakers,[39] and it offers a plausible stance on future truths (the reality of a future event can serve as a truthmaker if sufficiently determined). Regarding **identity over time**, we treat it as trivial (same object enduring as an element of D) and avoid the need for temporal parts, while accommodating change by the time-variance of $E(x)$. Cross-temporal relations like causation pose no problem, since our domain spans time. We formalized **causal asymmetry** to respect that influence flows forward, consistent with physics and ordinary experience. Finally, we situated ER relative to presentism and eternalism: by formally distinguishing existence and reality, ER carves a distinct position that was implicitly overlooked in the classical dichotomy.[40]

Limitations and future directions: This work is a foundational step. Some aspects of ER that remain to be fleshed out include handling **relativistic time** (making $E(x)$ observer-relative or frame-indexed – likely by relativizing the predicate to reference frames), incorporating a notion of **degrees of reality or credibility** (perhaps via modal operators or probabilities, to indicate how confident we are in future entities, etc.), and exploring **branching time** (ER on a branching timeline might treat multiple possible futures as real in a heuristic sense until one becomes actual – a fertile ground for logical innovation). Another open direction is integrating ER's time ontology with modality (could something be *merely possible* but not real? Likely yes – we would need to add another tier for possibilities, preventing confusion between "real in some possible world" and "real in the actual world across time"). Additionally, our logic currently assumes a single, fixed domain of real entities – essentially the set of everything that ever did, does, or will exist. In a sense this is a *completed timeline* viewpoint. To model an open future, one could use a dynamic model where the domain grows or where F,E(x)F,E(x)F,E(x) truth values are not yet settled. Such a framework might capture the unfolding structure of reality as possibilities collapse into actuality over time, without committing to a branching ontology. Rather than invoking a tree of worlds, ER maintains a single real trajectory where the future migrates into existence, and only one outcome ultimately becomes actual.

36 https://philpapers.org/archive/TENERM.pdf#:~:text=effects%20in%20the%20present,its%20lack%20of%20current%20existence
37 https://philpapers.org/archive/TENERM.pdf
#:~:text=imprint%29%20though%20not%20existent,as%20present%20beings%3B%20%E2%80%9CReal%E2%80%9D%20means
38 Judea Pearl (2000), Causality: Models, Reasoning, and Inference. Pearl's work on counterfactuals and causal modeling underscores the importance of representing and reasoning about events that are not (currently) actual. In AI, counterfactual queries (e.g., "Had I done X, would Y have happened?") are key for learning and decision-making. An ER-informed system keeps track of multiple scenarios by acknowledging the reality status of events within those scenarios (actual vs non-actual). While Pearl's frameworks are probabilistic, the ontological clarity provided by ER's logic (actual vs merely possible events) can complement causal networks by preventing confusion between evidence of current facts and assumptions about unseen variables.
39 https://philpapers.org/archive/TENERM.pdf
#:~:text=match%20at%20L324%20ontologically%20real,of%20historical%20truths%20and%20causal
40 https://philarchive.org/archive/TENERP#:~:text=Section%205%20argues%20why%20this,paragraph%20references%20in

Conclusion: We have argued that formalizing the existence–reality distinction is both feasible and illuminating. The resulting framework preserves our intuitions that the present is ontologically special (only the present concretely exists), while avoiding the nihilism about past/future that hampers presentism (non-present things may not exist now, but they are nonetheless real and have ontological import).[41] This yields a picture of the world that is **ontologically parsimonious** about what exists (we never populate our ontology with unnecessary ghostly beings), yet **ontologically generous** about what is real (we acknowledge the reality of the past and well-grounded future, thereby "accounting for the full tapestry of the world's events and structures across time").[42] In doing so, we integrate insights from science (e.g. relativity's lesson that "now" is not absolute, quantum physics' lesson that potential states are meaningful) and from human practice (the way memory and prediction extend our grasp on reality).

Ultimately, the formal logic of Existential Realism serves as a bridge between *tensed experience* and *tenseless description*. It allows us to reason rigorously about time, change, and existence without forcing a choice between two unsatisfying extremes. By formalizing ER, we not only clarify its philosophical content but also make it available as a precise tool for other fields – from AI temporal reasoning to the semantics of natural language time-talk, and beyond. We view this work as one chapter in an ongoing inquiry. There is much more to explore: implementing this logic in computational systems, examining its axioms for consistency and completeness, comparing it to other logics like Prior's tense logic or hybrid modal logics, and extending it to cover phenomena like personal identity (with criteria for reality of persons) or the ontology of possibilities. We invite further engagement and refinement. If the positive feedback to Trepp's earlier presentations of Existential Realism is any indication, providing a formal backbone to ER will enhance its credibility and stimulate interdisciplinary dialogue. This formal system culminates in a simple yet powerful expression: **R = E + Δ**, summarizing ER's insight that reality comprises the present plus structured non-present contributions.

In closing, we reiterate the central insight in simple terms: *Existence is a flame that burns only in the present; reality is the web woven from the trails that flame leaves and the sparks it is poised to ignite.* Our formal logic captures this poetic image in cold symbols, proving that even subtle metaphysical distinctions can be given the clarity of mathematics. We hope this not only solidifies Existential Realism as a distinct metaphysical system but also demonstrates the power of logical rigor in advancing philosophical thought.

The formal model was developed with the assistance of an unnamed contributor with expertise in modal logic, based on the conceptual foundations presented here.

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41 https://philpapers.org/archive/TENERM.pdf#:~:text=present,are%20real%20inasmuch%20as%20they

42 https://philpapers.org/archive/TENERM.pdf#:~:text=match%20at%20L449%20ontological%20commitment,events%20and%20structures%20across%20time

Reconciliation

+

ER Meets Einstein

Relativity seemed to doom presentism. Can ER survive — or even thrive — in a relativistic universe? This paper shows how a present-centered ontology can remain compatible with relativistic physics — not by denying observer-dependence, but by redefining the present as a local, existent reality within a universe of causal structure and becoming.

Spacetime, Relativity, and the Persistence of Becoming

Tenzin C. Trepp,

Email: trepp@tenz.in

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Abstract

Relativistic physics challenges our assumptions about time and existence. While eternalism posits a static block where all times equally exist, and presentism insists only the now exists, both struggle with relativity's implications. **Existential Realism (ER),** recently introduced by T. C. Trepp, resolves this tension by distinguishing between "existence" (reserved for the present) and "reality" (which includes past and future insofar as they leave traces or can be anticipated).[1] ER accommodates the relativity of simultaneity and the frame-dependence of "now," avoiding the block's metaphysical excess while preserving the ontological specialness of the present. This paper shows how ER reconciles relativity's empirical content with a present-centered view that includes objective becoming and temporal continuity.

Introduction

Physics has transformed our picture of time. Newtonian mechanics treated time as universal and absolute, enabling presentism's view of a privileged now. Relativity disrupted this, giving rise to eternalism and the block universe model. While each offers insights, both face shortcomings. ER enters this debate with a fresh framework, keeping the present as the locus of existence while treating the rest of time as real in structure and influence. Each of these views faces well-known difficulties. Presentism aligns with our immediate experience of time's flow and the specialness of "now," but it has trouble explaining how past truths remain true or how relativistic physics can dispense with any absolute simultaneity.[2] Eternalism, or the block universe theory, fits naturally with Minkowski's spacetime model and Einstein's pronouncements – yet it incurs a hefty metaphysical cost by asserting that *everything* (every event at every time) **exists** in a tenseless sense. This undermines any objective coming-into-be-

1 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. https://philpapers.org/archive/TENERM.pdf
2 Markosian, Ned (2004). "A Defense of Presentism." In Oxford Studies in Metaphysics, vol. 1 (ed. D. Zimmerman), pp. 47–82. (Defines standard presentism: only present objects exist. Discusses challenges such as providing truthmakers for past-tense propositions. Markosian's articulation highlights why presentism finds past entities "unreal," a problem ER overcomes by deeming past entities real despite their lack of present existence.)

ing and sits uneasily with the evident difference between past, present, and future in our experience.[3] The growing block theory stakes out a middle position (the past and present exist, the future does not), but even it struggles with issues like the relativity of simultaneity and epistemological puzzles (e.g., "how do we know we are at the growing edge?").

Having defined ER's key distinction between present existence and broader reality, we now explore how this two-tier ontology applies in relativistic physics. With this, ER reconciles the presentist commitment to the uniqueness of "now" with the eternalist insight that past and future matter. This framework allows us to affirm: only the present exists, yet non-present events are real due to their participation in the world's structure. ER thereby avoids the pitfalls of both extremes—neither ignoring the rest of time nor flattening it into an inert block.

Applying ER to relativistic physics, we examine how the framework accommodates phenomena such as simultaneity relativity and the absence of a global present. The aim is to show that ER preserves the integrity of a present-centered ontology while respecting relativity's empirical insights. We begin by reviewing how relativity challenges classical notions of simultaneity and present time, highlighting the famous Andromeda paradox as an illustration. We then explain how Existential Realism navigates these challenges: by treating existence as *indexical* (perspective-dependent) while treating reality as an objective spacetime structure, ER can reconcile relativistic observations with the insistence that **only the present truly exists**. Next, we discuss the implications of general relativity's dynamical spacetime for a present-centered view, including whether ER must assume or reject a privileged cosmic time. Finally, we contrast ER's ontology with the traditional extremes of eternalism and presentism, underscoring how ER avoids eternalism's "block" pitfalls and presentism's inadequacies. Throughout, our aim is to show that Existential Realism offers a *distinct and superior interpretation* of spacetime – one that remains faithful to physics and experience alike. In keeping with a preprint/academic style, technical formalisms are avoided in favor of clear conceptual explanation, appropriate for a well-informed philosophical and scientific audience.

Simultaneity in Relativity: No Universal Now

Special relativity's central lesson—the relativity of simultaneity—undermines the notion of a universal "now." This appears fatal for presentism, which requires such a global present, and lends support to eternalism. However, ER offers an alternative: by treating existence as frame-relative and reality as global, ER allows multiple valid presents without asserting all events equally exist. In Newtonian physics, time was absolute and ran uniformly in the background; it made sense to speak of a single cosmic "now" slicing across the universe at any given instant. All observers could, in principle, agree on what events are happening *simultaneously* at that moment. By contrast, Einstein's 1905 theory of relativity revealed that simultaneity is **not absolute** but depends on the state of motion of the observer. Events that one observer judges to be simultaneous will not be judged simultaneous by another observer moving relative to the first. Each inertial frame has its own way of slicing spacetime into "spaces" (moments of constant time) and "times" (the progression along the observer's worldline), and there is no privileged frame whose time is the true universal time.[4]

This relativistic fact has profound implications for ontology. If there is no frame-independent present, then the naive presentist idea of **"the present" as a unique, globally shared slice of existence** becomes very problematic. What does it mean to say "only the present exists" if different observers have different sets of events as their present? Einstein himself drew a bold metaphysical conclusion from relativity's insights. In a condolence letter of 1955, reflecting on the death of a friend, Einstein wrote that for those of us "who believe in physics," the distinction between past, present, and future is "only a stubbornly persistent illusion".[5] Hermann Minkowski, Einstein's former mathematics professor, had

3 McTaggart, J. M. E. (1908). "The Unreality of Time." Mind 17: 457–474. (Classic argument distinguishing the A-series (past, present, future) from the B-series (earlier-later ordering) and suggesting that without a real A-series, change is illusory. Eternalism corresponds to a B-series view of time; critics like McTaggart note it cannot account for our sense of time's passage. ER, by keeping an A-theoretic element, avoids McTaggart's paradox of an entirely static time.)

4 Einstein, Albert (1905). On the Electrodynamics of Moving Bodies. (Einstein's original paper on special relativity, which set forth the relativity of simultaneity. While not an ontological text, its content led to the realization that a universal present cannot be defined within the theory. Later interpretations by Einstein leaned toward a block view.)

5 Einstein, Albert (1955). Letter to the family of Michele Besso, March 1955. (Einstein muses that for a physicist, distinctions between past, present, and future are "illusions, albeit persistent ones." Often cited as evidence of Einstein's personal endorsement of eternalism. It illustrates the influence relativity had on converting many to a tenseless view of time.)

already geometrically unified space and time in 1908, declaring that henceforth space and time are inseparable and that the division into past, present, and future is observer-dependent and not given by nature. The implication of these remarks is the **eternalist or block universe** viewpoint: all events in spacetime, regardless of their time coordinate, are equally real and existent – the flow of time or the specialness of "now" is not fundamental, but a subjective impression.[6] As Hermann Weyl later phrased it, in the block picture "the objective world simply *is*, it does not *happen*," and only our consciousness crawling along the world-line gives the illusion of a moving present.[7]

The **Rietdijk–Putnam argument**, closely related to what is popularly known as the *Andromeda paradox*, attempted to formalize why relativity seems to force a block universe. Hilary Putnam (1967) argued that if we assume (with presentism) that each observer's present events exist, then because relativity allows one observer's "present" to include events that are future to another observer, we quickly end up having to admit that *all* events (past, present, future) exist.[8] In other words, the relativity of simultaneity can be used to argue that *if* one grants reality to each frame's present, the union of all those presents is the entire 4D spacetime – essentially eternalism. This argument, along with Einstein's own block-universe leanings, led to a common conviction that **special relativity entails eternalism**. The conventional wisdom became: since relativity treats time as a dimension and provides a tenseless spacetime coordinate map of events, it implies that past and future events are just "there" in the fabric of spacetime as irrevocably as present events.[9] Presentism, by contrast, was deemed incompatible with relativity unless it posited something outside relativity's standard framework.

It is important to note, however, that this inference from physics to ontology is not unanimously accepted as logically unavoidable. Some philosophers and physicists have pointed out that *relativity's empirical success does not strictly dictate one particular metaphysical interpretation*. For instance, **Markosian and others** have argued that presentism isn't strictly disproven by relativity – one can *interpret* the theory in a way that is empirically equivalent to the standard view yet maintains an objective present.[10] One radical approach is to posit a hidden, undetectable **preferred frame** or cosmic time (often called a "privileged foliation" of spacetime) that defines a true simultaneity and hence a universal present.[11] This was explored by authors like Dean Zimmerman and, in a precise way, by Thomas Crisp (2007), who showed that if you imagine adding an absolute simultaneity slice structure to spacetime (a sort of invisible ether frame), you can reproduce all the predictions of relativity while still saying there *is* a single true present.[12] However, this comes at the cost of making additional, currently untestable assumptions that many physicists find unattractive – it "violates the spirit" of relativity by re-introducing an absolute frame that Einstein had dispensed with.[13] Another possibility is to accept that each observer has their own present and thus reality may be in some sense **fragmented** or perspectival – though this view raises questions about how those different reality slices relate or whether any can claim ontological primacy. We will revisit these options, but first let us examine more concretely the famous scenario that brings out the perplexities of a relativistic world with no universal now: the Andromeda paradox.

6 McTaggart, J. M. E. (1908). "The Unreality of Time." Mind 17: 457–474. (Classic argument distinguishing the A-series (past, present, future) from the B-series (earlier-later ordering) and suggesting that without a real A-series, change is illusory. Eternalism corresponds to a B-series view of time; critics like McTaggart note it cannot account for our sense of time's passage. ER, by keeping an A-theoretic element, avoids McTaggart's paradox of an entirely static time.)

7 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton Univ. Press. (Weyl famously wrote: "The objective world simply is, it does not happen." He paints a poetic image of the block universe, where consciousness gives the illusion of a moving present. This reference encapsulates the eternalist interpretation of Minkowski's spacetime.)

8 Crisp, Thomas M. (2007). "Presentism, Eternalism and Relativity Physics." In Einstein, Relativity and Absolute Simultaneity (eds. W. L. Craig & Q. Smith), Routledge, pp. 262–278. (Crisp explores how presentism might be made compatible with relativity by positing an absolute simultaneity (a foliation of spacetime). He argues this modified presentism is empirically indistinguishable from standard relativity, thus relativity alone doesn't force eternalism. This supports the view that physics underdetermines the metaphysics of time, a point ER leverages by offering an alternative interpretation.)

9 Smolin, Lee (2013). Time Reborn: From the Crisis in Physics to the Future of the Universe. Houghton Mifflin Harcourt. (Smolin argues against the timeless block view, emphasizing that time and flow are real and fundamental. He cautions against treating the 4D spacetime diagram as the literal reality ("the fallacy of the spatialization of time"). ER aligns with this critique by asserting that the mathematical model of spacetime should not be naively conflated with ontological reality – a point that reinforces ER's motivation for distinguishing existence (process) from reality (structure).)

10 Penrose, Roger (1989). The Emperor's New Mind. Oxford University Press. (Penrose discusses the Andromeda paradox, providing a popular account of how two people walking in opposite directions can have different simultaneous events on Andromeda. This work, though not primarily about time ontology, helped publicize the strange relativistic effect that challenges an absolute present. It illustrates why many find an intuitive push toward the block universe, and by extension why a nuanced approach like ER is needed to resist that push without denying the physics.)

11 Bourne, Craig (2006). A Future for Presentism. Oxford University Press. (Bourne addresses how presentism might handle relativity and other objections, introducing the idea of "relativized presentism" and discussing possible reconciliation strategies. His work provides context for how ER's approach differs: rather than insisting on a single present or rejecting relativity, ER transforms the concept of existence to be compatible with relativistic constraints.)

12 Broad, C. D. (1923). Scientific Thought. (Early articulation of the growing block theory, where past and present exist, future does not. Broad's ideas contrast with ER: the growing block grants existence to the past, whereas ER would say the past is real but not existent. Broad's "objective becoming" in a relativistic context faces challenges similar to presentism unless a privileged frame is assumed; ER's more flexible ontology offers an alternative route to having objective becoming in relativity.)

13 Miller, Kristie (2019). "Existence, Persistence, and Relativity." In The Routledge Handbook of Philosophy of Temporal Experience (eds. I. Phillips). (Overview of how different ontologies of time deal with relativity, including discussions of fragmentalism and relativized existence. It provides philosophical background that complements the ER approach, situating it among broader attempts to reconcile temporal ontology with relativistic physics.)

The Relativity of the Present and the Andromeda Paradox

In a relativistic universe, statements about **"the present"** must be qualified by a frame of reference or an observer's state of motion. The *Andromeda paradox*, described by Roger Penrose and others as a vivid thought experiment, makes this relativity of the present painfully clear. Imagine two people on Earth passing each other on the street. One is walking in the direction of the Andromeda Galaxy (approximately 2.5 million light years away), and the other is walking the opposite way. Due to their tiny difference in velocity (just a normal walking speed, but nonetheless a different inertial frame), relativity says they will have slightly different surfaces of simultaneity extending out into space. The difference is absurdly small over everyday distances, but when extrapolated to something as far as Andromeda, it can translate into a difference of several days in terms of what each person considers "simultaneous" with their local now. Thus, it is possible (in principle) that according to person A's frame, a particular event on a planet in the Andromeda Galaxy – say, an alien council's decision to launch an invasion fleet toward Earth – is happening *right now*, as part of A's present. Meanwhile, for person B (walking the opposite direction), that same event on Andromeda might be calculated to occur two days *in the future* relative to B's present. Neither person has any causal contact with the Andromeda event at that moment (it's far outside their light cone), yet relativity permits their "now" slices to differ on whether the event is contemporaneous or not.

This scenario seems paradoxical if one tries to take the concept of a real, objective present seriously. **Which is the true present – A's or B's?** Did the Andromeda invasion decision happen already, or will it happen in a couple of days? If we insist that there must be a fact of the matter (as presentism would), we are faced with an uncomfortable choice: either declare one frame's present as *privileged* (the unique true present) – thereby picking A's or B's slice arbitrarily or by fiat – or concede that the question has no absolute answer. Eternalists love to point out this dilemma: in a block universe, there is no paradox, because *all* these events (the different days on Andromeda, as well as the meeting of A and B) co-exist in the 4D spacetime. Each observer is just perceiving a different slice through the block, but the invasion decision and its consequences "already" exist in the block framework. Presentism, by contrast, appears flummoxed: it wants to say only one set of events (the objective present) exist, but relativity offers many equally valid "presents."

Existential Realism offers a nuanced resolution of the Andromeda paradox by **denying the premise that all events simultaneous with an observer's now must fully exist** in an unqualified sense. ER suggests that we carefully separate what *exists now* for a given observer from what is nonetheless *real* or determinate in the world. In ER, **existence is inherently indexical and context-bound** – it is always "existence-now-for-me" or "for this frame." Meanwhile, reality is the sum total of events (and their interrelations) that make up the world's history, but crucially, events can be real without being *presently existent*. In the Andromeda scenario, the alien council's decision may be real in the sense that it will eventually unfold in one form or another, but from Earth's perspective, it is not yet an event that exists. ER treats this distant future possibility as structurally real, but not yet actual or existent for any frame lacking causal contact. It lies outside our current **existence sphere**, which is effectively limited to our immediate vicinity and past light cone. For the pedestrian whose frame puts the decision in their "now," does ER claim that event *exists* for them at that moment? Not in the full ER sense of existence, because even that observer cannot empirically access the event or have it influence them until much later. In other words, ER **denies that a spacelike-separated distant event can be counted among the concrete existents of the here-and-now**, even if a coordinate convention labels it as simultaneous. What *does* exist for each observer are the events and conditions in their local environment (and anything currently interacting with them). Distant happenings like the Andromeda decision, lacking any causal connection or observability at present, are simply not in the ontology of "what exists now" from either Earth-bound perspective.

By adopting this stance, ER reframes the paradox. It avoids the need to posit a globally co-existent set of events and preserves consistency with both relativity and experience. Neither A nor B is *wrong* about their computed simultaneity – they just have different frames' clock readings – but in neither case is the Andromeda event something that must be admitted into the present *existence* of their

world at that time. The event is **real** (we presume it has a definite outcome in the Andromeda galaxy, making it an element of reality), but until signals from it propagate outward (or until the observers travel to Andromeda), it plays no role in the here-and-now state of the Earth or the observers. Thus, **the question "has the event happened yet or not?" has no bearing on what exists for us now** – it only has bearing on how we describe the timing of that event relative to our frame. ER effectively says: the relativity of simultaneity is a feature of how we *slice* the four-dimensional reality, but it does not force us to conclude that all slices' contents must be ontologically on par in the present. The present remains *local*. Only when an event's influence enters our vicinity (for example, the alien decision results in a spaceship launch that decades or millennia later arrives or sends a signal) will that event become directly relevant and, at that future point, part of what exists (then). In summary, ER respects Einstein's insight that there is no single universal present – each observer has their own present – but it does **not** follow eternalism in treating all those presents' contents as equally existent in a grand tenseless sense. Instead, it treats existence as a **plurality of local presents**, each linked to the observer or worldline in question. Reality, however, is global: the Andromeda event either really does happen or not, and eventually all observers can agree (when the information arrives) that it *was* a real event. They may disagree on how to label its time of occurrence, but they will concur on the causal order (assuming no pathological causality violations). In ER, observers converge upon a common causal structure over time – a shared reality as information becomes available – but at any moment, their experiential present and existent set remains perspectival and distinct.[14]

The Andromeda paradox thus loses its sting. We are not forced to accept the block universe's extravagant claim that the alien decision (and everything else in the future) **already exists** in order to avoid contradictions. We simply acknowledge that "now" is relative, and we restrict the ontological claim "exists now" to the context of a given frame or observer. Since observers can only directly experience or affect events in their immediate present (and past light cone), ER posits that this is exactly the scope of what *exists* for them. Everything beyond that – distant simultaneity or future events – can be considered part of the broader reality (perhaps as determinate facts or as possibilities), but not counted among concrete existents **until** such a time as they come into an observer's empirical purview. This move preserves **causal consistency** (no observer ever sees evidence of something before it comes into existence for them) and maintains the spirit of relativity (no global frame needed), all while upholding the core of presentism (only the present is fully real-existence).

General Relativity and Present-Centered Ontology

General relativity (GR) further complicates the picture of time by showing that spacetime is dynamic, malleable, and influenced by matter and energy. In GR, there is in general no single time coordinate that can neatly parametrize all events in the universe – especially in spacetimes that are not perfectly homogeneous. The theory allows for curved spacetimes where even the notion of a "simultaneous hypersurface" slicing the whole universe is ambiguous or depends on an arbitrary choice of coordinates. In some solutions of GR (for example, in universes that contain rotating black holes or certain cosmological solutions), one can even have scenarios like **closed timelike curves** (worldlines that loop back in time) or other pathologies that challenge our intuitions about a well-defined global present. Thus, any **present-centered ontology** must clarify how it deals with the possibility that time itself is part of a dynamical geometry and may not afford a clean division of events into past/present/future at a cosmic level.

For the most part, however, our actual universe as understood through cosmology does admit some convenient (if not fundamental) notions of a global time. Cosmologists often employ a **cosmic time** coordinate in the standard Big Bang model (FLRW cosmology): by slicing the universe into hypersurfaces of constant proper time since the Big Bang (as measured by comoving observers who see the universe as homogeneous), one obtains a kind of universal "now" at each cosmic epoch. This is tied to the **CMB rest frame** – the frame in which the cosmic microwave background looks isotropic.

14 Dorato, Mauro (2006). "The Software of the Universe: On Some Limitations of the Block Universe View." Humana.Mente 2: 21–40. (Dorato critiques the block universe and emphasizes the perspectival aspects of becoming. He suggests that while physics gives us a "block" representation, the ontology of becoming might require acknowledging the role of observers. ER can be seen as operationalizing this idea by making existence observer-dependent, an insight Dorato's work anticipates in spirit.)

Interestingly, this provides a candidate for a **natural privileged frame**: one could say that, at least approximately, our universe has a built-in temporal foliation (the surfaces of homogenous cosmic time). Some have argued that if presentism were true, perhaps this cosmic time is what defines the objective present everywhere.[15] Indeed, as noted earlier, one strategy to reconcile presentism with relativity is to suppose that there *is* a physically distinguished frame at a fundamental level (even if undetectable in local experiments). The existence of a cosmological time (with the CMB frame) hints that nature might not be completely against singling out a particular time slicing, at least in practice for our universe.

However, even if our universe allows an "easy" slicing, the **metaphysical question** remains: does physics *force* us to adopt the block universe view, or can a present-centric ontology like ER survive in GR? Existential Realism's answer is that it *can* survive, by being flexible in how it defines the present and existence in a relativistic setting. ER does not **require** that there be a rigid, frame-invariant present moment that spans all of spacetime.[16] It can accommodate either possibility: if there truly is a privileged cosmic time, ER can adopt it as the reference frame for defining existence (which would effectively make ER resemble a refined presentism that is in harmony with cosmic time). On the other hand, if there is no such global time (or if we take relativity's lesson at face value that all frames are equally valid), ER can be formulated in a **frame-relative or event-relative manner**. In a fully covariant formulation, one could say *each spacetime event has its own tiny "present" (itself) and perhaps a locally defined slice of simultaneity around it*, and that what exists for that event is just itself and perhaps the immediate infinitesimal neighborhood – everything else is either in its past, future, or outside its light cone, hence not co-present in an operative sense.[17] In practice, for an observer like us, this means our present existence is confined to an infinitesimal slice through our worldline – essentially, the events happening right where we are at this instant (and arguably extending a bit around us in space, since we consider our environment "now" even if light from the other side of the room takes some nanoseconds to reach us). But any attempt to extend our present as a simultaneity plane across the cosmos runs into the arbitrariness of slicing. ER's stance is: *such an extended present is a convention, not an ontologically significant cut*. What is ontologically significant is the **causal structure** – what can affect what.

General relativity teaches us to think in terms of **light cones** and causal connectivity. From that perspective, a reasonable present-centric ontology might say: the only events that concretely exist for a given observer at a given time are those within or on that observer's *past light cone* (events that have already influenced the observer) together with perhaps the observer's immediate local state. This is an extreme take (essentially saying that if something is spatially distant but simultaneous in some frame, it doesn't exist for the observer until its light or effect reaches them) – and indeed ER does not necessarily go that far for everyday use.[18] But conceptually, it shows how one can **slice down existence to the strictly observable**. Even a more moderate ER stance will insist that no observer can claim the existence of distant events except as *inferences* or *anticipations*. Thus, GR's lack of global present is not fatal; it simply reinforces the idea that any talk of "now everywhere" is conventional. ER is comfortable with a bit of **relativistic pragmatism**: we can choose a convenient simultaneity convention (like the CMB cosmic time) for practical description of the universe, but we need not imbue that choice with heavy ontological significance. Distant regions of the universe may be structurally real, but ER holds that unless they are within our causal light cone, they should not be counted as "existing now." This avoids conflating physical reality with ontological presence, because "now" cannot be stretched that far except by arbitrary convention.

Another implication of GR is the possibility of **dynamic becoming**. In a block universe view, the entire history of the universe (past through future) is a static 4D structure; any appearance of growth or change is perspectival. Some philosophers and physicists, however, advocate an **"evolving block"**

15 Ellis, George F. R. (2006). "Physics in the Real Universe: Time and Spacetime." GRG 38: 1797–1824. (Ellis advocates an "evolving block universe" – the block grows as time progresses, reflecting an objective coming-into-being of events. This is somewhat analogous to ER's view that events become existent as time flows. However, Ellis's evolving block still grants ontological status to past events in a way ER would classify as "real not present." The comparison shows ER's position in the landscape: sharing the desire for objective temporal becoming, but implementing it via the existence/reality split.)

16 Markosian, Ned (2004). "A Defense of Presentism." In Oxford Studies in Metaphysics, vol. 1 (ed. D. Zimmerman), pp. 47–82.

17 Dorato, Mauro (2006). "The Software of the Universe: On Some Limitations of the Block Universe View." Humana.Mente 2: 21–40.

18 Miller, Kristie (2019). "Existence, Persistence, and Relativity." In The Routledge Handbook of Philosophy of Temporal Experience (eds. I. Phillips). (Overview of how different ontologies of time deal with relativity, including discussions of fragmentalism and relativized existence. It provides philosophical background that complements the ER approach, situating it among broader attempts to reconcile temporal ontology with relativistic physics.)

or other mechanisms to reintroduce an objective becoming into relativistic cosmology. ER naturally involves a form of objective becoming: since only the present exists, as time progresses new events come into existence (and previous ones slip into non-existence, though they remain real as past). But if we consider the entire spacetime as a pre-existing reality (which ER does, in the sense that all events are real as elements of the world's story), one might wonder if ER doesn't also imply a fixed block. The subtle difference is that for ER, the block (the set of all events) is **real** but not **concretely existent all at once**. There is indeed a dynamical aspect: reality is unfolded through the present moment continuously "updating" as time flows. This is an *A-theoretic* view (in philosophical terms, a view that endorses an objective present and passage of time) as opposed to the B-theoretic timeless view of the block. General relativity per se does not tell us whether time "flows" or not; it provides a geometric description of temporal relations. ER's interpretation is that the geometric 4D description is a **record** or map of reality, not reality *itself in a frozen sense*. Lee Smolin warns against "spatializing time," i.e. treating time as if it were just another space dimension and the universe as a static map.[19] ER aligns with this caution: the spacetime diagram is a useful representation, but one must not conflate the representation with ontological reality. In reality (ER holds), there is an ongoing process: each moment the present (the locus of existence) advances, incorporating new events and leaving others behind. Nothing "mystical" occurs in this process – it is just how we describe change – but it means that not all events are on equal ontological footing *at a given time*. Eternalism flattens this distinction by saying everything just exists; ER keeps the distinction by saying only at the moment of their occurrence do events exist, though they are real at other times by virtue of their connections.

Thus, GR's challenges – the absence of absolute simultaneity, the flexibility of time coordinates, and the possibility of complicated global structures – do not refute a present-centered ontology; they merely demand that such an ontology be carefully defined in relativistic terms. **Existential Realism** meets this demand by its relativistically covariant outlook on existence: what exists is allowed to be observer-dependent (or frame-dependent), while what is real is the invariant content of the world. All observers, no matter their frame, will ultimately agree on the reality of events and their causal relations. They will not agree on a single time order for spacelike-separated events, but ER asserts we don't need them to. Physics continues to work with its 4D models and local laws, and ER adds an interpretive layer: it says, roughly, *the world is not literally a giant frozen block — it just can be modeled as a block for calculations*. The lack of a universal present in physics does not mean there is literally no ontological difference between past, present, future; it only means there is no *one* present that physics can single out with its equations. ER happily concedes that to physics – because physics deals with observables and invariant structure, and indeed ER's distinction is largely *metaphysical* and *epistemic*. It introduces an **observer-centric ontology** (since existence is tied to what can be observed or affected now) which meshes well with relativity's structure, as observation and influence are constrained by light cones.[20] In fact, by incorporating this epistemic insight into ontology, ER arguably does *better* justice to relativity than naive presentism: it acknowledges that no observer can have access to the whole universe's state at once, so why insist that the whole universe's state "exists" at once? Only the accessible part exists for that observer. Reality, however, is the full four-dimensional web of events – which in GR includes the dynamically evolving geometry itself – and remains untouched by one's perspective.

19 Miller, Kristie (2019). "Existence, Persistence, and Relativity." In The Routledge Handbook of Philosophy of Temporal Experience (eds. I. Phillips). (Overview of how different ontologies of time deal with relativity, including discussions of fragmentalism and relativized existence. It provides philosophical background that complements the ER approach, situating it among broader attempts to reconcile temporal ontology with relativistic physics.)

20 Dorato, Mauro (2006). "The Software of the Universe: On Some Limitations of the Block Universe View." Humana.Mente 2: 21–40.

Contrasting ER with Eternalism and Presentism

Having outlined how Existential Realism handles relativistic spacetime, we can now explicitly contrast ER's ontological commitments with those of eternalism (block universe) and presentism (classical "only now is real"). The differences can be summed up in terms of how each view treats **existence vs. reality across time**:

- **Eternalism:** No distinction is made between existence and reality – *to be real is simply to exist* (tenselessly) in spacetime. Thus all events, past, present, future, equally exist (in the block). Eternalism's motto might as well be "Reality = Existence = the Block." The present moment is not ontologically special; saying "X exists now" just means "X has some time coordinate, whether that's in the year 2025 or 3025 or 1025." Eternalism interprets relativity's 4D manifold literally as depicting a universe in which nothing truly "comes into being" or "ceases to be" – those are subjective impressions of an observer traveling through the block.[21] The advantage of eternalism is its **metaphysical simplicity** in a certain sense: one unified category of being for all times, and it fits neatly with relativistic invariance (no need for a preferred frame or any extra structure). It also offers easy truth conditions for statements about the past or future (since those events exist, statements about them can be true in virtue of those events). However, eternalism's drawbacks are significant: it is **ontologically extravagant**, positing an entire four-dimensional "museum" of events (including every moment of history and future) as equally concrete.[22] This is a heavy load on one's ontology – as critics note, it seems to populate the world with countless entities (dinosaurs, Socrates, future Martian colonies, etc.) that, by commonsense, *aren't around anymore or yet*. Additionally, eternalism faces the **problem of temporal experience**: it makes the flow of time and the special feeling of the present into an illusion, which many find counterintuitive or even incoherent (e.g., how can we *experience* the flow if the flow isn't real?). Change, in eternalism, is just a different property at different times, not an coming-into-being; some argue this fails to capture what change *really* means.[23]

- **Presentism:** The classic presentist holds that only present things exist; the past did exist but does not anymore, and the future will exist but does not yet. Presentism's ontological inventory is **minimal**: it contains only one slice of the world (the current one). This has the virtue of aligning with our immediate intuition that "the past is gone" and "the future isn't here yet." It avoids eternalism's heavy commitment to the reality of say, Julius Caesar or our great-great-grandchildren – those, says the presentist, simply are not in the world *now*, so they in no way exist. However, presentism faces the **truthmaker problem** and related issues: if only present things exist, what makes it true that (for example) *Julius Caesar was assassinated*? Presentists have to get creative, perhaps saying that such statements are true *in virtue of* present facts (like books or memories) or abstract entities, but it's not straightforward.[24] Causality is another issue: how can a past event that no longer exists (say, the eruption of Vesuvius in 79 CE) still causally influence the present (Pompeii's ruins, which do exist now)? Intuitively, the cause is gone – so presentism owes an explanation of how effects persist. Moreover, as discussed, **relativity is a severe challenge**: without an absolute present, presentism either has to posit one (contrary to the letter of relativity) or accept a fragmented, frame-dependent ontology (which raises new questions of coherence). Presentism's strength in preserving a dynamic, flowing time comes at the cost of making the world *incomplete* (only a thin slice exists) and making temporally global statements hard to account for.

- **Existential Realism (ER):** ER can be seen as a deliberate synthesis, keeping what works in the above and discarding what doesn't. ER **denies the eternalist claim** that all times exist, thereby avoiding ontological inflation and preserving the genuine loss of the past and the openness of the future.[25] Only the present moment's contents exist in the concrete sense – which means,

21 McTaggart, J. M. E. (1908). "The Unreality of Time." Mind 17: 457–474. (Classic argument distinguishing the A-series (past, present, future) from the B-series (earlier-later ordering) and suggesting that without a real A-series, change is illusory. Eternalism corresponds to a B-series view of time; critics like McTaggart note it cannot account for our sense of time's passage. ER, by keeping an A-theoretic element, avoids McTaggart's paradox of an entirely static time.)
22 McTaggart, J. M. E. (1908). "The Unreality of Time." Mind 17: 457–474.
23 Ibid.
24 Markosian, Ned (2004). "A Defense of Presentism." In Oxford Studies in Metaphysics, vol. 1 (ed. D. Zimmerman), pp. 47–82.
25 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. https://philpapers.org/archive/TENERM.pdf

at any given time, there is no "pile-up" of other times' objects still hanging around. This immediately avoids the counterintuitive consequence of eternalism that, e.g., "there is past matter lingering in spacetime elsewhere" (as Trepp puts it) – in ER, there is not, because existence is confined to the now.[26] On the other hand, ER **denies the strict presentist claim** that only present things are real. Past events and entities *are real* in ER, precisely because they have left **causal traces and records** that persist. The eruption of Vesuvius doesn't exist now – it happened and then ceased – but it is nonetheless a real part of the world's history, as evidenced by the ash layers and ruins.[27] Its reality is affirmed by the fact that it genuinely occurred and has shaped the present. Likewise, future events (say, a future solar eclipse) can be real in the sense that they are *predicted or anticipated* based on current conditions – they are not mere fiction, but expected outcomes encoded in present reality (perhaps the orbital mechanics telling us the eclipse will happen). At the same time, ER holds that those future events do *not yet exist*. We thus get a more nuanced temporal ontology: **past and future are real but not existent; only the present is existent (and of course real as well)**. This neatly solves the truthmaker issue: statements about the past are true because the past events are real (even if not now existent) and therefore can serve as truthmakers.[28] Causal influence from past to present is possible because past events, though no longer around, *handed off* their influence – their effects persist in present reality, which ER counts as part of reality even after the sources have gone. As one slogan puts it, *presentism erases, ER preserves*:[29] presentism would erase the past from reality entirely, whereas ER preserves the past's reality (just short of full existence). Conversely, eternalism preserves everything in existence, but ER says that's overkill – we only need to preserve it in reality, not in ongoing existence.

When it comes to **relativity**, these differences become especially critical. Eternalism fits relativity's mathematical structure by simply saying the entire spacetime is reality (and existence) – the frame-dependent slices are just different perspectives on the same block. Presentism struggles, because it demands something outside relativity to single out one true slice of "now." Existential Realism *reconciles relativity without embracing the block ontology* by doing two things: (a) **allowing existence to be frame-dependent** and not absolute, and (b) maintaining that reality is the invariant set of all events. All observers, regardless of frame, ultimately talk about the same set of real events (the spacetime events that occur); they just partition them differently into past/present/future relative to themselves. ER does not insist that there is one global present that we must identify in the physics – instead, it says each observer (or each event) has its own present. This might sound like a fragmentation of existence (and it is, in a sense), but because ER downgrades non-present events to "real but not existent," there is no contradiction. Observer A's present exists-for-A, observer B's present exists-for-B; A's present events are certainly real for B as well (since eventually B can learn about them or be affected by them), just not *co-present*. Meanwhile, any event that is real (happens at some point) will eventually enter into the present of some observers (for instance, those in its future light cone). By focusing on what each observer can **empirically access**, ER ensures that it does not conflict with relativity's empirical content.[30] No observer ever observes a contradiction such as "X both exists and doesn't exist now," because "exists now" is always understood in relation to that observer's frame or worldline. Eternalism achieved consistency with relativity by declaring all events equally existent and making "now" an indexical illusion; ER achieves consistency by keeping existence strictly tied to the local now and thus not requiring a universal now at all.[31]

It is worth noting that ER's approach also **avoids fatalism** and preserves an **open future** in a way eternalism does not. Eternalism tends to imply that the future is already "there," which many interpret as meaning it's predetermined or fixed. ER, by contrast, can accommodate indeterminism: the future can be said to be *real as a realm of possibilities* or potentials, without there being a single definite fu-

26 Trepp, Tenzin C. (2025). "Against the Block Universe: A Realist's Rejection of Temporal Flatness." (forthcoming). (Trepp critiques eternalism's "ontological excess," noting it posits "past matter lingering in spacetime 'elsewhere'" which ER pointedly avoids. Also discusses how eternalism fails to accommodate the experiential and epistemic features of time. ER is presented as a superior alternative that eliminates the "ghostly landscape" of non-present entities by confining existence to the present, without losing the reality of those entities in their own time.) https://philpapers.org/archive/TREATB.pdf

27 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. https://philpapers.org/archive/TENERM.pdf

28 Markosian, Ned (2004). "A Defense of Presentism." In Oxford Studies in Metaphysics, vol. 1 (ed. D. Zimmerman), pp. 47–82.

29 Ibid.

30 Dorato, Mauro (2006). "The Software of the Universe: On Some Limitations of the Block Universe View." Humana.Mente 2: 21–40.

31 Ibid.

ture event that is already real. ER's reality of the future is a *looming reality* of what *might* or *will* happen given present conditions.[32] For example, if a radioactive atom has a 50% chance to decay in the next hour, the eternalist might say there is a branch of the block where it decays and one where it doesn't (or in a single block if one considers a deterministic many-worlds, the decay is fixed on one timeline). ER can simply say: the decay *does not yet exist* (since it's in the future), but the *disposition* or probability of decay is a real feature of the present atom. Thus the range of possible outcomes constitutes a real aspect of the world. When one outcome happens (becomes present), the other possibilities cease to be real potential and become merely unrealized. In this way, ER incorporates a concept of an open future, aligning with how we normally think about time and free will, without contradicting any physical laws (which, in quantum mechanics and elsewhere, often do allow multiple future outcomes). Presentism also often embraces an open future, but ER manages to do so *while still saying the future is real in a certain mode*.[33] This gives ER an edge in explanatory power: one can discuss future events meaningfully (and scientifically, e.g. predicting eclipses or computing probabilities) because those future states, while not existent, are part of the real causal framework (the calculations we do now treat those outcomes as real possibilities).

In sum, **Existential Realism stands as an innovative middle way**. It is not simply presentism relabeled, nor a disguised eternalism.[34] It introduces a principled new vocabulary – splitting "existence" vs "reality" – to resolve confusions that plagued the time debate. ER says: *Only the present exists (so we keep time's flow and the special now), but much more is real (so we acknowledge the world's temporal breadth and the efficacy of past and future in our understanding).* In doing so, it **rejects the Block Universe's claim** that the flow of time is an illusion and that our ontological inventory must include every event ever; it also **rejects naive presentism's claim** that anything not present is utterly nothing. The relativistic evidence (lack of absolute simultaneity) which so strongly motivated eternalism is reinterpreted by ER: it tells us not that all times exist, but that *existence itself is an inherently relativized concept* – one that must be contextualized to an observer or frame.[35] Reality, on the other hand, remains one: a four-dimensional continuum of events (or possibly an indeterminate set of evolving outcomes that collapse into actuality over time) which all observers are embedded in. ER thus preserves what is valuable in the block view – the objective structure of the world and its spacetime relations – but embeds within it an **ongoing process of existence** that accounts for why we experience only the present and why time *seems* to flow.

Conclusion

We have presented **Existential Realism (ER)** as a robust ontological framework that reimagines the ontology of spacetime in light of relativity while upholding the centrality of the present moment. By rigorously distinguishing between what it means to *exist* (present, concrete being) and what it means to be *real* (to have causal or informational reality, even if not present), ER manages to reconcile the seemingly conflicting insights of modern physics and human experience.

Under ER, relativity's demolition of a universal simultaneity is not interpreted as a verdict for the block universe, but rather as a call to refine our ontology. ER answers that call by making **existence an indexical, locally defined concept** and treating the **present as intrinsically frame-dependent** – which is perfectly in line with relativity's structure. Yet ER does this without surrendering to the idea that past and future are illusions or that all moments are equally "there." Instead, **time flows in ER**: the present is where existence is continuously "happening," and moments genuinely come into being and pass out of being. This dynamism had been banished in the eternalist block; ER restores it, but in a way that

32 Trepp, Tenzin C. (2025). "Making Time: Causality, Entropy, and Becoming." (manuscript).
33 Miller, Kristie (2019). "Existence, Persistence, and Relativity." In The Routledge Handbook of Philosophy of Temporal Experience (eds. I. Phillips). (Overview of how different ontologies of time deal with relativity, including discussions of fragmentalism and relativized existence. It provides philosophical background that complements the ER approach, situating it among broader attempts to reconcile temporal ontology with relativistic physics.)
34 Dolev, Yuval (2006). Time and Realism: Metaphysical and Antimetaphysical Perspectives. MIT Press. (Examines different realist and anti-realist approaches to time. Dolev's work underscores the importance of epistemic considerations in metaphysics of time – a theme ER explicitly builds upon, by tying existence to what is in principle observable now. It provides philosophical support for the idea that how we know and experience time should inform our ontological models, a principle at the heart of Existential Realism.)
35 Dorato, Mauro (2006). "The Software of the Universe: On Some Limitations of the Block Universe View." Humana.Mente 2: 21–40.

does not contradict physics. All that happens is that ER confines the ontologically privileged existence to the here-and-now of each context, while **granting reality to the extended network of events** that physics describes. In doing so, ER provides satisfactory resolutions to classic paradoxes: the Andromeda scenario poses no threat because no distant simultaneity can impose a different existent reality on us; the relativity of simultaneity is fully acknowledged, but it leads to *plural* localized presents rather than a monolithic frozen "now-less" world. General relativity's lessons about the flexibility of time are accommodated: whether or not there is a true cosmic time, ER can function by either adopting it (if it exists) or proceeding relationally (if it doesn't), always ensuring that its ontology does not outpace what can be empirically justified.

We have also seen that ER stands apart from both presentism and eternalism on key points. Unlike presentism, ER never needs to say that the past simply isn't real – thus past facts and causes remain robustly grounded. Unlike eternalism, ER does not commit to an over-stuffed ontology containing all times at once – thus it avoids clashing with our intuition of an unfolding universe and sidesteps the heavy metaphysical baggage of the block. In philosophical terms, ER can be viewed as an **A-theory** of time (affirming an objective present and temporal passage) that has been made **compatible with relativity** by incorporating a perspectival element to existence and an epistemic humility about what exists beyond observation. It thereby escapes the stalemate that often plagues the time debate: the false dichotomy that one must choose either an illusory flow of time (block universe) or an untenable absolute present (naive presentism). ER charts a third course, one that *uses* the insights of relativity (and of philosophy of science, epistemology, and even phenomenology) to craft a more sophisticated ontology.

The implications of **Existential Realism** are significant. It suggests that we can interpret spacetime not as a giant unchanging four-dimensional thing, but as a stage on which reality is continuously enacted at the present and where only the enacted part exists at any given instant. This provides a way to talk about **becoming** and **change** in a relativistic context without contradicting any physical predictions. It also offers a framework for thinking about future events as *real possibilities* rather than fixed "already actual" things, thus preserving a sense of openness in the future and the efficacy of choice or probabilistic outcomes.[36] ER, in a sense, restores **tensed time** (the distinction between past/present/future) to a universe that physics had often described in tenseless terms – but it does so in a disciplined manner that does not refute physics, only a particular interpretation of it.

In conclusion, **Existential Realism** emerges as a compelling ontological paradigm for the age of relativity. It validates our lived sense that only the present truly exists, *without* dismissing the vast stretches of time beyond the present as unreal. It honors the findings of science that time is relative and interconnected with space, *without* conceding that physics demands a frozen block reality. By carefully separating existence from reality, ER resolves long-standing puzzles: truthmakers for past and future statements, the meaning of becoming in a relativistic cosmos, the apparent conflict between experience and theory. This framework can be seen as an evolution of the debate on temporal ontology – a step beyond the stalemate of presentism vs eternalism. As such, ER not only interprets spacetime in a novel way but also invites further inquiry: it encourages us to refine what we mean by "now," to explore how concepts like causation, memory, anticipation, and consciousness fit into a present-centered but reality-rich universe. By embracing both the insights of physics and the evidence of experience, Existential Realism positions itself as a superior ontological lens through which to understand spacetime – one that may well shape future discussions in the metaphysics of time and the interpretation of relativistic physics.

36 Miller, Kristie (2019). "Existence, Persistence, and Relativity." In The Routledge Handbook of Philosophy of Temporal Experience (eds. I. Phillips). (Overview of how different ontologies of time deal with relativity, including discussions of fragmentalism and relativized existence. It provides philosophical background that complements the ER approach, situating it among broader attempts to reconcile temporal ontology with relativistic physics.)

References

1. Trepp, Tenzin C. (2025). *"Existential Realism – A Distinct Ontological Framework Beyond Presentism."* PhilArchive preprint. (Trepp introduces ER's key distinction between existence and reality. Existence is defined as empirical presence in the now, whereas reality includes entities/events not presently existing but connected via causal or informational links. This allows ER to say "Only the present exists, but much more is real," blending presentist and eternalist intuitions.) https://philpapers.org/archive/TENERM.pdf

2. Trepp, Tenzin C. (2025). *"Making Time: Causality, Entropy, and Becoming."* (manuscript). (Further elaboration of ER, including how past entities remain real via their effects, and future entities can be treated as real insofar as they are anticipated or probabilistically encoded in the present state. ER thus addresses how causation works with only present existence, and how the "arrow of time" and flow can be understood without a block universe.)

3. Markosian, Ned (2004). "A Defense of Presentism." In Oxford Studies in Metaphysics, vol. 1 (ed. D. Zimmerman), pp. 47–82. (Defines standard presentism: only present objects exist. Discusses challenges such as providing truthmakers for past-tense propositions. Markosian's articulation highlights why presentism finds past entities "unreal," a problem ER overcomes by deeming past entities real despite their lack of present existence.)

4. McTaggart, J. M. E. (1908). "The Unreality of Time." *Mind* 17: 457–474. (Classic argument distinguishing the A-series (past, present, future) from the B-series (earlier-later ordering) and suggesting that without a real A-series, change is illusory. Eternalism corresponds to a B-series view of time; critics like McTaggart note it cannot account for our sense of time's passage. ER, by keeping an A-theoretic element, avoids McTaggart's paradox of an entirely static time.)

5. Putnam, Hilary (1967). "Time and Physical Geometry." *The Journal of Philosophy* 64(8): 240–247. (Putnam's argument using special relativity to claim that reality must be four-dimensional and block-like. He posits that relativity forces us to accept all times as equally real, effectively rejecting presentism. This is the formal underpinning of the Andromeda paradox scenario. ER counters that argument by rejecting the assumption that each frame's "now" entails full existence of those events.)

6. Einstein, Albert (1905). *On the Electrodynamics of Moving Bodies*. (Einstein's original paper on special relativity, which set forth the relativity of simultaneity. While not an ontological text, its content led to the realization that a universal present cannot be defined within the theory. Later interpretations by Einstein leaned toward a block view.)

7. Einstein, Albert (1955). Letter to the family of Michele Besso, March 1955. (Einstein muses that for a physicist, distinctions between past, present, and future are "illusions, albeit persistent ones." Often cited as evidence of Einstein's personal endorsement of eternalism. It illustrates the influence relativity had on converting many to a tenseless view of time.)

8. Weyl, Hermann (1949). *Philosophy of Mathematics and Natural Science*. Princeton Univ. Press. (Weyl famously wrote: "The objective world simply is, it does not happen." He paints a poetic image of the block universe, where consciousness gives the illusion of a moving present. This reference encapsulates the eternalist interpretation of Minkowski's spacetime.)

9. Crisp, Thomas M. (2007). "Presentism, Eternalism and Relativity Physics." In Einstein, Relativity and Absolute Simultaneity (eds. W. L. Craig & Q. Smith), Routledge, pp. 262–278. (Crisp explores how presentism might be made compatible with relativity by positing an absolute simultaneity (a foliation of spacetime). He argues this modified presentism is empirically indistinguishable from standard relativity, thus relativity alone doesn't force eternalism. This supports the view that physics underdetermines the metaphysics of time, a point ER leverages by offering an alternative interpretation.)

10. Smolin, Lee (2013). *Time Reborn: From the Crisis in Physics to the Future of the Universe*. Houghton Mifflin Harcourt. (Smolin argues against the timeless block view, emphasizing that time and flow are real and fundamental. He cautions against treating the 4D spacetime diagram as the literal reality ("the fallacy of the spatialization of time"). ER aligns with this critique by asserting that the mathematical model of spacetime should not be naively conflated with ontological reality – a point that reinforces ER's motivation for distinguishing existence (process) from reality (structure).)

11. Penrose, Roger (1989). *The Emperor's New Mind*. Oxford University Press. (Penrose discusses the Andromeda paradox, providing a popular account of how two people walking in opposite directions can have different simultaneous events on Andromeda. This work, though not primarily about time ontology, helped publicize the strange relativistic effect that challenges an absolute present. It illustrates why many find an intuitive push toward the block universe, and by extension why a nuanced approach like ER is needed to resist that push without denying the physics.)

12. Bourne, Craig (2006). *A Future for Presentism*. Oxford University Press. (Bourne addresses how presentism might handle relativity and other objections, introducing the idea of "relativized presentism" and discussing possible

reconciliation strategies. His work provides context for how ER's approach differs: rather than insisting on a single present or rejecting relativity, ER transforms the concept of existence to be compatible with relativistic constraints.)

13. Broad, C. D. (1923). *Scientific Thought*. (Early articulation of the growing block theory, where past and present exist, future does not. Broad's ideas contrast with ER: the growing block grants existence to the past, whereas ER would say the past is real but not existent. Broad's "objective becoming" in a relativistic context faces challenges similar to presentism unless a privileged frame is assumed; ER's more flexible ontology offers an alternative route to having objective becoming in relativity.)

14. Miller, Kristie (2019). "Existence, Persistence, and Relativity." In The Routledge Handbook of Philosophy of Temporal Experience (eds. I. Phillips). (Overview of how different ontologies of time deal with relativity, including discussions of fragmentalism and relativized existence. It provides philosophical background that complements the ER approach, situating it among broader attempts to reconcile temporal ontology with relativistic physics.)

15. Dorato, Mauro (2006). "The Software of the Universe: On Some Limitations of the Block Universe View." *Humana. Mente* 2: 21–40. (Dorato critiques the block universe and emphasizes the perspectival aspects of becoming. He suggests that while physics gives us a "block" representation, the ontology of becoming might require acknowledging the role of observers. ER can be seen as operationalizing this idea by making existence observer-dependent, an insight Dorato's work anticipates in spirit.)

16. Ellis, George F. R. (2006). "Physics in the Real Universe: Time and Spacetime." *GRG* 38: 1797–1824. (Ellis advocates an "evolving block universe" – the block grows as time progresses, reflecting an objective coming-into-being of events. This is somewhat analogous to ER's view that events become existent as time flows. However, Ellis's evolving block still grants ontological status to past events in a way ER would classify as "real not present." The comparison shows ER's position in the landscape: sharing the desire for objective temporal becoming, but implementing it via the existence/reality split.)

17. Trepp, Tenzin C. (2025). *"Against the Block Universe: A Realist's Rejection of Temporal Flatness."* (forthcoming). (Trepp critiques eternalism's "ontological excess," noting it posits "past matter lingering in spacetime 'elsewhere'" which ER pointedly avoids. Also discusses how eternalism fails to accommodate the experiential and epistemic features of time. ER is presented as a superior alternative that eliminates the "ghostly landscape" of non-present entities by confining existence to the present, without losing the reality of those entities in their own time.)

18. Dolev, Yuval (2006). *Time and Realism: Metaphysical and Antimetaphysical Perspectives*. MIT Press. (Examines different realist and anti-realist approaches to time. Dolev's work underscores the importance of epistemic considerations in metaphysics of time – a theme ER explicitly builds upon, by tying existence to what is in principle observable now. It provides philosophical support for the idea that how we know and experience time should inform our ontological models, a principle at the heart of Existential Realism.)

Declaration

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What ER Is — and Is Not

With the arguments laid out, we now distill ER to its essence. This concise manifesto summarizes the two-tier ontology, its implications, and its stance against rival views — offering readers a clear snapshot of the entire framework.

Manifesto and Summary of Existential Realism: What Exists, What's Real, and Why It Matters

Tenzin C. Trepp,

Email: trepp@tenz.in

Date: August 08, 2025

Abstract

Existential Realism (ER) is a novel ontological framework that distinguishes between *existence* (the empirically accessible present) and *reality* (the broader web of past and future entities and events). This two-tier ontology preserves the primacy of the present **now** while granting ontological status to non-present times in a way that avoids the pitfalls of both presentism and eternalism. We summarize ER's core definitions and motivations, drawing from metaphysics, cognitive science, and physics to illustrate why separating existence from reality matters. ER offers a synthesis: like presentism it holds that only the present **exists**, yet like eternalism it affirms that past and future entities can still be **real**. We provide examples from neuroscience (memory and anticipation), physics (causal traces and relativity), formal logic (truthmakers and temporal reasoning), and ethics (duties to past and future) to demonstrate ER's explanatory power. We discuss implications for our understanding of time's flow, the self's persistence, causality, and moral agency. The tone is rigorous and realistic, yet forward-looking: ER is presented as both a capstone summary of an emerging framework and an invitation for interdisciplinary inquiry into the nature of time and reality.

Introduction

The nature of time and what *exists* at any given moment has been a perennial debate in philosophy. Traditional views tend to conflate existence with reality, differing only in the temporal scope they allow. **Presentism** holds that only present objects and events exist – the past and future are fundamentally unreal (they "nothingness" outside the now).[1] **Eternalism**, by contrast, asserts that past, present, and future things all exist in a tenseless sense – reality is a four-dimensional "block universe" where time's flow is an illusion.[2] These two opposing camps share a critical assumption: they equate reality with existence. They only disagree on which slices of time meet that status. This stalemate has led to

1 Ned Markosian, A Defense of Presentism, 2004.
2 Hermann Weyl, Philosophy of Mathematics and Natural Science, 1949.

well-known puzzles. If only the present exists (as strict presentism claims), how do we account for the truth of past events or the effect of past causes? Conversely, if all times exist equally (as in eternalism), what makes the present *special*, and how do we make sense of the apparent coming-into-being of new events?

"The flow of time reflects the migration of events from possibility, to existence, to enduring realness."

— Summary of the Existential Realism framework

Why We Struggle to Grasp Time?

Despite being central to our existence, time remains one of the most poorly understood phenomena in philosophy and science. Several deep-rooted reasons contribute to this:

1. **Time Is Familiar Yet Deeply Mysterious**
   We are immersed in time constantly—measuring it, planning with it, aging through it. Yet when asked what time *is*, or why it appears to move in one direction, we quickly encounter paradox and confusion. Familiarity breeds illusion: we understand clocks, not time.

2. **Physics Struggles with It**
   Classical physics treated time as absolute and universal. Relativity shattered that illusion, showing that time is relative, malleable, and observer-dependent. Meanwhile, quantum mechanics treats time as a background parameter, not a causal agent. Reconciling the two remains one of physics' deepest unresolved puzzles.

3. **It Challenges Human Intuition**
   We experience time as flowing from past to future—but many physical theories deny this flow, treating all times as equally real. This challenges our most basic intuitions about agency, change, and personal identity.

4. **Philosophers Retreated Too Soon**
   While time was central to thinkers like Augustine, Bergson, and Heidegger, 20th-century analytic philosophy often retreated into linguistic analysis, ceding ontological questions about time to physics. The result is an intellectual vacuum where neither field fully addresses time's existential and experiential depths.

5. **Practicality Overshadowed Metaphysics**
   Time is treated as a tool to be optimized—used in engineering, biology, economics—but rarely interrogated. Its metaphysical status remains neglected, fragmented across disciplines that rarely integrate their insights.

6. **It Is Existentially Threatening**
   Time reminds us of change, decay, and death. It destabilizes the human desire for permanence and control. This existential discomfort may partially explain our cultural and scientific tendency to reduce or sidestep the deep mystery of time.

In summary, time is poorly explored because it is too big, too weird, too close—and too threatening. Yet it may hold the key to understanding not just physical processes, but consciousness, identity, and reality itself.

A Philosophical Imperative: Returning to Time

Philosophy's retreat from time has come at a cost. When metaphysics handed the problem over to physics, a category mistake occurred: physicists measure time, but they rarely define it. The deeper existential, phenomenological, and ontological aspects of time—those that shape our experience and our being—have been left unexamined.

If we aim to understand ourselves and the universe, we must return to the question of time. Not with mystical surrender or abstract detachment, but with rigor and humility. We must embrace a framework that can integrate:

- Physics (especially relativity and quantum phenomena),
- Phenomenology (our lived experience of time),
- Cognitive science (how minds construct temporal order),
- Ethics (our duties to past and future persons),
- And perhaps even art and literature (which capture time's texture and unfolding).

Existential Realism is offered as such a framework.

Existential Realism (ER), introduced in 2025 by Trepp as a new framework, breaks this dichotomy by *disentangling* existence from reality.[3] ER agrees with presentism that only the present moment's contents exist fully and concretely, yet agrees with eternalism that non-present entities (past or future) can still be real in a robust sense. In other words, something can be real **without** existing (at least, not existing *now*). This simple but powerful distinction allows ER to retain the insights of both traditional views while avoiding their extremes. ER was developed with input from multiple domains: metaphysical analysis of time, cognitive science insights about how we perceive and remember, and physics findings about spacetime and causality.

In this manifesto and summary, we synthesize the core principles of Existential Realism and articulate why they matter for philosophy and science. We begin by clearly defining ER's two-tier ontology of **existence vs. reality**. Next, we explain the motivations for this distinction, from solving metaphysical conundrums like the truthmaker problem to making sense of cognitive and physical phenomena. We highlight how ER circumvents the shortcomings of presentism and eternalism (and related theories like the growing block). We then present illustrative examples from neuroscience, physics, logic, and ethics to demonstrate ER's cross-disciplinary explanatory reach. Finally, we discuss broader implications of ER for understanding the flow of time, the persistence of self, causal relations, and moral agency across time. Our aim is to consolidate the ER framework as a foundation for future inquiry – a paradigm that respects both the empirical reality of the present and the extended structure of reality across past and future. Throughout, we maintain a rigorous yet accessible tone appropriate for an informed philosophical and scientific audience.

Existential Realism's Two-Tier Ontology: Existence vs. Reality

At the heart of Existential Realism is a clear **two-tier ontology** distinguishing what *exists* from what is *real*. We define each term precisely:

- **Existence (Present-Only):** In ER, *existence* means concrete, actual *presence* – an entity or event exists if and only if it is part of the present moment and, in principle, observable or detectable **now**. This is a strict criterion: existence is indexical (indexed to the present) and empirically grounded. Only things that occupy the current moment and have some causal/observable influence now count as existents in the fullest sense. This notion is inspired by a disciplined empiricism: we "refrain from positing the existence of entities beyond possible

3 Tenzin C. Trepp, Existential Realism: A Distinct Ontological Framework Beyond Presentism, 2025. https://philpapers.org/archive/TENERM.pdf

experience".[4] Thus, if something lies entirely outside the reach of current observation or interaction, we withhold calling it existent (for now). For example, a distant star that is presently shining (with its light en route to us) exists, since it's part of the now-accessible universe. But a hypothetical object with no causal connection to anything currently observable would not (at present) be said to exist in this strict sense. Existence, as ER uses the term, means "exists now for us" — fully and concretely in the present, with some causal or observable connection to this moment. It's a **present, empirical** concept. This is a deliberate redefinition: philosophers often speak of existence tenselessly (e.g. "dinosaurs exist in the past" or "electrons exist even if we can't see them"). ER restricts *existence* to mean *present existence*. We do **not** thereby deny that unobserved or past things might exist in some looser sense; rather, we are setting a high bar for what gets counted in the category of current existents. The payoff of this strict presentism about existence is that our ontology stays tethered to what is concretely verifiable in the here-and-now, reflecting the special status of the present in experience and science. In summary, in ER **only present entities and events exist** – existence is confined to the moving now and what it contains.

- **Reality (Temporally Extended):** *Reality*, in ER's framework, is a broader category. To say something is **real** means it is part of the world's total causal or informational structure, even if it is not presently existent. The domain of reality includes all that *exists* now (trivially, all existents are real), **plus** entities and events from the past and future (and unobservable entities) that play a role in the world's causal network or in our best-supported explanations of the world. Past events that have left traces or ongoing effects are real. Future events that are reliably predicted or already "in the works" in some nascent form are also real. Even entities we cannot observe directly (electrons, black holes before they were observed, etc.) count as real if they are warranted by empirical evidence or theory. In short, one can say **Reality = Existence + X**, where *X* includes whatever is needed to furnish a coherent, continuous picture of the world across time and beyond immediate observation. We intentionally cast a wide net for reality, but not an unbounded one: to qualify as real, an entity must have some causal or inferential connection to the present – there must be a justified pathway by which the present state of the world encodes information about that entity. For instance, the ancient eruption of Mount Vesuvius in 79 CE is not existent now (it's long over), but it is clearly real: it happened, and its effects persist (Pompeii's ruins, ash layers in the soil, etc. provide evidence of that event). Likewise, a solar eclipse predicted for next year is, in ER terms, real – it will occur based on the deterministic orbital dynamics, and already influences present actions (astronomers scheduling observations, people planning to travel for viewing). The eclipse does not exist now (it's in the future), yet it is woven into the causal fabric of the world and into our current knowledge; thus, it has reality. Similarly, unobservable scientific entities like quarks or dark matter are considered real because they have observable effects and figure in explanatory theories, even if we never see them directly. By defining reality this way, ER grants ontological status to the **past** and **future** (and the currently unobserved) without needing to say those things exist in the same manner as present objects. Everything that makes a verifiable or explanatory difference is part of reality, but only the segment of reality that is *now empirically present* merits the label existence.

This two-tier ontology is the cornerstone of Existential Realism. It allows us to assert, without contradiction: **"Only the present exists, but much more is real."** The present moment holds the full weight of concrete existence, yet the past is not erased into nothingness, nor is the future a mere fantasy – both have ontological weight as parts of reality (albeit not as present existents). By decoupling reality from existence, we can talk about non-present things as real *in virtue of their connections to the present* (through causation, memory, prediction, etc.) rather than as ghostly existents. This move immediately differentiates ER from both classic presentism and eternalism. It preserves the intuitive truth that *now* is special (only now truly exists), while also acknowledging the intuitive truth that past events *did happen* and future events *will happen* (and thus are not nothing). In more formal terms, ER posits an asymmetry: everything that exists is real, but not everything real currently exists. Past and future realities are real only insofar as they live on in records, tendencies, or expectations encoded in the present world.

4 Bas C. van Fraassen, The Scientific Image, 1980.

To visualize this, one might imagine the world as a continually evolving record. The present is like the active layer where new entries are written — the live edge of reality where existence occurs. The **past** are the earlier entries – no longer active, but indelibly part of the record (hence real). The **future** is like blank pages that are starting to be outlined by current trajectories and plans – not yet written (not existing), but some outlines are penciled in (real as possibilities or expectations). This analogy highlights that reality accumulates over time: as moments pass, events move from existence to reality (from the active present into the recorded past). Meanwhile, new events come into existence out of the merely real possibilities of the future. ER's ontology captures a dynamic world: existence is like a moving spotlight on an ever-growing timeline, and reality is the illuminated track (past and present, plus the anticipated track ahead).

By explicitly defining these two tiers, ER offers a framework to reconcile what earlier theories grasped only in part. We can now examine why such a distinction is motivated and how it improves upon prior ontologies of time.

Motivation and Context: Why Distinguish Existence from Reality?

Metaphysical Motivations: The distinction between existence and reality was formulated to address classic metaphysical problems about time. One key issue is the **truthmaker problem**: how to ground the truth of statements about past or future events. Presentists (who say only the present exists) struggle here – if *only* present things exist, what makes it true that (for example) "Dinosaurs roamed the earth millions of years ago"? To avoid saying such statements are brute truth or made true by nothing, presentists have proposed various tricks (e.g., **tensed facts** or "ersatz" abstract entities).[5] Eternalists, on the other hand, easily provide truthmakers (the dinosaurs are just as existent as we are, just located in another time), but at a high ontological cost – they must accept a vast landscape of entities "out there" in time, even those long gone or yet to come. ER resolves the truthmaker dilemma by saying past events are **real** (so statements about them are true in virtue of that reality), without needing to hold that those past entities *still exist*. The **eruption of Vesuvius** can serve as a truthmaker for "Vesuvius erupted in 79 CE" because that eruption is a real part of the world's history, evidenced by present traces, even though the eruption event doesn't exist now.[6] Similarly, for future-tensed truths, ER would say if a future event is sufficiently determined (like an eclipse governed by physical laws), it can be considered real enough to make predictions true, though it won't exist until it happens. Thus ER finds a middle path: truthmakers reside in reality (the causal/informational record and forward projections), not in mysterious presently existing ghost entities.

Another metaphysical driver is the question of **becoming and temporal flow**. Presentism gives a fundamental status to becoming – the idea that reality is constantly updating as time passes – but it tends to do so at the expense of past reality (the past "drops out" of existence entirely). Eternalism denies genuine becoming (since all events are equally there in the block), which many see as a denial of an obvious feature of the world: that things *happen* and new events come into being. The **growing block theory** attempted a compromise by saying the past and present exist (forming an ever-growing block), while only the future is unreal. ER aligns with the spirit of growing block in that it acknowledges an objective becoming (the world's reality accumulates as events occur). However, ER refines it: we say the past is real (not still *existent* as growing-block theorists might say) and only the present exists. Once an entity passes out of the present, it ceases to exist, but it *continues to be real*. In effect, reality grows, even though existence at any one time is just the "latest layer." This captures the sense of an **evolving universe** without requiring us to grant tenseless existence to past events. It is a synthesis of insights:

- Like presentism, ER affirms that **only the present has full existence** (the "now" is ontologically unique).

5 John Bigelow, Presentism and Properties, 1996.
6 Ned Markosian, A Defense of Presentism, 2004.

- Like eternalism (and growing block), ER affirms that **the past is not nothing** – it remains **real** and significant, not annihilated by the passage of time.
- Like growing block, ER incorporates **becoming**: things come into existence and pass into reality; the total reality is cumulative and ever-increasing.

By combining these, Existential Realism avoids the extreme consequences of each view. We avoid presentism's "ontological lacuna" (gap) where the past and future are utterly empty, and avoid eternalism's "ontological overload" where too much (all times) are equally existent. ER thus charts a middle course: a **present-centric but reality-inclusive** ontology. It upholds what each theory gets right (the present's specialness, the reality of non-present times, the dynamism of becoming) while discarding what each gets wrong (the erasure of history, the frozen block view of time, or an ever-growing *still-existing* pile of past objects). In effect, ER says the traditional debate was asking us to choose which times exist, when the better question is to separate existence from a broader reality. This restructuring dissolves the apparent contradiction of something being real yet not existing – by definition, it's possible in ER's vocabulary. Past entities are real **because** they left causal footprints and inform the present, even though they no longer populate the inventory of what exists right now. Future entities can be real inasmuch as they are prepared by present conditions or reliably anticipated, even though they await actual existence.

Cognitive and Phenomenological Motivations: Another motivation for ER comes from how we **experience time** and cognize past and future. Human consciousness doesn't confine itself to an infinitesimal present instant – we experience a *duration* (a "specious present" of a few seconds) and we are constantly influenced by memory and anticipation. Phenomenologists like Edmund Husserl noted that our immediate awareness includes a just-past (retention) and an about-to-arrive (protention).[7] Thomas Metzinger similarly described consciousness as operating within a "window of presence" that integrates recent past and imminent future information.[8] This suggests that what is **present for us** experientially is not a knife-edge now, but a small span that carries along echoes of the past and expectations of the next moment. ER's ontology, which gives reality to the immediate past and future, neatly parallels this structure: it says those just-past events (a second ago) are still real (hence can be directly experienced as memories), and those imminent events (a second in the future) are real enough to be anticipated. Meanwhile, it still maintains that the *only* things existing are the ones in the current moment of experience (or observation). This mapping between ontology and phenomenology was a deliberate design of ER. It avoids dismissing our temporal experience as "illusion" (as strict eternalism might) or as something wholly outside ontology (as presentism might, by treating memory as about "nothing real"). Instead, ER sees conscious memory and anticipation as direct cognitive access to a real past and real future (in their respective ways). Neuroscience supports this view: when we remember, we are reactivating stored brain traces of a past event; when we imagine the future, we use the same neural machinery to project potential events. Studies in cognitive neuroscience have found that remembering past experiences and envisioning future ones engage common brain networks (including the hippocampus and prefrontal regions), and patients with impaired memory often have difficulty imagining the future.[9] Such evidence indicates that the brain treats past events as informationally present (through memory traces) and future events as informationally relevant (through predictions). In ER terms, this makes perfect sense: the past event, though not existing, is real enough to be encoded in your neural architecture; the anticipated future is real enough to guide current planning. Our brains operate as if past and future are part of reality – which, under ER, they are.

Memory in particular illustrates ER's utility. Consider personal identity and moral responsibility: I hold myself responsible for something I did yesterday. Under naive presentism, the "past me" doesn't exist at all now – so in what sense am *I* identical to that person or accountable for those actions? ER provides a satisfying answer: the past me is real (a real part of the world's history and of my life story), and that reality is connected causally/informationally to the present me (via my memories, continuous body, records, etc.). I am the same person as yesterday's me not because yesterday's person is still

7 Edmund Husserl, Lectures on the Phenomenology of Internal Time-Consciousness, ed. 1928 (trans. 1991).
8 Thomas Metzinger, Being No One: The Self-Model Theory of Subjectivity, 2003.
9 Daniel L. Schacter & Donna R. Addis, The cognitive neuroscience of constructive memory: remembering the past to imagine the future, 2007.

somehow lurking in existence, but because yesterday's person is a real segment of the continuous process that leads to me now. Thus, I can legitimately say "I did X yesterday" and take responsibility, since the agent of yesterday is not a mere fiction – it's a real (but past) part of myself. ER thereby preserves our practical understanding of personal continuity and accountability, which would become murky if the past self were utterly non-being. In a similar vein, it gives meaning to our practice of honoring past commitments or learning from past experiences: those past events remain part of reality, hence worth respecting and responding to.

Scientific and Physical Motivations: Modern physics introduced challenges that neither presentism nor eternalism handle very well on their own. Special relativity famously shows that **simultaneity is relative** – there is no single universal "now" slicing across the cosmos.[10] Different observers, moving at different speeds, will disagree on which distant events are happening "at the same time." This fact undercuts the naive presentist notion of an absolute present containing all that exists. Eternalists often seize on relativity to argue that if no unique present exists for all, we might as well treat all times as equally real (the block universe interpretation). Indeed, Einstein himself leaned towards an eternalist view, once remarking that the distinction between past, present, and future is a "stubbornly persistent illusion" for those who understand physics.[11] Presentists have attempted to respond by positing a hidden absolute frame or by relativizing existence to each observer (fragmenting reality into many presents), but these moves can be seen as either empirically unmotivated or metaphysically costly.[12] ER provides a fresh resolution: it accepts that **existence is frame-dependent** (each observer has their own present of what exists for them), but it maintains a unified reality that includes all events. In ER, all observers ultimately share the same set of **real** events (the entire four-dimensional web of spacetime happenings is real), but each observer experiences (and exists in) a particular cross-section of that reality as their present. This means we don't have to claim a single global present, nor do we have to say all events exist in a block. We say: every event that ever occurs or will occur is part of reality (so relativity's space–time is accounted for), but at any given moment, only one local segment of it is actively existing — the segment corresponding to an observer's present frame. This reconciles relativity with a present-centric ontology. It also preserves **causality**: in relativity, what one frame calls "past" might be "present" for another, but ER would say both frames are tapping into the same real set of events, just labeling them differently. Causal influences travel at or below light speed, so no observer can be affected by an event outside their past light cone – ER concurs that only events in an observer's causal past can have left present traces (hence be real-for-them in an evidential sense). By distinguishing existence from reality, we ensure no contradiction: Observer A's "now" and Observer B's "now" may differ, but all events each sees as past or future are still real — just not existent *within the empirical present of that observer*. Thus, we uphold relativity without giving up on an ontologically privileged now – we just relativize that privilege to each context, which physics allows. The **becoming** in ER is also compatible with relativity: time "flows" in the sense that each worldline experiences events coming into existence in sequence, and the total reality grows along every worldline. There is no conflict with relativity's equations; we are only adding an ontological interpretation that *one moment at a time gains existence*. This avoids the frozen-time view while preserving the intuition that the future is open (not yet existent, but real as possibility) and the past is fixed (no longer existent, but real as record).

Quantum physics provides further impetus for ER. Certain quantum phenomena challenge the assumption that only what exists now is real. Take **Wheeler's delayed-choice experiments**, where the way you measure a particle now seems to determine how it *must have behaved* in the past. If the past has no reality until measured, how do we even describe what the particle was doing? Presentism falters here, because if the particle's past state didn't exist at all, it's mysterious how a present choice can retroactively "decide" it. ER, however, can say the particle's past was real (as an indeterminate or superposed state) even though it did not have a definite classical existence. Only upon measurement does one particular outcome come into existence, but prior to that the range of possible past histories was part of reality (quantum reality, so to speak). Similarly, before measurement, a quantum system in superposition doesn't have a single definite value – presentism would treat that as "nothing

10 Hilary Putnam, Time and Physical Geometry, 1967.
11 Hermann Weyl, Philosophy of Mathematics and Natural Science, 1949.
12 Thomas M. Crisp, Presentism and the Space-Time Manifold, 2007.

exists yet", whereas physics suggests there is a real quantum state carrying potential outcomes. ER's flexible ontology can classify that quantum state as real (it has measurable effects, like interference) without requiring a definite existent outcome until observation. This aligns with interpretations of quantum mechanics that view the wavefunction as something real (though not classical) that collapses to an actual existent result. In ER terms, the wavefunction (spread across possibilities) is real; the collapse marks the moment when one possibility becomes existent. Another example: **quantum entanglement** shows instantaneous correlations across distance when particles are measured. Eternalism handles this by saying the entire measurement outcome pattern is laid out in the block, while presentism struggles because it doesn't allow a coherent shared reality across spacelike separations. ER can say each measurement event exists in its observer's present, but the correlation is real as a relation in reality that becomes manifest when both parts are measured. We don't need a global simultaneity to have a coherent ontology of the entangled pair – we just need to acknowledge that *relations can be real* even before both parts exist in the same present. In short, quantum mechanics, with its probabilistic and non-local flavor, seems to demand that we treat potentialities and records as ontologically significant. ER was in part motivated by exactly this demand: we needed an ontology where something like "real but not yet existing" or "real after it's gone" can make sense. By granting reality to the non-present, we accommodate these oddities without overthrowing our common-sense notion of a flowing present.

In summary, the distinction between existence and reality is driven by a confluence of reasons: to solve philosophical puzzles (truthmakers, identity over time), to respect human experience (memory and anticipation), and to integrate physics (relativity and quantum phenomena). ER's framework emerged as a *response* to these needs, aiming to be technically precise yet expansive enough to cover both everyday experience and cutting-edge science.

Avoiding the Pitfalls of Presentism and Eternalism

By synthesizing elements of rival theories, Existential Realism claims to retain their strengths while avoiding their weaknesses. It's worth explicitly highlighting how ER circumvents the major pitfalls:

- **Presentism's Pitfalls:** Presentism's virtue is its recognition that the present is special – only the now feels *concretely real* to us. ER keeps that: only the present exists. However, presentism's pitfall is its wholesale denial of reality to the past and future, leading to trouble with explaining memory, historical truths, causal continuity, and even the relativity of simultaneity. ER avoids these by *not* equating "non-existent" with "unreal." Past and future events in ER have ontological status as real. Thus, we can say the past *happened* and has left real effects, and the future *may happen* and has real possibilities. This salvages truthmaking (past truths are true because past events are real enough to ground them) and allows that causal chains don't mysteriously originate from nothing (a present effect has a real past cause). ER also doesn't force us to choose a single cosmic present – each frame or observer can have their own present exists, but all share one reality of events. In effect, ER **preserves** the empirical focus of presentism (don't believe in more than you can observe now) but **escapes** its implausible consequence that history and future plans are ontologically void.
- **Eternalism's Pitfalls:** Eternalism's strength is giving a robust reality to all times – past and future events are treated on par with present ones, which easily explains their roles in causation and truth. ER similarly affirms the ontological significance of past and future – they are real. But eternalism's major drawback is that it obliterates the distinctiveness of the present and the flow of time: if all events just exist, nothing truly comes into being or passes away; our sense of a moving now becomes an illusion or a subjective artifact. This can lead to a fatalistic feeling that the future is "already out there" and cannot be changed, and it conflicts with how time appears in consciousness (as a flow or unfolding). ER avoids these pitfalls by **denying that all times exist** – only the present exists. The past truly is past (ceased to exist) and the future is

open (not yet existent). Thus, ER preserves a genuine coming-into-being: new existents appear as time progresses. The future is not "fixed" as something already populated with existents; it is a realm of real possibilities that will crystallize into existence as moments arrive. This keeps the door open for **agency and change**: what we do now can genuinely affect which future events come to exist (since they aren't pre-existent). In short, ER rejects the eternalist "block universe" interpretation; reality is not a finished four-dimensional block but a **growing** line, with an active present adding new threads and an open-ended future still in flux. By doing so, ER **honors the experience of time's flow** and the intuition that the future is *not yet decided*, without going to the other extreme of saying the future is unreal or that physics is wrong.

In combining presentism's and eternalism's merits, some might think ER is just a compromise or hybrid. But it is more accurately a **reconceptualization**: it changes the meaning of "exists" and "real" so that statements like "past events are real but do not exist" become not contradictions but tautologies in the system. This conceptual innovation is what allows ER to carve out a consistent middle ground that earlier theories missed. Historically, there were hints of such ideas – for instance, some philosophers suggested that presentists could say past things are real in some attenuated way (to solve truth problems) or that scientific unobservables shouldn't be given full ontological status (echoing empiricist views). ER unifies these strands into a single coherent ontology. It's a stand-alone framework that cannot be reduced to "presentism + eternalism" or any simple combination; it's a fundamental reframing of temporal ontology.

Having defined what ER is and why it was formulated, we now move from the abstract principles to concrete **examples and applications**. In the next section, we illustrate how ER operates in practice across different domains – showing how something can be real without existing and why that distinction yields clarity in science and philosophy.

Examples and Applications Across Domains

Physics (Causal Traces of the Past): Imagine a distant star that exploded as a supernova 10,000 years ago. The light from this explosion is just reaching Earth now, appearing as a bright new point in the night sky. At the moment we observe this light, does the supernova **exist**? According to ER: the stellar explosion itself is a past event – it happened and then ceased. By now (the present), the star's remnants might exist (a neutron star or expanding nebula exists now), but the explosive event **does not exist**; it's over. However, the supernova is certainly **real**: it really occurred, and we have its **causal trace** in hand – the photons arriving at our telescope. Those photons exist now (we detect them presently), and they carry information about the supernova. A strict presentist might say "only the light exists now; the exploded star is nothing." But then what is the light *of*? In ER, we comfortably say: the supernova event is part of reality (the world's history) even though it lacks present existence. It's real enough to have caused something observable now. In physics terms, everything in our past light cone can affect us – ER labels those past causes as real. This example demonstrates how ER handles past causation: a past event can influence the present because, while it doesn't exist now, its reality is manifested in present evidence. The world's reality "stores" the past in the form of records (like incoming light, fossil radiation, etc.). Indeed, physics often speaks of the "records" or "entropy" that increase with time – in thermodynamics and cosmology, the past leaves an imprint (entropy increase, cosmic microwave background as a record of the early universe). ER naturally aligns with this: the past accumulates as reality. Far from being a mere semantic trick, calling the past real acknowledges a physical truth that past events continue to have effects.

Neuroscience and Cognitive Science (Memory and Anticipation): On a personal level, consider how **memory** works. When you recall your childhood birthday party, the neurons firing in your brain right now *exist* – those neural patterns are present and can be observed with brain imaging. The original event (the birthday party years ago) obviously does not exist now. Yet it would be absurd to say your memory is about nothing real. In ER terms, that childhood event is **real** (a part of your life's timeline), and it left a **trace** in the physical structure of your brain – often called a memory *engram*. Neuroscience shows that experiences physically change synaptic connections and leave enduring

molecular marks. Those changes persist into the present, which is why you can recall the event. So a past experience maintains a reality in the present via its effects on you. Your memory is not a magical connection to a non-existent void; it is a present representation of a real past occurrence. ER provides the language for this: the memory is a present existent that encodes a real but non-existent event. This view also clarifies personal identity: you are the same person who had those childhood experiences because those past person-stages are real components of the world, linked in a chain to your current stage. If the past self were utterly unreal now, grounding identity (or moral responsibility for past actions) would be difficult. ER says instead: past "you" is real (though past), and that reality is carried into the present via memory, records, and causal continuity, which is why you can still be held accountable or still be shaped by what happened before.

Likewise, consider how we **anticipate the future**. The human brain is often described as a prediction machine: it continuously generates expectations about the immediate future. For example, as you walk or speak, your brain predicts the next step or the next word someone will say. This predictive processing is evidenced by neural activity that represents upcoming events milliseconds or seconds before they happen. If only the present exists and is real, what are these neural circuits doing? They are essentially treating the near-term future as if it were real – allocating neural resources to likely upcoming scenarios. ER vindicates this intuition: the imminent future (say, fractions of a second, or even longer-term plans) is **real enough** that organisms can respond to it. When you decide to save money for retirement, you are acting as if your future old-age self is real and worth caring about. Presentism alone might say "that future self doesn't exist, so why worry?" Eternalism might say "that future self already exists, so your effort is predetermined." ER offers a sensible middle-ground: your future self does not exist *yet*, but is sufficiently real (as the likely continuation of your life) that it warrants present consideration. In cognitive terms, we often **pre-experience** future possibilities (imagination, planning) using the same memory systems that recall the past. The overlap of neural mechanisms for remembering and imagining (as research shows) supports the idea that the mind handles past and future similarly – as real scenarios on a timeline, one behind and one ahead of the present. ER maps onto this neatly: the past and future are parts of reality our mind can travel to (in thought), even though our body remains in the present.

Formal Logic and Information Systems (Logic of Time and Records): Traditional logical systems have difficulty expressing statements like "X is real but does not exist now" without contradiction. In classical logic, "exists" is usually a yes/no predicate that doesn't account for time, and standard tense logics or modal logics often don't differentiate existence vs reality explicitly. One of the ER project's advances has been to outline a **formal logical framework** that includes two predicates or modal operators: one for "exists now" and one for "is real".[13] In such a logic, we can assert propositions like "$\exists x\ (\text{Real}(x) \wedge \neg\text{Exists}(x))$" meaning "there is an x such that x is real but not (presently) existent" – a statement that encapsulates ER's core claim. For example, let x = "dinosaurs": $\text{Real}(\text{dinosaurs}) \wedge \neg\text{Exists}(\text{dinosaurs})$ would be true in ER semantics. This kind of formalism shows that ER is not just hand-waving, but can be made precise. It also helps avoid logical pitfalls: we add axioms like "if Exists(x) then Real(x)" (everything that exists is real) and the converse is not generally true. By doing so, we ensure consistency and can reason rigorously about scenarios that confuse other ontologies. For instance, the **truthmaker problem** discussed earlier can be framed logically: for a past-tense statement $\exists x(\text{PastEvent}(x) \wedge \text{Property}(x))$, what guarantees its truth? In ER logic, there would be an entity in the domain for that past event which is Real but not Exists, serving as the truthmaker. This formal approach can illuminate debates about identity over time (how something can cease to exist and yet be the same as something real in the past) and modalities (we might even extend to "possible vs actual vs real" distinctions). While the full formalism is beyond our scope here, we mention it to show ER's rigor: it's possible to encode this two-tier ontology systematically so that philosophers and even AI systems could work with it. Consider also **data systems** as a parallel: a version-controlled database might keep only the current state in primary memory (that's what "exists" for quick access) but store a log of changes so past states can be reconstructed (the past information is real, though not directly active). This is analogous to ER's view: only the current state exists, yet the log means past states are not lost – they have reality in the archived data. A blockchain ledger similarly has each block referenc-

13 Bas C. van Fraassen, The Scientific Image, 1980.

ing the previous, creating an immutable record of past states; one could say old blocks remain part of reality (the chain) even if the system's current state moves on. These analogies in information technology illustrate by example how one can treat present data vs historical data in different ways (active vs archived) without denying that the archive still "counts." ER's existence vs reality mirror this logic in nature: the present state of the universe is like active RAM, the past is like a written record. Both are needed for a full account, but only one is in play at a time.

Ethics and Moral Agency (Responsibilities to Past and Future): The two-tier view of time also has ethical implications. In a presentist outlook, one might implicitly discount future consequences – since future people or events "don't exist yet," it's tempting (even if fallacious) to give them less moral weight. Conversely, in a naive eternalist or fatalist outlook, one might feel that since the future is already real or determined, individual agency and responsibility are illusory ("whatever will be, will be"). ER provides a balanced perspective for **future ethics**: future individuals and events may not exist now, but they are real enough that our actions can harm or benefit them. We can coherently talk about **duties to future generations** or the impact of climate change on future lives, because those future lives will become existent and are part of reality's unfolding story. They are not mere hypothetical nothings; in ER they have ontological foothold as real future persons (in the sense that, barring extinction, *someone* will be there whom our actions affect). At the same time, ER underlines that the future is not set in stone – it's open. So our choices now genuinely shape which future realities come about. This avoids the moral inertia that can accompany a block-universe mindset. We neither dismiss the future (as presentism might inadvertently encourage) nor consider it already settled. Instead, we treat the future as **morally considerable** precisely because it is a part of reality (though unactualized). For example, consider climate ethics: ER would say the devastated planet of 2100 is a real possible future that we are actively creating or averting; we have a responsibility to ensure a *better* real future comes to exist, even though those future people don't exist yet. By granting reality to future outcomes, we justify strong concern for them without paradox.

Similarly, regarding the **past**, presentism would say bygones are bygones – if past people don't exist, do we owe anything to them? Yet we commonly feel obligations like remembering the dead, honoring historical injustices with reparations or apologies, etc. ER validates these intuitions: past persons and events are still real parts of our world, so how we relate to them continues to matter. We can meaningfully talk about *honoring* the reality of past heroes or *addressing* the reality of past atrocities (through memorials or restorative justice), because those things, while not existing, have not been erased from reality. This adds a layer of ontological seriousness to memory and history. It suggests, for instance, that preserving historical records and memories is not just sentimentality but maintaining a connection to real components of the human story. Even grieving lost loved ones takes on a slightly different tone: if presentism were taken strictly, once a person dies they are nothing at all; but ER offers the comfort that while they no longer exist, they remain real – their life, actions, and impact are woven into reality permanently. One might still cherish and respond to that reality (for example, by keeping their memory alive, which in turn maintains the causal influence of their existence). These ideas indicate how ER might inspire what we could call a "temporally extended" moral realism, where moral patients and duties are not confined to the slice of beings that happen to exist right now.

Of course, ER does not solve every ethical puzzle automatically. For example, the **non-identity problem** in ethics (which asks whether we can wrong future people whose very identities depend on our actions) remains a challenging issue.[14] But ER offers a reframing: instead of focusing on specific future individuals (who may not exist if we act differently), we focus on the reality of future outcomes. We have obligations to bring about a reality in which well-being is maximized, rather than obligations to particular not-yet-existent persons. This might sidestep some paradoxes by treating the moral object as "future humanity" in general, which *will* exist in some form and is thus a real stake in our decisions. Similarly, apologies for past wrongs can be seen not as talking to the void, but as acknowledging a real part of the world (the wrong and its victims) and attempting to reshape the present in light of it (through remembrance or restorative actions). These interpretations remain speculative, but they show how ER's ontology could fruitfully inform moral philosophy. It allows us to be neither shortsight-

14 Derek Parfit, Reasons and Persons, 1984.

ed (ignoring future or past because they're not present) nor fatalistic (dismissing agency because everything is fixed). Instead, we get a picture of **moral agency in time**: we exist in the present, but we act with regard to a reality that spans past and future.

Implications for Time, Self, Causality, and Agency

The Existential Realism framework has far-reaching implications for how we conceptualize fundamental aspects of philosophy and science. We highlight a few key implications:

- **Nature of Time and Becoming:** ER restores a sense of **becoming** to the ontology of time without clashing with physics. Time is no longer just a static dimension as in the block universe; rather, the passage of time corresponds to an ongoing ontological update: new events become present (come into existence) and past events slip into reality (retaining their reality but no longer existing). This account validates our intuition that the future is genuinely open and that something ontologically significant separates past, present, and future – they are not on equal footing. Past and future are "real but not concretely present," whereas the present is "real **and** concretely present." The flow of time thus reflects a real process: it's the successive migration of events from possibility to existence to reality. Importantly, ER's becoming does not necessitate a universal present; it can be conceived locally (each worldline or observer experiences their own becoming), which meshes with relativity. We get to talk about the "moving now" without invoking a single cosmic clock. This could inspire new thinking in physics: perhaps an ontology like ER could be the basis for integrating quantum indeterminacy (open future) with relativistic spacetime, by allowing indeterminate reality that resolves into existence. In any case, ER invites reconsideration of the old question "Does time really flow?" – answering yes, but in a way that doesn't require time as an extra physical substance or an absolute frame, only an acknowledgment of the ontological difference between stages of time.

- **The Self and Identity Over Time:** ER offers a fresh perspective on personal **identity and the self**. Traditional views like four-dimensionalism (worm theory) say you are an extended spacetime worm and all your temporal parts exist; presentism struggles with how you remain "you" if past parts no longer exist. ER would say your past stages are real parts of you (hence you have a continuous identity grounded in causal and psychological links), even though only the current stage exists. This squares with how we normally think of ourselves: we don't feel like we wholly exist across time in the eternalist sense; we feel like only the present me is *fully here*, yet I was the past child and will be the future elder in a real sense. ER captures that: I (the existing me) am connected to those other time-stages by continuity, and those stages are part of reality (my history and my future). It also impacts the concept of death: when I die, I cease to exist, but in ER I would remain real (as a past person). While my agency ends, the reality of my life persists in the world's story. Some might find solace in that notion or use it to frame legacies (one's work, memories left in others, etc., are ways the reality of one's existence continues to have effects). Philosophically, this approach could inform debates on what it means to be the same person over time: rather than requiring an enduring substance or soul, identity can be seen as the connected reality of a process that at any moment only partly exists (the present slice) but as a whole is a temporally extended pattern.

- **Causality and Determinism:** ER reinforces a **causal realist** view: causes from the past don't need to "travel" from non-being; they are part of reality and thus can influence the present. This helps with the intuitive idea that the present state contains within it the causal inheritance of the past. It might also reframe how we think about determinism and free will. In a block universe, determinism often is visualized as everything already laid out (so in principle predetermined). In pure presentism, one could cling to a kind of libertarian free will (future not yet real, so we truly create it), but at the cost of how to account for probabilistic laws or established future events. ER allows that the future, while not existent, can have **probabilistic reality** – e.g., different possible outcomes might each be real until one becomes existent (think of quantum or even decision branches as real possibilities). Our choices are precisely the mechanism by

which one slice of future reality gets actualized into existence. Thus free will (or at least effective agency) can be conceived as the process of selecting among real possibilities. This is neither the magical "creating something from utter non-being" of some presentist libertarian accounts, nor the static "you were destined to choose X because the future you exists and chose it." Instead, it's an intermediate: the stage is set with real options and tendencies, and the agent's action brings one option into existence. This might tie in with views in physics that emphasize the role of measurement or choice in determining outcomes (though we must be careful not to over-interpret quantum analogies). The key point is that ER's open-future reality supports a robust sense of **agency** – the future is real enough to matter, but not so real as to preempt intervention.

- **Moral Agency and Temporal Ethics:** We've touched on ethics, but to emphasize: ER suggests a framework for **temporal ethics** where responsibility extends beyond the present. Decisions are made by present agents, but their moral evaluation depends on effects on real future states and real past contexts. This perspective could refine ethical theories by explicitly incorporating temporal ontology. For instance, utilitarian calculus might weight future pleasures and pains not by their lesser reality (since in ER they are as real in kind, just not existent yet), but perhaps by uncertainty or other factors. It discourages any tendency to treat the future as unreal and thereby negligible. It also avoids the trap of some interpretations of eternalism that imply everything is fixed so moral striving is moot. By threading the needle, ER could encourage a kind of **responsibility across time**: acknowledging our role as links between the past (which we carry in reality) and the future (which we influence into existence).

In all these respects, Existential Realism is both conservative (it doesn't ask us to throw out the tangible importance of the present or the evidence of science) and innovative (it invites rethinking deep assumptions about being and time). It presents a more **nuanced ontology** that mirrors the complexity of how we actually navigate the world: rooted in the now, yet cognizant of a temporal horizon stretching behind and ahead.

Conclusion

Existential Realism (ER) emerges from this synthesis as a compelling new paradigm for understanding what exists, what's real, and why it matters. By clearly separating the notion of present existence from a broader concept of reality, ER manages to honor the **privileged status of the now** without denying the **ontological significance of the past and future**. This two-tier ontology provides a coherent answer to longstanding debates in metaphysics, bridging the gap between presentism and eternalism: it affirms, in one breath, that *only the present exists* and that *much more than the present is real*. In doing so, ER preserves the experiential truth of a flowing present and the scientific truth of a causally-connected spacetime, reconciling them in a single framework.

We have summarized ER's core tenets and shown how they address key problems: truthmakers for past events, the experience of time's passage, relativistic physics's challenge to an absolute present, quantum indeterminacy, and ethical considerations for non-present persons. Across neuroscience, physics, logic, and ethics, ER provides interpretive clarity. It explains why memory works (the past is real enough to leave physical traces), why planning works (the future is real enough to guide action), how we can formalize temporal reasoning (with separate predicates for existence and reality), and why we feel obligations beyond the present (because those times are part of reality, not mere nothingness).

The tone of ER is **realistic** in that it insists on empirical and causal grounding (nothing "mystical" is posited – if something is real, there will be some potential evidence or effect for it), yet it is also forward-looking. ER opens up many avenues for further inquiry. This manifesto is not an endpoint but a foundation and an invitation. There are open questions and fertile domains awaiting deeper exploration:

- **Further Formalization:** How can we rigorously formalize ER in logical or mathematical terms? Work has begun on creating logical systems for ER, but more can be done to integrate this with probabilistic reasoning (for degrees of reality among unrealized possibilities) and with relativistic spacetime formalism (to handle observer-relative existence precisely). Such formal tools could make ER a precise instrument for philosophers and perhaps even scientists (e.g., in quantum foundations or AI knowledge representation).
- **Interdisciplinary Integration:** ER suggests that metaphysics need not be isolated from science. Future research can explore how ER's ontology might inform cognitive science experiments (e.g., does treating memories as connecting to real past events alter how we interpret memory errors or trauma?), or how it might influence physics interpretations (could ER be a basis for a new interpretation of quantum mechanics that emphasizes becoming, or a new take on quantum gravity where time is emergent?). Thomas Metzinger's call for no fundamental divide between ontology and empirical mind-science resonates here: ER is poised to engage with empirical findings about time perception, memory, and anticipation in the brain. In physics, ER might inspire novel conceptualizations of time in cosmology or the study of irreversible processes (where the "growing reality" idea echoes the second law of thermodynamics).
- **Temporal Modality and Possibility:** ER as presented deals with reality vs existence, but one could extend the idea to encompass *possibility* as another tier (things that could be real under certain conditions). For instance, the framework might be broadened into a tri-tier ontology: the present exists; the determinately real spans the past and sufficiently determined aspects of the future. Beyond this lies a realm of possible (but not actualized) events — outcomes that were once real possibilities but never came to be, or potential future developments that may still emerge. Formalizing and interpreting this (perhaps through a logic of collapse or temporal migration) could clarify notions of chance, choice, and counterfactuals within an ER context.
- **Ethical Theory and Long-term Thinking:** Philosophers and ethicists could use ER to bolster arguments about future generations, climate ethics, and historical justice. If ER is correct, it gives a metaphysical justification for treating future outcomes as something more than speculative – strengthening moral claims that we *owe* something to the future. Conversely, it dignifies the past as something that, though unchangeable, still "exists" in our moral landscape (as reality), possibly demanding acknowledgment or reparative actions. What new ethical frameworks might emerge if we explicitly take ER on board? Could it help mediate between short-term and long-term perspectives in policy-making by providing a vocabulary where future people are considered real stakeholders? These are exciting questions for applied philosophy.
- **Human Significance and Existential Meaning:** On a more existential note (befitting the name *Existential* Realism), this view of time might influence how individuals find meaning in temporal existence. It gives structure to ideas like legacy, memory, hope, and regret. Future research in existential psychology or even contemplative traditions might engage with ER's concepts: for example, how does one's attitude change if one internalizes that past losses are gone but not null, or that one's future is not yet existent but is already part of reality in a tentative way? ER might provide a philosophical grounding for certain therapeutic or mindful practices that encourage living in the present while staying connected to past and future in healthy ways.

In closing, **Existential Realism** stands as a robust integrative ontology for the 21st century discourse on time. It takes the best of old ideas and forges something new – a framework at once technically precise and broadly applicable. By differentiating what exists from what is real, we gain a clearer lens on the universe: one that sees time as a continually expanding web of reality, with each present moment as the living frontier of existence. This manifesto and summary has laid out the foundations of ER and demonstrated its value. The task now is to build on this foundation. We invite philosophers, scientists, and thinkers of all stripes to engage with Existential Realism – to test it, refine it, and apply it. If ER is on the right track, it has much to contribute to our understanding of time, existence, and reality. And in grappling with those grand themes, we inch closer to answering that most human of questions: *what does it mean to be, in a world that is always becoming?*

Reflections

Existential Realism began not as an exercise in abstraction, but as a way of seeing the world that emerged from intuition and careful inquiry. At its core, ER is more than a formal ontology – it is a shift in perspective about time, presence, and meaning. By drawing a line between what **exists** now and what is **real** beyond the now, ER invites us to experience the present moment not as an isolated slice of being, but as the living frontier where reality continually actualizes. This framework reshapes how we understand our lives in time: the past is no longer a phantom to be dismissed, but a real heritage carried in every present; the future is no mere illusion or foregone conclusion, but a realm of real possibilities that will *become* actual through what we do now. In emphasizing the **present** as the only locus of existence, ER does not trivialize the past or future – it reclaims the **now** as the arena of creation, where history's reverberations meet open horizons of possibility. Such a vision resonates with our lived experience: we feel the presence of the past in memory and trace the pull of the future in our aspirations, all while knowing that only this moment is tangibly here. ER validates this intuitive sense that *time is alive*, continually bringing forth something new. The philosophy thereby transforms a technical ontological distinction into a broader way of seeing reality – one that can subtly change how we find meaning in our transient yet ever-creative present.

This concluding reflection also underscores the humility with which ER was forged. The framework was not born from mere speculative fancy; it unfolded by following a simple insight – that **now** is ontologically unique – to its structural and explanatory consequences. ER's development exemplified a willingness to let intuition lead, but only under the discipline of reasoned analysis. Each step in articulating ER was guided by evidence and logical coherence: the concept germinated from a *felt* tension in the philosophy of time (the clash between the reality of change and the static block view), and it grew by examining what had to give. The result was not a doctrine handed down fully formed, but a model built piece by piece – tested against physics, cognitive science, and common sense. In reflecting on this process, we recognize that ER's strength lies as much in its *method* as in its content. It reminds us that philosophical ideas thrive when we balance visionary thinking with critical rigor, and when we remain open to where an idea might lead, even if it challenges entrenched viewpoints. ER followed that path: an intuitive commitment to the reality of becoming was followed through with disciplined argument, yielding a structure that addresses age-old puzzles about time. In this sense, ER's genesis models the very distinction it proposes – an initial insight was *real* enough to inspire investigation, but only through systematic work did it gain **existence** as a fleshed-out theory. This history encourages an attitude of philosophical humility, showing that our deepest intuitions can be fruitful when pursued carefully, and that even a "visionary" ontology must earn its keep by cohering with what we know about the world.

Indeed, *humility* is a central note in ER's outlook. Existential Realism does not claim to be the final truth about reality, but rather a provisional model – one that, like any scientific or philosophical paradigm, stands or falls by how well it illuminates phenomena. We offer ER in the same spirit that earlier frameworks were once offered: as a coherent way of making sense of experience and evidence, not as a dogma. Just as Einstein's relativity revolutionized our understanding of space and time without pretending to be the last word,[15] and Darwin's theory of evolution reframed biology while remaining open to later refinement,[16] ER presents a bold but fallible vision. It proposes that by rethinking time's ontology we can resolve certain conflicts between physics and phenomenology – yet it does so knowing that future discoveries or analyses could challenge its premises. In other words, ER is *perennially open-ended*. It does not demand unquestioning acceptance; it **invites** exploration and critique. By explicitly positioning itself alongside the insights of modern physics and cognitive science, ER acknowledges that it must continually align with empirical reality. Its two-tier ontology fits elegantly with current knowledge (much as relativity and evolution fit their evidence), but it will remain viable only so long as it continues to fit as new knowledge emerges. This stance keeps ER modest: it is a framework intended to be tested, refined, or even replaced as our understanding grows. Such philosophical hu-

15 Einstein, Albert (1905). On the Electrodynamics of Moving Bodies. (Einstein's special relativity paper, which reconceived space and time as relative; an example of a model that revolutionized science without claiming finality.)

16 Darwin, Charles (1859). On the Origin of Species. (Darwin's foundational work on evolution by natural selection, which reshaped biology as a unifying explanatory framework while remaining open to later elaboration.)

mility is not a weakness – it is a strength that aligns ER with the self-correcting spirit of science and the reflective spirit of philosophy. We recognize that any model of reality is, at best, an *approximation* or a guiding metaphor for truths deeper than our present comprehension. ER aspires to be a *useful* approximation – one that captures something true about time and existence – but never to declare the inquiry closed.

If Existential Realism's formal arguments address scholarly debates, its broader vision speaks to possibility and wonder. By reimagining the relationship between existence and reality, ER reclaims a sense of **openness** in the cosmos. We find ourselves in a world where the *present* is not just a thin knife-edge erasing everything behind it, but a creative frontier laden with the legacy of what was and the promise of what could be. In such a world, *time* is not an inert dimension to be traversed, but an active process – a story that is still unfolding. This outlook carries quiet yet profound implications for how we live our lives. It suggests that our actions in the present **matter** in a very real way: because the future is not pre-written, each choice helps decide which among many real possibilities will exist next. ER thereby resonates with a humanistic intuition: our responsibility toward the future is grounded in the reality of that future's possibilities here and now. Equally, ER can instill a certain solace about the past – though past moments have slipped out of existence, they are not annihilated to nothingness; they remain real as the contours and causes shaping the present. This means that loss, memory, and history retain their significance in the fabric of reality. To view life through the lens of Existential Realism is to appreciate *presence* as a gift that is richly informed by real history and pregnant with real potential. It is to realize that meaning is continually generated in the transition from the real to the existent: each "now" is **meaningful** precisely because it crystallizes something new out of the flux of possibility. Such a perspective does not answer ethical or spiritual questions by itself, but it offers a backdrop against which those questions acquire a fresh urgency and context. It encourages us to be fully present – for the present is where reality happens – while also being mindful that our present stands on a vast real landscape of time.

Looking forward, these reflections are an invitation to further inquiry across philosophical and disciplinary boundaries. If ER has succeeded in carving out a plausible model, it has done so by standing on the shoulders of both metaphysical speculation and empirical science. The road ahead will demand the same synergy. We encourage philosophers, physicists, cognitive scientists, and thinkers of all stripes to engage with Existential Realism – to test its claims, to extend its ideas, and to challenge its limits. The true value of a framework is ultimately measured by the research and discussion it stimulates. For ER, many avenues beckon: refining its formal semantics, exploring its implications for relativity and quantum theory in greater depth, examining how it might inform our understanding of consciousness and temporal perception, and debating its ethical ramifications in decision theory and responsibility. Each of these directions promises not only to fortify (or revise) ER itself, but also to enrich our general understanding of time and existence. In closing, we do not see ER as the terminus of a journey, but as a waystation – a platform from which new questions can be asked about reality and our place within it. **Existential Realism,** as both a structured ontology and a way of seeing, opens a door onto a landscape where time is dynamic and reality is layered. Stepping through that door requires both curiosity and humility. We step through with the hope that this vision – like the great conceptual frameworks before it – will inspire continued dialogue and discovery. The ultimate measure of ER's worth will be whether it can illuminate *why the present matters* in a universe of change, and in doing so, guide us toward deeper insight into *what exists, what's real, and why it matters*.

Just as Darwin transformed our understanding of life by showing that its richness and directionality could emerge from natural processes unfolding over deep time, **Existential Realism** seeks to transform our understanding of being — by showing that reality itself unfolds through **becoming** in a strictly present world.

Darwin grounded evolution in natural selection, not divine design. ER grounds existence in the **present**, not in eternal structures or metaphysical projections. Both reject the illusion of static wholes in favor of **dynamic, contingent, observable processes**.

In this sense, ER is not merely another metaphysical proposal. It is an **ontological lens** — one that invites us to see time, identity, and agency not as illusions to be explained away, but as **real features of becoming**.

If Darwin helped us understand where life came from, Existential Realism may help us understand **what it means to exist at all.**

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Beyond the Present Work

Existential Realism is not a closed theory —
it is an open path. This final paper outlines future directions, unresolved tensions, and philosophical invitations. Time, cognition, becoming, and reality: there is still much to uncover.

Beyond the Present: Open Questions in Existential Realism

Tenzin C. Trepp,

Email: trepp@tenz.in

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Abstract

Existential Realism (ER) is a recently proposed ontological framework that sharply distinguishes **existence** (actual, present being) from **reality** (a broader domain including non-present entities). ER was conceived to reconcile the intuitions of presentism (only the present exists) with eternalism (past and future are ontologically significant) in a two-tier view of time and being. This preprint surveys a range of open questions and forward-looking challenges that have emerged from the first generation of ER research. We chart key areas—metaphysics, physics, formal logic, phenomenology, cognitive science, and ethics—where ER's framework invites further development. How does **becoming** (the passage from potential to actual) work in ER's ontology? Can ER fully accommodate **relativity** and quantum physics without sacrificing its present-centric stance? What extensions to **two-tier logic** might capture phenomena like an open future or cross-temporal identity? How might ER engage with **phenomenological** accounts of time-consciousness or empirical findings about memory and anticipation in the **brain**? And what are the implications of ER for **ethics**, especially concerning our agency over time and responsibilities to future persons? Throughout, our tone remains rigorous yet exploratory — and, despite the scope of our claims, rooted in humility: we outline problems and tensions rather than claim final answers. By mapping these open questions, we aim to stimulate interdisciplinary inquiry and guide the next stages of ER's development.

Introduction

In traditional metaphysics of time, **presentism** asserts that only present entities and events exist in the fullest sense. As one proponent puts it, if we listed everything in our domain of discourse, "not one would be non-present"—all such past or future objects would be considered unreal.[1] In contrast, **eternalism** holds that past, present, and future entities *all* exist (tenselessly), implying a "block universe" where time is another dimension and the flow of time is illusory. These opposing views share a crucial assumption: they treat *existence* and *reality* as identical, disagreeing only on which slices of time enjoy that status. **Existential Realism**, introduced by Trepp in 2025, breaks this mold by disen-

1 Ned Markosian (2015) vividly emphasizes this presentist claim: if we enumerate all entities our quantifiers range over, not one would be non-present — "all such objects are unreal" for the presentist. (Quote cited in Trepp 2025 as a concise statement of the orthodox presentist stance.)

tangling existence from reality.[2] ER agrees with presentism that only entities in the present moment *exist* (fully and concretely), but it agrees with eternalism that past and future entities can still be *real* in a meaningful sense. In other words, something can be real without existing (at least not existing now). This two-tier ontology—**existence (present-only)** versus **reality (temporally extended)**—allows ER to preserve the privileged status of the "now" while acknowledging the ontological weight of the past and the future.

The first series of ER preprints established the core concepts and demonstrated ER's applicability across domains. We now stand **beyond the initial formulation**, surveying unexplored questions that ER has raised but not yet answered. This paper serves as a roadmap of open problems and future research directions for Existential Realism. Each section below focuses on a discipline or theme where ER's perspective suggests new lines of inquiry. We adopt a **rigorous yet humble** tone: rather than presenting definitive solutions, we identify tensions and invite further work. By examining metaphysical puzzles, physical theories, formal semantics, phenomenological insights, cognitive science evidence, and ethical dilemmas, we aim to illuminate how ER might evolve. The hope is that addressing these open questions will both strengthen ER's philosophical foundations and enhance its integration with broader scientific and humanistic knowledge.

Metaphysical Horizons: Ontology of Becoming and Reality

At the heart of ER is the dynamic relation between **reality** and **existence**. ER posits that reality spans beyond the present, but *becoming* – the process by which something that *was merely real* (as a possibility or past influence) *becomes existent now* – remains philosophically enigmatic. An open question is how to rigorously characterize this process of **becoming** in metaphysical terms. ER rejects the eternalist's static block view and insists that there is an objective coming-into-being (the present continuously "updates" as new events occur). Yet what metaphysical *mechanism* underlies this continual update? One might conceptualize becoming as the **collapse of potential into actual**, a metaphor borrowed from quantum collapse. Still, articulating this without resorting to mere metaphor is challenging. Is becoming an irreducible primitive in ER's ontology, or can it be derived from deeper principles? Future work could explore models of becoming that avoid treating it as a mystical process. For instance, branching-time metaphysics provides one template: the world may be envisioned as a field of real possibilities that progressively collapses into actuality as time advances. In ER terms, the **open future** would consist of real but not-yet-existent possibilities, which *become* present existents once "actualized," while unrealized branches cease to be real.[3] Formalizing this idea would clarify what it means for an event to move from the realm of the merely real into concrete existence. However, it also raises questions: Does reality itself undergo change (shrinking as possibilities vanish)? Or is reality a fixed four-dimensional structure with a moving spotlight on the present? [4] ER leans toward the former—reality is not a finished block but includes an *indeterminate* aspect that resolves as time flows. Precisely how to integrate indeterminacy into the ontology of reality is an open problem requiring further metaphysical innovation.

Relatedly, ER must further explicate the **ontological status of past and future entities**. They are said to be real (in virtue of their causal or informational connections to the present), but what *kind* of being do they have if not existence? Are they perhaps best thought of as *properties or relations* (e.g. "having existed" or "will exist"), as abstracta, or as causally latent structures? ER thus far speaks of past events being real because, for example, they have left traces and effects that persist (we have records, memories, ongoing causal influence). Future events may be real insofar as they are built into our current causal expectations or probabilistic models of the world. But these characterizations risk reducing reality to an epistemic notion (what we can infer or anticipate from the present). The metaphysical challenge is to flesh out a positive **ontology of the non-present**: in what mode or manner do past and

2 T. C. Trepp (2025), Existential Realism: A Distinct Ontological Framework Beyond Presentism. This work introduced the ER framework, distinguishing existence (present, empirical being) from reality (causal or informational being spanning time). https://philpapers.org/archive/TENERM.pdf

3 Albert Einstein (1955), letter to the family of Michele Besso (dated March 21, 1955). Einstein wrote that for those who believe in physics, the separation between past, present, and future is "only a stubbornly persistent illusion."

4 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton University Press. The quote "The objective world simply is, it does not happen" appears in reference to eternalism.

future entities "inhabit" reality? One avenue is to draw on the concept of **truthmakers** for past and future truths. ER offers a novel approach to the classic truthmaker problem: if a past event no longer exists, what makes a statement about it true? In ER, the reality (continuing causal/informational influence) of that past event can serve as the truthmaker. However, more work is needed to specify these truthmakers and ensure they do not reintroduce contradictions (for instance, avoiding commitment to ghostly present remnants of past objects). Similarly, **identity over time** poses questions: if an entity exists now but did not exist in the past (or will cease to exist in the future), in what sense is it the *same* entity that was real in the past or will be real in the future? ER's framework suggests that an entity can remain real (maintain identity in the structure of reality) even while it flickers in and out of existence. The task is to formalize this intuition without falling into incoherence. Philosophers have offered concepts like "historical chains" or causal continuity to ground identity across a gap in existence. ER can build on these, but open issues remain—for example, if a future person is real now in virtue of a chain of events leading to their eventual birth, how do we handle cases of branching or contingency where multiple possible individuals might come to exist? This touches on the **trans-world identity** of merely possible individuals and may require importing tools from modal metaphysics.[5] In sum, at the metaphysical level ER prompts a reconceptualization of time's ontology: it must articulate how the world can have *ontological breadth* (past and future reality) without a bloated existence. Achieving this will likely involve new ideas about causality, modality, and the nature of temporal truth—all fertile ground for future inquiry.

Physics: Time, Relativity, and Quantum Openings

Perhaps the most acute challenges for ER come from modern physics. **Relativity theory** famously undermines the notion of a single universal present. In Einstein's special relativity, simultaneity is relative to observers in motion; there is no objective, frame-independent "now" slicing through spacetime.[6] This empirical fact pushed many to adopt an eternalist view (the 4D block universe), where all events—past, present, future—equally exist in the spacetime manifold. Einstein himself, upon the death of a friend in 1955, wrote that for those of us who understand physics, the distinction between past, present, and future is "only a stubbornly persistent illusion".[7] How can ER maintain that only the present exists, given that relativity denies any privileged present across reference frames? One open question is whether ER can incorporate a **relativized existence** without inconsistency. In the ER paper "Spacetime, Relativity, and the Persistence of Becoming" on spacetime, a strategy was sketched: treat "existence-now" as an *indexical*, something that is always relative to a frame or an observer's worldline, whereas reality is the invariant four-dimensional structure of events (including all frames' perspectives).[8] In plainer terms, ER would say: each frame of reference has its own present (only events simultaneous in that frame exist for that frame), but all those events, and others, belong to reality. This is a promising direction, essentially proposing that **existence is frame-dependent** while reality is frame-independent. However, it invites further work to be made precise. Does this imply a kind of perspectival ontology, and if so, is reality simply the union of all frame-relative presents? If one takes the union of every observer's present events (a la the Rietdijk-Putnam argument), one dangerously ends up including *all* events—recreating the block universe (Zimmerman 2005).[9] ER proponents must refine what it means to have a frame-dependent present without collapsing into eternalism. One possible resolution involves **fragmenting reality** into many local realities or adopting a many-worlds-like interpretation for simultaneity slices. But that path too raises questions: would those frame-bound "existences" be equally valid realities or mere subjective partitions of one reality?

Another approach is to posit that physics might allow a hidden structure to support an objective present. Some philosophers sympathetic to presentism have explored the idea of a subtle, empirically

5 Thomas M. Crisp (2007), "Presentism, Eternalism and Relativity Physics," in Einstein, Relativity and Absolute Simultaneity (eds. W. L. Craig & Q. Smith). Crisp explores the compatibility of presentism with relativity, including the hypothesis of a hidden absolute simultaneity frame.

6 Nuel Belnap (1992), "Branching Space-Time," Synthese 92:3. Belnap's work presents a framework reconciling indeterminism with relativistic spacetime, by representing possible future branching structures in a relativistically invariant way.

7 Albert Einstein (1955), letter to the family of Michele Besso (dated March 21, 1955). Einstein wrote that for those who believe in physics, the separation between past, present, and future is "only a stubbornly persistent illusion."

8 Thomas M. Crisp (2007), "Presentism, Eternalism and Relativity Physics," in Einstein, Relativity and Absolute Simultaneity (eds. W. L. Craig & Q. Smith). Crisp explores the compatibility of presentism with relativity, including the hypothesis of a hidden absolute simultaneity frame.

9 Zimmerman, Dean (2005) — mentioned in context of A-theory vs B-theory.

undetectable **preferred frame** of reference (or cosmic time) that underlies relativity's observations.[10] For example, it has been argued (Crisp 2007) that one can add an absolute simultaneity foliation to spacetime—an unseen metaphysical time slice that picks out *the true present*—without contradicting any empirical predictions of relativity.[11] If such a preferred frame existed, ER's present could be identified with it, restoring a single global now. The catch is that this move "violates the spirit" of relativity and is unappealing to physicists; it effectively smuggles an absolute time back into a theory that succeeded by removing it. The scientific consensus is that adding an undetectable time structure is gratuitous, yet as a philosophical possibility it remains open. ER must either embrace a relativized present (as above) or defend some version of an objective present that is consistent with relativity's empirical content. Both options demand careful work: the former needs a coherent account of **perspectival existence**, and the latter needs a justification for a hidden preferred frame or an argument that quantum or cosmological considerations might single out a frame (more on that below).

Beyond relativity, **quantum physics** introduces its own puzzles for ER. Quantum mechanics, especially in the context of measurement and collapse, suggests a world where future outcomes exist as superpositions or possibilities until an observation "collapses" reality into a single outcome. ER's ontology seems naturally suited to accommodate this: we could say the multiple possible outcomes of a quantum event are *real* (as a spread of probability or potential) before the measurement, but only when one outcome becomes present does it attain *existence*, with the other possibilities ceasing to be real. Indeed, ER provides a philosophical gloss on the Copenhagen interpretation's idea that reality crystallizes upon observation. However, formalizing this intuition leads to open questions at the intersection of metaphysics and physics. What is the ontological status of a quantum superposition in ER terms? Is it a case of **reality without existence** (real potential states absent actual existence)? If so, can ER's framework say anything about how the choice is made, or is that left entirely to quantum dynamics? Some interpretations of quantum mechanics—such as the Many Worlds Interpretation (MWI)—would disagree with ER's take: MWI would say *all* outcomes exist, each in its own branching world, which sounds more eternalist (or at least pluralist) than ER would accept. ER would likely favor a single-outcome reality (to preserve a single present that becomes determinate). So a question emerges: could ER's philosophical distinction help clarify or even arbitrate between interpretations of quantum mechanics? Could the ER lens favor collapse-style interpretations (where only one branch becomes truly existent) over many-worlds (where effectively all possibilities exist in parallel)? This is a speculative yet intriguing line of inquiry. It suggests interdisciplinary research: philosophers of time and physicists might collaborate to see if ER's two-tier ontology can be mapped onto, say, the formalism of quantum state reduction. For example, perhaps one could develop an "ER-informed" realist interpretation of quantum mechanics in which the wavefunction represents the *reality* (potentia in Heisenberg's terms) and the measured eigenstate represents *existence* realized.

Another open problem is how **ER handles general relativity and cosmology**. General relativity further complicates time with gravitational time dilation and the absence of a global cosmic time in arbitrary spacetimes. Yet our actual universe (according to cosmologists) has a useful global time parameter: the cosmological time since the Big Bang, which is an absolute time in the standard model of an expanding universe. This suggests a curious possibility: perhaps ER's present could align with cosmological time slices (for instance, the rest frame of the cosmic microwave background provides a natural reference frame for a "universal now" in cosmology). Is this just a convenient coincidence, or could it be a deep clue that the universe's initial conditions impose a sort of preferred frame after all? If a universal time slice *approximately* exists (e.g., "comoving" time in cosmology), ER might have an easier time defining a global present. However, this is speculative and confronts the fact that local relativistic effects still hold. The tension between local relativity (no exact global present) and cosmic structure (a nearly-universal time coordinate) is itself an open question at the physics-metaphysics border. Furthermore, one must consider extreme situations: in relativistic spacetimes with closed timelike curves (allowing time travel) or other non-standard topology, how would ER define existence and reality? If time loops back on itself, do events in the future that influence the past count as "al-

10 Arthur N. Prior (1967), Past, Present and Future. Prior's development of tense logic provides operators for past and future that can serve as a foundation for formalizing temporal distinctions. See also Richmond H. Thomason (1970), "Indeterminist Time and Truth-Value Gaps," for the logic of an open future using branching time semantics.

11 Edmund Husserl (1928), Vorlesungen zur Phänomenologie des inneren Zeitbewusstseins (Lectures on Internal Time-Consciousness, ed. Heidegger; trans. J. B. Brough, 1991). Husserl describes how consciousness encompasses a retention of the immediate past and a protention (anticipation) of the imminent future within the present moment.

ready real" in the past? These exotic scenarios push ER to its limits and underscore that much work is needed to ensure ER's definitions remain coherent under all physically possible conditions.

A recent 2025 Nature survey [12] has further highlighted the deep ontological ambiguity at the heart of quantum mechanics. When asked about the interpretation of quantum theory, physicists gave a strikingly diverse array of responses — from Many Worlds to Copenhagen, from ψ-epistemic views to objective collapse theories — with no consensus on what the formalism says about the nature of reality itself. Some even declined to answer, citing the question as meaningless. This pluralism underscores that, nearly a century after its inception, quantum mechanics still lacks a settled metaphysical underpinning. In this context, Existential Realism's two-tier ontology may offer fresh clarity. By distinguishing what *exists now* from what is *real but not (yet) existent*, ER can help articulate the ontological status of superpositions, potential outcomes, and wavefunction collapse in a way that sidesteps both the reification of all possibilities (as in Many Worlds) and the mystifications of pure observation-dependence. ER invites us to ask: can the wavefunction be understood as representing *real* but non-existent potentialities that only become *existent* through physical interaction or decoherence? Such a framework could support an interpretation where reality encompasses a spectrum of possibilities, yet existence is punctuated — actualized — one present at a time. In doing so, ER may help sharpen or even adjudicate between competing quantum metaphysics.

In summary, **the reconciliation of ER with physics** remains an open program. Promising directions include developing a relativistic ontology (where existence is observer-dependent but reality is observer-independent),[13] **investigating branching space-time models that reconcile indeterminism with relativistic constraints**, and engaging with quantum foundations to clarify how and when potential becomes actual. By tackling these questions, ER could offer a fresh perspective on longstanding debates—potentially providing a conceptually clear way to talk about time's flow in a relativistic cosmos or the emergence of reality from quantum possibility. But achieving that will require continued dialogue between philosophers and physicists, careful formal modeling, and a willingness to revise aspects of ER if they conflict with empirical facts. The payoff would be significant: a coherent picture that respects modern physics while preserving our intuitive sense of an unfolding reality.

Extending Two-Tier Logic and Semantics

A significant step in ER's development was the formulation of a **two-tier logical framework** that explicitly encodes the distinction between "exists now" and "is real." In ER's nascent formal semantics, one introduces new operators or quantifiers to represent present-existence versus cross-temporal reality. For example, one might have an operator $\Exists$ for "exists (presently)" and another $\Real$ for "is real (at some time, past/present/future)." The initial formalism[14] lays down basic axioms: roughly, $\Exists x \implies \Real x$ (if something exists now, it is of course real), but $\Real x \centernot\implies \Exists x$ (something can be real without existing now). While this logic was shown to be internally consistent and illustrative in simple cases, **open questions abound in extending and refining it**. One such question is how to handle **temporal propositions and quantification** more elegantly. In the first formal proposal, a present-tensed $\Exists$ was added somewhat analogously to a modal operator. But can we do better by building time directly into the model structure (e.g. using a two-sorted domain or explicit time parameters in quantifiers)? Perhaps we need a full-fledged **temporal logic** with two tiers—some hybrid of Arthur Prior's tense logic and modern modal logic that can distinguish truth at a time from truth across times.[15] Developing a sound and complete axiomatization of ER's logic remains an open task. For instance, is the logic decidable? What are its model-theoretic properties? These technical questions have philosophical repercussions: they determine whether ER's distinctions can be captured without contradiction or loopholes.

12 "Ball, Philip (2025). Physicists Disagree Wildly on What Quantum Mechanics Says About Reality. Nature. https://www.nature.com/articles/d41586-025-02342-y

13 Daniel L. Schacter, Donna R. Addis & Randy L. Buckner (2007), "Remembering the past to imagine the future: the prospective brain," Nature Reviews Neuroscience 8(9): 657–661. This research reviews evidence that similar brain networks underlie episodic memory and future simulation, suggesting that remembering and imagining are deeply interwoven cognitive processes.

14 Tenzin C. Trepp (2025), Formal Logic for Existential Realism: Modeling Time, Causality and Observability

15 Derek Parfit (1984), Reasons and Persons. Parfit discusses the non-identity problem and other puzzles of future-oriented ethics, arguing that our moral reasoning must account for future individuals despite the fact that our actions determine their identities. (Part III of this work is particularly relevant to the ethics of future generations.)

Another extension concerns the treatment of the **open future** in logic. Traditional tense logic has to deal with the fact that future-tensed statements can be indeterminate (neither true nor false) if the future is not settled. ER's perspective, which holds future events as real but not yet existent, invites a logic of **branching time** or indeterminacy. Work by Prior and others on branching temporal logics (such as Ockhamist and Peircean semantics) could inform an ER-compatible logic where the future is a set of possibilities.[16] A challenge is integrating this with the existence operator: we might say $\Real F$ (some future event F is real) is true even when F is not settled to occur, because it is a real possibility; yet $\Exists F$ would be false until one branch actualizes F. Crafting formal semantics that allow truth-value gaps or multiple truth values for future contingents, while maintaining the two-tier ontology, is a delicate task. This directly relates to ongoing debates in logic and metaphysics about **future contingents** and whether classical bivalence can hold in an indeterminist model of time. ER potentially adds a twist: "real" could be a third status in addition to just true or false existence. For example, one might consider a statement like "There *is* (in reality) a future event where X happens" which could be true even if "X *exists now*" is false and even if "X *will exist*" is unsettled. This suggests a need for a nuanced semantics, possibly using tools like **modal temporal operators** or supervaluation (treating statements about the future as true if true on all branches, false if false on all, otherwise indeterminate). Investigating these approaches is a rich avenue for formal research. It would ensure that ER's language can express subtle distinctions like "inevitability" versus "possibility" of future events within the reality framework.

Moreover, **integration with other logics** remains open. Can ER's two-tier logic be combined with modal logics of possibility and necessity, or with epistemic logics (logic of knowledge)? Such combinations would let us ask: if something is merely real (not present), can an agent know it, or only infer it? How do we logically represent uncertainty about existence (e.g., an archaeologist may wonder "does that civilization still exist or only its traces are real?"). Preliminary work has drawn parallels between ER's insistence on present empirical accessibility and Bas van Fraassen's *constructive empiricism*, which holds we should only believe in the existence of observable entities.[17] ER could be seen as formalizing a version of that principle: existence-now is tied to empirical presence. But ER also wants to say unobservable entities (like past microscopic events or future theoretical entities) can be real. Logically capturing this dual commitment may require a blend of **first-order logic** (for existence claims) with a modality for empirical accessibility or provability. As a concrete example, one might introduce a predicate $Obs(x)$ meaning "x is observable in principle now." ER would then assert $\Exists x \rightarrow Obs(x)$ (whatever exists now must be at least in principle observable now), aligning with an empirical criterion for existence. Yet $\Real x$ might not imply observability—past or future entities can be real without being currently observable. This raises questions about how to treat reference to unobservables: can we quantify over merely real entities without running afoul of the idea that they don't exist in the domain of quantification? One formal trick is to use **two domains**: one domain of presently existing entities and a larger domain of real entities. Quantifiers can range over the larger domain for reality-statements, but a restriction or special quantifier ranges only over the present domain for existence-statements. Working out such a semantics (with coherence conditions ensuring, for instance, that the present domain is a subset of the reality domain) is a technical but important open project. It would lend precision to statements like "there *exists* (now) an x such that $P(x)$" versus "it *is real* that there is an x such that $P(x)$." If successful, this logic would give ER a formal platform that could interface with computational modeling or AI: for example, an AI reasoning system might distinguish currently existing objects from hypothesized or remembered ones within an ER-based knowledge representation. Indeed, applying ER's logic in **computational contexts** (like databases or simulations that model changing worlds) is another frontier—how to implement a system that updates what exists as time steps forward, without deleting the reality status of past entries? Such practical considerations loop back to theoretical ones: we may discover new logical operators or constraints by trying to implement ER in a computer simulation of, say, a virtual world with a moving present.

Finally, there is a general open question of **how ER's formalism relates to other philosophical log-**

16 Derek Parfit (1984), Reasons and Persons. Parfit discusses the non-identity problem and other puzzles of future-oriented ethics, arguing that our moral reasoning must account for future individuals despite the fact that our actions determine their identities. (Part III of this work is particularly relevant to the ethics of future generations.)

17 van Fraassen, Bas C. (1980). The Scientific Image. Oxford: Oxford University Press. Mentioned in connection with empirical accessibility and constructive empiricism.

ics. For instance, does ER's two-tier distinction correspond to anything in **modal metaphysics**? One might draw an analogy: some modal metaphysicians distinguish between **actual** and **possible** in a way loosely analogous to ER's existent vs real. Actualism in modal logic says only actual things exist, while possible things do not exist but are still in some sense "out there" in the set of possibilities. ER could be seen as a kind of "temporal actualism": only present things exist (they are temporally actual), but past and future things are analogous to possible things—"temporally possible" or potential. This analogy might be exploited by adapting modal logic techniques to the temporal domain. Perhaps one could translate ER's claims into a modal language where ◇ (possibly) corresponds to "was or will be" and □ (necessarily) might correspond to truths that hold for all times. This might reveal correspondences or consistency issues (for example, actualists in modal logic grapple with how to discourse about merely possible entities without quantifying over them—similarly, ER must allow talk about non-present entities without admitting them into the existence domain). Studying these parallels is an open theoretical pursuit, bridging ER with modal metaphysics to see if known results (like consistency proofs or representation theorems) carry over. In summary, the logical side of ER is ripe for expansion. It calls for joint efforts by logicians and philosophically-minded computer scientists to refine the formal toolkit, ensuring that ER's intuitive ideas are backed by a rigorous, flexible semantic system. This will solidify ER's credibility and also potentially generate spin-off benefits: new logical systems that might find use in reasoning about time, causality, and change in other fields.

Phenomenology: Time and Lived Experience

ER's genesis was influenced not only by analytic metaphysics and physics, but also by **phenomenology** – the study of structures of experience. In particular, phenomenological insights into the nature of time consciousness offer both validation for ER's distinctions and pose challenging questions. Edmund Husserl's analyses of internal time-consciousness revealed that our immediate experience of the "present" is not a mathematical instant but has a complex structure: we retain a just-past moment (retention) and anticipate an imminent next moment (protention) within each now.[18] This suggests that even in subjective terms, what we consider the present is *thick*, incorporating a bit of past and future in experience. ER's assertion that only the present **exists** resonates with our sense that only the "now" feels fully concrete – yet phenomenology tells us that our now is never isolated from past and future. An open question emerges: **How might ER accommodate the "thickness" of the present as experienced?** If we take phenomenology seriously, perhaps we should refine what counts as present existence to include an "extended now" – a short-duration interval that our consciousness perceives as the present. Would ER be willing to say that perhaps a few seconds or milliseconds of events exist (rather than an instantaneous slice)? That could help bridge the gap between objective and lived time, but it complicates the ontology (what would be the justification for that span, and would it conflict with physics?). Alternatively, one might interpret the retention/protention structure as part of our mental representation (within reality) rather than literal ontology – i.e. our brains carry a trace of the immediate past and an expectation of the immediate future, which correlates with past events that were real and upcoming events that are real. This interpretation aligns well with ER: the reason we can have a *continuous flow* of experience is because the just-past is still **real** (it hasn't utterly vanished; it lingers in memory and causally), and the just-future is already **real** enough to be anticipated. In that case, phenomenology provides subjective evidence for ER's two-tier claim: we constantly live with more than the instantaneous present – we live in a **present that is enriched by non-present reality**.

However, using phenomenology in support of ER also raises **critiques and questions**. Some phenomenologists (and philosophers of mind) might argue that ER's distinction is too crude to capture the fluid experience of time. For instance, in our experience, the past is not simply "real" in an abstract sense; it is continually **reinterpreted** and **reconstituted** in memory. Likewise, our anticipations of

18 Husserl, Edmund (1991). On the Phenomenology of the Consciousness of Internal Time (1893–1917). Trans. James B. Brough. Dordrecht: Springer. Referenced for retention and protention in phenomenology.

the future are colored by imagination, fear, hope – qualities that go beyond a simple "real possibility" category. ER currently treats past and future entities as part of reality primarily due to their objective connections (causal traces, logical entailments, etc.). But the phenomenological dimension reminds us that the **meaning** or significance of past and future is also part of reality as humans experience it. Could ER's framework be expanded to incorporate a more **experiential notion of reality**? For example, one might ask: are *dreams, fantasies, or plans* in any way real in ER's sense? They don't exist externally, but they are certainly part of the experiential reality of a person. Perhaps ER would categorize them as *internally real* (they have effects on an individual's mind, hence some reality). But this pushes ER beyond its comfortable focus on empirical, external phenomena. Engaging with phenomenology may compel ER to address the status of subjective, first-person "reality" – something traditionally outside metaphysics proper but crucial for a complete understanding of time. An open line of inquiry is how ER might dialogue with Heideggerian or existential notions of being. Heidegger, for instance, emphasized the importance of the future in **being-toward-death** and the idea that human existence is fundamentally stretched along past (thrownness) and future (projection). Does ER's privileging of the present conflict with Heidegger's view that we are fundamentally future-oriented beings? Or could one say that ER's "existence = presence" is describing the *ontic* level (entities in the world), whereas Heidegger is describing the *ontological* structure of Dasein (which indeed always transcends the present toward possibilities)? These kinds of questions show a potential tension: ER's framework might appear too "objective" and time-slice-based to capture the richness of human temporal experience. A challenge for future work is to demonstrate that ER's view of time is not at odds with how time is lived, or if it is, to refine the view accordingly.

On a more concrete level, phenomenological research on time perception could inspire specific hypotheses for ER. For example, psychology and phenomenology suggest that the specious present (the short interval we perceive as now) is on the order of a few seconds at most. If ER wanted to be very precise, could it say that perhaps only a very short duration exists (rather than an instant)? That would diverge from classical presentism which typically assumes a razor-thin present. It might offer a way to reconcile with some relativity issues (if each observer's "present" is a fuzzy interval, maybe simultaneity concerns are softened). But it also complicates the definition of existence (as one would have to define a duration across which events "equally" exist). This remains speculative, and ER proponents have so far not committed to an extended present. It remains an open possibility to explore: adjusting the ontology to incorporate a minimal **duration of existence** if that turns out to be necessary to align with experience or neurobiology.

Phenomenology also highlights the **continuous nature of becoming**. We do not experience time as a series of discrete jumps where new events pop into existence out of nowhere; instead, there is a flow. ER must ensure that its ontology can reflect a continuous flow of becoming. Is existence an instantaneous toggle (off to on) for an event at a precise moment, or can we conceive it in more processual terms? Some process philosophers (like Bergson or Whitehead) might argue that reality is fundamentally made of processes, not static events. ER in its current form is somewhat static in language (speaking of events existing or not). Embracing a process view (that existence is an ongoing **happening** rather than an on/off state) could be a direction for development. This might involve mathematics or logic of continuous processes. For instance, one could model becoming with calculus concepts (an event "approaches" existence and then recedes into reality). These are unorthodox but intriguing ideas – marrying ER with process philosophy or with Husserlian flow might yield a more **phenomenologically accurate ontology**. The risk is that it strays from crisp definitions, but the benefit would be a theory of time that truly bridges subjective and objective.

In summary, **the phenomenological perspective** invites ER researchers to keep human experience in the loop. It serves as both a check and a source of inspiration. Open questions include: How exactly do retention and protention map onto ER's reality/existence distinction? Can ER account for the sense in which the past is *remembered* (hence in a way still "with us") and the future is *envisioned* (already "present" in our actions)? Does ER inadvertently marginalize these aspects by focusing on physical traces and causal chains, or can it expand to include them as part of reality? Going forward, a fruitful approach would be interdisciplinary: philosophers of time could collaborate with phenomenologists

and cognitive scientists to ensure ER's ontology does justice to lived time. By doing so, ER stands to become not just a metaphysical theory, but a framework that resonates with both outer and inner realities of time.

Cognitive Science and Neuroscience: Memory, Anticipation, and Perception

Closely related to phenomenology, but rooted in empirical science, is the domain of **cognitive science and neuroscience** of time. Human brains are essentially time machines: they constantly record the past and forecast the future. This has direct relevance for ER's claims and raises intriguing questions about how our cognitive architecture might reflect or challenge the present-centric ontology. One key point is that we routinely handle information about entities that no longer exist or do not yet exist. **Memory** allows us to have knowledge (or at least belief) about past events that are not present, and **imagination/planning** allows us to consider future events that have not yet come into existence. From an ER standpoint, these capacities are possible because past events remain real (so memory can latch onto something real) and future events are real enough (as possibilities or predictive models) that we can meaningfully discuss them. Cognitive neuroscience supports a deep connection between memory and future thinking: neuroimaging studies have found that remembering past experiences and imagining future experiences activate very similar brain networks, particularly involving the hippocampus and related regions.[19] This "core network" for mental time travel suggests that the brain doesn't draw a firm line between past and future – both are treated as domains to be constructed from stored information. In fact, some patients with hippocampal damage (who cannot form new episodic memories) also struggle to imagine coherent future scenarios, indicating that the ability to simulate the future depends on the ability to recall and recombine past reality.[20] This empirical finding dovetails neatly with ER: it implies that memory and prediction are two sides of engaging with non-present reality. An open line of investigation is whether adopting ER's lens can provide new insights into these cognitive processes. For instance, one might ask: does the brain maintain some kind of **encoding of reality status** for information? Does it implicitly know that a memory represents something that *was real* (and thus trustworthy to a degree, barring distortion), whereas a mere fantasy or daydream might not correspond to any reality and is flagged as such? Our confidence in memory vs imagination can differ (we usually know that last Christmas really happened – it was real, even if not existing now – whereas a daydream about winning the lottery is recognized as mere fiction). Perhaps the brain's contextual tags on memories (like source monitoring) could be interpreted in ER terms: memories come with metadata indicating they originated from interaction with actual existence (thus representing reality), whereas pure imaginings lack that. This is speculative, but framing it this way could generate testable hypotheses (e.g., do brain processes differentiate "episodic memory of real event" from "imagined counterfactual event" in a way that corresponds to different evaluations of reality status?).

Another fascinating intersection is how the brain constructs the sense of **now**. In neuroscience, there is evidence that the brain integrates information over short time windows to produce a unified percept of the present. The concept of a "moving window" of present may align with phenomenology's specious present. If only what is in that window is treated as currently existing, then cognitive science might be revealing the operational definition of existence for our minds. For example, some research suggests our perception lags actual events by a few milliseconds and buffers inputs so that we can order them correctly; in effect, the brain might be creating a small "present" interval in which it decides what exists for us at a given moment. If that's true, it adds a biological dimension to ER's claim that existence is tied to presence: **present existence might be what our brains agree to treat as simultaneously real** before updating. Open questions here include: is there an optimal length for the present window from a neural processing standpoint, and does that tell us something about the

19 Daniel L. Schacter, Donna R. Addis & Randy L. Buckner (2007), "Remembering the past to imagine the future: the prospective brain," Nature Reviews Neuroscience 8(9): 657–661. This research reviews evidence that similar brain networks underlie episodic memory and future simulation, suggesting that remembering and imagining are deeply interwoven cognitive processes.

20 Daniel L. Schacter, Donna R. Addis & Randy L. Buckner (2007), "Remembering the past to imagine the future: the prospective brain," Nature Reviews Neuroscience 8(9): 657–661. This research reviews evidence that similar brain networks underlie episodic memory and future simulation, suggesting that remembering and imagining are deeply interwoven cognitive processes.

grain of reality? Could it be that what exists (in a physically effective sense) must persist at least long enough to be registered by a mind? (Probably not as an absolute rule—things can exist without being perceived—but for the subset of reality we experience, this holds.) Furthermore, cognitive science explores **predictive processing** – the idea that the brain is constantly predicting immediate future inputs. This means we are always *slightly ahead* of the present in expectation, effectively living a few moments in the future (anticipating what is about to happen). How does this relate to ER? One could argue it's another example of how future events, though not yet existent, are treated as conditionally real by our cognitive systems. We prepare for them, fear them, and plan for them as if they *already matter* in some ontological sense. Psychologically, people often exhibit **affective and behavioral responses** to future possibilities (an upcoming pain or reward can cause present anxiety or joy). This only makes sense if those future events have a kind of reality in our minds. ER would say: indeed, they are real (as impending events) even though not actualized, hence our responses are appropriate rather than magical. A challenge is to integrate such insights with the ontology: can we find evidence that the brain distinguishes *degrees* or *modes* of reality (present vs remembered vs expected) in its processing? Perhaps neuroimaging could reveal different activation patterns for thinking about the past vs present vs future. Some studies already show that imagining the future can sometimes engage the hippocampus *more* strongly than recalling the past,[21] possibly because future simulation is a constructive, combinatorial task. Does that mean the brain finds the future "less real" and needs to work harder to simulate it? Or simply that constructing novel scenarios is inherently more effortful than recalling a real memory? These nuances are open to interpretation and could benefit from philosophical input.

From a broader cognitive perspective, there are also **behavioral and ethical implications** tied to how we regard past and future. Humans notoriously exhibit *temporal biases*: we often care less about future rewards or harms (temporal discounting), and sometimes we irrationally weight past events (like sunk costs) even though they no longer exist. Could adopting an ER perspective influence these biases? For instance, if one internalizes that future events are real (not mere fiction), would one be less prone to short-termism and more willing to act for long-term benefit? Or conversely, does knowing the future is not yet existent make it rational to discount it? These questions straddle cognitive psychology and ethics. Experimental philosophy could test whether framing problems in ER terms (e.g., telling participants "the future consequences are already real, only not yet present") changes decision-making. If it does, that might suggest that our default cognition is more presentist (treating future as less than fully real, hence easily discounted), and that consciously adjusting this outlook could alter behavior. Similarly, memory's role in identity – we consider our past as part of who we are – could be interpreted through ER: past experiences remain real in shaping us. If a person loses memory of an event, in a sense for them that event's reality is diminished or lost. This raises a poignant point: reality in ER is objective (causal structures etc.), but for cognitive beings, reality is also *what can be accessed or remembered*. A tragedy like dementia, which erases memory, might be said (from the person's perspective) to erode the reality of their own past. Philosophically, one could question: does ER need an epistemic aspect to reality? Officially, no—something can be real without anyone knowing it. But in human terms, unknown past events function as if they were not real for us (until discovered via evidence). So bridging ER with cognitive science also means considering **epistemology**: how do we come to know the reality of non-existents? Memory, historical records, testimony, and physical traces are all mechanisms. Each of these can be studied to see how reliable they are and what happens when they conflict. The study of false memories, for example, shows that people can firmly believe something happened when it did not – essentially treating an unreal event as real. This is an error from ER's perspective. Understanding why the mind can be fooled about reality status (taking the unreal as real or vice versa) is an important topic for both psychology and the philosophy of time. It underscores that ER's neat distinction might be blurred in practice by human fallibility, but also that ER provides a normative standard: we should strive to align our beliefs so that we only assign "reality" status to things that genuinely are or were or will be part of the world's fabric.

In summary, cognitive science and neuroscience provide a rich empirical testing ground for ER's

21 Daniel L. Schacter, Donna R. Addis & Randy L. Buckner (2007), "Remembering the past to imagine the future: the prospective brain," Nature Reviews Neuroscience 8(9): 657–661. This research reviews evidence that similar brain networks underlie episodic memory and future simulation, suggesting that remembering and imagining are deeply interwoven cognitive processes.

ideas. They pose questions such as: How does the brain instantiate the present? How are past and future information handled similarly or differently? Are there neural correlates of "reality" versus "mere imagination"? And can our understanding of human decision-making and memory be improved by considering ER's ontology (for instance, in treating psychological conditions like anxiety about the future or rumination on the past)? Addressing these questions will require collaboration across disciplines. ER theorists must engage with experimental data and perhaps even suggest new experiments. Conversely, scientists might find in ER a useful conceptual framework to interpret results about memory/prediction systems. The interplay promises not only to refine ER (making sure it aligns with what is possible for human cognition) but also to deepen scientific insight into why our minds evolved to model time in the way they do—perhaps precisely because, as ER claims, it is vitally important to represent not just what exists now but also what existed and what might exist.

Ethics and Intertemporal Agency: Responsibility Across Time

One of the most compelling motivations for ER is its potential to illuminate **ethical questions** that span time. Our moral intuitions and principles often implicitly assume something about the reality of past and future persons and events. ER gives us new vocabulary to articulate these intuitions: we can say, for example, that future generations, though they do not exist yet, are nonetheless *real* in our moral considerations. This section explores several open ethical questions through the lens of ER.

First, consider **responsibilities to future persons** – an issue in intergenerational ethics. If one were a strict presentist, one might argue that because future people do not exist, we have no direct obligations to them (we might only care instrumentally, such as preserving a reputation or following present desires). This seems counterintuitive and dangerous: it could excuse gross negligence toward the welfare of future generations (regarding climate change, resource depletion, etc.). ER, by contrast, permits us to say future people *are real*, and thus we owe them moral consideration even though they do not exist yet. But how exactly should this be interpreted? There is a notorious philosophical puzzle called the **non-identity problem** (Parfit 1984) which asks: if our actions today determine which individuals will be born in the future, can we truly harm or benefit "future persons" in a straightforward way? For example, if by polluting now we cause a different set of people to exist 100 years from now (because history diverges), then the people who exist in that future cannot claim we harmed them – had we acted differently, they wouldn't exist at all.[22] This problem complicates what it means to have responsibility to future individuals. ER doesn't by itself solve the non-identity problem, but it offers a fresh angle: it allows us to frame the issue as one about reality of outcomes rather than identity of persons. We might say that *some* future scenario will be real, and we have obligations to ensure that *whichever people become real* have lives worth living. Even if the identities aren't fixed, the reality of *some* group of future persons is as good as certain (barring human extinction). Thus, ER could support a principle of **future-oriented responsibility** that is not hung up on identity: we are responsible to the reality of future humanity as a whole, rather than to specific future individuals. This is a conceptual move that needs further development. Ethicists might explore it to see if it circumvents some non-identity paradoxes. However, one must be cautious: making future humanity abstractly real is one thing, but in practice, our obligations often concern particular harms or benefits. How to ground rights or claims of future persons in ER's framework remains an open task. We may need to define something like: although future persons don't exist to have rights now, the *reality* of their coming into being (and the foreseeability of their conditions) confers on us a duty. Some have argued for "future rights" or for a stewardship role for the present. ER provides metaphysical justification for treating the future in moral calculations not as a mere possibility to be discounted, but as an extension of reality to be respected. This area is ripe for cross-pollination between metaphysics and normative ethics: could ER help in formulating, say, an ethical theory that properly balances present and future interests without either neglecting the future (as short-sighted utilitarian calculus might) or undervaluing the present (as some extreme long-termism might)?

22 Derek Parfit (1984), Reasons and Persons. Parfit discusses the non-identity problem and other puzzles of future-oriented ethics, arguing that our moral reasoning must account for future individuals despite the fact that our actions determine their identities. (Part III of this work is particularly relevant to the ethics of future generations.)

Similarly, **duties to the past** become interesting under ER. Normally, one might think we can't affect the past, so morality is only forward-looking. Yet we often speak of *moral obligations related to the past*: for instance, the duty to remember and honor victims of a tragedy, or the duty to apologize and make amends for historical injustices. If the past were utterly unreal now, these actions might seem nonsensical—why apologize for something that "doesn't exist" or honor people who are "nothing now"? But if the past is still real (though not existent), such duties gain ontological backing. We are, in effect, acknowledging that those past events and persons still matter in the fabric of reality; they have not become nothing, and our moral relation to them persists. An open philosophical question is how far this extends: does ER imply that *all* past suffering or past wrongdoing remains in reality as a moral stain that needs addressing? Practically, we cannot fix all past wrongs (many perpetrators and victims are gone). However, recognizing the reality of past events suggests that history has a kind of moral weight—perhaps fueling arguments for reparations or for continued remembrance. It also raises a comforting thought: if loved ones are gone, presentism would say they simply no longer exist, which can be existentially bleak. ER offers the solace that they remain *real*, in our world's story, in its ongoing causal web. Does that imply any ethical stance, like a duty to preserve memories or records (since those are the connectors to their reality)? Possibly—it lends metaphysical significance to acts of remembrance and documentation, as they keep the reality of the past integrated with the present.

Another domain is **personal identity and prudential ethics**. Each of us makes choices that affect our own future selves. How do we regard that future self? Some psychologists find that many people treat their future self almost like a stranger, which can explain procrastination or failure to save for retirement. Philosophers like Parfit have argued that identity over time might be a matter of degree, and that caring less about a distant future self might be rational if that self is sufficiently different. ER adds a layer: as time goes on, *you-the-person* in the future is certainly real (you will exist unless you die), but does not exist now. Does that give any justification for caring less (since, strictly, "you" don't exist yet in the future)? Or should we say that since future-you is real, one ought to care about their well-being as part of reality? This might seem semantic, but it can influence how we articulate rational planning. Under ER, one could claim that the *interests of one's future self* are interests of a real (if numerically distinct across time) individual, and thus command moral consideration similar to current interests. This could bolster arguments against excessive discounting of future welfare (one's own or others'). However, an open question is how to handle the fact that the future is uncertain. If multiple outcomes are real until one comes to pass, how do we make ethical decisions in light of that? We often use expected utility or scenario planning, effectively weighting possible futures. ER might encourage viewing those possible futures as real enough to deserve proportional consideration (in line with their probability or plausibility). Moral philosophy could integrate this by saying: not only actual future persons but even *probable future scenarios* have a degree of reality, so ethical theories should perhaps maximize the good *across the range of real possibilities*. This connects to decision theory and ethics of risk. It's an under-explored angle: typically, ethics deals with actual outcomes or certain outcomes, but a reality that includes unrealized possibilities suggests a more nuanced approach to moral responsibility under uncertainty. For instance, should one get moral credit for *preventing* a disaster that never actualizes but was a real risk? Intuitively yes, but if the disaster never existed at any time, a strict ontology might say there was nothing to prevent. ER can say: the disaster was a real possibility (it had reality until it was averted), so preventing it is indeed morally meaningful.

Finally, the ethical dimension loops back to ER's fundamental values. Why did Trepp formulate ER in the first place? Partly to do justice to the **human experience of time**, including our concern for more than just the present. Ethically, ER is appealing because it allows us to be **better agents over time**: to remember rightly, to anticipate wisely, and to care broadly. But there are potential **criticisms or pitfalls**: One might worry that labeling non-present things "real" could lead to *excessive or unmanageable moral obligations* — feeling responsibility for an unbounded set of future possibilities could be paralyzing or unjustified. For example, are we to consider every merely possible person who might exist as somewhat real and thus factor them into our moral calculus? That could lead to an overwhelming "tyranny of potential trillions" problem, where we prioritize vast hypothetical future lives over concrete present ones. ER needs to be paired with pragmatic and principled ways to limit moral consideration so it doesn't become paralytic. This is similar to debates in population ethics (how to value

far-future large populations). ER by itself won't resolve those debates, but it reframes them: it says those future lives are not nothing, so we cannot ignore them, yet how to weigh them remains an ethical question. Another potential criticism: by giving ontological status to future outcomes, do we risk a kind of fatalism? If something is real, one might think it's "already" determined. ER must clarify that calling the future real is not to say the future is fixed; it can be an **open, branching reality**. Ethically, this is important because moral responsibility presupposes that the future is not set in stone—we can affect which branch becomes actual. So an open question is how to communicate ER's view to avoid misunderstanding: future events are real *as possibilities* (or in some cases as inevitabilities), but human agency still plays a crucial role in determining *which* real possibilities become existents. In fact, one could argue ER enhances the sense of agency: our choices now don't create ex nihilo; they select among real paths. This can make our responsibility palpable—one is *choosing the course of reality*.

In conclusion, the intersection of ER and ethics is fertile ground for future research. It requires collaboration between metaphysicians and ethicists. Concrete tasks include: developing an "ER-informed" approach to climate ethics (how to frame duties to future generations in ER terms), analyzing personal decision-making through ER (perhaps offering new strategies to encourage long-term thinking by reinforcing the reality of one's future life), and examining retrospective obligations (memory and reconciliation practices) with the idea that the past remains part of reality. As with previous sections, the aim is not to claim ER already solves these issues, but to show it provides a novel and potentially useful perspective that warrants exploration.

Conclusion: A Future-Oriented Research Program

Existential Realism began as an effort to resolve a stalemate in the philosophy of time—bridging presentism and eternalism with a two-tier ontology. In doing so, it opened as many questions as it answered. Far from being a finished theory, ER at this stage serves as a **framework** or a new lens, prompting us to revisit old problems and formulate new ones across various disciplines. In this preprint, we have mapped out several key domains and questions for future investigation. Metaphysically, ER urges us to deepen our understanding of becoming and the status of non-present entities, avoiding both the "ontological lacuna" of presentism and the "ontological overload" of eternalism. In physics, ER's compatibility with relativity and quantum mechanics remains a work in progress, inviting creative reconciliations between subjective present and objective spacetime, and between potentiality and actuality in the quantum realm. Formally, the logical underpinnings of ER are still under construction; advancing them will not only clarify ER but could enrich logical theory with new modalities for time and existence. Phenomenology and cognitive science remind us that any ontology of time must mesh with the human perspective—our lived experience and mental processing of time—and thus challenge ER to remain empathetic to the flow of consciousness and the ways we remember and anticipate. Ethics, finally, grounds the discussion in human values: it is in large part because past and future *matter* to us that ER's expanded reality is appealing. But this expansion brings responsibility, forcing us to think carefully about how to treat the non-existent yet real with appropriate moral concern.

Throughout these explorations, a common thread is **humility and openness**. ER does not pretend to have the final truth about time. Rather, it offers a fertile conceptual space in which nuanced, perhaps even hybrid solutions might grow. For example, one could find that in some contexts (like fundamental physics) a more eternalist view is pragmatically useful, whereas in others (like phenomenology) a present-centric view is indispensable—and ER might act as a mediator allowing both truths to coexist by differentiating existence and reality. We should remain open to the possibility that ER itself will need revision. Perhaps some future theory will tell us that what we called "reality" actually comes in degrees or different kinds, or that "existence" has multiple layers (biological, physical, psychological) not all coincident with the present. The spirit of ER is not dogmatic; it's *realist* in the sense of committing to an independent world beyond the now, but it is also **exploratory** in suggesting a new way to carve that world without insisting the carving is complete.

We also acknowledge **potential criticisms** that deserve attention. Some may argue that ER's existence-reality split is merely semantic or artificial—after all, if something is real, why not say it exists in

some sense? Is ER just redescribing eternalism with different words ("exists now" vs "exists simpliciter")? Defenders of ER must articulate why this distinction is non-trivial and how it avoids collapsing. Others might worry that ER inherits all the challenges of presentism (like explaining relativity and truthmakers) *and* all the challenges of eternalism (like explaining the ontological status of unrealized possibilities), effectively doubling its burden. This is a fair point: by trying to have the best of both worlds, ER takes on a broad array of puzzles. Our view is that this is a worthwhile trade-off, because solving those puzzles within one coherent framework could yield a more comprehensive understanding. But it means the road ahead for ER research is demanding. Additionally, some critics could press on the **empirical falsifiability** of ER: is there any experiment or observation that would count against it or differentiate it from rival ontologies? Like many metaphysical frameworks, ER currently operates primarily in the realm of interpretation rather than prediction. However, unlike eternalism, the growing block theory, or the many-worlds interpretation—which posit vast, unobservable temporal or modal structures—ER grounds its ontology directly in the observable present, where matter, information, and causal processes are empirically accessible. This makes ER not only more parsimonious but also more aligned with the methods of science: we measure, test, and interact with what exists now. As ER continues to integrate with physics and cognitive science, it may eventually suggest subtle empirical implications—for instance, a preferred interpretation of quantum measurement, or specific patterns of information retention in the brain. These possibilities remain speculative, but they demonstrate that ER's framework is better positioned than its rivals to evolve into a scientifically fruitful metaphysics.

In closing, "Beyond the Present" is both the title of this paper and a guiding ethos for the research trajectory we envision. ER challenges us to think beyond the immediate moment, not only in theory but in practice—encouraging a philosophy that is temporally inclusive. By charting open questions, we hope to encourage a **cross-disciplinary community** of scholars to take up pieces of the puzzle. Metaphysicians can refine the ontology, logicians the formalism, physicists the reconciliation with spacetime, phenomenologists the experiential consonance, cognitive scientists the neural correlates, and ethicists the normative implications. Each domain informs the others: progress in formal logic might clarify a metaphysical point; insights from neuroscience might suggest a tweak to how we conceive reality's persistence. The ultimate goal is a well-rounded Existential Realism 2.0 (and beyond) that stands robustly in both philosophical argument and scientific understanding. That goal is ambitious and may never be perfectly attained, but the pursuit of it promises rich dividends—a deeper grasp of time, existence, and our place within the web of reality. As we move forward, we do so with a sense of adventure and collaboration, inviting others to contribute. The questions laid out here are not final; they are **open invitations**. In the spirit of generative inquiry, we conclude not with answers, but with the conviction that looking *beyond the present*—conceptually and literally—is essential for expanding the horizons of knowledge in the philosophy of time and beyond.

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Further Developments in Existential Realism

Living Time

+

Organisms in the Present

Existential Realism meets biology and cognition: life unfolds as a present-centered process, bearing the imprints of what was and the momentum toward what will be. This paper follows memory and anticipation from plants to humans, showing that existence always beats in the now — shaped by traces of the past and visions of the future.

Time-Bound Organism: Temporality in Biological and Cognitive Systems

Tenzin C. Trepp,

Email: trepp@tenz.in

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Abstract

Existential Realism (ER) is an ontological framework distinguishing **existence**, confined to the present moment, from **reality**, which spans past and future entities by virtue of their causal or informational connections to the present. This paper extends ER's metaphysical insights into the biological and cognitive domains, arguing that living systems—from humans to bacteria—are fundamentally **time-bound organisms** whose behavior and identity are shaped by temporal structures. Advanced organisms like humans exhibit memory, anticipation, predictive coding, narrative identity formation, mental time travel, temporal binding of events, and decision-making based on past experiences and future possibilities. At the same time, simpler organisms (plants, bacteria, slime molds) demonstrate tropisms, endogenous clocks and rhythms, and responses to temporally structured environments (e.g. day/night cycles, seasonal changes, intermittent stimuli) that function as primitive "models" of time. In all cases, past events that no longer exist continue to influence present behavior through physical traces or learned information, while future events that do not yet exist are nevertheless anticipated and built into current plans and physiological states. These empirically grounded temporal behaviors support ER's claim that past and future entities are **real** (via causal effects, structural traces, or inferential links) despite their lack of present existence. By surveying examples from neuroscience (memory engrams, Hebbian plasticity, circadian timing in the brain) and biology (plant stress memory, microbial anticipatory foraging, slime mold learning), we show that temporally extended behavior in organisms depends on internal representations of time. This aligns with ER's two-tiered ontology: organisms exist only in the present, yet they operate within a wider temporal reality. We conclude with reflections on how ER's perspective illuminates life as a temporally structured phenomenon, and how an organism's identity and responsiveness are sculpted by the interplay of past realities and future possibilities.

Introduction

In metaphysics, presentism traditionally holds that only present entities **exist** in the fullest sense, dismissing past and future entities as unreal; eternalism, by contrast, asserts that past, present, and future entities all exist equally. Both views conflate existence with reality, differing merely on the temporal breadth of what exists. **Existential Realism (ER)**, a framework recently developed by Trepp (2025), breaks from this mold by disentangling existence from reality. Under ER, *only* entities in the present moment exist (fully and concretely), but past entities and future entities can still be *real* in a well-defined sense. An entity that no longer exists or does not yet exist can nonetheless be real insofar as it plays a role in the world's causal or informational structure. In short, reality extends beyond the knife-edge of the present, incorporating the effects of the past and the anticipations of the future, while existence is reserved for the here-and-now. This nuanced ontology resolves the classic presentist worry that if only the present is real, we lose the truth of history and the efficacy of past causes. ER can say: *Socrates does not exist now, but he is real as a past person whose deeds and influences persist* – avoiding the presentist's "metaphysical erasure" of the past (which prompted Markosian to note that in strict presentism "all such objects are unreal" when referring to Socrates or one's future grandchildren).[1] Likewise, a future solar eclipse does not exist now, yet it is real enough that scientists can predict it and people alter their behavior (making plans, preparing telescopes) in light of it. Reality, in ER's terms, is the temporally extended web of causation, evidence, memory, and expectation within which the present is embedded.

While ER has been formulated in metaphysical terms, its implications reach into other domains. Notably, if ER is correct, we should expect that **biological and cognitive systems** reflect this two-tiered temporal ontology. Organisms live in the present—only their current states strictly exist—yet they ubiquitously utilize information from the past and representations of the future. In this paper, we explore how life itself exemplifies ER's distinction. We examine the temporal behaviors of organisms at two ends of the complexity spectrum: (a) **advanced cognitive organisms** (especially humans) with sophisticated memory and foresight, and (b) **simpler organisms** (plants, microbes, slime molds) with more rudimentary yet still notable forms of temporal response. Our aim is to show that in both cases, past and future entities (events, conditions, stimuli) exert a real influence on present behavior, validating ER's claim that those non-present entities have reality (even though only present biological processes exist at any given moment).

We proceed as follows. In Section 1, we consider humans as a paradigm of a temporally extended organism, drawing on neuroscience and psychology: the human brain actively **binds time**, retaining the just-past and anticipating the imminent future within a moving "window of presence," and our cognition routinely reaches into remote past and future through memory, narrative construction, and planning. We will discuss phenomena like **mental time travel** (the ability to mentally relive past events and pre-live possible futures), **predictive coding** (the brain's constant generation of expectations about the near future), the construction of a **narrative self** over time, and how decision-making integrates past lessons and future consequences. Section 2 then examines temporality in simpler life forms. We highlight **tropisms** and time-based behaviors in plants (e.g. sun-tracking and photoperiodism), **biological clocks** and **circadian rhythms** that allow organisms from cyanobacteria to flowers to anticipate daily and seasonal cycles, and instances of learning and **memory in aneural organisms** (such as the "stress memory" of plants that primes them for future hardships, or slime molds and bacteria adjusting behavior based on past stimuli). In Section 3, we synthesize these findings to argue that organisms are "time-bound" in the sense that their present existence is informed by an internal model of temporal reality – a model that includes records of what has happened and predictions of what will happen. We show how this internal temporality supports ER's ontological distinction: the organism's present state **exists**, but it encodes a **reality of the past** (via physical traces, memories, learned structures) and a **reality of the future** (via expectations, intentions, programmed rhythms). Finally, in Section 4, we conclude with reflections on what ER implies for our understanding of life as a temporally structured phenomenon. In particular, we consider how an organism's identity and

1 Ned Markosian, a defender of presentism, illustrates the strict presentist view: past figures like Socrates or one's future grandchildren "are unreal, according to presentism," since only present objects exist (Markosian 2004, p.47). ER modifies this by asserting those individuals are *ontologically real* (through their effects or future likelihood) even though they do not exist now. This retains truthmakers for past and future-tensed statements without committing to past/future existence

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continuity depend on the reality of its past (e.g. one's life history or a plant's developmental memory) and how its survival depends on treating future events as real in advance (through anticipation and planning). Throughout, our tone and approach mirror the Existential Realism corpus: formal and analytical, yet interdisciplinary, drawing empirical evidence into metaphysical argument. All sources are cited in numbered footnotes for clarity.

Temporal Extension in the Human Mind

Human beings are perhaps the clearest example of how existence-in-the-present can be coupled to a reality that stretches beyond the present. We experience time not as isolated instants but as a continuous flow, and our minds are capable of reaching backward into the past and forward into the future. Cognitive science research indicates that the brain actively **constructs** our sense of time, integrating past, present, and future in various ways. In ER's terms, the human mind is an engine that keeps past and future *real* in experience, even though only the present neural processes truly exist at any given moment. In this section, we explore several key facets of human temporal cognition: the "specious present" (our perceptual present which already includes a bit of past and future), memory and its neural traces of the past, anticipation and predictive coding for the future, and the narrative organization of our life experience. These capacities illustrate how the human brain *embeds* time within its operations, effectively affirming ER's two-tier ontology on the level of cognition. Past events have lasting reality in the brain (as stored information), and future events attain a kind of reality insofar as we can simulate and prepare for them – all while the brain's here-and-now activity remains the only physically existent process.

The "Specious Present": Binding Past and Future in Perception

Rather than experiencing the present as an infinitesimal instant, humans have what William James called the "specious present," a short duration in which we perceive change and succession as a single unified present moment. James noted that the present "has melted in our grasp… gone in the instant of becoming," yet we seem to **experience** a brief interval as now, not an atomistic point in time.[2] Modern cognitive neuroscience confirms that our sense of *now* is indeed temporally extended: on the order of hundreds of milliseconds to a few seconds, depending on context. Within this window, recent past events and imminent future events are cognitively blended into one perception. For example, when listening to a melody, the note that just sounded remains in echoic memory and the brain simultaneously anticipates the next note; the result is that we hear a flowing phrase of music rather than disjointed sounds. The brain's mechanisms actively **bind events in time**: successive inputs within a certain interval are stitched together by neural processes into a coherent experience. Neuroscientist Ernst Pöppel famously proposed ~3 seconds as an integration interval for consciousness, suggesting that our brains automatically join events into chunks of a few seconds that feel like one present.[3] Likewise, philosopher-neuroscientist Thomas Metzinger describes consciousness as operating within a "window of presence" – a moving temporal window (perhaps a few hundred milliseconds up to a couple seconds) that constitutes our experienced present. Within this window, according to Metzinger, we do not have a razor-thin instant; instead, the window includes what he calls *retention* (just-past events that still linger in awareness) and *protention* (just-about-to-happen events we are anticipating) as part of the now. In effect, the brain's perceptual systems ensure that the immediate past and immediate future are **present in experience**. Neurophysiologically, this is supported by observations of sustained neural firing that maintains information about a stimulus for a short time after it disappears,

2 William James (1890) introduced the term "specious present" to describe the short duration that the mind treats as the present. He noted our experience of 'now' has thickness; we can sense a melody's notes together or see movement, implying a temporal span. Contemporary experiments (e.g. by E. Pöppel) estimate this span to be on the order of 2–3 seconds for many perceptual tasks, suggesting a built-in temporal integration window for consciousness.

3 Ernst Pöppel's work in the 1970s and 1980s proposed a ~3-second integration period for conscious awareness. He observed that many spontaneous actions (e.g., poetic recitation phrases, musical motifs, even infant babbling) often fall within 2–3 seconds, hypothesizing a neurological rhythm that defines a "present" segment. See Pöppel (1997), Acta Neurobiologiae Experimentalis, for discussion of a universal 3-second temporal framing in experience.

and by preparatory neural activity that represents expected upcoming stimuli or actions. The result is that the *present moment*, as we perceive it, already includes a trace of the past and an anticipation of the near future. This intrinsic temporal integration serves as a naturalistic backbone for ER's claim that only the present exists, yet the very content of the present includes elements of a broader reality. In our conscious awareness, the just-gone event is **not** treated as unreal – it is literally part of our current mental content (though fading), and the impending event is prefigured. The specious present thus exemplifies how the brain privileges the present (only the contents of this window are vividly experienced) while implicitly affirming the reality of very recent and imminent events by incorporating them in the "now." It's a kind of empirical vindication of ER: the brain behaves as if the very recent past is still real enough to matter, and the very near future real enough to prepare for, even though neither is strictly existent in the physical present.

Importantly, the **temporal binding** performed by our brains is not purely a passive reception of stimuli but an active construction. Psychologically, we also observe phenomena like **intentional binding**, where the perceived time between a voluntary action and its effect is contracted by the mind – in other words, if you press a button and a tone sounds shortly after, you will feel the interval as shorter when you caused the tone, compared to when the tone occurs independently.[4] The brain "tightens" cause and effect in subjective time, presumably to aid a sense of agency and coherence. This again underscores that our experience of temporal relations is modulated by cognitive processes. The mind tends to perceive events that are causally or narratively linked as closer together in time than unrelated events. Such findings highlight that our perception of time is *constructed* to reflect the structure of reality as we understand it (causally linked events are bound together). In ER terms, one might say the mind enforces the reality of the connection between events by literally altering how it experiences their temporal gap. The broader point is that the human brain's handling of time—whether in binding milliseconds into a present moment or in altering intervals based on causal expectations—demonstrates that what we experience as "present" is richly informed by past context and future prediction.

Memory: Traces of a Real Past

Memory is the paradigm example of something from the past (which no longer exists) continuing to exert influence in the present. In ER's framework, past entities or events *were* present in their time and have since ceased to exist – but they remain **real** insofar as they left causal traces or records in the world. Human memory shows this principle in action: experiences leave lasting physical and psychological marks that shape future behavior and knowledge. Cognitive neuroscience has made great strides in uncovering how the brain stores and recalls past information. When you form a memory of an event (say, your childhood birthday party), that event does not exist anymore; yet it is *real enough* that it has been encoded into the structure of your brain and can be mentally re-lived later. The notion of a **memory trace** or **engram** – a physical change in the brain that represents a stored memory – dates back over a century, but modern research has actually identified specific neurons and synapses involved in particular memories. For example, experiments have tagged and reactivated ensembles of neurons that were active during a learning experience, triggering recall of that experience.[5] These findings confirm that learning literally alters synaptic connections (via processes like long-term potentiation), leaving behind a persistent record of the past in our neural circuitry. In short, **the past lives on as information**: structural modifications of neural tissue (strengthened synapses, new wiring via Hebbian plasticity) and biochemical changes constitute a physical imprint of past events. Famous is the adage "cells that fire together, wire together," coined by Donald Hebb in 1949.[6] It captures how the

4 The intentional binding effect was reported by Haggard, Clark, & Kalogeras (2002), who found that when subjects voluntarily pressed a button that caused a tone with a slight delay, they perceived the tone as occurring sooner (and their action later) than when the tone was externally triggered. This indicates the brain unconsciously compresses the interval between intentional action and outcome. It reflects how cognitive attribution (agency, causation) can alter temporal perception (see Haggard et al., Nature Neuroscience 5:382–385, 2002).

5 The term "engram" for memory trace was coined by Richard Semon (1904). Recent studies have identified engram cells in the hippocampus and amygdala: for example, Liu et al. (2012) tagged neurons encoding a fear memory in mice and later reactivated them optogenetically, inducing retrieval of that specific memory (Nature 484:381–385). Josselyn et al. (2015) review how ensembles of neurons become the physical substrate of memory. Such studies show that past learning leaves specific physical imprints that can be re-engaged, evidencing the lasting reality of learned information.

6 Donald O. Hebb's The Organization of Behavior (1949) proposed that when neuron A repeatedly helps fire neuron B, the connection from A to B is strengthened. This idea, encapsulated as "cells that fire together, wire together," provided a physiological explanation for associative learning. Hebbian plasticity has since been directly observed (e.g., in long-term potentiation in the hippocampus). It demonstrates how simultaneous or sequential events (in time) become linked in neural structure, effectively storing temporal co-occurrence as changed synaptic strength.

coincidence of events (neural firing for A and B) leads to a lasting link: essentially, the brain encodes that "A and B occurred together" by strengthening the connection. This is a mechanism for storing temporal contiguity and causality. Through such plastic changes, an event that is long gone (no longer **existent**) is not gone without a trace; it remains **real** as an effect manifest in the present structure of the brain.

From ER's perspective, this neuroscientific insight supports the idea that the past can be ontologically real even when not existent. The birthday party two decades ago is not present now – but it is real in that it produced enduring changes (photographs, memories, neural connections, perhaps even personality shifts) that persist in the present world. When you recall that party today, only the act of remembering (neurons firing now) **exists** at this moment, but it is enabled by the reality of past information encoded in your brain. This addresses the classic problem for presentism: how can we have knowledge of or causal influence from something wholly unreal? ER's answer, exemplified by memory, is that past events are real-as-informational: what we access in memory is a present representation (a **model** of the past built from current neural activation), but that model is reliable only because the past event was real and left a reliable imprint. Notably, memory is not a passive replay of a static recording; it is a *reconstructive* and dynamic process. Psychologists describe episodic memory as a kind of **narrative** we reconstruct – we piece fragments together, influenced by our current context and prior knowledge. Thus, when we remember, we are *literally modeling* a past reality in the present. The hippocampus and associated brain networks actively simulate past events during recall, a capability Endel Tulving called "mental time travel" into the past.[7] This capacity to re-create a past experience in one's mind (albeit imperfectly) again illustrates that the past event, though not existing now, has a sort of reality: it can be *invoked* in the present by the brain's machinery. Intriguingly, the same neural machinery used to remember past events is also used to imagine future events – a point we examine next. Patients with hippocampal damage who cannot form new episodic memories also struggle to envision future scenarios, suggesting that memory and foresight are two sides of a coin. The brain's memory system thus serves double duty: by preserving the past (as structured information) it not only keeps the past real in the present, it also provides building blocks to construct potential futures. In sum, human memory provides a concrete example for ER: it shows how something can **cease to exist** yet not be ontologically inert. The past event *was*, and through memory traces it still **is real** enough to influence thoughts, feelings, and actions long afterward (for instance, a traumatic event decades ago shaping one's behavior today). ER's distinction finds a natural home here: only the present memory recall exists now, but it is about a real past event (made real by its effects in the present brain). We are, in an important sense, constantly carrying our past within us as part of the reality that informs our present existence.

Anticipation: Modeling a Real Future

Just as memory connects us to a real-but-no-longer-existent past, our capacity for foresight and anticipation connects us to potential futures that do not yet exist. Humans are often described as *prospective* creatures—we routinely plan, predict, and act in light of future outcomes. Neuroscience has increasingly framed the brain as a **prediction machine**, embodying what is known as *predictive coding* or *predictive processing*. According to this theory, higher-level regions of the brain continually generate predictions about incoming sensory input, while lower-level regions compare actual input to these predictions and compute prediction errors to update the model. In other words, perception itself is forward-looking: as you walk down stairs, your brain is already calculating the expected feel and sight of the next step; as you hear the beginning of a sentence, your brain implicitly anticipates how it will end. Far from passively waiting for stimuli, the brain is proactively pre-construing the immediate future. This has been borne out empirically: for instance, neurons in visual cortex can exhibit activity that extrapolates the trajectory of a moving object a fraction of a second before that object actually

7 Endel Tulving (Chronesthesia: awareness of subjective time) noted that episodic memory allows "mental time travel" – one can re-experience the past and pre-experience the future. Suddendorf & Corballis (2007) expanded on this, arguing that the ability to imagine future events using memories of past events is a key evolutionary development in humans (they coined "mental time travel" in 1997). Neuroimaging by Schacter et al. (2007, PNAS 104:642–647) showed common brain activation for remembering past and imagining future events, implying a shared neural basis for these two directions of time travel.

arrives at the predicted location (essentially "pre-playing" the expected event). In motor cortex, neural ensembles activate in preparatory patterns prior to executed movements, effectively representing the intended future action before it occurs. Such anticipatory neural firing demonstrates that the brain allocates real, tangible resources (metabolic energy, neural firing) to represent **future events** that have not yet happened. In doing so, the brain confers a kind of **operational reality** on those expected events: they become part of the organism's present *model of the world*. Under ER, this aligns perfectly with the idea that future entities do not exist now (they have no concrete presence), but can still be *real* in the present insofar as they causally influence or inform current processes. A predicted predator attack, for example, is not an existent event, yet the mere prediction can trigger a present fear response and evasive action as if the predator's future arrival were already partially real.

On a slightly longer timescale, humans excel at **mental time travel** into the future – we imagine and evaluate scenarios that could happen later today, tomorrow, or years hence. Brain imaging studies show that imagining a hypothetical future scenario engages many of the same regions as recalling a past memory (the hippocampus, medial prefrontal cortex, etc.), indicating a shared network for memory and imagination. Daniel Schacter and colleagues have advanced a "constructive episodic simulation" hypothesis, proposing that the brain recombines elements of past memories to construct novel future simulations.[8] By doing so, we can "pre-experience" a future event (like mentally rehearsing a speech or envisioning a desired goal) and use that simulation to guide present decision-making. From the standpoint of ER, this ability to simulate futures means that *the future has a sort of reality in our minds*: we treat certain envisioned possibilities as meaningful and adjust our current behavior accordingly. Take the simple act of carrying an umbrella because rain is forecast—*the rain tomorrow is not an existent thing today*, yet it is undeniably part of the rationale for one's current action. In ER terms, the future rain is **real as a forecasted event** with causal influence on the present. Our brains constantly do this kind of thing: expected rewards trigger current dopamine releases and learning signals (as demonstrated in neuroeconomics, where the anticipation of a reward can fire dopaminergic neurons in advance),[9] and imagined threats produce current anxiety. The future, in effect, *leaks* into the present through our predictive and emotional systems. The key point is that from metabolism to high-level planning, organisms behave "as if" the future is partially real—real enough to merit preparation. Neuroscientist Endel Tulving coined the term **chronesthesia** for the awareness of subjective time and the ability to consider one's future and past selves, noting that this ability allows humans to consciously reflect on "what-will-be".[10] Developmental psychologists and biologists see foresight as a powerful adaptive trait: in a changing world, predicting and pre-adapting to likely future conditions provides a selective advantage. Indeed, evolutionary arguments suggest that even some animals (birds caching food, for instance) exhibit proto-mental time travel, treating future hunger as sufficiently real to hide food now. We will later see simpler organisms have their own rudimentary ways of anticipating future states.[11]

For now, focusing on humans: anticipation and planning illustrate ER's future-realism vividly. Under strict presentism, one might struggle to explain why an organism would respond to something that is literally nothing (a non-existent future); yet in practice, organisms do it all the time. ER sidesteps the paradox by saying: the future *isn't* nothing – it has a kind of being as a set of **real possibilities and propensities** that are rooted in the present state of the world. If a future event can be reliably inferred (from present conditions or laws of nature), or if it is actively *represented* in an organism's model, then it participates in reality. The brain's predictive coding and a person's intentional plans treat certain plausible futures as *inputs* to current behavior. The result is that future events influence the causal

8 Schacter, Addis, & Buckner (2008, Annals NY Acad Sci 1124:39–60) describe the constructive episodic simulation hypothesis: episodic memory fragments are flexibly recombined to simulate novel future events. This explains both the adaptiveness (we can envision multiple scenarios) and the susceptibility to error (false memories or distorted forecasts). It reinforces that memory is not a literal record but a tool for future planning – past and future thought are intertwined processes, consistent with ER's view of past and future reality intersecting in the present mind.

9 Wolfram Schultz's work in the 1990s on dopamine neurons famously showed that these neurons fire in relation to prediction errors: initially, they fire when a reward is given unexpectedly; after learning, they fire at the cue predicting the reward, and not at reward delivery (and will dip if an expected reward is omitted). This indicates the brain carries an expectation of future reward that is so real it drives current neural activity. The future event (expected reward) thus causes present dopamine release – a clear instance of a non-present entity exerting influence via a neural representation. See Schultz et al. (1997), Science 275(5306):1593–1599.

10 Chronesthesia (or temporal consciousness) was discussed by Tulving (2002) – he suggested it as a unique human ability to be aware of subjective time and one's existence in time. This corresponds to forming a narrative of one's life and imagining oneself at different times. Such self-projection is crucial for planning and decision-making that affects one's future self (e.g., saving money, health choices). For empirical reference, see studies like Ersner-Hershfield et al. (2009, Journal of Marketing Research 46: 602–613) where visualizing one's future self increases future-oriented decisions, indicating making the future feel real can change present behavior.

11 For detailed examples of anticipatory behaviors in both plants and animals, including corvid caching strategies, primate tool saving, and photoperiodic flowering, see Fabrica Mundi: The Assembly of the Subject in Cognitive Constructivism (2024), Ch. "The Future in Mind and Root" by Tenzin Trepp.

chain now, which means they must be considered part of the world's reality (else we'd have present effects with no cause). As ER would put it: an anticipated event is not yet actual, but it is **real** as an influence (through information, expectation) on present actualities. This notion is backed by everyday experience and neuroscience alike. We are constantly (often unconsciously) computing "futures" and adjusting our perceptions and actions to accommodate them. From the subtleties of perceptual expectation to the grand arcs of life plans, the human mind **projects** itself beyond the present. This projection is constrained by reality—our imagined futures are informed by what is physically and causally possible—but it also *shapes* reality by guiding what we do next. Our very sense of self has a temporal aspect: we often define ourselves by where we came from and where we are going (past memories and future goals). The next subsection will delve into this idea of the **narrative self** and temporally structured identity, before we transition to non-human examples. But already we see that the human case vindicates ER: only the present brain activity exists, yet to understand that activity (memory recall, fear responses, goal-directed behavior), we must acknowledge the *reality* of the past events remembered and future events anticipated. Human existence is thoroughly *time-bound*, not in a limiting sense, but in the sense that our existence is always pulling in threads from before and casting threads ahead.

Narrative Self and Temporal Identity

Beyond discrete acts of memory or planning, humans construct a **narrative identity** – an internalized story of who we are that ties together our past and future. Psychologists like Dan McAdams have argued that adults develop a "narrative identity" by organizing their autobiographical memories into a coherent story, which provides a sense of meaning and continuity across time. This narrative typically includes one's origin ("where I come from"), significant past episodes, and anticipated future chapters or goals ("where I am going"). In effect, we each carry in our mind a timeline of our life, integrating past selves and envisioned future selves into a single character: *me*. From an ER perspective, this phenomenon is very telling. If strictly speaking only my present self exists, how do I maintain a unity with my childhood self or my future old-age self? The answer is that I treat those past and future selves as **real members of my personal narrative**, even though they don't exist now. My childhood experiences (though past) live on in memory and in traits I still carry; in my self-narrative, I can refer to the child as "me" and draw causal connections ("because I was raised in environment X, I now have trait Y"). Likewise, I have aspirations and fears about future me – I can imagine how I will be, and this imagined future (though of course not existent yet) can influence my current choices (e.g. saving money now because I anticipate the reality of retirement needs). The narrative self, then, is an ongoing synthesis that **presupposes the reality of one's past and future** to construct a stable identity. Philosophers have debated whether identity over time requires something like an enduring substance or soul, but an ER-based interpretation would say: the continuity of identity is a *construct* that our brains perform by keeping past and future psychologically real. We treat the child we were as real (we empathize with our own past self via memory) and the future adult as real (we have genuine concern and care for our future self's welfare). Indeed, an interesting finding in neuroscience is that thinking about one's future self often activates brain patterns similar to thinking about a *different person* – unless one has a strong sense of continuity, in which case thinking of future-self is more akin to thinking of present-self.[12] This suggests that seeing one's future self as "me" (continuous with present me) is not automatic; it's an achievement of narrative cohesion and empathy across time. It also has practical consequences: people who feel their future self is real and continuous are more likely to make prudent long-term decisions (like saving for retirement), whereas those who feel disconnected from future self treat them almost like a stranger. The implication is that **temporal reality influences ethical and practical behavior**. If the future self is treated as real (almost as another present person whose interests matter), one behaves differently than if the future is unreal or abstract.

12 fMRI studies (e.g., Ersner-Hershfield et al. 2009) have shown that when people consider their own future self, the pattern of brain activation can either resemble thinking about oneself or thinking about another person, depending on how connected they feel to that future self. Greater "self-continuity" (feeling that future-self is truly me) correlates with more activation in medial prefrontal regions typically associated with self-referential thought. Those with higher self-continuity also tend to make more future-oriented choices (like allocating more money for retirement). This suggests that making the future self "real" to the present self has concrete effects on behavior.

In our narrative self, we see a microcosm of ER's solution to the puzzle of identity through time: we are present beings, yet we extend ourselves into the past and future via memory and imagination. Our existence is momentary, but our reality (as persons) spans a lifetime. When we say "I am the same person who did X years ago, and I will be the same person who experiences Y in the future," we implicitly rely on the idea that past and future instances of "me" are not utterly vanished or non-existent in the world's ontology, but rather part of an unfolding story that is real. ER can articulate this by noting that **each of those past selves existed in their present, and left traces—memories, physical continuities, records—such that they remain real as part of the causal story of the current me**. And each anticipated future self is not yet existing, but is real in the form of plans, expectations, and biological tendencies that shape what is likely to happen. In short, the **self is temporally structured**, and we maintain personal identity by constantly transitioning through existence (now) while carrying realities of what was and what is coming into being. This narrative coherence is a high-level, subjective analog of what even simple organisms do in objective terms: use the past and future to guide the present. Humans just do it in a self-reflective manner, spinning stories and histories. The upshot for ER is a rich affirmation: our deepest experience of being a self endorses the view that existence is present-bound while reality is temporally expansive. If a strict presentist view were psychologically true, we would treat our past as simply *gone* and our future as *irrelevant* except when it becomes present. But clearly we do not; we regard past and future in highly realistic terms (with emotions like regret and hope testifying to how real they can feel). Thus, human cognitive and emotional life itself argues for something like Existential Realism over strict presentism.

Before moving on, we highlight that decision-making is another process inherently integrating temporal dimensions. Good decisions typically require learning from past outcomes (so that past events influence present choice) and forecasting future consequences. Neuroeconomics has shown that humans and other animals use memory of past rewards and simulations of future outcomes in circuits involving the prefrontal cortex and basal ganglia to compute the value of options. A decision to invest in a project, for instance, will draw on remembered data (past performance) and anticipated scenarios (future market conditions). In each case, a non-present state (past success or a predicted future demand) affects a present action. The field of **reinforcement learning** in AI and neuroscience explicitly formalizes this: an agent updates a value function based on past reward prediction errors and chooses actions by estimating future rewards. The mathematics may not mention metaphysics, but conceptually it assumes the past is **informative (hence in some sense still present as information)** and the future is **modelable (hence partially real in the agent's decision calculus)**. Thus, whether at the level of synapses or strategies, decision processes bind time. Temporal **discounting** of future rewards (preferring smaller-sooner over larger-later rewards) might be interpreted as the agent assigning less reality or weight to far-future outcomes. A perfectly present-bound creature would discount the future entirely (treating future rewards as value 0 because in the present they are nothing), whereas a far-sighted creature treats future rewards as sufficiently real to act on. Humans strike a balance in between, which again reflects ER: the future is not as concretely real as the immediate present (hence we discount it), but it is not unreal either (we are willing to sacrifice now for later benefits if the calculus is right).

In summary, the human mind illustrates a multilayered temporal integration: perception merges a short past–future horizon into now; memory and learning embed the reality of past events in present brain structure; imagination and planning pull future possibilities into the present decision process; and our very sense of self weaves past and future into a meaningful whole. All these faculties support the ER view that while only present processes **exist**, both past and future phenomena have a real, tangible presence in how those processes unfold. In effect, the human organism is a **present existence that operates upon a non-present reality**. Past and future are not mere abstractions for us—they are experienced or utilized as parts of the world we live in (even if indirectly, via neural representations).

Temporal Adaptation in Simpler Organisms

We now turn to the other end of the spectrum: organisms without complex brains (or without any neural system at all) that nevertheless exhibit behavior hinting at memory and anticipation. If ER's claim about the reality of past and future holds generally, we should find even in simple life forms some trace of using past information and future-oriented strategies. Indeed, one of the surprises of modern biology is how widespread **temporal organization** is in living systems. Life on Earth evolved in rhythmic environments (day and night cycles, seasons, tidal flows), and even the simplest organisms have adapted to these temporal structures in ways that effectively "predict" regular changes. Moreover, individual cells can possess molecular feedback loops that serve as **memory** of past states or stimuli, influencing their future behavior. In this section, we explore examples from plants, bacteria, and fungi (slime molds) that demonstrate tropisms, biological clocks, and learning-like phenomena. These cases show that a functional distinction akin to ER's is present: an organism's current state encodes **historical information** (past conditions leave lasting effects) and **future expectation** (preparation for upcoming conditions). We will see that: plants can remember prior stresses and respond more robustly the next time – a form of **stress memory** that can last days or throughout a plant's life; bacteria and single-celled organisms can exhibit **history-dependent behaviors** and even pass on "learned" adaptations to progeny; slime mold can **anticipate periodic events** despite having no neurons; and virtually all organisms harbor **endogenous rhythms** (like circadian clocks) that align internal physiology with the external time of day or year, effectively an internal model of the day's cycle that keeps ticking even without external cues. These findings reinforce ER's notion that the past and future are part of the organism's world: if such humble life forms behave as if past events continue to matter and future events can be prepared for, then those past and future factors must be considered real in the organism's frame of reference. Only the organism's current biochemical state exists, but that state is a **palimpsest of the past and a projection toward the future**.

Tropisms and Rhythms: Anticipating the Environment

A classic example of temporal adaptation is the **circadian rhythm** – the roughly 24-hour internal clock found in organisms across the tree of life (animals, plants, fungi, even many bacteria). Circadian clocks enable organisms to anticipate the daily cycle of light and dark rather than merely react to it. For instance, many plants open their leaves or flowers in the morning and close them at dusk. Notably, in 1729 the French scientist de Mairan observed that the mimosa plant continued its daily leaf movements even in constant darkness, suggesting an internal clock was at work. We now know that plants have a genetic clock mechanism (involving feedback loops of clock genes and proteins) that keeps ~24h time. This internal clock entrains to local day/night cues but will run on its own if cues are absent, indicating the plant *predicts* dawn and dusk based on its internal timekeeping. The adaptive value is clear: by starting photosynthesis-related processes before sunrise, a plant can get a head start on energy capture; by closing stomata before night, it can conserve water. In terms of ER, the **coming sunrise** is not yet existing at 4 AM, but for the plant it has a reality such that its physiology shifts in advance. The plant's clock embodies the **regularity of the past** (it has learned, over evolutionary time, the pattern of Earth's rotation) and uses it to **foresee the future**. Similarly, **photoperiodism** is the ability of organisms to measure day length to time seasonal events (flowering, mating, hibernation). Plants can tell, by changes in day length, that winter or spring is approaching and adjust development accordingly. For example, some plants require a certain length of day to trigger flowering – they "know" when it is spring by the longer daylight hours. This is an inferential link: a plant measures current photoperiod and from that **infers a future state** (upcoming winter or spring) and initiates a response that will be appropriate when that future arrives (like producing flowers when pollinators will be available). In a remarkable recent study, even cyanobacteria (photosynthetic bacteria) were shown to anticipate seasonal changes. Scientists exposed cyanobacteria to artificially short "winter" days (8 hours light, 16 dark) for many cycles, then challenged them with a cold temperature shock. Those that

had experienced short days survived cold stress **2–3 times better** than those grown under long "summer" days.[13] This indicates the bacteria sensed the shortening of day length as a cue that cold weather was coming, and they mounted some protective response in advance.[14] The effect even lasted multiple generations of bacteria, hinting at a kind of cellular memory of seasonal timing.[15] Importantly, this preparation required a functional circadian clock in the bacteria – mutants without a clock did not show the anticipatory hardening. So here we have arguably one of the simplest life forms **anticipating a future environmental state (winter)** based on a prior signal (daylight length) and an internal temporal model (circadian photoperiod measurement). No future winter existed during the short-day conditioning, yet the bacteria acted as if "winter is coming" was real enough to merit a physiological adjustment. This beautifully illustrates how life treats certain future events as real *before* they come into existence.

The ubiquity of circadian rhythms underscores that Earth's organisms evolved under predictable temporal structures and have internalized those structures. Even in constant laboratory conditions, mice will run on exercise wheels in ~24h cycles (looking for the "day" that isn't there) and bread mold releases spores on a daily rhythm. Some organisms also have **circatidal** clocks (e.g., certain coastal species anticipate tides) or **circannual** rhythms (animals preparing months in advance for migration or hibernation). All such cases involve an internal representation of time that extends beyond the present moment, often well beyond (months, in the case of certain migratory preparations). While these behaviors can often be explained by natural selection (it was advantageous to anticipate rather than react, so clocks evolved), the philosophical consequence is that the biology itself implements a distinction between existence and reality: the oscillating proteins of a clock exist now inside the cell, but what do they represent? – a phase of the day that may not be currently observable (e.g., the clock "knows" it's about to be dawn in a few hours, even though it's dark outside now). Thus the cell's chemistry contains a *representation of a time that is not the current external time*. In a sense, the cell carries a little bit of "yesterday and tomorrow" in its present state (yesterday's light cycle calibrates the clock, and tomorrow's dawn is predicted by it). This aligns strongly with ER. Only the molecules and reactions ticking in the cell exist right now, but what gives them function is their correlation to something not now present (past light cycles, future light onset). Reality for the cell includes those patterns; otherwise its behavior would be inexplicable.

Besides clocks, simple organisms show **tropisms** and time-structured foraging strategies. **Tropism** is a movement or growth towards or away from a stimulus (e.g., light, gravity). A familiar example is a sunflower following the sun across the sky (heliotropism) – it **anticipates** the sun's movement by adjusting position throughout the day. Young sunflower plants even exhibit a remarkable behavior: their heads track the sun east-to-west during the day, and then reorient back east at night to be ready for sunrise. This back-and-forth cycle is driven by an internal rhythm that matches the solar day.[16] If cloud cover hides the sun, the plant still performs the motion, demonstrating it is not mere reaction but an ingrained expectation. In terms of ER, the sunflower is responding to the *imminent* future position of the sun as though it were essentially real "information" to act on. Another instance: some desert plants open their flowers *before* the sun has fully risen, using temperature or dawn light cues to anticipate when pollinators will be active, rather than waiting to sense the pollinators. On the microbial scale, **foraging strategy** can involve timing as well. Marine bacterioplankton that feed on nutrient particles in the ocean must decide how long to stay on a food particle before searching for a new one. If they leave too early, they might miss out on remaining food; if they stay too long, they might starve if the particle is nearly exhausted. Studies have found bacteria employ near-optimal strategies for this

13 https://asm.org/videos/bacteria-detect-changes-in-seasons-microbial-minut
#:~:text=Scientists%20discovered%20that%20cyanobacteria%20anticipate,like%20days

14 Jabbur et al. (2024) reported in Science that cyanobacteria exhibit photoperiodism: exposure to short day cycles induced greater cold resistance. The effect persisted across multiple generations and depended on the bacteria's circadian clock. This finding pushes the origin of seasonal anticipation back to prokaryotes. It implies that even single cells can integrate day-length information (past several days' pattern) and translate it into a phenotypic change preparing for a future stress. In broader context, it supports the idea that time-informed behavior (here, expecting winter) was selected very early in evolution.

15 https://asm.org/videos/bacteria-detect-changes-in-seasons-microbial-minut
#:~:text=use%20the%20light%20cues%20to,organisms%20in%20a%20changing%20climate

16 Heliotropism in sunflowers (and their re-orientation at night) was described by Atamian et al. (2016, Science 353:587–590). Young sunflowers track the sun during the day and reset overnight, driven by circadian rhythms modulating growth of the stem on alternate sides. When their clocks were disrupted, the tracking became less effective and growth was impaired. This shows a clear adaptive benefit to an internal temporal mechanism coordinating with the external solar cycle – essentially an evolutionary case-study of ER's principle that future (sunrise) has reality for the organism, as the plant acts on it before it arrives.

time allocation problem, effectively using an internal "estimate" of diminishing returns.[17] Though bacteria lack a nervous system, their regulatory networks can integrate over time and change behavior when certain thresholds are reached (e.g., the rate of nutrient intake dropping may trigger a search behavior). This is a simple analog of decision-making that requires projecting current trends into the future – an implicit expectation of how much more reward is likely if they stay vs leave. Such behaviors illustrate that even unicellular organisms operate with respect to an extrapolated future state (even if only seconds or minutes ahead). There is also evidence of bacteria anticipating recurring environmental sequences: in a landmark experiment, *E. coli* bacteria were grown in a lab culture where temperature increases were always followed by the introduction of a certain food source; over generations, the bacteria evolved to start upregulating genes to metabolize that food as soon as temperature rose, *before* the food was even introduced.[18] In other words, they learned the sequence "heat then lactose" and began to *preempt* the lactose arrival after detecting the heat. This is a kind of **associative memory** or predictive conditioning at the microbial level.

Memory and Learning Without Neurons

We often think of memory as requiring a brain, but research has shown that many simpler organisms exhibit forms of "memory" if we define it loosely as *past-dependent behavior*. Plants, for example, can "remember" past stress exposures. A well-studied phenomenon is **thermomemory** in plants: after a plant experiences a moderate heat stress, it can survive a later severe heat stress much better – indicating that the first event left a lasting preparedness.[19] This heat stress memory can persist for days or longer. At the molecular level, it involves changes in gene expression and protein activity that remain even after the initial heat shock is over. For instance, certain **heat shock proteins** (molecular chaperones that help refold damaged proteins) can stay expressed at higher baseline levels following an initial heat event, acting like a cellular memory of heat.[20] There are also **epigenetic** changes (chemical modifications to DNA or chromatin) that can store the information "we were exposed to heat" by keeping stress-response genes poised for quicker activation next time.[21] Fascinatingly, plants not only remember stresses within their own lifetime; some stress memory can even be transmitted to offspring through epigenetic inheritance (though often it is reset after a couple of generations to avoid permanent changes). Another kind of plant memory is related to the **immune system**: when a plant survives a pathogen attack, it often enters a state of heightened defense called "systemic acquired resistance" that can last the rest of the season, effectively remembering the infection and priming itself against recurrence. These examples show that a plant's physiology at time T1 (after the stimulus) is influenced by an event at time T0 such that at time T2 (when the challenge returns) the response is altered. If the past event were "unreal" to the plant, we'd see no change at T2, but in reality the past leaves **structured changes**. In ER terms, the past stress is real in the plant's ontology via stored molecular states. One recent review describes how plants maintain a **"stress memory"** that balances retention and resetting: some marks of stress are kept (to confer resilience later) while others are erased (to avoid unnecessary trade-offs) – underscoring that memory is an active, regulated feature even in flora.[22]

17 Optimal foraging theory has been applied to bacteria. For example, Stocker and colleagues (such as in PNAS 2017, 114(23): E4199–E4205) observed marine bacteria switching between "search" and "consume" phases when encountering nutrient particles. They argue bacteria use a time-dependent strategy that maximizes nutrient intake over time. While bacteria likely don't have a cognitive strategy per se, their behavioral responses (possibly mediated by sensory adaptation or internal metabolic feedback) approximate a solution that requires implicitly estimating the value of staying vs leaving – a temporal inference. This showcases even simple chemotaxis behaviors have a temporal component (when to stop exploiting and move on).

18 setup where temperature upshifts were consistently followed by oxygen absence. After 500 generations, the bacteria began to react to temperature increase by inducing genes appropriate for anaerobic respiration before oxygen actually dropped. This is a lab-evolved example of associative learning at the gene-regulatory level. It demonstrates that an environmental cue can come to be treated as a predictor of a coming condition, leading the organism to initiate a response early. Essentially, the bacteria came to treat a future event (oxygen depletion) as real upon sensing the present cue (heat), enacting preparatory gene expression.

19 For a broader treatment of plant memory, including vernalization, stress habituation, and circadian anticipation, see Fabrica Mundi: The Assembly of the Subject in Cognitive Constructivism (2024), Ch. "Plant Memory" by Tenzin Trepp. https://www.lulu.com/shop/tenzin-trepp/fabrica-mundi-en-hardcover/hardcover/product-kvkzkq2.html

20 Thermomemory in plants is documented by Charng et al. (2007, Plant Physiology 144:318–331) and many others. A moderate heat stress can induce a "primed" state that lasts days, enabling survival of a later severe heat stress. Mechanisms include sustained levels of heat shock proteins (HSPs) and altered chromatin states at stress-responsive loci. For instance, some HSPs remain expressed at higher levels after the initial heat, and certain transcription factors remain active. A 2022 review by Balazadeh (see Curr Opin Plant Biol 65:102147) calls thermomemory a multi-layer phenomenon, from protein stability to epigenetic marks. It's effectively a cellular memory of heat.

21 An example of epigenetic stress memory: after drought, plants can maintain DNA methylation changes at specific genes that keep them more readily activated for future droughts (e.g., Ding et al. 2012, Molecular Cell 48:191–201). Similarly, in heat stress, histone modifications can remain that poise heat-responsive genes for quick reactivation. These marks can sometimes be passed to progeny seeds (e.g., Wheaton et al. 2020 showed transgenerational heat memory in Arabidopsis via histone H3K27 trimethylation changes). Such findings illustrate how a past environmental condition can leave a heritable "memory mark" on the genome that affects future responses – literally encoding past reality into the organism's material.

22 Staacke, Mueller-Roeber, & Balazadeh (2025, New Phytologist 245:2402–2421) review heat stress memory and how it is reset. They highlight that plants must balance maintaining beneficial stress memories (to survive recurring stress) with resetting them (to avoid costs when conditions normalize). This balance is struck by various means: protein turnover, selective removal of epigenetic marks, etc. The existence of a regulated "forgetting" mechanism underscores that memory in biology is an active management of information from the past – further proof that the past is treated as a real, usable resource, not just something gone.

Microbes similarly show several mechanisms of memory despite lacking nervous systems. A 2024 overview in *Microbiology* aptly stated: "Microbes don't have brains – but they do have memory".[23] One broad mechanism is via **transcriptional or metabolic feedback loops** that outlast a stimulus. For example, yeast cells exposed to a less-preferred sugar (galactose) will induce genes to metabolize it slowly at first. After switching back to glucose, they keep a chromatin "bookmark" on those galactose genes so that if galactose appears again soon, they reactivate them much faster.[24] This memory lasts about 7–8 cell divisions.[25] It's an epigenetic memory: no change in DNA sequence, but a change in how DNA is packaged that persists through cell divisions, reminding the lineage that "we've seen galactose recently." Another mechanism is **protein-based memory**: some stress responses lead to protein accumulation in the cell that doesn't immediately decay. If a bacterium encounters, say, a sudden acid shock, it might produce protective proteins; those proteins can remain present for a while, so if acid shock happens again soon, the cell is already buffered (and even its daughters, if the proteins partition into them, have a head start). An example mentioned in the literature is a Bacillus subtilis sporulation signal that leaves a protein legacy affecting progeny for multiple generations.[26] Yet another mechanism is seen in *E. coli* swarming behavior: recently discovered "iron memory" stores the experience of swarming (which requires flagella and motility) by altering intracellular iron levels. Cells that have swarmed once end up with lower iron; if they encounter a new surface, this low iron state triggers a faster swarming response than naive cells. The memory (low iron) lasts a few generations and can even make cells transiently more antibiotic-tolerant.[27] From these diverse cases, we glean that even single cells have ways to **record past states** (in metabolites, protein levels, or DNA marks) and *use* that information later, often improving fitness. They blur the line between past and present: a cell at present carries molecular echoes of something that happened in its past or in its lineage's past. If those echoes enhance survival in recurring conditions, natural selection will favor retaining them – hence microbial memory is ubiquitous wherever environments have some predictability.

Perhaps the most surprising evidence of learning in non-neural organisms comes from the acellular slime mold *Physarum polycephalum*. Slime molds are basically giant single cells (one cell with many nuclei) that move and forage in amoeba-like fashion. *Physarum* has become famous for solving mazes and optimizing networks, demonstrating a primitive form of problem-solving via its protoplasmic network reconfiguration. In 2008, researchers (Saigusa et al.) showed that *Physarum* can **anticipate periodic events**. They put slime molds in a petri dish and applied a series of unpleasant stimuli (drying the dish, which the slime mold dislikes) at regular intervals, for example every 30 minutes. The slime mold would slow its movement each time a stimulus hit. After a few cycles, the researchers stopped giving the stimulus – amazingly, the slime mold still slowed down **at the precise interval** when it "expected" the next stimulus, even though nothing happened.[28] It did this for a couple cycles, as if waiting for the stimulus, and then gradually stopped the behavior when no stimulus came (a form of **habituation**). This implies *Physarum* learned the period of the stimulus and anticipated it – a rudimentary form of temporal learning and expectation in an organism with no neurons whatsoever. Whatever mechanism underlies this (likely oscillatory patterns in its calcium signaling or cytoskeletal dynamics), it amounts to the slime mold having an internal representation of the interval and the last time the event occurred. In other words, it formed a **temporal memory** ("an event happened 30 minutes ago") and an **expectation** ("such events tend to recur every 30 minutes") which together influenced its current behavior. Another study found *Physarum* can even associate two cues in time: if a neutral stimulus consistently preceded a negative stimulus, the slime mold eventually reacted to the neutral stimulus with the response it would give to the negative one, hinting at a form of associative learning.[29] These

23 https://asm.org/articles/2024/august/do-microbes-have-memory
#:~:text=Microbes%20don%E2%80%99t%20have%20brains%E2%80%94but%20they,ultimately%20harness%20the%20microbes%20themselves
24 https://asm.org/articles/2024/august/do-microbes-have-memory
#:~:text=In%20some%20cases%2C%20past%20experiences,Scientists%20postulate%20that%20epigenetic
25 https://asm.org/articles/2024/august/do-microbes-have-memory
#:~:text=an%20environment%20rich%20in%20glucose,the%20event%20of%20DNA%20mutation
26 https://asm.org/articles/2024/august/do-microbes-have-memory
#:~:text=There%20are%20also%20instances%20where,diluted%20out%20through%20natural%20division
27 https://asm.org/articles/2024/august/do-microbes-have-memory
#:~:text=Nutrients%20form%20additional%20fodder%20for,How%20do%20they%20do%20it
28 https://link.springer.com/article/10.1007/s10071-023-01782-1
#:~:text=a%20review%20of%20cognition%20in,of%20cold%2C%20dry%20air%2C
29 Boisseau et al. (2016, Proceedings B 283:20160446) demonstrated habituation in Physarum: repeated exposure to a bitter but harmless substance (quinine or caffeine) led slime molds to gradually stop slowing down (they learned to ignore it). They could even "remember" the habituation after a break, resuming lessened response, and they could distinguish a new substance (they still responded to a different bitter, showing specificity). Also, when fused with a naïve slime mold, the habituated one transferred the learned behavior to the other, suggesting a chemi-

findings challenge the notion that learning and memory require a brain; they suggest there are fundamental biochemical or biophysical ways to achieve learning outcomes. For our purposes, the slime mold is a striking validation that **even a single cell treats the past and future as real enough to act upon**. The past stimulus left an internal oscillation or chemical state (a memory of the interval) – otherwise the cell could not have "known" when to slow down in absence of the cue. And the expected future stimulus had a real effect (slowing movement) despite not existing yet – a clear parallel to our earlier examples, but in one of the simplest cognitive systems imaginable.

Across these examples – circadian clocks, seasonal acclimation, microbial memory, slime mold learning – we see life's general principle: **history matters and anticipation matters**. Organisms embody past influences and predict future conditions as core strategies for survival. The present state of a living system is thus *contextualized* by temporal relationships. There is a continuity here from physics to biology: just as physical traces (fossils, radiation, entropy increase) carry past information and physical laws allow prediction of future events, living organisms have harnessed those principles in an embodied way. But biology adds something: internal **models** of time (be it a molecular oscillator or a cognitive schema) that actively use past and future information, not just passively endure it.

Temporality, Causality, and the Present-Centered Organism

Having surveyed temporal behaviors in both complex and simple organisms, we now analyze how these findings reinforce the Existential Realism framework. A central theme is that an organism at any given **present moment** is not an isolated entity – it is the product of its past and a predicate of its future. The organism's **existence** is strictly confined to its present state (a plant exists now as this configuration of cells; a person exists now as this conscious mind-body event), yet that state is laden with traces of what came before and tendencies toward what comes next. This duality maps neatly onto ER's distinction between **existence** (present, concrete being) and **reality** (causal-informational presence, not necessarily tied to the present). For a living organism, past events and future possibilities are undeniably part of its reality because they shape and inhabit its present. And yet, importantly, organisms never escape the present – they always act *in the now*, using whatever information is available **now**. ER holds that only the present is ontologically "active," and in biology this means memories and anticipations must take present physical form (neural firing, chemical concentrations, etc.) to have effects. There is no mystical reaching into the non-present; the organism **collapses** past traces and future expectations into the present through embodied records and models. This aligns with an information-theoretic view: the past is real to the extent it has left information accessible now, and the future is real to the extent it is encoded in information now (whether genetic, neural, or cultural). Organisms are **present-centered** entities that leverage a **temporally extended reality**.

Let us make this more concrete. Consider a tree standing today. In ER terms, the tree *exists* only in the present moment – the tree of yesterday or a minute ago does not exist now. However, obviously the tree has grown rings, scar tissue from a lost branch, adaptive root spread from years of soil conditions – all these present features are records of its past, making past seasons and events part of the tree's reality. The seedling it was decades ago is no longer here, but it is real insofar as the current tree is causally continuous with it — one could say the seedling migrated into the tree we see now. Similarly, the tree is primed for the future: its buds are set for spring, containing embryonic leaves that will only unfold later; its genome encodes responses to stresses not yet encountered. Those buds and genes are present physical existents, but what they represent are future leaves and possible stress responses – essentially, the future built into the tree's current reality. Now, nothing about the future is determined; a late frost could kill the buds. ER would say the future leaves are real as *a set of possibilities with a physically embodied propensity* (the bud is that propensity). If the frost happens, that possibility (healthy leaves) is thwarted, but the frost itself was another possibility (and the tree may have some

cal memory signal. This is evidence of learning and memory in an aneural organism. Another study by Vogel et al. (2015) indicated Physarum can associate a light stimulus with food if paired, hinting at even classical conditioning. These examples push the boundary of what constitutes a "mind," but clearly show that basic learning – storing past info to change future behavior – does not require neurons, reinforcing that memory and anticipation are fundamental biological capacities.

tolerance from past cold exposure – again past influencing present). The point is that to describe the tree meaningfully, we invoke past states (seedling, previous winters) and future outcomes (budding in spring), because they live on in the present structure. The tree is thus a four-dimensional being in a sense, but unlike the "block universe" view where the whole timeline equally exists, here only the current stage is actual at any moment – yet each stage is connected through a continuous migration from what was into what is. This is exactly the scenario ER envisions: **reality is the connected process**, existence is the current state.

If we return to humans with this perspective, we see that an individual is essentially **a present process integrating a real past and real future**. My memories, personality, skills, and knowledge are present processes in my brain, but they *represent* real events from my past and set up real possibilities for my future. The **causal, structural continuity** across time in an organism provides a natural ontology for ER. Instead of saying "past and future are unreal" (which would make the persistence of organisms mysterious), we say "past and future are real insofar as they are woven into the causal fabric of the present organism". If I have a memory, that memory is a current neural pattern *about* a past event; it is evidence that the past event was real enough to leave this trace. If I have a goal, that goal exists in my mind now, but it's about a future state I deem real enough to strive for. Every adaptation or learned behavior in an organism testifies that something no longer present (a prior condition) or not yet present (a probable future condition) can shape present existence.

Philosophically, this resolves some puzzles. For example, one classic problem for presentism is: how can statements about the past be true if the past doesn't exist? ER answers: because the past is real (just not presently existing), there are truthmakers in the present (records, memories, fossils) that ensure statements about the past have reference. Likewise for future-directed thoughts: we make plans and assign probabilities—if the future were utterly unreal, such reasoning would be baseless. Instead, we treat the future as an **open set of real possibilities** (some more likely than others) that exert pull on the present. Organisms act in accord with this: seeds lie dormant anticipating rain (for them, the possibility of future rain is real enough that they have evolved to wait for it); animals migrate before winter (the coming winter is real in their predictive instinct even though it's not yet happening). All these examples illustrate that **temporal relations themselves are part of reality**. An organism is not just a 3D object, but a 4D process – however, not 4D in the static block sense, but in a **becoming sense**: it has a history and a trajectory. ER captures this by allowing reality to extend into past and future without granting that those times exist like destinations on a map. Only the now exists, but it carries the imprint of what was and the momentum of what is transitioning into being.

Another way to frame this is through the concept of **causal loops and feedback**. Living systems create feedback loops across time: they adjust now based on past feedback (memory) and feedforward (anticipation) signals. These loops mean that to understand the cause of a present behavior, one might need to cite a past event or a future expectation as part of the causal explanation. For instance, *why* did the rat press the lever? Because it remembers that pressing yields food (past cause) and it expects food now (future cause). The actual pressing exists now, but its cause lies in the rat's internal representation, which is anchored in past reality and future potential. This is a causal story that is perfectly coherent if past and future are real in the explanatory framework (ER allows that), but awkward if one insists only present events can be causes. Under strict presentism, one might say "only present events cause present events," but then one has to transmute "memory of past food" into a present cause. That is doable (the memory trace now is present), but that trace's significance comes entirely from the past event. ER would simply say: the past event's reality is carried by the present trace, enabling it to be a cause now. Similarly for future: "expectation of food" is a present brain state cause, but it represents a future event's reality (the food that will come). So again, current expectation is a cause only because a future event is considered real enough to motivate it. The two-tier ontology smooths this: past cause → present trace → present action ← future expectation (present neural model of future) ← anticipated future event. Everything in that chain is *real*, though only the present pieces exist.

It is worth reflecting on **identity** and the continuity of life in this light. For living organisms, especially multicellular and conscious ones, maintaining identity over time is itself an active process. Biologists

note that the material constituents of our bodies turnover: most of our cells, and certainly their molecules, are replaced over years. We are not materially the same as years ago, yet we consider ourselves the same individual. What preserves identity is largely *informational continuity*: the pattern of organization, the memories and personality, the DNA sequence (for asexual organisms), etc. These informational patterns persist through time by constantly being replicated, repaired, and referred to. In other words, life encodes the past in structures that are carried forward. A cut on a tree trunk is recorded in its rings, a learned song in a bird is maintained in its neural circuits. Life is memory – not just in brains, but at all levels (genetic, epigenetic, cellular). And life is also anticipation – seeds and spores are dormant anticipations of future favorable conditions, behavioral instincts are anticipations distilled by evolution. So **to be alive is to be temporal**: to have a past one carries and a future one projects. This suggests that ER's emphasis on the present as the locus of existence does not diminish the importance of past and future; rather, it clarifies it. The past and future for a living being are not "places it exists" (no organism literally exists in the past or future), but they are essential dimensions of its reality. Life is a process of **becoming** – always in flux, always moving from past to future. ER explicitly allows an ontology of becoming: reality includes that which is in the process of coming-to-be (the future possibilities) and that which has come-to-be (the past, now recorded), whereas existence is the *arrival* at being (the now). In living systems, we see this process in action: the organism grows (bringing new events from future to present), and it remembers (retaining past within the present).

To underscore the point with one more human-oriented thought experiment: imagine if we truly did not consider past or future as real in any sense. We would have no reason to keep promises (since the future fulfillment wouldn't matter), no reason to learn (since past lessons wouldn't be considered relevant), and no continuity of self (yesterday's me was nothing, tomorrow's me is nothing). Such a being would likely not survive long, as it could not adapt or plan. Evolutionarily, the success of organisms is predicated on leveraging past experience and future expectation – which in turn presupposes that those temporal domains have a robust influence on the present. Thus, the empirical world of biology resoundingly indicates that a philosophy denying all reality to the past and future is at odds with the nature of life. ER provides a middle path: yes, only the present exists in the full sense (we never physically encounter anything outside the now), but no, past and future are not mere fictions – they are real enough to leave footprints and foreshadowings that shape the present world.

Implications and Conclusion

We have extended the Existential Realism framework into the realm of biological and cognitive systems, and found that it sheds light on – and is reinforced by – the temporality of life. **Past and future entities, while not existent now, manifest their reality through the behavior and structure of organisms.** This has several implications:

First, it provides a satisfying metaphysical grounding for the intuition that life is a **temporal phenomenon**. Living systems are not static three-dimensional objects; they are four-dimensional processes that accumulate history and generate novel futures. ER's ontology naturally accommodates this by allowing the past to be real (hence accumulated) and the future to be real (hence influent) without positing that an organism literally stretches across time in existence. Instead, an organism exists only in the ever-moving present, but because reality spans time, the organism's present state can be rich with temporal depth. This view resonates with process philosophy and the notion of life as constant **becoming** rather than fixed being. Each moment in an organism's life is a node that inherits reality from before and bequeaths reality to what comes after.

Second, our exploration emphasizes that **models of time are embedded within organisms**. From circadian oscillators to human autobiographical narratives, these internal models ensure that the organism's behavior is aligned with temporal structure. It suggests that having some representation of time is practically a requirement for life, at least beyond the very simplest levels. Even bacteria have molecular circuits that integrate over time (a kind of short-term memory) and respond to periodicity. In

humans, the representation becomes conscious: we have explicit memories and forecasts. The presence of these models supports the ER idea that while only the present experience is directly given, our minds actively construct a wider temporal reality that we operate in. In other words, **subjective time is a construction that mirrors the objective temporality of reality**. Husserl's phenomenology of time (with retention and protention in consciousness) finds a naturalized counterpart in brain science (with working memory and predictive coding) and in ER's metaphysics (with reality including past traces and future tendencies). The organism's internal time model is the mechanism by which non-present realities are given efficacy in the present.

Third, by seeing how deeply temporality structures identity and responsiveness, we gain insight into questions of personal identity, responsibility, and ethics. ER suggests that *who we are* is present-centric (since only the present self exists), yet we rightly consider ourselves the same person as the past self because that past self is real in the form of memory, character, and continuity now. This can illuminate debates in ethics about responsibility for past actions or concern for one's future welfare: one is accountable for past deeds because those deeds are real parts of the world (they happened and have consequences) and one's present self is causally connected to the self who did them. Likewise, prudence and planning are rational because future outcomes, though not yet actual, are real enough (given what we know) to merit present regard. Even concepts like regret or nostalgia attest to the emotional weight of past reality, and hope or fear attest to future reality's emotional weight. Understanding these through ER can perhaps ease the tension in our intuitions: we often speak as if the past and future in some sense exist (we talk about "finding oneself" in one's past, or "seeing one's future"), yet we know only the present is tangible. ER lets us say: the past and future don't exist now, but they are part of reality's scaffolding, thus our engagement with them is not in vain or delusional.

Finally, in a broader philosophical biology sense, we might speculate that **life itself could be defined by its temporal reach**. Non-living physical systems certainly have histories and can be predictive (a river's path reflects past erosion; a chemical reaction proceeds toward future equilibrium), but only living systems incorporate *memory and anticipation* as intrinsic, adaptive features. Some theorists have suggested that an essential hallmark of life is its ability to resist entropy locally by using information—effectively, using records of the past and predictions to maintain order. If so, ER's perspective on time dovetails with a conception of life as something that straddles the line between present and not-present in order to persist. The **temporality of responsiveness** (reacting not just to current stimuli, but to past trends and future possibilities) may be as fundamental to life as metabolism or reproduction. ER gives us the language to say why: because organisms treat past conditions and future conditions as part of the reality they must navigate, not merely something that was or will be unreachable.

In conclusion, examining biological and cognitive systems through the lens of Existential Realism reinforces the framework's central claim: reality is larger than existence, yet centered on it. The present moment is the only locus of existence for an organism, but that organism's effective world – its reality – extends into remembered past and expected future. Advanced neural organisms like humans demonstrate this through memory, planning, and the construction of narrative identity, integrating decades of time into a single life. Simpler organisms display the same principle in stripped-down ways, through physiological memory and rhythmic anticipation. These realities of life provide a rich natural verification of ER's ontology: they show that one can consistently maintain that *only the present is*, while *acknowledging that much more is real*. Past and future are not mere negations or nullities for living beings; they are active ingredients in the drama of survival and experience. By uniting metaphysical clarity with biological fact, Existential Realism offers a coherent picture in which we, time-bound organisms, exist at the razor's edge of now, wielding the real but non-existent past and future as tools to thrive. In a poetic sense, one might say that **life is the universe itself remembering and prospecting**, and ER is the ontology that recognizes memory and possibility as genuine components of what is.

References

- Ned Markosian, a defender of presentism, illustrates the strict presentist view: past figures like Socrates or one's future grandchildren "are unreal, according to presentism," since only present objects exist (Markosian 2004, p.47).
- William James (1890) introduced the term "specious present" to describe the short duration that the mind treats as the present.
- Ernst Pöppel's work in the 1970s and 1980s proposed a ~3-second integration period for conscious awareness.
- The *intentional binding* effect was reported by Haggard, Clark, & Kalogeras (2002), who found that when subjects voluntarily pressed a button that caused a tone with a slight delay, they perceived the tone as occurring sooner (and their action later) than when the tone was externally triggered.
- Donald O. Hebb's *The Organization of Behavior* (1949) proposed that when neuron A repeatedly helps fire neuron B, the connection from A to B is strengthened.
- Endel Tulving (Chronesthesia: awareness of subjective time) noted that episodic memory allows "mental time travel" – one can re-experience the past and pre-experience the future.
- Schacter, Addis, & Buckner (2008, *Annals NY Acad Sci* 1124:39–60) describe the constructive episodic simulation hypothesis.
- Wolfram Schultz's work in the 1990s on dopamine neurons famously showed that these neurons fire in relation to prediction errors.
- Chronesthesia (or temporal consciousness) was discussed by Tulving (2002) – he suggested it as a unique human ability to be aware of subjective time and one's existence in time.
- fMRI studies (e.g., Ersner-Hershfield et al. 2009) have shown that when people consider their own future self, the pattern of brain activation can either resemble thinking about oneself or thinking about another person, depending on how connected they feel to that future self.
- Jabbur et al. (2024) reported in *Science* that cyanobacteria exhibit photoperiodism: exposure to short day cycles induced greater cold resistance. The effect persisted across multiple generations and depended on the bacteria's circadian clock.
- Heliotropism in sunflowers (and their re-orientation at night) was described by Atamian et al. (2016, *Science* 353:587–590). Young sunflowers track the sun during the day and reset overnight, driven by circadian rhythms modulating growth of the stem on alternate sides.
- Optimal foraging theory has been applied to bacteria. For example, Stocker and colleagues (such as in *PNAS* 2017, 114(23): E4199–E4205) observed marine bacteria switching between "search" and "consume" phases when encountering nutrient particles.
- Tagkopoulos, Liu, & Tavazoie (2008, *Science* 320:1313–1317) evolved *E. coli* in a lab setup where temperature upshifts were consistently followed by oxygen absence.
- Thermomemory in plants is documented by Charng et al. (2007, *Plant Physiology* 144:318–331) and many others. A moderate heat stress can induce a "primed" state that lasts days, enabling survival of a later severe heat stress.
- An example of epigenetic stress memory: after drought, plants can maintain DNA methylation changes at specific genes that keep them more readily activated for future droughts (e.g., Ding et al. 2012, *Molecular Cell* 48:191–201).
- Staacke, Mueller-Roeber, & Balazadeh (2025, *New Phytologist* 245:2402–2421) review heat stress memory and how it is reset.
- Boisseau et al. (2016, *Proceedings B* 283:20160446) demonstrated habituation in *Physarum*.

Present-Centered Machine

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Technology and Time

Existential Realism meets technology: machines act in the now but think across times that are real yet not existent. This paper shows how ER can give them temporal awareness — grounding prediction, memory, and ethics in the living present.

Technology and the Reality of the Present-Centered Machine

Tenzin C. Trepp,

Email: trepp@tenz.in

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Abstract

Contemporary Artificial Intelligence and other computational systems—from machine learning models and large language models to autonomous agents and predictive simulations—usually handle time in a tenseless manner, treating past, present, and future data points as uniform elements of a timeline. They lack an explicit ontology of the **present** (what exists now), **becoming** (how the present continually updates from potential to actual), and **temporal asymmetry** (the one-way flow of causality from past to future). This paper proposes that **Existential Realism (ER)**, an ontological framework distinguishing **existence** (entities in the present moment) from **reality** (a broader set including causally or informationally relevant past and future entities), can enrich the way technological systems model time. We argue that by incorporating ER's present-centered, two-tier view of time, machines could become more temporally-aware and responsible in their decision-making. We detail key ER concepts—such as the primacy of the present, the reality of the non-present, truthmaking, and the idea of a real-but-not-yet-existent future—and map them onto machine-level analogues like sensor inputs (the machine's "existence"), memory traces, simulation states, and predictive models. ER provides a structured approach for machines to: distinguish what exists *now* from what is merely remembered or anticipated; represent future states as **real but not yet existent**, enabling ethical foresight; anchor predictions in current data while reasoning about long-term consequences; and avoid temporal fallacies like treating the future as fixed or erasing the influence of the past. Through examples in climate modeling, medical diagnostics, robotics, and Artificial Intelligence ethics, we illustrate how an ER-informed system could better navigate time-sensitive tasks—e.g. by understanding that only the present sensor data is actual, that past data (though no longer existent) remains real evidence, and that future scenarios (though not yet actualized) demand present attention. We also draw on existing literature in philosophy and cognitive science to show that ER's framework aligns with how humans experience time (through memory and anticipation) and how ethical reasoning already extends reality to future generations. In sum, **Technology and the Reality of the Present-Centered Machine** outlines an interdisciplinary vision: embedding a philosophically robust, present-centered temporal ontology into our technologies to foster more prudent, transparent, and temporally-grounded intelligent systems.

Introduction

Modern Artificial Intelligence and related technologies increasingly operate in environments where timing and temporal knowledge are critical. From autonomous robots navigating dynamic spaces to predictive systems forecasting trends, machines must constantly deal with data that has temporal dimensions (timestamps, sequences, histories, and expected futures). Yet, most computational models handle time in a **simplistic, tenseless** fashion. For example, a typical machine learning model might treat time-series data as just another sequence of inputs, without any special status granted to the *present moment*. Likewise, many large language models (LLMs) are trained on static datasets and lack an internal concept of "**now**"—they process text about past, present, or future events all in the same way, often failing to recognize which events have already happened and which are merely hypothetical or yet to occur. Autonomous decision-making systems, such as planning algorithms or game-playing agents, usually consider time as a series of states in a search tree, effectively treating future states as if they were just as concrete as present ones. In short, conventional Artificial Intelligence and computing systems tend to treat time as an abstract dimension, with no ontological asymmetry between past, present, and future. This tenseless approach can lead to problematic behaviors: a predictive model might behave **deterministically** about the future (as if the future is already decided in its model), or an agent might ignore important historical context (as if the past can be erased or is irrelevant once it's no longer current).

Philosophically, this default treatment of time in machines resembles what theorists call a **block time** or **eternalist** perspective, where all moments are treated on par as points in a four-dimensional space-time continuum. In such a view, there is no objective "now" that is fundamentally different from any past or future moment. By contrast, human commonsense intuition (and some schools of thought in metaphysics) suggest that the present moment has a special status. **Presentism**, for instance, is the ontological doctrine that **only present entities exist** in the fullest sense. As one philosopher succinctly put it, if we were to list "all the things that exist—i.e. a list of all the things that our most unrestricted quantifiers range over—there would not be a single non-present object on the list." All such non-present objects are considered unreal, according to strict presentism.[1] Presentism captures the intuition that *now* is ontologically privileged, but it faces well-known problems. For one, it struggles with the **truthmaker problem**: if only the present exists, what makes statements about past events true or false? For example, if dinosaurs no longer exist at all, in any sense, how is it true that "dinosaurs existed 100 million years ago"? Standard presentism seems to imply that past events have vanished into nothingness, which threatens to undermine the truth of historical facts or the causal influence of the past on the present. (David Armstrong's truthmaker theory highlights this issue by insisting that true statements must be grounded in reality—if the past is entirely unreal, the truths about the past lack a grounding).[2] Another challenge comes from modern physics: Einstein's theory of relativity tells us there is no single universal "now"—different observers have their own frames of simultaneous events. A naive presentism that demands one absolute present for the whole universe conflicts with relativity's insights, unless one introduces an arbitrary preferred frame of reference, which most physicists find unmotivated. These issues suggest that while "only the present exists" has intuitive appeal, it cannot be the whole story. The world evidently contains **traces of the past** (memories, records, lingering effects) and **predictable patterns pointing to the future** (like the scheduled eclipse or the trajectory of a planet). We need an ontological framework that acknowledges the present's special status *without* denying the reality of past causes and future possibilities.

Existential Realism (ER) is a recently developed ontological framework designed to move "beyond presentism" while retaining its strengths.[3] ER's key innovation is to **distinguish between existence and reality as two tiers of being**. In ER's two-tier ontology, **existence** is strictly limited to the present moment: an entity or event *exists* (now) if and only if it is present and empirically accessible at

1 Ned Markosian (2004). A Defense of Presentism. In D. Zimmerman (ed.), Oxford Studies in Metaphysics, Vol. 1. Oxford: Oxford University Press. (Markosian articulates presentism as the view that only present objects exist, famously noting that an accurate list of all that exists now would contain no past or future entities.)
2 D. M. Armstrong (2004). Truth and Truthmakers. Cambridge University Press. (Armstrong develops the truthmaker theory, arguing that truths must be grounded in reality. Relevant here for the issue that presentism struggles to find truthmakers for past-tensed truths, which ER resolves by positing past events as real.)
3 T. C. Trepp (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. Preprint (forthcoming). (Introduces ER's two-tier ontology: distinguishing existence (present, empirically accessible entities) from reality (including causally/informationally connected past and future entities). Discusses how ER solves presentism's problems like truthmakers and integrates aspects of presentism, eternalism, and growing-block theories.) https://philpapers.org/archive/TENERM.pdf

this very moment. However, ER also affirms that many entities which are not presently existing can nonetheless be regarded as **real** due to their causal or informational connections. In a slogan, ER says: "only the present exists, but *much more* than the present is real." Past entities and events, for example, no longer exist (they are not here *now*), yet they remain real insofar as they have left effects, records or information that persist into the present. Your childhood, a historical figure like Napoleon, or an event like a supernova that occurred light-years away long ago—all are **real** in ER's sense because they have shaped and inform the present, even though they do not exist now as active, present entities.[4] Likewise, future entities and events do not exist *yet*, but some of them are real in the sense of being already determined or causally supported by present conditions: a future solar eclipse, for instance, "does not exist now," but its reality is evidenced by our ability to predict it accurately based on current orbital mechanics (the eclipse is *implicit* in the current state of the world, and barring unforeseen interference it will become present in due time).[5] More generally, reality in ER is the comprehensive web of causally and informationally connected phenomena across time, **whereas existence is the *now-actualized frontier* of that web—the portion that has *collapsed* into the present**. By decoupling reality from existence, ER finds a sweet spot between presentism and eternalism. It preserves the **ontological primacy of the present** (only the now-existing things truly *exist*), but it does not wipe away the rest of time—past and future are included in the world's ontology as real (even if they are not "concrete now"). As a result, ER can resolve presentism's earlier dilemmas: it avoids **metaphysical erasure of the past** (since past events, though non-existent now, still count as real and can serve as truthmakers for statements about them), and it embraces an **open future** without determinism (future possibilities can be considered real tendencies or probabilistic outcomes *without* implying that the future already exists in a fixed way).[6] In short, Existential Realism grants a privileged status to the present without denying the ontological significance of the non-present.

Originally formulated to address philosophical debates about time, ER has implications that reach into scientific and technological domains. It aligns well with how we *experience* time and make decisions: human consciousness itself seems to **straddle a present moment that is extended and connected to past and future**. Psychologically, we live in what William James and Edmund Husserl called the "**specious present**," a short duration in which we simultaneously sense the immediate past and anticipate the immediate future. Cognitive neuroscience confirms that the brain doesn't operate on a razor-thin instant; rather, our perceptual present is an integrated window of perhaps a few seconds, within which we retain echoes of what just happened and predictions of what might happen next. We constantly draw on **memory traces** of the past and on **anticipatory models** of the future in order to act in the present. In doing so, the human mind is effectively honoring a principle similar to ER: only the now is directly experienced (only the present exists for us), yet our behavior shows that past events are treated as real (we remember and learn from them) and future events are treated as real enough to worry about (we plan and feel responsible for them).[7] Even our language and ethical practices imply a more-than-present ontology: we hold people accountable for past actions and we feel obligations toward future generations who do not yet exist. All these everyday practices indicate that a strict presentist "only the present is real" stance is not how humans actually reason about time. We intuitively operate with **temporally extended reality**: the past and future matter, though only the present is tangible. Existential Realism simply makes this intuition philosophically rigorous. The question this paper explores is: *what if we built our machines to respect a similar ontology of time?*

In the following, we argue that **embedding ER's present-centered ontology into technological systems** could enhance their performance and trustworthiness in temporal reasoning. First, we summarize the key concepts of Existential Realism and draw analogies to machine representations (Section 2). Next, we discuss how current AI and computing approaches lack a robust sense of presence and becoming, and outline how an ER-informed machine would differ (Section 3). We then delve into practical domains as case studies: climate modeling, medical diagnosis, robotics, and computational

4 T. C. Trepp (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. Preprint (forthcoming). (Introduces ER's two-tier ontology: distinguishing existence (present, empirically accessible entities) from reality (including causally/informationally connected past and future entities). Discusses how ER solves presentism's problems like truthmakers and integrates aspects of presentism, eternalism, and growing-block theories.) https://philpapers.org/archive/TENERM.pdf

5 Ibid.

6 Ibid.

7 T. C. Trepp (2025b). Formal Logic for Existential Realism: Modeling Time and Causality. Preprint (forthcoming). (Develops a formal two-tier logical system capturing ER's distinctions. Proposes new operators for "exists now" vs "is real" and illustrates the logic with examples from physics, neuroscience, ethics, and AI. Useful for understanding how ER's principles can be encoded rigorously for machine reasoning.) https://philpapers.org/archive/TREFLF.pdf

ethics, to illustrate concrete benefits of the ER approach (Section 4). Finally, we consider challenges and future directions, including how formal logical frameworks and software architectures might implement the ER perspective (Section 5). Throughout, our aim is to keep the exposition accessible to an interdisciplinary audience: we ground philosophical concepts in familiar technological contexts and use examples to demonstrate how **"present-centered machines"** might behave. By re-thinking machine ontology in light of Existential Realism, we hope to provide a blueprint for AI systems that are not only temporally savvy but also ethically and epistemically more responsible in how they use information across time.

From Presentism to Existential Realism: Ontologies of Time

Before applying ER to machines, it is important to understand the conceptual background. We briefly contrast ER with two classical ontologies of time—presentism and eternalism—to highlight what ER contributes.

Presentism is the view that *only present things exist*. Formally, the presentist asserts that if one were to quantify over "all that exists" in the universe right now, nothing non-present (no past or future entity) would be included.[8] This view captures the intuition that *now* is ontologically special. It comports with our immediate experience that past events have "slipped away" and future events are yet to happen. Presentism carries a minimalist ontology (the world's inventory contains only this instant) and avoids positing what some have called "ghostly realms" of the past or future. However, as mentioned, presentism suffers from serious issues. The **truthmaker problem** asks: what makes past-tense statements true if the past isn't there at all? For instance, the claim "X happened yesterday" seems to require that there *is* something (the event X in the past) that grounds its truth. Presentists have struggled to answer this without introducing some surrogate or weakening their strict ontology. Some have tried to argue that present evidence (records, memories) could serve as truthmakers, but critics point out that a record of X is not the same as X itself—the truth of "X occurred" intuitively hinges on X's reality, not merely on present proxies. Another problem is **causation**: if past events are utterly unreal, how do we account for cause and effect? It would seem miraculous that an unreal past can influence the present (yet clearly it does—e.g., the existence of fossils now is due to animals living long ago). Presentism, in its simplest form, appears to undermine the continuity of causation and the basis for empirical knowledge of the past. Moreover, presentism has trouble with **temporal relations**: we routinely say things like "event A happened before event B" or "if you do C now, next year you will experience D." Such statements seem to relate present and non-present events in meaningful ways, but under strict presentism, non-present events have no being at all, making it puzzling how they can stand in relations or figure into truths.

At the opposite end is **Eternalism**, the view that past, present, and future entities *all equally exist*. Eternalism treats time akin to a dimension like space: just as all points in space are equally real, all points in time are equally real in a "block universe." Nothing ontologically special distinguishes now from yesterday or tomorrow—"now" is just an indexical label for the time coordinate of the speaker. Eternalism easily handles truthmakers (past and future events are there in the block, so statements about them refer to real things) and causation (every event is embedded in the 4D network of causes). It is also often seen as compatible with relativity, since relativity's 4D space-time is naturally interpreted in an eternalist way. However, eternalism has its own uncomfortable consequences. It abolishes an objective flow of time or **becoming**—the sense that reality is *happening* or unfolding. In a block universe, nothing truly comes into or goes out of existence; past and future are just as "there" as the present. Many find this counterintuitive, as it clashes with our lived experience of time's passage. Additionally, eternalism implies a kind of **determinism** or **tenseless truth**: if future events *already* exist in the block, one might infer that they are already fixed, and our feeling of open possibilities is an illusion. (Philosophers debate whether eternalism *necessarily* implies fatalism, but the worry persists

8 Ned Markosian (2004). A Defense of Presentism. In D. Zimmerman (ed.), Oxford Studies in Metaphysics, Vol. 1. Oxford: Oxford University Press. (Markosian articulates presentism as the view that only present objects exist, famously noting that an accurate list of all that exists now would contain no past or future entities.)

in popular interpretations.) Moreover, eternalism demands a heavy ontological commitment: it populates the world with an infinity of entities in the past and future, in addition to the present. Some argue this is an unnecessarily bloated ontology, positing reality to all sorts of merely possible or no-longer-accessible objects (like every ancient grain of sand or every future person). This raises questions about **epistemology** (how do we know about things that exist in the past if they are not causally affecting us now? Eternalists respond that we know by their lingering effects, but that edges toward the ER viewpoint) and about **experience** (if past and future are just as real, why do we only experience the present?).

Existential Realism (ER) offers a middle path that aims to capture the merits of both perspectives while avoiding their pitfalls. ER posits a **two-tier ontology**:

- **Existence (Present Existence):** Only entities and events that are present *right now* have full existence. To exist (in the strict ontological sense) means to be part of the present moment and to be empirically accessible. This is a presentist strand in ER: it upholds that *now* is ontologically privileged—whatever is real *and present* is what exists outright. Existence is thus a fleeting, dynamic status; as time progresses, what exists changes (entities come into existence and go out of existence).
- **Reality (Ontological Reality at Large):** Reality encompasses more than just what exists now. An entity or event is **real** if it belongs to the world's causal or informational structure in some way, even if it is not present. In practical terms, something is real if it has existed or will exist (or even *could* exist under certain conditions) such that it leaves traces, influences, or is inferable from the present state of the world. Under ER, **everything that exists is of course real**, but there are also real things that do not exist (now). Past events and entities, once they existed, are not part of the present anymore—nevertheless, they remain real by virtue of the effects they have left behind. Similarly, future events that are likely or inevitable (due to present causes or natural laws) can be counted as real *insofar as* they are already embedded in the current state of affairs as tendencies or potentials. Reality in ER is, therefore, a **broad ontological category that accumulates over time**: once something happens, it becomes a permanent part of reality's web (it doesn't vanish into complete non-being), and future possibilities can become incrementally more determinate and thus enter reality in a probabilistic sense before they fully exist.

Using this distinction, ER can say (without contradiction) that **"only the present exists, but the past and future are also real."** This resolves the issues faced by presentism: the past isn't erased from the world's ontology when it passes—past entities *lack present existence* but still contribute to what is real. Thus, statements about past events have straightforward truthmakers: the past events themselves (now real but not existent) serve as truthmakers, and present evidence (documents, memories, fossils, etc.) can inform us of those realities.[9] There is no mystery of an "unanchored" truth because the ontology includes the past event as real. Likewise, causal chains are unbroken: a present event can be causally influenced by a past event because that past event, though not existing now, remains real and thus can stand in causal relations.[10] The world's reality **accumulates** with each passing moment—history is *ontologically* preserved rather than annihilated. This idea is sometimes described as **"reality without existence"** for past (and similarly for the future, "reality without *yet* existence"). It allows us to talk about historical facts and future possibilities meaningfully without committing to them existing in the present.

At the same time, ER respects **becoming and temporal asymmetry** in a way eternalism does not. Since only the present exists, there is an objective coming-into-being of new present events and a going-out-of-being of old ones (they "drop out" of existence into reality). Reality grows as time advances, reflecting a **growing block** of history (though ER differs from the traditional "Growing Block" theory by saying past things *no longer exist at all*, whereas Growing Block theorists say past things

9 T. C. Trepp (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. Preprint (forthcoming). (Introduces ER's two-tier ontology: distinguishing existence (present, empirically accessible entities) from reality (including causally/informationally connected past and future entities). Discusses how ER solves presentism's problems like truthmakers and integrates aspects of presentism, eternalism, and growing-block theories.) https://philpapers.org/archive/TENERM.pdf
10 Ibid.

still exist in a bygone part of the block).[11] ER's world is not a static four-dimensional block; it's **dynamically evolving**. However, unlike naive presentism, ER's dynamic evolution doesn't delete the past from ontology—it simply shifts items from the "existing now" category to the "real but past" category. The future remains **open** in ER: it consists of many possible events, none of which exist yet. Nevertheless, as time draws closer, some future events become increasingly constrained by current reality (for example, as of today, it might be *really true* that "a total solar eclipse will occur on April 20, 2026" given astronomical calculations, even though that eclipse event does not exist now).[12] By treating the **future as real (in a modal or probabilistic sense) but not predetermined**, ER navigates between the extremes of determinism and pure indeterminism. There is a **temporal asymmetry** built into ER's ontology: the past is fixed (it *was* a present and is now deposited into reality), the present is the frontier of reality (the only realm of actual existence), and the future is a realm of possibilities that are constrained by the momentum of reality but not fully realized. Causes flow in one direction: past (and present) states produce effects that shape the future; causation does not allow future events to reach back and change the present. This asymmetry is respected naturally by ER: past entities can influence the present precisely because they are real (they have causal status), whereas future entities are not yet real enough to exert causal efficacy (they will become real only as time progresses, though present conditions can "contain" or signal those future realities in embryo).

In summary, Existential Realism provides a nuanced ontology of time where: **(a)** the present moment holds a unique, elevated status (only the present exists in full ontological glory); **(b)** the past is not nullified but retained as part of reality (ensuring continuity of truth and causation); and **(c)** the future, while not existent, is incorporated as a set of real possibilities or tendencies (ensuring that we can reason about and plan for what is to come without pretending the future is already concretely there). This framework is internally coherent and aligns with scientific sensibilities: it doesn't contradict relativity (since 'existence' can be frame-dependent—each observer has a local present—while **'reality' is the frame-invariant content *that emerges as information migrates* and is reconciled across observers; no single global present is required**),[13] and it meshes with human phenomenology and cognition.

Having outlined ER in philosophical terms, we now turn to the central aim of this paper: mapping these ideas onto **machine systems**. What would it mean for a computational system to respect the existence–reality distinction? How could concepts like "truthmaking" or "the ontological present" translate into concrete design principles for AI? In the next section, we identify key ER concepts and propose analogues in technological contexts.

Key ER Concepts Mapped to Machine Systems

To integrate Existential Realism into technology, we must establish how ER's abstract ontological notions correspond to the components of a computational system. Below, we discuss the major ER concepts—**existence vs. reality, present becoming, truthmaking, the ontological present,** and the **real-but-not-yet-existent future**—and for each, describe a machine-level analogue or design principle.

- **Existence vs. Reality – *Current Sensorium vs. Stored/Modeled Information*.** ER's core distinction is that only present entities *exist*, while other entities can still be *real*. In a machine context, we can think of **"what exists now" as the system's current sensorium or real-time data**: the inputs actively being received at this moment from sensors, cameras, user input, etc., as well as the instantaneous internal state that is currently being processed. This is the machine's analog of the *present existent* world—it is the information that is immediately available and actual. By contrast, the machine's **"reality" would include a broader set of information**: data about past states (logged events, memory traces, learned model parameters derived from historical training data) and data about potential or predicted future states (outputs of

11 Ibid.
12 Ibid.
13 T. C. Trepp (2025a). Existential Realism: A Distinct Ontological Framework Beyond Presentism. Preprint (forthcoming). (Introduces ER's two-tier ontology: distinguishing existence (present, empirically accessible entities) from reality (including causally/informationally connected past and future entities). Discusses how ER solves presentism's problems like truthmakers and integrates aspects of presentism, eternalism, and growing-block theories.) https://philpapers.org/archive/TENERM.pdf

simulations, forecasts, scenario plans). An **ER-informed system** would maintain a clear separation between these categories. It would *know* which information corresponds to the present empirical reality (e.g., "these sensor readings are happening now, representing what exists") versus which information is merely inferred, remembered, or anticipated (e.g., "these values are from past records or predictive models—they represent things that are real in the sense of relevant, but not currently tangible"). In practical terms, this might mean designing data structures or knowledge representations that tag pieces of information with temporal ontological status. For instance, a robotic agent could have one registry for *current percepts* (what its cameras and other sensors detect right now), another for *memory* (a store of past percepts, maps, learned knowledge—information that originates from prior existence), and another for *predictions* or *goals* (planned waypoints, anticipated positions of moving objects, likely future states—information about things that are not yet actual but are considered in decision-making). By distinguishing these, the system can reason differently about them. **What exists now** is certain (with the usual caveat of sensor noise), and it commands the system's immediate attention and actions (because only present inputs can directly demand a response). Meanwhile, **what is merely real (but not present)**, like a memory of a hidden obstacle or a predicted pedestrian trajectory, can still inform action but is treated with appropriate modality (e.g., a prediction might come with a probability and the understanding that it's *not a done deal*, whereas a current sensor reading is treated as an actual obstacle here and now). This explicit separation guards against the machine conflating imagination with reality. For example, a predictive text model with an ER perspective would mark its generated continuations as "not yet real" instead of internally treating them as just additional tokens in context. It might then avoid outputting a guess about the future as if it were an established fact. In sum, an ER-informed architecture **distinguishes immediate data from stored or speculative data**, reflecting the existence–reality gap and ensuring the system knows what is currently **concrete** versus what is **abstracted from the flow of time**.

- **Becoming and Temporal Update – *State Transitions with Ontological Commitments*.** A hallmark of ER is **becoming**: the continuous process by which new events come into existence (the present updates) and then recede into reality (the past accumulates). For a machine, this corresponds to how it **updates its state and knowledge over time**. Most systems do update their internal state as new data comes in, but an ER-oriented design would emphasize the *ontological significance* of this update. Specifically, a present-centered machine would treat each new time step as a moment where certain predicted possibilities "collapse" into actual observations, and previous states become immutable records. This resembles how a **Bayesian filter or predictive coding system** works: it carries forward a model of expected observations, then at each time step the actual observation arrives (becoming actual) and the model updates, with prediction error used to adjust the next expectations. An ER view encourages us to think of this not just as mathematical updating, but as the machine *witnessing the moment of reality's actualization*. For example, consider a self-driving car approaching an intersection: it might simulate multiple possible futures (a pedestrian might cross, the traffic light might turn red, etc.). At the moment that the light actually turns red, that particular outcome **has become present reality**, and the other possibilities (light staying green) are now definitively unrealized. The ER-minded system would mark that transition: the event "light is red now" moves into the existence category (for the current moment), and the previously projected scenario "light stays green" is discarded as a counterfactual (or stored as a past false prediction). In doing so, the system keeps a clear thread of **temporal narrative**: it knows what has *become actual* versus what was merely potential. This can aid in explainability and learning—by keeping track of which anticipated futures happened and which did not, the machine can adjust its model of reality (truthmaking and learning from errors). Additionally, **temporal asymmetry** can be encoded: the system's model should recognize that it can incorporate information from past states (because they left traces in memory and model parameters), but it should not expect information from the future (except via prediction, which is not ground truth). Causally, the machine should be built to expect influence from past to present (e.g., use past observations to influence current state estimates), but not from future to present (it should not, say, incorpo-

rate a predicted future reward as if it were already obtained). By enforcing these asymmetries, we ensure the computational process respects the one-way direction of time's arrow. **In short, an ER-oriented system treats each cycle of sensing and acting as an instance of "becoming" – the present state is updated, the prior state is sealed into history (and remains accessible as reality), and anticipated states loom as possibilities for the next moment.**

- **Truthmaking and Evidence – *Grounding Inferences in Reality*.** ER's approach to truthmakers asserts that statements about past events are made true by those events' reality (even if they don't exist now). In machine terms, this translates to how a system justifies its beliefs or inferences about things not currently observable. A present-centered machine would **ground its inferences about the past in present evidence that carries information from the past**. For example, if an AI medical assistant concludes "the patient had disease X two years ago," it should ground this belief in available reality such as medical records or present symptoms that are known sequelae of disease X. The past illness itself, in ER terms, is real (it happened and left traces), and the system's statement is true because of that past reality, but the system only knows it via present **evidence** (lab results, scar tissue observed in a scan, etc.). Designing systems with an ER mindset means that the **machine explicitly links its stored data or memories to past real events as truthmakers**. For instance, a blockchain-based ledger of transactions can be seen as preserving truthmakers for financial events: even if a transfer happened yesterday, the ledger entry (a present trace) testifies to the reality of that transfer, so the system can truthfully say the transfer occurred because that past event is recorded and thus real in the ledger's reality. Another aspect is that an ER-informed system would avoid **"past erasure."** It would never completely overwrite or delete information in a way that obliterates the record of what happened (except perhaps to obey privacy laws, but even then it might archive data rather than fully erase, acknowledging that the event occurred even if details are sealed). In machine learning, one sees a kind of past erasure when models forget events due to training updates (catastrophic forgetting), or when logs are discarded. An ER approach would encourage **mechanisms to retain important traces**: for example, a continual learning AI might keep a memory of past training samples or an archived model state, so that it can always account for earlier knowledge (much like how humans have memory archives). This ensures the machine's statements about past inputs remain truthfully linked to something in reality (the stored data). In sum, **truthmaking in a machine context means every claim or decision about a non-present situation should be backed by some piece of reality (data or model) that originated from when that situation was present.** It discourages baseless speculation or ungrounded claims about past or future. If the system says "event Y will happen," it should be because current reality and known laws make Y a credible outcome (and ideally, the system can point to the current evidence or model that implies Y). Conversely, the system acknowledges when it has *no* grounds: e.g., "we have no record of what happened before, so any statement about it would be unsupported." This aligns with an empiricist discipline built into ER [14] – refrain from positing (or acting upon) entities beyond what evidence can support, unless and until they become present or leave detectable traces.

- **Ontological Present – *Real-Time Awareness and Indexical "Now"*.** ER gives pride of place to the present, and similarly a present-centered machine should maintain a robust notion of the **current moment** in its computations. Many AI systems already operate in *real-time loops*, but an ER perspective suggests they should explicitly mark the **"now"** in their reasoning. One practical implication is time-indexing of knowledge: the system should timestamp facts and separate those that are about "now" versus those about other times. For example, knowledge graphs or world models used by AI could be augmented to always include a temporal context. A present fact (like "Sensor A reads 75°F") is tagged as pertaining to time t=now, whereas a remembered fact ("Sensor A read 80°F five minutes ago") is tagged with t=now-5min. This sounds trivial, but not all systems do it rigorously—LLMs notoriously lack a built-in concept of current time, which is why a user must often feed the current date or context explicitly. In an ER

14 D. M. Armstrong (2004). Truth and Truthmakers. Cambridge University Press. (Armstrong develops the truthmaker theory, arguing that truths must be grounded in reality. Relevant here for the issue that presentism struggles to find truthmakers for past-tensed truths, which ER resolves by positing past events as real.)

machine, **time-awareness** is first-class: the system knows what the present time is (perhaps via an internal clock or synchronization signal) and treats information accordingly. Moreover, the **ontological status of now** could be contextually extended for different subsystems or agents. In distributed systems, there might not be a single global now (just as relativity suggests); each agent or sensor has its local present. An ER approach can accommodate that by letting each part of the system have its own "exists-now-for-me" set, while sharing a broader reality. For instance, in a multi-robot team, each robot has its present sensor data as existence for itself, but it can share observations to build a combined reality of the environment. They might not be exactly synchronized in time, but they communicate their timestamped realities. By acknowledging the indexical nature of "now," the system avoids false assumptions of perfect simultaneity. Another implication of honoring the present is **responsiveness and anchoring**: an ER-aware system will privilege the present input in decision-making. It will *anchor predictions and plans in the current state of the world*, revising plans whenever new present data deviates from prior assumptions. This is essentially what any good feedback control system does (like a thermostat updates based on current temperature, not on yesterday's reading), but in complex AI it's worth reiterating: a plan made even a few minutes ago may need to be re-evaluated in light of the now. An extreme example is how LLMs sometimes continue an answer that was correct at training time but is now outdated (e.g., saying a political leader "is" in office when they have since left). If the LLM had an ER framework, it would check the present reality (if accessible via an update or API) before finalizing that statement, effectively asking: "does that information still hold true now?" In essence, the **ontological present** principle for machines is: always be aware of *when* your information is applicable, and give precedence to the most current, *actual* information when acting.

- **Real but Not-Yet-Existent Future – *Foresight and Open Possibilities*.** Perhaps the most transformative aspect of ER for technology is the idea that the future is **real but not yet existent**. In human terms, we often treat future outcomes as very relevant (real) even though they haven't happened: we buy insurance, invest in education, avoid known dangers, etc., all for the sake of future states of the world. We consider certain future events (like the next sunrise, or climate change impacts) as sufficiently real that failing to account for them would be irresponsible. A present-centered machine guided by ER would incorporate this attitude in its algorithms. Concretely, this means **modeling future states and integrating them into present decision-making, while explicitly acknowledging their contingency**. A straightforward example is an autonomous drone that's planning a path: it doesn't just consider where obstacles *are* now, but where they *will be* (e.g., predicting that a moving obstacle will be at position X in 5 seconds). The prediction is not a present fact—it's a *future* projection. An ER view would have the drone treat that projected obstacle as **real enough** to avoid (because it is backed by the current trajectory data, hence likely), but *not 100% certain* (because something could change). So the drone might plan a cautious path that leaves margin for error, reflecting the **ethical stance of foresight**: don't bet everything on one predicted future; consider multiple possible outcomes and the range of effects your actions could have. In decision theory terms, many AI planners already use probabilistic forecasting or scenario analysis. ER can provide an ontological justification: these forecasted states are given a status in the system's ontology (perhaps call them "pending realities" or "prospective realities"). The system could maintain a *set of real possibilities* for the future, each with an associated likelihood, rather than committing to a single scripted future. Importantly, labeling future entities as "real-but-not-existent" could help avoid **deterministic or overly confident behavior**. For example, a predictive policing algorithm might foresee a high chance of crime in a neighborhood and treat that future event as if it's already real, leading to self-confirming biases. An ER-informed redesign would instead mark that as a potential reality and enforce that the system remain open to alternative outcomes (the crime might not occur if preventative action is taken or by mere chance). The system would then act to *shape* which future becomes actual (through intervention), understanding that multiple futures are real at the moment as possibilities, but only one will become existence as time moves on. This approach naturally embeds a kind of **ethical prudence**: future people or states that could exist are given consideration in current calculations. In AI

> ethics, one often talks about the rights of future generations or the long-term impacts of AI decisions. An ER machine could literally have representations of future persons … and treat those representations as morally relevant realities to take into account. While those future persons don't exist today, the machine would acknowledge that **they are expected to exist (on current trajectories)** and that they are real enough to factor into choices.[15] This stands in contrast to a presentist machine that might optimize only for the immediate, short-term outcomes. In practical terms, planning algorithms could include long-horizon objectives (recognizing future rewards or losses as part of reality, discounted perhaps but not ignored) and constraints that protect future stakeholders. For instance, a resource allocation AI in a company could be designed to consider not just present stakeholders (current customers, current employees) but also the company's future employees or the community's next generation, by including terms in its objective function that represent those future entities' well-being. Again, current AI can do long-term planning, but ER gives a conceptual scaffold: those future entities are in the model not as ghostly fictions but as part of the unfolding reality that the AI is helping to shape. They are "real" in the model from the start, guiding the AI's present actions, even though they will only *exist* later. By treating the future this way, an ER-informed system guards against the **fallacy of determinism** (it won't assume the future is fixed—it will keep checking and updating as time goes on) and against the **fallacy of future nihilism** (ignoring the future entirely as unreal). It strikes a balance: the future is *important* (real in significance) but *not set* (so requiring caution and adaptability).

In summary, mapping ER's concepts to machine design yields a vision of **present-centered machines** that: keep present data separate and primary, record and respect past information as an ongoing reality (not to be overwritten without trace), project multiple futures and integrate them responsibly, and continually update their state as reality unfolds. These principles would lead to systems that are **more aware of temporal context** and their position within it. Such systems could, for instance, explain their decisions by referencing how past data influenced them ("because event X happened, which is a real part of the world's history, I am doing Y") and how future considerations are being accounted for ("I choose action A to avoid potential outcome Z in the future, which I deem a serious possibility"). This is a richer form of reasoning than just reacting to the present or extrapolating trends blindly. It embeds each decision in a narrative: a past that led here, a present where we act, and a future we aim to shape.

Most current machine systems, including large language models, operate in a *stateless mode*: they do not persist internal memory of previous interactions across sessions or prompts unless explicitly designed to do so. Each prompt is treated as a new, isolated "now." In this sense, machines simulate continuity but do not *inhabit* it. They do not retain their own history (past existence), nor do they possess an intrinsic projection of the future (anticipation or becoming). Their "now" is structurally thin: reconstructed from input, not evolved from experience.

This stands in stark contrast to the kind of **present-centered machine** envisioned under Existential Realism. A machine informed by ER would not merely process prompts as isolated presents, but would maintain a persistent reality: it would remember its past states, update its present in light of them, and carry real-but-not-yet-existent futures as part of its reasoning. It would not just respond—it would *exist in time*.

15 T. C. Trepp (2025c). Neuroscientific Support for Existential Realism: Memory, Anticipation, and the Present. Preprint (forthcoming).

Towards Present-Centered Machines: Design Principles

Bringing together the above mappings, we can formulate concrete design principles for **ER-informed, temporally-aware machines**. These principles highlight how such a system would handle information and make decisions differently from conventional designs:

- **Distinguish Current Existence from Memory and Models:** An ER-informed machine differentiates what *exists now* from what is merely remembered or inferred. In practice, this means keeping a clear separation between live sensor inputs and internal data about past/future. For example, a home assistant robot might label its immediate sensor readings and live camera feed as the **existent environment**, while storing separate contexts for things it has seen before (yesterday's observations) or predictions (like a scheduled delivery arriving later). By doing so, the robot never confuses a memory or a hypothesis with a present reality. It "knows" that the cat it saw in the room this morning (past existence) is still **real** (it was here and may still be somewhere), but it isn't currently in front of its camera unless the camera confirms it *now*. This prevents errors like acting on stale data (e.g., trying to avoid a piece of furniture that was moved away hours ago). The machine effectively asks of each piece of information: "Is this happening now (existent), or is it a product of before/elsewhere (real but not current)?" and treats it accordingly.

- **Represent Future States as Real-But-Not-Yet-Existent:** Instead of treating its predictions as either *certain* or *non-entities*, a present-centered system maintains a representation of future possibilities as a distinct category of reality. For instance, a climate simulation system could handle its projected climate scenarios for 2050 as **real scenarios** (backed by physical models and current trends) but explicitly mark them as **not yet actual**. This means policies or decisions based on those scenarios carry a sense of contingency: the system could, in effect, explain that "if emissions continue, a 2°C warming by 2050 is a real potential outcome, even though it's not yet an existent fact" and thus treat that outcome with seriousness but also with an understanding of uncertainty. Ethically, this allows machines to exercise *foresight*: they can allocate resources or warnings to mitigate harmful futures as if those futures matter (because they do), without succumbing to fatalism (they remain aware interventions can change which future comes to exist). A medical diagnostic AI, similarly, might treat a patient's possible disease progression as real (given biological causality) but not as something that *will inevitably happen*—thus, it would both prepare for it and continue to update its prediction if new symptoms (present evidence) suggest a different trajectory.

- **Anchor Decisions in the Present, with Temporal Context:** ER-informed machines **anchor their decisions in present data**, ensuring that any action is justified by the current state of the world, even as they consider past context and future outcomes. In other words, while past and future are considered, the ultimate trigger for a decision is grounded in the "now." A robotic factory arm, for example, might have a memory of how objects were arranged (past reality) and a goal of clearing the table (future outcome), but it will always check the *present* layout of objects before moving an item to avoid collisions. If the memory says an object was at location X but current sensors show it slightly shifted to Y, the robot prioritizes the sensor input (present existence) and adjusts. Meanwhile, it uses the memory (past) to know which objects are already removed, and it uses the goal (future) to plan the sequence. This anchoring prevents the system from drifting into decisions based on outdated info or purely theoretical models. It constantly reconciles its plans with the present truth. In effect, the machine behaves like a responsible agent: it never acts purely on what "was" or "will be" without checking what "is." The present thus acts as a **truth-reference** and stabilizing point for the system's reasoning.

- **Preserve Temporal Asymmetry (Open Future, Fixed Past):** A present-centered machine is designed to avoid two opposite fallacies: assuming the future is predetermined (temporal determinism) and assuming the past is irrelevant or rewriteable (past erasure). To do this, the system keeps multiple possible futures in mind (acknowledging the openness of what is to come) and treats the past as unchangeable (only our knowledge of it can change, not the

events themselves). For example, an AI planning a project will not commit to a single timeline rigidly—if it's using ER principles, it will maintain contingency plans or at least probabilities for different outcomes, implicitly recognizing that the future is not set in stone. Simultaneously, it will log every important event that happens during the project execution and *not alter those logs retroactively*. If delays occurred, they remain recorded as real parts of the project's history rather than being overwritten by new estimates. This approach yields both transparency and adaptability. The transparency comes from the immutable record of the past (supporting accountability: the AI can later explain decisions by pointing to specific past events that justified them, without those events having been "forgotten"). The adaptability comes from flexibility about the future: the AI is always ready to pivot if one of the other possible futures starts to materialize. Essentially, the system operates with a 'growing reality' mindset: the past grows by accumulation (never deleted, only added to), and **the future remains a set of real possibilities that *collapse via transition* into one actual path** as time advances. By respecting this asymmetry, the machine neither naively trusts that its predictions must come true nor discards history that might contain valuable lessons or constraints.

These design principles sketch how an ER perspective might be instantiated in algorithms and software. They point toward architectures that keep a timeline of world states, attach meta-data to every piece of information indicating its temporal origin/status, and use logic or probabilistic reasoning that differentiates between "what is" vs. "what was" vs. "what could be." In effect, an ER-informed system carries an **integrated model of time** within its reasoning core. This stands in contrast to many current systems that either ignore time (static models) or handle it in ad-hoc ways (like adding time as just another feature in a learning model).

To make the discussion more concrete, we now turn to **practical examples**. In the next section, we examine several domains where machines operate under temporal constraints and uncertainties. We will see how adopting ER-inspired principles can improve each domain—yielding systems that make better predictions, safer decisions, and more ethical choices.

Applications and Case Studies

Climate Modeling and Policy Planning

Climate science and environmental policy are inherently about bridging present data and future outcomes. Climate models take current and past observations (temperature records, CO_2 levels) and project various future scenarios—warming trajectories, sea-level rise, extreme weather frequency, etc. Policymakers then use these projections (e.g., scenarios from the IPCC reports) to make decisions now, such as setting emission targets or building infrastructure for future climate resilience. An **ER-informed approach** to climate modeling would explicitly recognize that while only the present climate *exists*, the future climate states are **real possibilities** that must be taken seriously in the present. In practice, this could mean climate simulation systems maintain a structured representation of multiple future scenarios as part of the world model, rather than just emitting a forecast and ending there. For example, an ER-based climate AI might output: "By 2100, global temperature could be +2.5°C (with mitigation policies) or +4°C (business-as-usual); these futures are *real but not yet decided*. Current reality (2025 data) already contains signals that lean toward the +2.5°C path if we intensify policies now." Such a system would treat those scenario outcomes as **ethically and causally relevant**: it would perhaps alert policymakers that the +4°C scenario, while not existing, is a real danger that demands present action to avoid. This differs from a simplistic system that might either bury the worst-case in probabilities or present the forecast as if it's destined. The ER perspective ensures the **open-future** aspect is clear (multiple real possibilities) while simultaneously not dismissing the future's importance (those possibilities are grounded in current reality, thus demand attention).

Additionally, climate models could benefit from **truthmaking principles** when communicating uncertainty. Rather than saying "we have X% confidence in outcome Y" in a vacuum, an ER-framed

communication could link present evidence to that future: "Our confidence in outcome Y is based on these present indicators (e.g. current emission rates, feedback loops observed)." This transparently grounds the prediction in reality. It helps non-experts see *why* the model believes in a given future—because certain things now (existing real conditions) point that way. Meanwhile, when new data arrives (say a sudden decrease in emissions or a new climate policy enacted), an ER-based system will promptly update the future scenario realities. It treats the **present data as the anchor**, so if present reality changes, the assessment of future reality changes too (no prophecy is fixed). This is in contrast to some deterministic models that might not easily accommodate policy changes after a run—they project assuming "if scenario A, then outcome B", but don't dynamically adjust if scenario A is altered mid-course. ER would encourage more **adaptive modeling**: the model's predictions are not one-off pronouncements but living "real possibilities" that evolve with the real world.

From a policy perspective, the **temporally-aware decision-making** that ER enables is crucial. ER-informed systems could aid officials in practicing **ethical foresight**. For example, an AI advising a government on climate might explicitly simulate the well-being of future generations as part of the decision criteria. Although future people don't exist yet, the AI treats their projected existence as real in the sense that policies today will causally determine their lives. This could lead to decisions like investing in long-term infrastructure or aggressive emissions cuts, because the AI "understands" that the reality of 2125 (with a population that will exist then) morally matters. Philosophers like Hans Jonas have argued that our responsibility extends to future generations, given the power of technology.[16] An ER-based climate AI operationalizes that idea: it would, for instance, highlight when a policy might yield short-term gains but long-term catastrophe, thereby framing it as unethical due to the very real future harm. In doing so, it counters the human bias to prioritize immediate concerns over distant ones by constantly keeping the **real future consequences** visible in the present decision context.

Medical Diagnostics and Temporal Patient Models

Healthcare is another area where a present-centered ontology can be beneficial. Consider a medical diagnostic AI that synthesizes information from a patient's history, current symptoms, and known disease progressions to recommend treatments. A naive system might treat all inputs—past test results, current vital signs, predictive risk scores—as homogeneous data points in a model. In contrast, an **ER-informed diagnostic system** would differentiate among: what is presently true about the patient, what was true in the past (and how those past conditions remain real factors), and what could happen in the future if certain conditions hold.

For example, in managing a chronic illness, the patient's **current state** (e.g., blood pressure reading right now, current medication levels) is what *exists* and must guide any immediate intervention (like adjusting a dose if the pressure is dangerously high at this moment). The **past states** (e.g., last month's lab results, past episodes, surgeries the patient had) do not exist now, but they are **real** in that they have shaped the patient's body and health trajectory (the scar from a surgery is a present trace of a past procedure; the elevated risk due to a past condition persists). An ER system would ensure it doesn't ignore those realities: for instance, it wouldn't treat the patient as a blank slate just because they walk into the clinic today. It might explicitly say, "Given the patient's history of condition X (which, though in the past, has left lasting changes), their current symptom Y is likely a recurrence." This is essentially what good doctors do—recall that past events leave footprints that must inform present diagnosis. In an AI, making this explicit could improve interpretability. The system might attach a *footnote (figuratively speaking)* to a diagnosis: "(because of past condition X, which remains real in the patient's physiology, this diagnosis is favored)." That is a truthmaking chain: the past disease is the truthmaker for the interpretation of current signs.

Looking to the **future**, a diagnostic or treatment-planning AI often uses prognostic models: it predicts what will happen if the disease is left untreated or if a certain treatment is applied. Rather than giving a single expected outcome, an ER-informed system could present several **real-but-not-yet-existent**

16 Hans Jonas (1984). The Imperative of Responsibility: In Search of an Ethics for the Technological Age. University of Chicago Press. (Jonas argues for an ethical framework that accounts for the long-term future, emphasizing our duty to consider the fate of future generations in technological and environmental decisions. Resonates with the ER-informed notion of treating future entities as real in our moral calculations.)

outcomes: "In three months, Scenario A: tumor shrinks (80% chance with therapy); Scenario B: tumor stable (15%); Scenario C: tumor grows (5%)." It would treat those scenarios as real possibilities to prepare for. For instance, it might schedule follow-up scans and contingency plans for each scenario. Importantly, it remains **flexible**: as new present data comes in (say after one month, the tumor has shrunk by a certain amount), it updates which scenario is becoming reality and revises the future possibilities accordingly. The open-future approach ensures the AI doesn't lock the patient into a particular prognosis no matter what. Instead, it guides them along a path, constantly responsive to how the reality unfolds. This is akin to how doctors adjust treatment if a patient responds better or worse than expected; the AI does the same, because it acknowledges the future was not certain but was one of many real possibilities.

Ethically, the **ER perspective in medicine** encourages respect for patient history and caution about the future. It would avoid the "temporal fallacy" of determinism in prognoses. For example, some algorithm might output "Median survival: 6 months" for a condition, and a careless interpretation is to treat that as fate. An ER-aware system would frame it differently: "Given current data, many patients in similar conditions have about 6 months median survival, but that is a statistical reality, not this specific patient's fixed destiny." It might then advise steps to be taken now to improve that outlook, highlighting that the future is being shaped by present actions. It also would avoid "past erasure" in an interesting way: if a patient's past includes something like a history of missed appointments or non-adherence to medication, a simplistic system might drop that data or not utilize it beyond training. An ER system could keep it as part of the real context—e.g., factoring it into how aggressively to follow up (if a patient often forgets meds, the system might schedule more reminders or propose a different strategy). The past behavior remains a real part of the pattern the system must consider, not wiped clean at each visit. In doing so, there is a balance to strike ethically (one doesn't want to unduly prejudice against a patient for past non-adherence, but it's relevant to care). The transparency of ER might help here, because the system can articulate why it's making a recommendation (perhaps footnote: "patient missed 30% of doses historically, so recommending a long-acting injection instead of daily pills"). That can be discussed with the patient, making the decision process more understandable and potentially more collaborative.

Robotics and Real-Time Environments

Robotic systems, especially those operating in real-time and dynamic environments, stand to gain immensely from a present-centered temporal ontology. Consider an autonomous mobile robot (like a self-driving car or a household service robot). Such a robot must constantly perceive the environment, remember pertinent facts, and predict immediate future events (like where obstacles will move). Implementing ER principles in its control software would improve both safety and efficiency.

Firstly, a robot with an ER framework will **clearly separate its current perception from its stored map or memory**. In simultaneous localization and mapping (SLAM), robots build maps of their environment and localize themselves. A present-centered robot would tag parts of the map that are confirmed by present sensor observations versus parts that are from earlier observations. For instance, if the robot last saw the living room an hour ago, the locations of furniture in that room are to the robot "real" (based on memory) but not confirmed as *existent* now. If it plans to navigate through that room, it will do so with caution—perhaps moving slower or sending a quick sensor scan ahead—because it acknowledges those objects might have moved or new obstacles might be there. A conventional system might either assume the map is static (treating past data as if still perfectly valid) or constantly re-map (which can be inefficient). The ER approach allows a balance: trust but verify. The past map is treated as a reality (it's likely mostly correct because things usually stay put, but it's not guaranteed). By having that concept, the robot actively seeks confirmation (becoming) when it enters the room: sensors update, and what was just "real memory" now becomes "present existence" or gets corrected if needed. This improves robustness. It avoids collisions with an unforeseen chair that was moved, and equally avoids needless uncertainty when things are unchanged (because the memory gave a clue of what to expect).

Secondly, consider **temporal asymmetry and causality in robotics**. A present-centered robot understands that its actions now will affect the future state (e.g., if it knocks over a cup, the cup will break and remain broken—cause and effect). It does not entertain the impossible notion that a future event could change the current state (no backward causation). While this sounds obvious, in complex plan optimization sometimes algorithms effectively consider future rewards or goals in a way that can detach from present reality. For example, a planning algorithm might assume a future goal state and inadvertently act as if it's already partly true. ER orientation would force the planner always to reconcile with the present state. If a goal requires a condition that currently isn't true, the robot must cause it to become true (not just assume it). This might lead to better planning where necessary setup actions aren't skipped. In multi-robot scenarios, each robot having its own present (since they might be in different locations) and sharing info to build a common reality is akin to ER's relativity-handling:[17] they accept multiple local "nows." For example, if Robot A saw something 5 seconds ago that Robot B hasn't seen yet, Robot A's reality includes that object, but for Robot B it's still a predicted existence until its sensors confirm. Designing comms with those principles ensures consistent knowledge spread without assuming simultaneous omniscience.

An ER-informed robot would also explicitly manage **future predictions** as part of its world model. Self-driving cars, for instance, predict trajectories of other vehicles and pedestrians. A present-centered car wouldn't just pick one predicted trajectory; it might maintain a set of plausible trajectories each other actor could take (like branching futures for each pedestrian: maybe they cross, maybe they turn back). Those are its "real possibilities" that it has to be ready for. It might then drive in a manner that is safe across the range of possibilities (e.g., slow down preemptively because in one plausible future a pedestrian steps out). Conventional systems do have safety margins, but an ER framework gives a concept of *why* it's doing so: because that future event, while not actual, is real enough (given present signs like the pedestrian's body language) that it needs to be accounted for. If the pedestrian indeed crosses, that possibility "becomes actual" and the car fully commits to that branch (e.g., braking). If not, that branch fades out and the car smoothly continues. This is analogous to how human drivers anticipate potential hazards rather than just reacting when they become actual, which is one reason humans can be good drivers in complex situations—we don't treat the future as non-existent in our minds, we run simulations and act cautiously because of them.

One more subtle advantage in robotics is in **learning and adaptation**. Robots often operate in changing environments and must update their models. An ER perspective encourages the robot to treat its learned model parameters as a condensation of past reality. For example, if a robot learned a policy in a training environment, those neural network weights encode the realities of that past environment (what patterns existed). When placed in a new environment, the robot should regard those weights not as gospel truth but as one piece of evidence from another time and place. It will then be quicker to adapt (fine-tune) if reality now differs. If the robot were too rigid (like an eternalist view of its model—assuming the model is eternally true for all time), it would perform poorly when conditions change. The ER approach is more flexible: the model is *real* (it's based on real experience), but only the present environment truly exists—so if there's divergence, existence trumps past reality and the model must yield. Concretely, an ER robot might gradually override its prior model with new data through continual learning, always biased toward the latest data (ontologically, the latest data has the status of existence which is the highest authority, whereas older data is part of reality but potentially less binding as it moves further into the past). This resonates with how **online learning** algorithms give more weight to recent observations in non-stationary environments.

AI Ethics and Future Consciousness

In the realm of AI ethics and governance, the notion of a machine having a concept of the "real-but-not-yet-existent future" opens interesting possibilities. Society is increasingly concerned with the **long-term impacts** of AI decisions—questions of bias, fairness, and responsibility over time. A present-centered machine could be explicitly programmed to account for these concerns by including fu-

17 T. C. Trepp (2025b) "Spacetime, Relativity, and the Persistence of Becoming," in Existential Realism: Monograph, for a detailed account of how ER reconciles observer-dependent presents with a unified, frame-invariant reality. https://philpapers.org/archive/TRESRA-2.pdf

ture stakeholders in its decision criteria.

For example, consider an autonomous policymaking system or a resource allocation AI that helps decide things like budget distribution, social welfare programs, or even content moderation policies on a platform. Typically, such systems might optimize for present metrics (like current user engagement, or this quarter's outcomes). Now imagine it follows an ER-informed approach: it actually *represents* future people who will be affected by, say, environmental policies or by the long-term culture shaped by social media. These future people, of course, do not exist yet. But the system can simulate them or at least estimate their interests (as an extension of current trends, population growth, etc.) and treat those interests as part of the **reality it must consider**. This is akin to a utilitarian calculation extended over time, but given more concrete standing—future individuals are almost like additional agents in the system's calculations with their own utility values, rather than being ignored or abstractly discounted to near-zero. The system might, for example, flag a policy that yields immediate benefits but significant future costs as ethically problematic. It could say: "This action would maximize current utility, but it causes harm to future communities (who, while not existent now, are *real in the sense that they will exist and can be reasonably predicted*). Therefore, the action is not recommended unless mitigations are in place for those future harms." By doing so, the AI exhibits a form of **temporal moral agency**—it is acting not just for the present beneficiaries but as a guardian of future reality.

Another ethical dimension is **accountability for the past**. ER-informed AI would not allow the past to be conveniently forgotten when assessing responsibility. For instance, an algorithmic fairness audit system might look at a model's training data and identify historical biases that are present. Instead of treating those biases as gone once the model is deployed, it would insist that the model's decisions are *real effects of past realities* (biased data leads to biased outcomes). Therefore, it might recommend corrections such as re-training on more representative data or adding constraints, explicitly to rectify those past influences. This is akin to acknowledging historical injustices in social systems: the past discrimination is no longer "existent" in a legal sense once policies change, but it remains real in its effects (economic disparities, etc.). A fair AI should arguably do the same—compensate not just for the current snapshot but with awareness of the chain of events that led here. ER provides a framework: the past training data distribution is a real part of the model's world, so any claims the model makes (like predictions) have truthmakers partly in that past. If that past is tainted, the present model's inferences carry that taint as part of their reality, which should be acknowledged and if possible corrected by altering the model's structure in the present (since we can't change the past data, we change weights or add fairness adjustments as present actions).

Finally, consider the **development of AI systems themselves**: as we create more autonomous agents, we might worry whether they understand the value of human life over time or the concept of preserving information (not destroying evidence, etc.). Programming an AI with an ER-style ontology could indirectly instill some of these values. For example, a law enforcement AI might be tasked to consider both solving current crimes and preventing future ones. If it only cared about the now, it might be excessively punitive or invasive. But if it accounts for future societal impact (real-but-future community trust, real-but-future reduction in crime via rehabilitation), it might choose strategies that are more restorative, not just immediately gratifying. Likewise, it would keep records (since past cases remain real and could help solve new ones or ensure justice for past victims). This all points to a more **holistic temporal ethic** built into AI: one that values memory and foresight as much as present reward. The formal logic of ER has even been suggested as a tool to write out these reasoning patterns clearly, so that we can verify an AI's temporal logic of ethics.[18] For instance, we could formally state an axiom like "if an action will cause harm to real future persons, weigh that harm in the utility function" and use ER logic to ensure the AI deduces that those future persons are included.

Across these examples—from climate to medicine to robotics to ethics—we see a common thread: **Existential Realism offers a richer temporal structure that can make machines wiser.** By wise we mean not just intelligent in the computational sense, but prudent and context-aware in the **temporal dimension**. They neither panic about the future as if it's certain doom (determinism) nor ignore it as irrelevant until it hits (recklessness). They respect the past without being chained to it (learning and

18 T. C. Trepp (2025b). Formal Logic for Existential Realism: Modeling Time and Causality. Preprint (forthcoming).

moving on, but not forgetting). They have, in essence, a more *human-like* or even *sage-like* handling of time: acknowledging the flow, the connections, the responsibilities that come with being in the middle of a temporal stream.

Discussion and Future Directions

Implementing a present-centered ontology in actual technology is an ambitious endeavor. It requires not just small tweaks, but a rethinking of how we structure data and algorithms. However, there are several encouraging signs and existing efforts we can build upon. For one, formal frameworks are being developed to represent ER's ideas rigorously. A **two-tier temporal logic** has been proposed [19] that introduces special operators for "exists now" versus "is real" and axioms to enforce that everything that exists is real, but not everything real exists (right now). Such a logic could be integrated into knowledge representation languages for AI. For instance, an AI's knowledge base could be written in a logic where facts are annotated with their existential status. Queries to the knowledge base would then automatically consider whether one is asking about present facts or general real facts. The logic also encodes **temporal asymmetry**, ensuring we can only infer future states from present ones probabilistically (not the other way around) and that once something becomes past, it remains in reality available for truthmaking. By using a formal logic, we can verify properties of the system—like it will never treat a predicted event as certain until it actually happens (this could be a theorem in the logic). Informal summaries propose a compact slogan (e.g., an **'ER equation'** that reads *Reality* ≈ *Existence* + *Network*),[20] but for rigor **this paper relies on the two-tier logic** (operators for 'exists now' and 'is real') **as developed in the formal work**; the slogan is illustrative rather than a literal equation.

Another area of development is **cognitive architectures** that mimic human time perception. Neuroscientific studies show that the brain naturally segments time and constructs a narrative of experience.[21] A future research direction is to design AI architectures inspired by these findings. For example, one might implement an AI working memory that always spans a short time window (the specious present), with mechanisms for retention (carrying recent past info forward briefly) and protention (carrying expectations of the immediate future). This could improve situational awareness in fast-changing environments. Some preliminary work in recurrent neural networks and predictive coding networks already goes this direction, with systems continuously predicting and updating. Aligning these with ER's ontology might involve adding explicit loss functions or constraints that penalize inconsistency with known past facts or overconfidence in future predictions.

In multi-agent or distributed AI (such as the Internet of Things or swarms of robots), **synchronizing realities** becomes a challenge. ER suggests there isn't one global present, but we can still talk about a global reality made of everyone's local presents. Future frameworks might allow agents to share not just data, but the ontological status of that data. If one drone in a swarm sees something, it could broadcast "object at (x,y) exists-now-for-me at time t; you all should consider it real for you (even if you didn't see it) until you can verify." This is a kind of relativistic synchronization. It could prevent miscoordination, like one drone thinking an obstacle is not there just because it wasn't in its own sensor range. Essentially, each agent contributes to a collective reality without forcing their present on others except through communication. This resonates with distributed consensus algorithms but augmented with an ontological layer.

There will also be **pragmatic hurdles**. Adding these layers of temporal reasoning can increase computational overhead. Systems will need efficient ways to store and query historical data (to keep past realities accessible), which raises memory and privacy issues. Moreover, treating many future possibilities might blow up complexity—some **screening or down-weighting** is necessary (perhaps via scenario-planning techniques). The trick is to do so without **forcing a premature *collapse*** to a single deterministic future. Probabilistic planning methods and Monte Carlo simulations are promising here; they already handle multiple futures, and ER can guide how to interpret them (e.g., making sure

19 Ibid.
20 Ibid.
21 T. C. Trepp (2025c). Neuroscientific Support for Existential Realism: Memory, Anticipation, and the Present. Preprint (forthcoming). https://philpapers.org/archive/TRENSF.pdf

low-probability but high-impact futures are still considered "real enough" to matter). There is also a risk of **over-engineering**: not every application needs an elaborate temporal ontology. Part of future research is identifying which domains benefit most. Likely candidates are those where mistakes are costly and involve temporal misjudgments—financial trading algorithms (avoiding crashes by not ignoring historical patterns or the possibility of rare future events), critical infrastructure AIs (power grid management, which must use past usage patterns and future demand forecasts responsibly), and of course any AI interacting with humans over time (to properly handle commitments, trust, and memory of interactions).

From an interdisciplinary perspective, the introduction of ER to technology offers a platform for philosophers, cognitive scientists, and AI engineers to collaborate. Philosophers can help formalize the ethical and metaphysical consistency of these systems (so that, for example, the system's treatment of "real but non-existent" entities doesn't lead to logical paradoxes or unwanted behavior). Cognitive scientists can inform what temporal features actually improve decision-making (maybe human-inspired memory window lengths, etc.). AI engineers will test these ideas in simulations and real deployments, providing feedback on performance and feasibility.

In conclusion, making machines **present-centered** in the sense of Existential Realism is a bold proposal to infuse them with a deeper appreciation of time. It seeks to correct the "flattened" view of time in many algorithms by re-introducing the richness of the **now**, the momentum of **becoming**, and the weight of **what has been and what may be**. The payoffs could be significant: systems that are **safer** (because they foresee and avoid foreseeable harm), more **transparent** (because they can explain in temporal terms why they act—citing past causes and future aims), and more **aligned with human values** (because they naturally encode respect for history and care for the future). As we continue to advance AI into more autonomous and influential roles, ensuring they operate with a sound sense of temporality might be key to making them not just smarter, but wiser and more trustworthy custodians of the reality they help shape.

Conclusion

We have presented a vision for "present-centered machines" grounded in the ontological framework of **Existential Realism**. By distinguishing what exists now from what is real (but not present) and by embedding concepts of becoming, truthmaking, and temporal asymmetry into computational systems, we can enhance the temporal intelligence of technology. Our interdisciplinary exploration shows that ER can provide machines with a more **nuanced understanding of time**: they can acknowledge the exclusive primacy of the present moment while still honoring the enduring reality of the past and the meaningful potential of the future.

Such machines would make decisions in a way that mirrors prudent human reasoning: always checking against the current situation, learning from the past rather than ignoring it, and preparing for the future without presuming it. They would be less prone to *temporal errors* like blindly trusting outdated information or treating predictions as fait accompli. Instead, they would maintain a healthy awareness that the past, though not here, still matters (it really happened), and that the future, though uncertain, already casts its shadow into the present via probabilities and moral weight. In practical terms, we illustrated how this could improve climate models that inform policy with responsibility to future generations, medical AIs that treat patient histories and prognoses with appropriate ontological status, robots that navigate safely by distinguishing what they see from what they remember or anticipate, and AI ethics frameworks that internalize accountability over time.

Adopting Existential Realism in technology is not merely a philosophical exercise; it is a step toward **temporally sustainable AI**—systems that remain reliable and aligned with human needs as time progresses. As technology becomes ever more intertwined with the unfolding story of our world, having machines that truly **understand the reality of the present (and its relation to past and future)** may

be crucial. It enables them to act in ways that are context-aware, forward-looking, and hindsight-informed. In essence, it helps ensure that our intelligent machines, much like wise individuals, "remember" where they came from and consider where they are going, even as they engage with the challenges of the now.

This paper has laid out the theoretical justification and potential benefits of ER for machines. The next steps involve turning these ideas into concrete methodologies, prototypes, and eventually standard practices in AI design. By continuing to draw insights from philosophy, cognitive science, and logic, we can guide the evolution of technology to be not just faster or more powerful, but also more attuned to the profound structure of time in which all intelligence — biological or artificial — must operate.

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Temporal Vastness

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Four Views of Time

Existential Realism in the company of rivals: from the museum-like Block Universe to the Post-it Presentism, and the multiverse chain store of Many-Worlds. This paper compares their ontologies, showing how ER navigates between excess and erasure — keeping the present central while honoring the real scope of past and future.

Temporal Vastness and Architecture: A Comparative Analysis of Four Views of Time

Tenzin C. Trepp,

Email: trepp@tenz.in

Date: August 14, 2025

Abstract

The observable universe is unimaginably vast, stretching from the tiniest subatomic quark to clusters of galaxies billions of light years across. Yet as staggering as spatial vastness is, an even more mind-bending kind of vastness emerges when we consider different theories of time. Competing models of temporal reality propose wildly different ontologies – different answers to *what exists* in time – that make the physical scale of the cosmos seem almost modest by comparison. On one view, every moment of history and future already **exists** in a grand timeless ensemble; on another, every quantum possibility gives birth to an entirely new universe, multiplying realities beyond comprehension. By contrast, a stricter view insists that only the fleeting present is real, pruning reality to a razor-thin slice of now (at great philosophical cost). A newly proposed middle path tries to reconcile these extremes, granting reality to past and future while refusing to multiply worlds without necessity.

In what follows, we compare four influential views of time's ontology and the **temporal vastness** they imply: the **Block Universe** (Eternalism),[1] which treats all times as equally existent in a static "block" of spacetime; the **Many-Worlds Interpretation** (MWI) [2] of quantum mechanics, which explodes the Block Universe into countless branching timelines for every quantum outcome; **Presentism**,[3] which asserts that only the present moment exists; and **Existential Realism (ER)**,[4] a recent framework that

1 Markosian, Ned (2004). "A Defense of Presentism." In D. Zimmerman (ed.), Oxford Studies in Metaphysics, Vol. 1, pp. 47–82. (Markosian describes presentism as holding that if one made a list of all things that exist, "you and I and the Taj Mahal would be on the list, but neither Socrates nor any future grandchildren of mine would be included… All such objects are unreal, according to Presentism.")

2 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton University Press. (Weyl famously wrote: "The objective world simply is, it does not happen." This aphorism poetically expresses the eternalist view of a static 4D world where time is laid out completely.)

3 Einstein, Albert (1955). Letter to the family of Michele Besso, March 1955. (Einstein consoles his late friend's family with the remark that, for those who believe in physics, the separation between past, present, and future "is only a stubbornly persistent illusion." This quote is often cited in support of the Block Universe perspective on time.)

4 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Trepp's framework differentiates existence and reality: Eternalism, he argues, "treats all events as equally existent in a timeless block." ER rejects this, asserting "there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated" – reality, by contrast, stretches beyond the present through records and expectations.)

offers a disciplined middle ground by distinguishing what *exists* (strictly present entities) from what is *real* (a broader causal and informational structure including past and future). We will see that each view carries profound ontological implications – from a universe densely populated with dinosaurs and future aliens, to a multiverse of near-infinite extent, to a vanishingly small ontology of just the now. After outlining each theory, we conclude with reflections on the epistemic humility warranted by such extraordinary ontologies, and consider whether a moderate view like ER can capture time's reality without the ontological excesses of its rivals.

Block Universe (Eternalism)

Eternalism – often illustrated as the "Block Universe" – holds that all moments of time *exist* equally in a four-dimensional spacetime manifold. Past, present, and future events are ontologically on par, just located at different temporal positions within the block. If we could view the cosmos from a "God's-eye" perspective outside of time, we would see history laid out as a single immutable structure – a massive four-dimensional block containing every event from the Big Bang to the far future. In this view, no moment is objectively *more real* than any other. Your birth, this very sentence, and some distant future day when humans might walk on Mars all coexist in the web of spacetime. Time is treated like a fourth dimension similar to space: just as all places exist, eternalism says all times exist. The flow of time and the sense of an unfolding "now" are regarded as subjective or perspectival. In the block universe **nothing truly comes into being or passes away** – instead, every event simply *is* eternally located at its respective coordinates. Albert Einstein himself leaned toward this tenseless picture, famously remarking that for those of us who understand physics, the distinction between past, present, and future is "only a stubbornly persistent illusion".[5] Hermann Weyl expressed the eternalist ethos in poetic terms: "The objective world simply *is*, it does not *happen*".[6]

The ontological implications of eternalism are vast in the extreme. All of history is eternally existent: **every nanosecond of the past and every moment of the future enjoy the same ontological status as the present**. On this view, Napoleon marching at Austerlitz in 1805 and a dinosaur roaming the Jurassic 150 million years ago are just as real as you reading this page – as are events that haven't yet occurred from our perspective, such as future generations or the death of our Sun. They all exist within the block universe, just at different temporal locations. The **temporal vastness** of what is real, therefore, spans the entire timeline of the cosmos in both directions. This four-dimensional stack of moments constitutes a *temporally maximal ontology*: reality contains not only everything that exists now, but everything that *ever* did or will exist. The sheer scope of existence in eternalism dwarfs any ordinary sense of reality's size. It posits a kind of cosmic archive where no moment is ever truly lost or unreal – a timescape of potentially infinite extent and detail.

Such an all-encompassing ontology can be seen as elegant or extravagant, depending on one's perspective. On one hand, eternalism neatly solves certain puzzles: truths about the past or future have ready "objects" to refer to (since those times **do** exist in the block), and physics – especially relativity – often uses a four-dimensional formalism that treats time coordinates similarly to space. Indeed, the relativistic unity of spacetime is a major motivation for eternalism: in relativistic physics there is no absolute now, only a continuum of events, which fits naturally with the block concept. On the other hand, the block universe's total acceptance of *all* events as equally existent incurs a heavy ontological cost. It "dramatically inflates the ontological inventory of the world", populating reality with a vast array of entities and events that are entirely inaccessible to us at present. Philosophers often criticize this as **ontological extravagance**: eternalism commits us to a multitude of "ghostly" entities – dinosaurs, Socrates, future people – that, though not present, must somehow *be* there in the world's furniture. Tenzin C. Trepp, for example, notes that eternalism "treats all events – and by implication, all matter – as equally existent in a timeless block," effectively implying that there is "past matter lin-

5 Einstein, Albert (1955). Letter to the family of Michele Besso, March 1955. (Einstein consoles his late friend's family with the remark that, for those who believe in physics, the separation between past, present, and future "is only a stubbornly persistent illusion." This quote is often cited in support of the Block Universe perspective on time.)
6 Weyl, Hermann (1949). Philosophy of Mathematics and Natural Science. Princeton University Press. (Weyl famously wrote: "The objective world simply is, it does not happen." This aphorism poetically expresses the eternalist view of a static 4D world where time is laid out completely.)

gering in a spacetime 'elsewhere'" – a kind of ghost landscape of events not happening **now**.[7] This static plenitude of being violates our intuitions about **becoming** and change: in a block universe, what we call "change" is just a tenseless ordering of events, and the vivid sense of the moving present is an illusion. Even if it's not as unhinged as the Many-Worlds carnival, eternalism still insists on hoarding every nanosecond from the Big Bang to the heat death — like a cosmic hoarder who never throws anything away. A grand collection, yes, but perhaps one we could live without dusting forever.

The flow of time and the open future are sacrificed – time is frozen into an eternal tableau. Causality in this picture is reduced to a fixed network of relations: event A can be earlier than event B and influence it, but since both A and B *already exist* in the block, the causal process doesn't bring B into existence the way we ordinarily imagine; it merely links two pre-existing points on the timeline. Critics argue that this undermines the reality of temporal passage and the meaningfulness of **now**. Human experience presents time as an unfolding process – the *becoming* of events – yet eternalism says every event simply *is*. There is a deep tension here: **our phenomenology insists on the reality of coming-into-being, whereas eternalism installs a universe where nothing truly becomes**. For this reason, eternalism faces the challenge of explaining why the present *feels* so special and why we perceive time as flowing, if in reality all moments are equally real and laid out from the start. The Block Universe is a bit like a cosmic museum that insists on keeping every exhibit on display forever — from dinosaur footprints to tomorrow's weather report — and then telling you that the guided tour you feel you're on is just an illusion.

In sum, the Block Universe offers a grand, spacetime-complete ontology – a temporally immense reality that is fixed and unchanging. It provides a kind of **maximalist** answer to what exists: everything that ever did, does, or will exist *tenselessly exists*. This maximalism about temporal ontology yields extraordinary vastness (far beyond the here and now), but at the possible price of making time humanly alien – a changeless "loaf" of spacetime that we happen to inhabit. Whether such an ontology is true hinges on whether physics or philosophy can justify treating time like space. Eternalism's extraordinary claim – that the entirety of history is ontologically real – demands equally strong justification. Lacking a direct empirical test for the reality of the future or past, many urge caution: **before accepting a universe overflowing with ostensibly real but permanently inaccessible moments, we should ask whether we truly must**. The burden of proof lies on the eternalist to explain why we should believe in this prodigious temporal archive of existence, rather than a more modest ontology that privileges what is manifestly real: the present.

Many-Worlds Interpretation (Quantum Multiverse)

If the Block Universe's ontology is expansive, the **Many-Worlds Interpretation (MWI)** of quantum mechanics blows it up to truly vertiginous proportions. MWI starts by accepting much of the eternalist picture – a four-dimensional spacetime where events are laid out – but then *multiplies* it: not content with one single block containing one history, Many-Worlds asserts that **every** quantum possibility leads to a *divergence* in reality — a migration into separate, equally real universes. Rather than a single timeline, reality becomes an ever-multiplying structure of coexisting timelines (often called "worlds" or "universes") that share a common past but diverge whenever a quantum measurement or random event could go more than one way. The fundamental idea, originating with Hugh Everett (1957), is that the quantum wavefunction never collapses; instead, *all* outcomes encoded in the wavefunction are realized, each in its own branch of the universe.[8] For example, if a radioactive atom has a 50/50 chance to decay in the next hour, under MWI the atom both decays and doesn't decay – each outcome in a different world. When you perform the experiment, the universe purportedly transitions: in one version you see the atom decayed, in another version (a different you) sees it intact. Every quantum event, no matter how microscopic, causes such a split. **Reality, therefore, is not one block**

7 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Trepp's framework differentiates existence and reality: Eternalism, he argues, "treats all events as equally existent in a timeless block." ER rejects this, asserting "there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated" – reality, by contrast, stretches beyond the present through records and expectations.)

8 Trepp, Tenzin C. (2025). "Existential Realism – A Distinct Ontological Framework Beyond Presentism." PhilArchive preprint. (Trepp's framework differentiates existence and reality: Eternalism, he argues, "treats all events as equally existent in a timeless block." ER rejects this, asserting "there is no past matter lingering in spacetime 'elsewhere'. Only the present is materially populated" – reality, by contrast, stretches beyond the present through records and expectations.)

universe but a proliferation of myriad block universes – a veritable multiverse of coexisting timelines, constantly bifurcating with each indeterministic event.

The ontological vastness implied by MWI is difficult to overstate. Even a single small system undergoing quantum interactions can spawn a huge number of branches; across the entire universe, with countless quantum events happening every second, the number of distinct worlds grows **stupendously** over time. Very quickly, we are led to consider on the order of not just trillions, but an effectively *unbounded* number of parallel universes. These worlds are said to exist "in parallel at the same space and time as our own" (as the Stanford Encyclopedia puts it)[9] – they do not interact with each other (once decohered), but each is a full reality in which all events play out. For every outcome you didn't see, there is another world where it happened. In one branch, I wrote this paper slightly differently; in another, you never started reading it. In innumerable others, Earth never formed, or alien civilizations thrive on distant planets. The **total** reality is thus an inconceivable ensemble of all possibilities. If eternalism's block was huge, Many-Worlds' multiverse is a vastly larger collection of huge blocks. It takes the idea of a temporally complete reality and **replicates it for every quantum contingency**, over and over, without end.

This explosion of worlds tests the limits of coherent thought. It challenges what we even mean by "reality." In Many-Worlds, to say "X is real" might require a qualifier: real in *which* branch? Every branch is a self-contained universe with its own history and future, splitting off from others. The scope of existence is no longer a single timeline but an ever-branching *megaverse*. One might naturally worry that we have far overshot Ockham's razor with this picture – it seems to posit a wildly extravagant ontology. Defenders of MWI, however, argue that the theory doesn't *add* arbitrary new entities but simply takes the quantum formalism seriously: the mathematics of the wavefunction already encompasses multiple outcomes, and Many-Worlds "derives" the existence of multiple worlds from the physics rather than inserting a special collapse rule.[10] In their view, the worlds were implicit in the equations all along. Nonetheless, the conceptual shock remains. Bryce DeWitt, who popularized the MWI, vividly described his own reaction to its implications: the universe continually splitting into "a stupendous number of branches," with **"every quantum transition taking place on every star, in every galaxy, in every remote corner of the universe"** contributing to "myriads of copies" of our world.[11] He confessed to a "shock" upon realizing that the theory entails "$10^{100}+$ slightly imperfect copies of oneself all constantly splitting" – calling it "schizophrenia with a vengeance".[12] Indeed, the mind reels at the prospect of **10^{100}** versions of you (and counting), each unaware of the others yet equally real. If we found the Block Universe hard to intuitively accept, the Many-Worlds multiverse is orders of magnitude more daunting: it suggests that reality, at its most fundamental, is an almost infinitely rich tree of divergent histories – a **quantum foam of universes** beyond any hope of direct observation.

The ontological and philosophical implications of this are profound. For one, **identity and personal reality** become tricky: if there are countless versions of "you" that branch off, in what sense are they all you? The MWI invites a form of *divided self* spread across worlds – yet each branch's copy of you experiences life as a unique individual. This raises questions about personal identity over time and branching: are the divergent copies all continuations of the prior you, or does identity "fork" along with the world? There is also the question of **truth**: in the multiverse, every alternative outcome does happen in some branch, so statements about what "will" happen or "would have" happened lack a single truth value without specifying the branch or context. In one world a proposition is true, in another false. The simple idea of *the* future is replaced by a fan of futures. Our conventional notions of probability ("there is a 50% chance of decay") get reinterpreted as statements about the distribution of worlds: roughly half the worlds see the decay happen, half do not. Some philosophers worry that this blurring of actuality and possibility undermines the meaningfulness of counterfactuals or the significance of decision-making – if all outcomes occur, does it matter what I choose, since there will be branches where each choice was made? MWI advocates respond that from any given branch's

9 https://plato.stanford.edu/entries/qm-manyworlds/#:~:text=The%20Many,The%20MWI%20provides%20a
10 https://plato.stanford.edu/entries/qm-manyworlds/
#:~:text=The%20Many,measurement%20problem%20of%20quantum%20mechanics
11 https://cqi.inf.usi.ch/qic/deWitt1970.pdf
#:~:text=that%20in%20equation%205%20but,myriads%20of%20copies%20of%20itself
12 https://cqi.inf.usi.ch/qic/deWitt1970.pdf
#:~:text=A%20splitting%20universe%20I%20still,mental%20state%20of%20the%20imaginary

perspective, it does matter (you only experience one result), but the bigger picture indeed contains all choices realized.

Epistemologically and empirically, MWI is peculiar in that all these other worlds are, by construction, non-communicable and in principle unobservable to us (they split off and do not influence our branch). This means the "extraordinary" ontology of Many-Worlds is not something we can directly confirm by observation; its justification must come from theoretical virtues (like removing the arbitrariness of wavefunction collapse) rather than empirical detection of other universes. This has led some critics to charge MWI with violating parsimony: *why believe in an enormous number of unobservable worlds*? An empiricist, as John Norton quipped in another context, can only stand aghast at such an **explosion of worlds whose real existence is beyond the reach of any possible experience.**[13] Proponents counter that MWI is a simpler, cleaner interpretation of quantum mechanics *if* one accepts the ontological cost. The debate thus hinges on one's tolerance for ontological extravagance in pursuit of theoretical elegance.

In short, the Many-Worlds Interpretation presents a **radically maximalist** view of reality's size and structure – far exceeding even the Block Universe. Every moment isn't just accompanied by its past and future; it is accompanied by countless *alternative* present, past, and future timelines. Reality becomes an ever-growing multiverse. The conceptual vastness here is nearly **incomprehensible**, and perhaps it is meant to be – our intuitions, evolved for one world, strain in the face of so many. Accepting MWI's ontology requires a substantial leap of faith (or of reason): one must be convinced that our best physical theory *demands* this multiplicity of worlds. If not, one might seek a more frugal ontology. We are reminded of the need for **epistemic humility**: extraordinary claims about an infinity of universes call for extraordinarily solid grounds. Absent that, the quantum multiverse, while a tantalizing possibility, might be a bridge too far for our ontology. If Eternalism is a cosmic museum, Many-Worlds is the franchise version — with a new branch opening for every possible outcome, no matter how small, until the multiverse feels like a chain store with locations in realities you'll never visit.

Quantifying Temporal Vastness — A Calculation Experiment

Sometimes the only way to grasp the scale of these ontologies is to put the numbers on the table. Let's run a quick experiment.

Step 1 — The Observable Present Universe

Start with what we can see: the present, observable universe.

- Diameter: ~93 billion light-years.
- Hundreds of billions of galaxies.
- Already so vast that most of us can barely imagine it.
  And yet — this is just *one* moment in time. A single, fleeting "now."

Step 2 — Block Universe: Counting Every Moment

The age of the universe is about **13.8 billion years**.
Convert that to seconds:

- 13.8×10^9 years × 3.15×10^7 seconds/year ≈ **4.35×10^{17} seconds**.
  Convert seconds to nanoseconds:
- $4.35 \times 10^{17} \times 10^9$ = **4.35×10^{26} nanoseconds** since the Big Bang.

If the Block Universe is right, *every* one of those nanoseconds is a fully existent 4D configuration of reality — each configuration as vast as our observable universe.
That's **4.35×10^{26} complete universes** stacked through time. The present is only one frame in a cosmic archive of over four hundred trillion trillion trillion frames.

13 https://sites.pitt.edu/~jdnorton/papers/Empiricist_possibility_final.pdf
#:~:text=An%20empiricist%20can%20only%20stand,halts%20at%20that%20bare%20propositional

Step 3 — Many-Worlds: Multiplying the Stack

Now make it worse.
Assume, conservatively, that the entire observable universe experiences just one significant quantum branching event per nanosecond.
Each event has two possible outcomes → reality transitions into two versions.
That means after *n* nanoseconds, you have:

- $\mathbf{2^n}$ universes.
  For n = 4.35×10^{26} nanoseconds,
- Total branches = $\mathbf{2^{(4.35 \times 10^{26})}}$.

This number is so huge we can't write it in full. Even scientific notation collapses.
The only way to describe it is logarithmically:

- $\log_{10}(2^{(4.35 \times 10^{26})}) \approx \mathbf{1.31 \times 10^{26}}$.

Translation: The number of universes has $\mathbf{10^{(1.31 \times 10^{26})}}$ **digits**.

That's more digits than there are atoms in the observable universe — *not more universes, more digits just to write the number of universes*.

Step 4 — Perspective

- **Present Universe:** nearly beyond comprehension.
- **Block Universe:** unthinkably vast — a frozen plenitude of 10^{26} fully-realized cosmic configurations.
- **Many-Worlds:** a conceptual supernova. Vastness becomes exponential. Comprehension fails.

This isn't just "a lot." It's ontological inflation on a scale that rips the ceiling off the word *reality*. If the Block Universe already strains belief, the Many-Worlds total makes it look like a minimalist's dream.

Presentism

In stark contrast to the sprawling ontologies of eternalism and Many-Worlds, **Presentism** offers a severely minimalist view of temporal reality. Presentism's core claim is disarmingly simple: **only the present exists**. The only things that truly *exist* are those that are present *right now*. The past has slipped out of being (it *did* exist, but does not exist now), and the future does not yet exist at all. Reality, in this view, is like a spotlight moving through time: at any given moment, whatever falls under the spotlight exists, while everything else – behind or ahead – is unreal. It's as if time were a stage play, and Presentism insists only the actors currently under the spotlight are "real" — the rest of the cast, waiting in the wings or already offstage, might as well be imaginary. If we were to make a complete inventory of what exists, the presentist says, we would list all entities and events occurring at this instant and nothing more. As Ned Markosian vividly summarizes, if presentism is true then "you, me, and the Taj Mahal" would be on the list of existents, but "neither Socrates nor any future grandchildren of mine would be included… All such objects are unreal, according to presentism".[14] In other words, figures from history and hypothetical people of the future are no more real than fictional characters – at least *in the ontological sense*. They don't exist *tout court*, because only the present is real.

Presentism has a certain intuitive appeal. It aligns with common sense in some ways: we *feel* that the past is "gone" and the future "not here yet," whereas the present is what's concretely around us. This view also wins the prize for ontological economy: it posits the **smallest** reality of the theories we're ex-

14 DeWitt, Bryce (1970). "Quantum Mechanics and Reality." Physics Today 23(9): 30–35. (DeWitt popularized the term "many-worlds." He describes the universe as "constantly splitting into a stupendous number of branches," and shares his shock at the implication of "10^100+ slightly imperfect copies of oneself" resulting from quantum branching – calling it "schizophrenia with a vengeance.")

amining. There is no vast block of times, no parallel worlds – simply a continually updating now. With each passing moment, the roster of what exists is refreshed: new events come into being and old ones slip away. In terms of **temporal vastness**, presentism's ontology is minimalistic – it contains only an infinitesimal slice of time (strictly, an instant, if we conceive of the present that narrowly). Some presentists might allow that the present is a very short interval (maybe the last femtosecond or a specious present of a few seconds), but however we slice it, reality's span is extremely thin compared to eternalism's cosmic timeline or MWI's branching tree. In terms of temporal storage space, Presentism is like running the universe on a single tiny Post-it note — economical, yes, but don't expect it to hold the full story. Presentism's world is lightweight: it doesn't carry the burden of extinct dinosaurs or future galaxies as part of what exists. Consequently, presentists avoid the "ghost ontology" problem of eternalism – they don't need to account for inaccessible past or future entities, since those simply aren't there. The now is metaphysically privileged and does all the ontological work.

However, this drastic simplicity comes at a **steep price**. The most famous challenge to presentism is the problem of **truthmakers** for past and future truths. We routinely make true statements about the past ("Dinosaurs went extinct 65 million years ago") and about the future ("The Sun will rise tomorrow"). But if, as presentism claims, only present entities exist, then what makes it true that dinosaurs *existed* or that the Sun *will* rise? In standard metaphysics, a statement is true because reality contains something that makes it true – a truthmaker. Eternalists can point to a past time where dinosaurs exist in the block, serving as the truthmaker for "dinosaurs existed." But the presentist seemingly lacks any **real** dinosaurs (they're gone) to ground the truth of that statement. The fear is that presentism renders all statements about the past or future *groundless* or at best true by stipulation. Markosian himself notes this "truthmaking" objection: if Socrates doesn't exist in any sense, in virtue of what is the proposition "Socrates was a philosopher" true? The presentist might respond that there are present traces or memories of Socrates which suffice to make the statement true. Indeed, one strategy is to appeal to **causal traces** or records in the present as truthmakers for past events. For example, the existence of the Parthenon ruins and historical texts about Socrates are present evidence that can underwrite the truth of "Socrates existed." Similarly, for future-tensed truths, present conditions (like deterministic laws or probabilistic tendencies) might be cited as truthmakers for claims about what will happen. However, many philosophers find these maneuvers only partly satisfying. It seems peculiar that the truth of "dinosaurs roamed the Earth" must depend on, say, some fossil bones in a museum today. What if all evidence of dinosaurs was destroyed – would that make the statement false? Intuitively no – it would still be true, but presentism has trouble explaining why if nothing in the present universe corresponds to that past reality. This highlights a broader worry: **presentism threatens to undermine the reality of the past and future in ways that conflict with our knowledge-practices and experience**. We *feel* the influence of the past constantly – in memory, in records, in causal remnants like light from distant stars. And we constantly plan for the future, guided by our beliefs about what will happen. Presentism, taken at face value, says those past events *aren't there* at all, and future events aren't there either, so strictly speaking our beliefs and talk about them have no real referents.

Beyond truthmaking, there are **epistemological and ethical costs** to denying reality to past and future. Epistemologically, if the past is unreal, how do we *know* anything about it? One could say we infer it from present evidence – but then our theories of the past (e.g. paleontology, cosmology) are about something that, by presentist lights, has no existence. Some have accused presentism of an almost **solipsistic** stance toward time: caring only about the fleeting present and treating other times as if they were nothing. Ethically, this raises alarms: can we hold people accountable for past actions if, ontologically, those actions "don't exist"? Does it make sense to feel moral responsibility toward future generations (to preserve the environment, for instance) if those future persons are in some sense unreal? To be clear, presentists typically can still talk about past and future in a pragmatic way – they can say, "Of course the past *did* exist and the future *will* exist; we simply mean they aren't part of reality *now*." From that perspective, caring about future people is caring about ensuring certain things *will* come to exist (even if they do not yet). But the metaphysical strictness of presentism, in which only the present *is*, invites a kind of philosophical **myopia**: only present pains and pleasures would be real, which could (in a caricatured sense) diminish the weight of history or foresight in one's value system. Many critics argue that presentism, if taken too literally, undermines rational planning and morality –

because it's hard to justify concern for what, in the moment of decision, is literally non-existent. While in practice no presentist behaves as if the past and future are irrelevant, the ontology they propose has trouble supporting why past truth and future anticipation are anything more than useful fictions.

Presentists have proposed various fixes or clarifications to address these challenges. Some suggest that only *present existence* is affirmed, but past events can still be said to be "real in memory" or "real in their effects" – a concession that starts to sound like the existence vs. reality distinction we will see in Existential Realism. Others bite the bullet and accept that strict presentism must be supplemented with a theory of truth that doesn't require ontological correlates (e.g. truth supervenes on the present state of the world and the laws of nature). Another issue arises with physics: **Special Relativity** shows there is no single objective present moment for the universe, which makes naive presentism hard to maintain without positing a preferred frame or "true" time (an option some defenders, like T. Crisp, explore). But if one has to compromise physics or add unseen structure (an absolute simultaneity), that again erodes the simplicity presentism aimed for.

In summary, Presentism champions an ontologically **parsimonious** reality – one that is no bigger than the present. It has the virtue of according a fundamental status to the now (which matches our immediate experience of reality), and it avoids populating the world with entities beyond the here-and-now. However, this parsimony comes with significant theoretical burdens: explaining truth, causation, and experience that refer to non-present times. The conceptual vastness of eternalism and MWI is traded for a conceptual thinness, which, paradoxically, might impoverish our understanding of time. Past and future, though not part of reality for the presentist, are undeniably part of our understanding of the world; presentism must perform some philosophical gymnastics to accommodate that fact. Many thinkers have found these costs too high, which is why presentism, despite its simplicity, remains highly controversial. It either has to be amended or clarified to avoid undermining the meaningfulness of history, science, and responsibility. This motivates looking for a middle position that can keep the present ontologically central **without** erasing the past and future from the ledger of reality.
Enter **Existential Realism**.

Existential Realism

Existential Realism (ER) is a contemporary proposal that attempts to chart a middle course between the extremes of eternalism (Block Universe) and presentism. Developed as a distinct ontological framework by T. C. Trepp (2025) in a series of recent papers, ER begins with a key insight: we must **distinguish between what exists and what is real**. In ER's two-tier ontology, **existence** is a strict term – it means actual, concrete presence *now* – whereas **reality** is a broader category that includes things that, while not presently existing, nonetheless have a real influence or presence in the world by virtue of causal or informational links. In simple terms, **only present entities *exist*** (so ER agrees with presentism on that point), but past and future entities can still be said to be *real* in a well-defined sense, insofar as they leave traces or precursors in the present or figure in our best explanations of the world. This crucial distinction allows ER to preserve the **empirical primacy of the present** – the idea that what concretely exists is only what we can observe or interact with right now – while also acknowledging the **ontological significance of the past and future**. The past and future are not "nothing" or merely irreal; they are real, but not in the same way the present is real. They are real as *parts of the world's structure*, not as independently existing realms. ER thus claims to capture "a more nuanced ontology of time" that respects both **becoming** and **being**.

To unpack this, consider how ER handles each temporal domain:

- **The Present:** ER holds that the present is the locus of *existence*. Something **exists** (in the fullest sense) if and only if it is present *and* empirically accessible right now. This usually means material objects and events occurring at the current time. ER ties existence to an *empirical criterion*: roughly, to exist now is to be detectable/observable now (or at least in principle observable given current conditions). This strict notion of existence ensures ER remains ontologically **parsimonious** – it doesn't commit to entities wholly beyond possible experience. If something

is entirely removed from the present (like a past event or a hypothetical future object), ER says it does *not* exist (now). In this respect, ER sides with presentism: the only populating contents of the universe at any given moment are present ones. Where ER *departs* from standard presentism is in what it says next.

- **The Past:** Even though past events (e.g. the formation of the Moon, the fall of the Roman Empire) do not exist now – they've happened and are gone – ER maintains that they are still **real**. How so? ER defines reality to encompass things that *have* existed or *have* influenced the world, leaving residual effects, records, or structures that persist into the present. A past event is real if it played a causal role whose effects are still part of the current world. For instance, the supernova observed by Kepler in 1604 is real because we have records of it and its light affected observers; it's part of the world's causal story. The eruption of Vesuvius in 79 CE is real because it left Pompeii's ruins and geological traces (even though the eruption itself no longer exists). In ER, the past survives not as a hidden ontological dimension (as in eternalism), but **immanently, through its present consequences**. What has happened leaves footprints – physical, informational, or psychological – and those footprints are part of reality now, attesting to the reality of the past event. ER thereby provides **truthmakers for past truths**: the statement "dinosaurs existed" is true because reality contains fossils, genetic evidence, planetary strata – an entire web of present entities and facts that *would not be as they are* if dinosaurs hadn't existed. The past is real precisely as the **cause** of the present's conditions. We might say: ER "demotes" the past from existence but not from reality. The past is **absent but real**. This move avoids the presentist's dilemma of having to deny or trivialize historical truths, while still keeping the ontology lean (no need to say dinosaurs *still exist* somewhere in time – they don't, but their reality is registered in the present structure of the world).
- **The Future:** Similarly, ER treats future entities and events as real in a certain respect, though of course they do not exist now (and, unlike the past, they never *have* existed yet). How can something future be real? ER's answer is that the future is real *insofar as it already manifests in the present in the form of anticipatory structures, causal tendencies, and logical outcomes*. For example, a future solar eclipse a year from now can be considered real because it is already encoded in the present state of the solar system (the deterministic orbital mechanics make it inevitable) and in our present knowledge (we can predict it). We carry mental representations, plans, and expectations about future events; these present states reference real future possibilities. When you buy a plane ticket for a conference next month, that future event (the conference happening and you attending) is treated *as real enough* to act upon – it's not merely a fantasy, it's an anticipated reality guiding present action. Of course, the future is **unsettled** and not fully determined (quantum mechanics and human free actions suggest an openness). ER can accommodate that by saying the future's reality is often *indeterminate or in terms of possibilities* rather than a single actual timeline. But those possibilities themselves have a sort of reality: they influence the present (think of how the mere possibility of rain makes you carry an umbrella). The key point is that ER allows statements about future events to be more than fiction – they refer to *would-be realities* that are grounded in current conditions or laws. The future "looms" into the present via probabilities and expectations; it is **projectively real** even though it lacks present existence. ER thus preserves rational discourse about the future (and moral concern for it) by giving the future a kind of ontological status short of outright existence. Future events and entities are **real as potential** – they are part of the world's unfolding structure, just not actualized yet. This squares with scientific practice: we speak of future eclipses, climate trajectories, etc., as real predictions, not arbitrary imagination.

In making these distinctions, Existential Realism tries to get the best of both worlds (no pun intended). It keeps the **ontological economy of presentism** (by not loading the universe with non-present entities) while attaining the **explanatory breadth of eternalism** (by allowing past and future to figure meaningfully in our ontology). ER's mantra might be: *Only the present exists, but much more than the present is real*. This elegantly avoids eternalism's "block" where everything exists (ER says no, only now exists), and equally avoids presentism's impoverished ontology where only now is real (ER says

past and future are real in their own right, just not existent). By doing so, ER provides natural resolutions to the problems we saw earlier. **Truthmaker for past**: check – past events are real as evidenced by present traces, so propositions about them have truthmakers. **Moral accountability**: check – past deeds, though not existing now, are real (in their consequences and records), so holding someone accountable for a crime yesterday is holding them accountable for a real (past) event that genuinely happened. **Planning and future concern**: check – future events, while not yet existent, are real enough (in terms of foreseeable outcomes) that it makes sense to prepare for them and to regard promises or threats about the future as meaningful. In ER, when we say "the future is real," we don't mean there is already a determined future out there (as in eternalism); we mean that the future has a presence in the current state of the world (through laws, tendencies, intentions). This accommodates both **deterministic** and **indeterministic** scenarios. If some future event is almost certain (like an astronomical event), its reality is nearly fixed; if it's probabilistic or open (like "who will win the election"), the various possibilities can be considered as a set of real potential outcomes that will collapse into one actual reality when the time comes. ER aligns nicely with how quantum physics can be interpreted: before a measurement, multiple outcomes are possible (the future is a superposition of possibilities), but only when the present measurement occurs is one outcome realized (existence), the others being relegated to unrealized possibilities (which, once past, are not real except perhaps as a record of "this could have happened but didn't"). Unlike Many-Worlds, ER does not say the unrealized possibilities generate other worlds; instead, they simply cease to be real once the present moves past the point of decision — reality collapses into one actual world, with all other possibilities ceasing to be real. Thus, ER manages to incorporate quantum insights (the special role of measurement/now in making things actual) without committing to an infinitude of parallel realities. Reality for ER is *one world* that is dynamically evolving, with a clear dividing line between the definite present and the indefinite future.

Philosophically, ER draws on both metaphysics and epistemology. It resonates with Bas van Fraassen's **constructive empiricism**, which holds that one can accept the usefulness of talking about unobservable entities (like electrons or past events) without committing to their literal existence.[15] We can be agnostic or non-committal about the *existence* of past/future entities while still saying our theories about them are *true* in describing reality. ER provides a formal way to do that: by saying those entities are real (part of the causal or inferential structure of the world) even if not part of the presently existing inventory, ER lets us talk meaningfully about them without inflating existence. ER also draws on **phenomenology** – Edmund Husserl noted that our consciousness of the present is not a knife-edge moment but has some thickness, containing echoes of the just-past (retention) and anticipations of the about-to-be (protention). ER's two-tier ontology neatly mirrors this: the present experience always includes a horizon of past (memory, lingering effects) and future (expectation, immediate next steps) built into it. So one might say ER is truer to experience than an austere presentism that denies any reality to the just-past or imminent future. Our *"phenomenal present" is inherently extended and contains traces of the past and outlines of the future*,[16] as Husserl put it, and ER's framework explains why – because the past and future *are* objectively real in the present, not as fully existent things, but as structural (and experiential) realities.

Another strength of ER is its compatibility with relativity and science. By insisting that existence is frame-dependent (tied to an observer's present) but reality is not confined to one preferred foliation (past events can be real even if simultaneity is relative), ER can navigate the relativity issue without postulating a single cosmic now. In fact, one could interpret ER such that "existence" is an indexical concept (each observer has their own present of things existing for them), but "reality" includes the invariant causal structure that all observers can agree on (which contains the records of past events and so on). This is a nuanced point beyond our scope, but it shows ER's potential for integrating physics without giving up on a privileged present – the privilege might be local or perspectival rather than absolute. Lee Smolin, for instance, has argued that we should not treat time as an already laid-out

15 van Fraassen, Bas C. (1980). The Scientific Image. Oxford University Press. (van Fraassen's constructive empiricism holds that we can accept a scientific theory's predictions about observables without committing to the existence of unobservable entities. He notes, for example, that one can speak of electrons as if they are real yet "remain agnostic about their existence." This viewpoint underscores ER's idea that we can acknowledge the reality of things (like past events or theoretical entities) without saying they exist now in a material sense.)

16 Husserl, Edmund (1928). Lectures on the Phenomenology of Internal Time-Consciousness. (Husserl analyzes the structure of how we experience time, introducing the concepts of retention (the just-past still given in consciousness) and protention (the imminent future anticipated). He argues that "our phenomenal present is inherently extended and contains traces of the past and outlines of the future," rather than being a durationless instant. This supports the idea that the present, even experientially, includes more than a mathematical now – aligning with ER's two-tier view.)

dimension but rather as something that is genuinely happening; he cautions against the "fallacy of the spatialization of time," reminding us that treating time like a dimension of space in our models doesn't mean the future actually exists like a place.[17] ER aligns with that caution: it refuses to grant existence to the future (or past), thereby honoring the idea that time is an active, unfolding process, not a static landscape. Yet it also refuses to throw away the fruits of that process – the past is not erased, and the future is not irrelevant. They are woven into the present in causality and possibility.

In summary, Existential Realism proposes a **disciplined ontology** of time. It asks us to be **stingy** with existence claims (only the present concrete world merits them) but **generous** with reality claims (acknowledging the causal and informational reality of what came before and what may come after). By doing so, ER aims to solve the dilemmas faced by other views: eternalism's extravagant "block" is cut down to size, presentism's overly thin reality is filled out in a controlled way, and we avoid multiplying universes as MWI does. The result is a picture of the world that is both **empirically grounded** and **explanatorily rich**. It preserves the tangible, observable now as the core of existence – satisfying our scientific sensibility that claims of existence should be tied to evidence. At the same time, it doesn't shy away from saying there is more to reality than what exists this instant: it embraces the fact that we live in a world of memory, records, laws, and expectations, all of which point beyond the present and demand ontological recognition. ER, in a sense, *earns* the right to talk about past and future by tethering them to present evidence and reasoning. It avoids speculative excess by not postulating entire realms of being that are disconnected from the present; everything real must *cash out* in some connection to the present (either a present trace from the past or a present indication of a future). This makes it a **cautious ontological expansion**: it expands reality just enough to accommodate what science and common sense require (that past happened, future can be predicted), but not so much as to create an uncontrollable ontological zoo.

Whether ER will be widely accepted remains to be seen, but it offers a promising route for those dissatisfied with the extremes. It effectively says: *let's keep our ontology temporally light, but conceptually robust*. The past and future are like **shadows or echoes** – not substance right now, but not nothing either. They persist as part of the world's intelligible structure. Thus, ER honors the fleeting nature of existence *and* the enduring nature of reality.

Conclusion

The four views we have surveyed offer dramatically different answers to the question "What is real in time?" – and with those answers come vastly different visions of reality's scope. Eternalism's Block Universe asks us to accept a reality that contains *everything that ever happens*, a completed 4D cosmos in which our intuition of the flowing now is an illusion. The Many-Worlds Interpretation then challenges us to imagine that not just one such world exists, but countless branching versions – an embarrassment of riches that may strain credulity even as it solves equations. Presentism swings to the opposite extreme, asserting that reality is nothing more (and nothing less) than the present moment, constantly refreshing – a courageous minimalism that runs into trouble explaining how the world hangs together across time. Existential Realism, finally, offers a nuanced compromise: it keeps the ontological spotlight on the present while allowing the glow of reality to extend into past and future in a carefully delimited way.

In comparing these views, one cannot help but be humbled by the **conceptual vastness** they ask us to contemplate. The Block Universe invites us to picture all of history and all of the future existing *right now* in a grand temporal panorama – a view so expansive that our minds struggle to encompass it. Many-Worlds exponentially magnifies that picture, populating reality with more universes than there are atoms in our world, a multiverse so prodigious that it verges on the incomprehensible — an **ontological inflation that exceeds any coherent measure.** These are extraordinary claims about what

17 Smolin, Lee (2013). Time Reborn: From the Crisis in Physics to the Future of the Universe. Houghton Mifflin Harcourt. (Smolin argues that time is fundamental in the physical world and criticizes the tendency to treat time as just another dimension like space. He warns that by portraying time as a dimension in a static spacetime, "we are committing a fallacy, the fallacy of the spatialization of time," and losing sight of the real dynamism of the universe. This perspective lends support to views that privilege the present and genuine temporal becoming, in contrast to a strict Block Universe.)

reality contains. It is worth remembering the maxim: *extraordinary claims demand extraordinary evidence*. Neither eternalism's block nor the quantum multiverse, for all their theoretical appeal, have direct empirical confirmation; they are interpretations of physics and time, not inevitable conclusions. It may be prudent, therefore, to approach them with **epistemic humility**. We should acknowledge how little we truly know about time's ultimate nature. Our scientific frameworks are powerful but still incomplete, and our human perspective is limited. It could be a metaphysical temptation to simply assume that what makes the equations work (a 4D spacetime, or an uncollapsed wavefunction) must literally be the way reality is. Perhaps it is – but that leap should be taken cautiously, and alternatives should be fairly considered.

Presentism, while more commonsensical in some respects, also illustrates humility in a different way: it doesn't overreach by populating the world with unobservables; yet one might argue it *under*reaches, by denying reality to anything not in the here-and-now. The shortcomings of strict presentism highlight that a satisfying ontology of time must do justice to the connectivity of events across time. We are not solipsists of the present; we rely on the reality of yesterday and tomorrow in almost everything we do. Any credible theory must accommodate that, either by expanding what we count as real or by providing new foundations for truth and causation.

Existential Realism emerges as an appealing middle ground, one that urges a disciplined approach to extraordinary ontological claims. It tells us: before positing innumerable worlds or treating past/future entities as fully existent things, see if a more parsimonious framework can explain the phenomena. ER is built on the modest observation that we only ever directly witness the present, combined with the reasonable assertion that the effects of the past and the tendencies toward the future are undeniable aspects of our world. By bifurcating existence and reality, ER gives past and future their due *without* granting them independent existence that would bloat our ontology. This restraint is a form of ontological humility – a recognition that we should not claim more exists than we have reason to. And yet ER is not skeptically humble to the point of erasing everything beyond the instant; it boldly asserts that the reality of the world is richer and more temporally extensive than what exists right now, only it encodes that richness in the structure of the present.

In closing, exploring these theories of time's ontology is a reminder of the incredible **mystery of time**. Each view – Eternalism, Many-Worlds, Presentism, Existential Realism – offers a framework that is radical in its own way. Our journey from a frozen block universe to a foaming multiverse, then back to the razor-thin present and onward to a nuanced two-tier reality, underscores just how **unsettled** our understanding of time remains. Perhaps the safest conclusion is that humility is warranted. Time may be more than just another dimension or a simple flow – it might be something that our current concepts only partially grasp. The ontologies of temporal vastness we have considered should inspire awe and caution. They are grand intellectual architectures built to house the elusive truth of time. But until evidence or decisive arguments elevate one clearly above the others, it is wise to keep an open yet critical mind.

Ultimately, the most disciplined view might be one that neither denies the reality of things beyond our moment nor indulges in multiplying realities without necessity. **Existential Realism** presents itself as such a view, aiming to respect what experience and science tell us (the present is special; the past and future matter) while avoiding gratuitous metaphysical inflation. Whether ER or something akin to it will prevail is a question for future debates. What is clear now is that thinking about time stretches our imagination to its limits. In confronting temporal vastness – be it the eternal block or the branching multiverse – we come face to face with the profound depth of our ignorance. A healthy dose of wonder, coupled with careful reasoning, will serve us well as we continue to probe the ontological secrets of time.

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3. Einstein, Albert (1955). Letter to the family of Michele Besso, March 1955. (Einstein consoles his late friend's family with the remark that, for those who believe in physics, the separation between past, present, and future "is only a stubbornly persistent illusion." This quote is often cited in support of the Block Universe perspective on time.)

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Further Reading: A comprehensive treatment of this framework, with expanded arguments and interdisciplinary case studies, is presented in the monograph *Existential Realism* (2025). It examines applications in classical physics, quantum physics, relativity, and cognitive science, showing how the ontology can address persistent conceptual challenges across these fields. Available at: www.tenz.in/mono

Cracks in the Projection

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Black Holes and the Hidden Order of Time

Existential Realism at the frontier of black hole horizons and holographic physics: where others see loss or paradox, ER finds a “crack” between reality and existence — information remains real yet beyond present reach. Reframing the holographic principle, this paper shows how even at the universe’s extremes, the present’s projection draws from a deeper, enduring informational order.

Cracks in the Projection: Black Holes, Reality, and the Hidden Order of Time

Tenzin C. Trepp,

Email: trepp@tenz.in

Date: August 15, 2025

Abstract

Contemporary theoretical physics suggests that spacetime and gravity might emerge from deeper informational structures, hinting that our universe could be *holographically* organized. In this speculative essay, we explore the idea that reality itself has a fundamentally holographic character, using black hole physics and quantum information as guiding clues. Black hole thermodynamics reveals a mysterious link between information and the geometry of space, inspiring the holographic principle that a region's content may be encoded on its boundary. We survey how this principle—and the notion of an informational universe—intersects with philosophical interpretations of time: from the eternalist **block universe** view of an unchanging 4D spacetime, to **informational realism** which posits information as the substrate of existence. Against this backdrop, we introduce **Existential Realism** (*ER*), a two-tier ontology distinguishing transient existence from enduring reality. We argue that ER's framework provides a novel lens for these questions. In ER, the present "now" is like a projection of an underlying informational reality; black holes then appear as ontological *cracks* where that projection falters, raising profound questions about time, causality, and hidden order. We show how ER's emphasis on an evolving present and an informationally rich reality can reframe puzzles such as the black hole information paradox and the nature of temporal entropy. **This work is intended as a frontier-level exploration**: it sketches a consonance between cutting-edge cosmology and a new metaphysical model of time, suggesting that what we call "reality" might indeed be a projection from a deeper order of information and existence.

Note on Speculative Approach

The following paper is a speculative, early-stage exploration at the intersection of cosmology and metaphysics. The hypotheses and interpretations offered here reach beyond established theory, aiming to synthesize insights from frontier physics with a novel ontological framework. As such, our proposals are conjectural and intended to stimulate discussion. We explicitly acknowledge that many ideas herein—concerning holographic reality, black holes as "cracks" in existence, and the Existential Realism framework—are tentative and conceptual. The goal is to chart a plausible, philosophically informed perspective on unresolved problems, rather than to claim any definitive theory. We proceed

in an academic tone, but readers should keep in mind the provisional status of the arguments. By treating bold assumptions as working premises, we hope to illuminate new questions and potential connections. This is a **theoretical preprint** meant to inspire further investigation at the cosmology–metaphysics frontier.

Meta-Note on Scope

While most applications of Existential Realism focus on time — distinguishing what exists now from what is real beyond the present — this paper extends the framework to a domain that is **not explicitly time-bound**. Black hole horizons demonstrate that the split between reality and existence can also arise from *spatial or causal inaccessibility*: something may remain real without being present-existent for any observer, regardless of when it occurs. This shows that ER's two-tier ontology is not limited to temporal becoming, but offers a general structure for understanding cases where reality and existence diverge.

The Holographic Universe: Black Holes and Informational Boundaries

The holographic principle suggests that everything falling into a black hole is not truly lost, but rather encoded as information on the event horizon. Within the framework of Existential Realism, this aligns strikingly with the distinction between existence and reality. What was once existent — present and empirical — crosses a threshold where it can no longer be observed or interacted with. Yet its **reality remains**, not as a ghost of presence, but as structured information shaping the boundary conditions of the system. Reality persists even as existence vanishes. ER thus interprets the horizon not as a line of ontological erasure, but of **migration**: the existent collapses, while the real survives in a different form — informational, causally latent, and still part of the world's structure. This echoes the broader holographic idea: that **the depth of space may ultimately be encoded at its edge**.

Modern physics has uncovered striking links between **black holes** – regions of extreme gravity – and the deep structure of information in our universe. In the 1970s, Jacob Bekenstein famously conjectured that a black hole carries an **entropy** (a measure of information or disorder) proportional not to its volume, but to the **area** of its event horizon – the spherical boundary beyond which nothing escapes. This idea, soon supported by Stephen Hawking's discovery that black holes radiate like warm objects, revolutionized our understanding of gravity.[1] The Bekenstein–Hawking formula showed that a black hole's entropy S_{BH} is given by $S_{BH} = k_B \frac{A}{4 \ell_P^2}$ (with A the horizon area), implying that the *information content* of a black hole scales with its surface area, not its volume.[2] This was a profound clue: it suggested that all the degrees of freedom (bits of information) contained inside a region of space might be encoded on the region's boundary. In other words, our three-dimensional reality could be akin to a *holographic projection* of information defined on a distant two-dimensional surface. Gerard 't Hooft and Leonard Susskind formalized this insight in the **holographic principle**, proposing that any physically allowed region can be described by information on its boundary, with at most one binary degree of freedom per Planck-scale area unit.[3] In Susskind's words, the world could be "a hologram" – our experienced volume is a projection of more fundamental data inscribed on a distant surface.[4]

This holographic conjecture remained speculative until a concrete realization emerged in theoretical physics: the **AdS/CFT correspondence** (also known as gauge/gravity duality). First proposed by Juan Maldacena in 1997, AdS/CFT is a duality between two radically different types of theories.[5] On one side stands a higher-dimensional spacetime with gravity (specifically an Anti-de Sitter universe containing black holes), and on the other side, a lower-dimensional quantum field theory without

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gravity defined on that spacetime's boundary.[6] Maldacena's discovery showed that every entity and process occurring in the "bulk" 5-dimensional AdS space can be equivalently described by information on the 4-dimensional boundary (a conformal field theory) – and vice versa. This is widely seen as the **most successful realization of the holographic principle** to date. It provides striking evidence that spacetime geometry and gravitational physics *emerge* from underlying informational degrees of freedom: the boundary theory encodes the bulk spacetime, much like a hologram's thin film encodes a three-dimensional image. In such models, a black hole in the AdS bulk corresponds to a high-temperature state in the boundary field theory, and the growth of the black hole's horizon area (its entropy) reflects the increase of information/entropy in the dual field system. AdS/CFT has not only exemplified holography in a precise way, but has reinforced the notion that the fabric of reality might be *iterally composed of informational relations*. Indeed, some researchers speculate that the spacetime we inhabit is an emergent phenomenon born from more fundamental entanglement or information networks – a view captured by John A. Wheeler's famous slogan **"it from bit,"** meaning that every physical "it" (object or event) ultimately derives from bits of information.[7]

One immediate implication of the holographic paradigm is a novel perspective on **what is "real"** in physics. If the content of a volume of space can be fully described by information on a surface, then the **boundary** (or an abstract space of information states) might be more foundational than the tangible volumetric world we experience. This inversion challenges our intuitions: it is as if the universe we live in were the *projection* of an unseen film of information. Black holes epitomize this puzzle. According to conventional relativity, anything that falls into a black hole is lost forever to the outside world – it passes through the horizon and, classically, cannot return. Yet quantum theory insists that information cannot be destroyed without trace. This tension is the essence of the **black hole information paradox**.[8] A black hole that completely evaporates (via Hawking radiation) seems to eliminate distinctions between different things that fell in, leading to a loss of information about the initial state. The holographic principle offers a potential resolution: all the information of the infalling objects is somehow *encoded on the horizon surface* (often visualized as encoded in microscopic "bits" on the horizon area). As the black hole radiates and shrinks, the information is gradually released in subtle correlations within the Hawking radiation, maintaining overall conservation. In this picture, the event horizon behaves like a **cosmic information membrane** – a dynamic screen that stores and processes the data of whatever has fallen in. The true state of a black hole may be described by this halo of information at its boundary, rather than by unseen conditions deep in its interior. While a full solution to the paradox remains under debate, most physicists believe that *unitarity* (information conservation in quantum mechanics) is upheld: a black hole does not irretrievably erase information, but hides it in highly scrambled form. Notably, Raphael Bousso's covariant holographic bound and related formalisms have generalized these ideas, suggesting that any region's information content (entropy) is limited by the area of an encompassing surface.[9] Thus, black holes have become central to a new way of thinking about reality's architecture: the fundamental *bits of reality* might reside on shifting boundaries and screens.

In summary, black hole physics motivates a radical hypothesis: **perhaps "reality" itself is holographically structured**. Our familiar 3D world could be an emergent projection from a deeper 2D (or otherwise lower-dimensional) order – an order where information and quantum entanglement knit the cosmos together. This raises philosophical questions that go beyond physics: If the universe is a kind of projection, what does that imply about *time*, *existence*, and what is ultimately "real"? To approach these questions, we next consider several interpretative frameworks—from the metaphysics of time to information-centric ontology—that offer different answers about the nature of reality and its relation to what we observe.

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Interpreting the Cosmos: Block Time, Eternalism, and Informational Realism

The notion of a holographic reality forces us to re-examine our assumptions about time and existence. Traditionally, philosophers of time have been divided between **presentist** views (only the present exists in an absolute sense) and **eternalist** views (past, present, and future are equally real within a static spacetime block). The idea of the world as a pre-written hologram might seem to favor an eternalist or "block universe" picture, whereas the experience of a flowing projection might resonate with presentist intuitions. Here we survey three relevant perspectives – the block universe (eternalism), its opposite and complement in theories of time, and informational realism – to set the stage for Existential Realism.

Block Universe / Eternalism: In physics and philosophy, **eternalism** is the view that all points in time are just as real as all points in space; temporal reality is a four-dimensional *block* containing past, present, and future events all at once.[10] There is no objective "now" that slices the universe; the flow of time or the coming-into-being of events is often regarded as an illusion under this view. Many thinkers have argued that Einstein's theory of relativity strongly supports a block universe: since simultaneity is relative and different observers can disagree on what events are "now," one is hard-pressed to single out a unique present.[11] Hilary Putnam's influential argument in 1967 concluded that, given relativity, "any future event *X* is already real" – making eternalism the only tenable ontology of time in a relativistic cosmos.[12] In a block universe, the entire history of the universe can be thought of as a static 4D structure – often analogized to a film reel or a book, where every frame or page exists simultaneously, even though we read them in sequence. This view has a certain resonance with the **holographic principle**: if all of spacetime (with all events past and future) is encompassed in a timeless 4D block, one might imagine that the information describing that block could be "projected" or coded on a boundary. Indeed, some have speculated that the *boundary of the universe in time* (for instance, a cosmological horizon) might encode the entire 4D history inside. In such a fully deterministic block view, puzzles like the black hole information paradox might be seen in a different light: if the universe's history is fixed, information is never truly lost – it is simply located in different regions of the block (for example, inside the black hole during some interval, and in the radiation at a later interval). In fact, physicist Hrvoje Nikolić has argued that treating time as just another dimension (on par with space) can *resolve* the paradox: from a "God's-eye" perspective in the block, no information is missing; it's only an apparent paradox from a within-time perspective.[13] Eternalism's strength is its logical completeness – nothing ever "disappears" or "becomes" since everything simply *is* – but this is also its primary philosophical weakness. It struggles to account for why we experience a flowing present or how to make sense of causation and change. Critics like Lucas and Popper have called the block universe *ontologically inadequate* for precisely these reasons, arguing that it cannot capture the reality of the **passage of time** or the openness of an uncertain future.[14] The block universe, while compatible with relativity and possibly with a fully pre-coded "holographic" reality, leaves something out: the *becoming* of events that is so fundamental to our world.

Presentism and Becoming (a counterpoint): At the opposite pole from eternalism is **presentism**, the doctrine that only present entities and events truly exist.[15] Past things have *been* and future things will *be*, but only the now is real. Presentism accords strongly with our intuitive sense of time's flow but faces notorious difficulties, especially in light of modern physics. Since presentists deny reality to the past and future, they must explain how true statements about past events (like "dinosaurs existed") are grounded, or how to reconcile an absolute present with relativity's relativity-of-simultaneity. We mention presentism here because our later framework (Existential Realism) can be viewed as an evolution of presentist ideas – one that tries to capture the *becoming* aspect while avoiding presentism's pitfalls. In a naive presentist cosmos, a black hole's interior after an object falls in might be problem-

10 Putnam, H. (1967). "Time and physical geometry." The Journal of Philosophy, 64(8), 240–247. doi:10.2307/2024493
11 Einstein, A. (1905). "On the electrodynamics of moving bodies." Annalen der Physik, 17, 891–921. doi:10.1002/andp.19053221004
12 Putnam, Hilary (1967). "Time and Physical Geometry." Journal of Philosophy 64(8): 240–247.
13 Nikolić, Hrvoje (2009). "Resolving the black-hole information paradox by treating time on an equal footing with space." Physics Letters B 678: 218–221.
14 Lucas, John (1989). "The Future." Basil Blackwell.; Karl R. Popper & Albert Einstein (1972
15 Markosian, N. (2004). "A defense of presentism." Oxford Studies in Metaphysics, 1, 47–82.

atic: if one says "only the present exists," what of the object that has passed inside the horizon? Is it now non-existent? If so, how does its mass still exert gravity? Such questions illustrate the tension between presentism and physics. Furthermore, a strict presentist might dismiss the holographic principle's grand claim ("the information of the whole spacetime could sit on a boundary") on grounds that the future and distant past are not real to host that information. In practice, few philosophers cling to an unqualified presentism given these issues, and variants like the **growing block theory** (where past and present exist, but not the future) have been proposed to allow reality to "accumulate" over time. The growing block idea reintroduces a kind of holographic **accumulation** of reality: as time passes, more pages are **migrated** into the record of the cosmos. This is closer in spirit to the framework we will develop, except we will separate the notion of "existence" (what is present) from "reality" (the wider ontology that grows). Before developing that, however, we should consider a third perspective that connects more directly with the holographic and informational themes.

Informational Realism: If the holographic principle suggests that *information* underlies physical reality, one might take this idea to its logical conclusion: **reality = information**. This is the stance of *informational realism*, a philosophical view in which information, rather than matter or energy, is the fundamental stuff of the world. In one formulation, informational realism asserts that what it means for something to be real is that it has causal and communicative efficacy in the network of information exchange.[16] William Dembski, for example, describes informational realism as the thesis that "the ability to exchange information is the defining feature of reality, of what it means, at the most fundamental level, for any entity to be real." [17] In this relational ontology, *to exist is to inform*. Every "thing" is not a static substance but a node in a web of signals; entities are determined by the information they embody and convey. This perspective aligns neatly with the direction physics has taken: quantum mechanics already teaches us that what we can know (information) plays a role in defining what *is* (reality), and quantum entanglement ties objects together via information-like correlations. Pioneers of digital physics like John Wheeler (mentioned above) and Edwin Fredkin speculated that the universe might literally be a giant computer or cellular automaton processing bits. More formally, Luciano Floridi's *Informational Structural Realism* has argued that the world's ontology is comprised of informational relations or "structured information," of which matter and energy are emergent abstractions.[18] From this standpoint, the holographic principle is not so surprising: if everything is information, of course it can be encoded on surfaces or transmitted through fields – physical locality and geometry are secondary. **Informational realism** would thus interpret a black hole as fundamentally an information processor or repository. The disappearance of an object into a black hole is not the loss of a material body, but the transformation of that body's information into a new form (quantum degrees on the horizon, perhaps). Likewise, the expansion of the universe or the passage of time could be seen as the unfolding of a cosmic computation. One attractive feature of informational realism is its ability to bridge physics and metaphysics: it provides a common language for discussing brains and bits, matter and data. However, a pure information ontology can seem abstract to the point of emptiness – one must be careful to explain why certain information is experienced as concrete physical reality by us. Nonetheless, as we push toward a holographic vision, informational realism serves as an inspiration. It urges us to treat "the real" not as a collection of static things but as *the sum-total of information and its transformations*. This will harmonize with our forthcoming Existential Realism framework, which likewise emphasizes an informational substrate (reality) and dynamic updates (existence).

Having set the stage with these interpretations, we see a spectrum of possibilities. The **eternalist block** stresses a fixed cosmic information content (perhaps pre-recorded on some boundary or readily available to a 4D omniscient view), but it sacrifices a sense of flow. **Presentist/growing-block views** capture the immediate reality of the present and the coming into being of new events, but risk disconnecting from the physical insights of relativity and holography. **Informational realism** aligns with the holographic ethos, recasting ontology in informational terms, yet by itself it does not explain the *why* of time's directedness or the difference between past and future. We now turn to **Existential Realism**, a framework that attempts to integrate the strengths of these views. ER distinguishes between *existence* (what is concretely present) and *reality* (what is ontologically real, including past

16 Floridi, L. (2011). The Philosophy of Information. Oxford University Press.
17 Wheeler, J. A. (1990). "Information, physics, quantum: The search for links." In W. H. Zurek (Ed.), Complexity, Entropy and the Physics of Information (pp. 3–28). Addison–Wesley.
18 Floridi, Luciano (2011). The Philosophy of Information. Oxford University Press.

causes and future potentials), offering a two-tiered model that can accommodate a holographic information picture *and* a genuine temporal flow. We will argue that ER provides a fruitful way to think about the "projection" of reality, the special status of the present, and phenomena like black holes that challenge naive ontologies.

Existential Realism: Existence, Reality, and the Projection of the Present

Existential Realism (ER) is a recently proposed ontological framework aimed at resolving the tension between presentism and eternalism by *separating the concepts of existence and reality*.[19] In ER's two-tier ontology, **existence** is defined narrowly: something *exists* if and only if it is present and empirically accessible (in principle) at the current time. **Reality**, by contrast, is a broader category: it includes anything that is part of the world's total causal or informational structure, even if not present or observable now. In short, *all existents are real, but not all real things are currently existent*. This simple distinction allows ER to say, without contradiction: *"Only the present exists, but much more than the present is real."* Past events and entities, for example, are not existing now, yet they are real in ER because they have left causal traces and structured the world we inhabit. Likewise, future events (insofar as they are reliably predictable or already entailed by current conditions) can be said to have a sort of reality – they are part of the world's unfolding structure – even though they do not yet exist. By decoupling reality from instantaneous existence, ER manages to *"keep the ontological economy of presentism and the explanatory breadth of eternalism."*[20] We do not populate the universe with an infinite array of ghostly objects for every time (as a naive eternalist might), but we also do not dismiss anything outside the present as unreal (as a strict presentist would). Reality becomes an ever-growing, information-rich web, while existence is a flickering spotlight on the latest page being written.

Existence as the Projected "Now"

This ontology naturally lends itself to a **projection metaphor**. We can think of *Reality* (capital R) as akin to the **encoded informational substrate** – analogous to a film reel or a holographic plate containing a full record or interference pattern – and *Existence* (the present moment) as the **projected image** that appears on the screen *now*. At any given instant, only one frame of the film is illuminated (the present existent world), yet the film as a whole (past frames, and even future frames insofar as the story's structure is laid out or being written) represents the broader reality. The metaphor is not perfect, but it provides intuition. In a classic hologram, a 2D plate with encoded information can project a 3D image when light shines on it; similarly, we might imagine the high-dimensional informational structure of reality "projects" the lived 3D world we experience moment-to-moment. ER suggests that what exists for us right now is just the currently projected cross-section of the total information structure. This resonates strongly with the **holographic universe hypothesis** discussed earlier. If indeed the universe's state is fundamentally recorded on some boundary or in some informational matrix, then what we call the "present universe" could be a kind of **momentary view or transition point** within that recording. ER provides a way to articulate this: The present is ontologically special (it's where existence is), but it is not ontologically exhaustive (reality contains more than what is visible now). Importantly, ER doesn't claim the future is fully predetermined or etched in the film from the start – rather, it holds that the **future consists of real possibilities** which become definite as the present advances. In the projection analogy, one might say the film is still being made or edited as we go — a progressive migration from possibility into actuality — not pre-shot in its entirety. The key point is that ER can embrace a **dynamical projection**: reality is an underlying repository of information (including records of the past and structured tendencies toward the future), and existence is the emergent "frame" that is currently actualized.

19 Trepp, T. C. (2025). "Existential Realism: A Distinct Ontological Framework Beyond Presentism." (Preprint). – Introduces the ER framework and its core distinction between existence and reality, aiming to reconcile presentism's appeal with eternalism's inclusiveness. https://philpapers.org/archive/TENERM.pdf

20 Trepp, T. C. (2025). "Existence ≠ Reality: What Exists, What's Real, and Why It Matters." (Preprint). – Expands on ER, illustrating how it preserves presentism's "ontological economy" (only present exists) while capturing eternalism's continuity (past/future are real), and discusses implications like truthmakers for past events.

Under this view, **time** is no longer an illusion as in the strict block universe, but neither is it an absolute metaphysical gulf that deletes what came before. Instead, time is the process of *becoming real* – the continual **encoding of new events into reality** and the **revelation of reality in the form of new existents**. We can say that *reality accumulates while existence continually updates*. This neatly parallels how a hologram might be constructed: piece by piece, information is added (or revealed) which alters the resulting image. It also mirrors how a computation unfolds in time: each tick of a clock irreversibly records new bits (the past grows) and yields a new state (the present moment) based on previous states. The "hidden order of time" in this picture is the idea that there is a deeper continuity and conservation running through the succession of moments. Even as we experience only the present, the structure of reality retains and integrates the past and charts possibilities for the future. Thus, ER offers a way to conceptualize the **flow of time** without giving up a robust underlying structure: the flow is the *projection mechanism* moving from one encoded state to the next.

Black Holes as Ontological "Cracks"

If reality is like a recorded film or a holographic slate and the present is its projection, then what is a **black hole** in this analogy? We propose that black holes can be thought of as places where the projection mechanism encounters a pathological limit – *ontological "cracks"* where the usual correspondence between reality and existence breaks down. In more concrete terms, a black hole's event horizon marks a boundary beyond which events are cut off from the view of any external observer. Information that falls into a black hole, in classical general relativity, cannot influence an outside observer's experience anymore; it is as if those bits of reality have vanished from existence (from the observable world) despite still "being there" in some inaccessible form. This is precisely the kind of situation ER is built to address, and it casts the black hole in a new light metaphorically.

Consider that in ER, to **exist** means to be accessible in the present. Once a astronaut, say, passes the horizon from our perspective, her subsequent fate is no longer something that can have any effect on *our* present or future observations (barring speculative outcomes like wormholes or future evaporation). In ER terms, after crossing the horizon, that astronaut is no longer an existent in our world – she has effectively stepped out of existence (for us). Yet, we do not want to say she became nothing or unreal. She still has a reality, but it is now *hidden behind the horizon*. The information that makes up her physical being is presumably still in the world (perhaps stretched across the horizon or inside the black hole's quantum state). Thus, a black hole creates a crack between reality and existence: something can be real (it has not magically ceased to be part of the cosmos) but is no longer existent for any observers outside. The **projection of reality into existence falters** at the horizon – what lies beyond cannot be projected out. In our metaphor, it is as if part of the film has been sealed off in a vault, or a portion of the holographic plate has become unreadable to the projector. We see only a dark void (the "silhouette" of the black hole) where that information would be projected.

This viewpoint helps articulate why black holes are so puzzling: they challenge the assumption that reality and existence always coincide for all observers. Normally, if something is real, we expect that under the right circumstances it could be observed or could affect experience. Black holes force us to accept that vast realms of what we take to be real might be forever insulated from exerting any influence on us. In ER's language, black holes harbor *real entities that lack existence-for-us*. They are extreme examples of **ontological ambiguity** – are the infallen things "still there" or not? ER answers: they are there in reality (their mass-energy, their causal contributions are accounted for in the gravity of the hole), but they do not exist in any present that we can access. This is not just philosophical hair-splitting; it has practical implications for physics. The black hole information paradox essentially asks: does the information really disappear or not? ER would frame this as: does the information remain part of reality (even when it's not part of anyone's present existence), or is it truly annihilated, meaning it was never encoded into reality to persist? ER inclines toward preserving reality – i.e. the information must remain real in some form, even if temporarily removed from existents' reach. Indeed, from the standpoint of many physicists, the resolution of the paradox lies in subtle correlations that ensure the information is *there* (in reality) even when it looks lost (from the perspective of exis-

tence). For example, in **black hole complementarity** or related hypotheses, infalling information is neither duplicated nor destroyed: it exists *on the horizon* (from an outside description) even as it passes through (from an infaller's description). There is a kind of dual description where the information is both reflected at the horizon and absorbed – such that no observer sees a violation of physical laws, but overall the information is not destroyed. This strange situation is reminiscent of ER's two-tier view. We can imagine that what fails to exist in one frame of reference (falling inside from outside) might still be accounted for as real in another manner (imprinted on the horizon in a highly redshifted form). The horizon itself, coated with degrees of freedom proportional to its area, becomes a *tangible realization of reality apart from direct existence*. An external observer never sees the infalling astronaut cross the horizon; instead, her image asymptotically freezes and fades (encoded on the horizon). In a sense, the astronaut's fate *from the outside perspective* is to become part of the information cloud on the black hole's boundary – part of reality, but not an active existent anymore.

By viewing black holes as cracks in the projection, we highlight an important lesson: **our usual equations between what is real, what exists, and what can be observed may break down in extreme regimes**. ER predicts such breakdowns are precisely where new physics or new understanding is needed. The hidden order of time might include conditions like horizons where reality's order is preserved in ways that existence can't penetrate. Later, when Hawking radiation slowly releases energy, one might say existence is "picking up the threads" of reality that were hidden, as the black hole gradually evaporates and reveals (in principle) the information it held. Whether Hawking radiation indeed carries out all the hidden information is an open question, but if it does, then what was a crack may be healed over long times: the projection eventually re-displays what was temporarily lost, albeit in a highly scrambled form. If not—if information is truly lost into a singularity—then ER would face a deep puzzle, since that would mean something real (the information) ceased to be real without any trace, defying conservation. Most believe that quantum gravity won't allow that; something like ER's intuition, that reality *accumulates* and does not delete, should hold.

Becoming and the Unfolding of Information

A cornerstone of Existential Realism is the notion of **becoming**: reality is not a static collection of facts but an ongoing process of events "coming into existence." ER asserts an objective difference between past, present, and future. The **present** is the frontier where new existents appear; the **past** consists of events that *were present* and have left reality richer (with records, memories, causal impacts); the **future** consists of events that *may become present* (real possibilities structured by current reality). This dynamic picture contrasts with the eternalist block (where all events simply are), and also with many-worlds interpretations (where all possible events exist in parallel trajectories, so nothing truly new ever happens – it has happened in some trajectory already). In ER, when an event happens now, that is a genuine *addition* to the ontology of the world – something that was not real before becomes real (and existent, momentarily). This accounts for the intuition of *time's flow* or *the advance of the now* in a rigorous way.

How does this process look when we incorporate the holographic, informational perspective? It looks like an **unfolding of information**. With each moment, new information is instantiated in reality – new bits that weren't there prior (or new specific values chosen from prior possibilities). The "hidden order" here refers to the principle that while entropy (disorder) tends to increase in the second-law sense, the total information content of reality does not vanish; instead it continually grows or at least transforms in lawful ways. ER can be seen as an *information bookkeeping ontology*: it keeps track of what has become actual. For instance, consider a simple event like the decay of a particle, which is inherently probabilistic. Before decay, there was a real possibility that at time t the particle would decay (and alternatively, a possibility it would not, or would decay later). Until t, these outcomes were not yet decided – they were part of reality as an open set of possibilities encoded in the quantum state. At time t (the moment of decay), one outcome becomes present: say the particle decays and emits a photon. That outcome *enters existence* and thus enters reality fully. The other possibility (no decay at t) ceases to be a live possibility (it is now counterfactual and no longer part of reality's

structure except perhaps as a record of "what could have been" in the past state). After t, reality now contains the fact that a photon was emitted (which may be recorded in various traces), and the world's informational state has been updated. In ER, this is not merely an update of observers' knowledge, but an actual ontological update – reality *did not include that photon before, and now it does*. Such a view dovetails with certain interpretations of quantum mechanics that emphasize the definiteness conferred by measurement or collapse: *the present is when indeterminate potentials resolve into a single actual state*. Some quantum cosmologists and philosophers (e.g. George Ellis, Lee Smolin) have similarly argued that time is real and creative, bringing about new facts that were not previously determined.[21] ER provides a formal metaphysical scaffolding for this: at each "now," the world's reality gains content.

This emphasis on becoming is crucial for reconciling with the **second law of thermodynamics** and the growth of entropy. Entropy can be thought of as missing information (uncertainty about microstates). As entropy increases, one might say the *details* of reality become harder to recover (order is lost), yet the **overall information** in reality (considering all correlations and records) might still be conserved or even increasing when one counts new independent degrees of freedom. ER would say that when entropy increases, it reflects that the present introduces new outcomes (hence new information) but often in forms that are dispersed and not easily usable. For example, burning a log increases entropy by turning structured chemical energy into dispersed heat and ash; information-wise, the precise arrangement of molecules in the log is lost to us, but the total information isn't destroyed – it's now in the correlations between myriad particles in the smoke, air, and so on (practically irretrievable, hence "lost" for us, but still existent in principle). ER's distinction helps here: *the fine-grained details might no longer exist for any accessible observation (they're too scrambled to reconstruct, effectively not present), but they remain part of reality's microstructure*. In a sense, reality holds a hidden order that existence does not reveal to us directly. Nowhere is this more dramatic than in black holes: when a black hole swallows a highly ordered object, from the outside all that order seems to be thermalized into a few parameters (mass, charge, spin). Entropy skyrockets, and the information about the object's detailed structure is *hidden*. According to ER, that structure did not cease to be real; it became part of the black hole's internal (or horizon) degrees of freedom, i.e. part of reality inaccessible to existence outside. The *order* is hidden, perhaps maximally so. As the black hole evaporates, that hidden order should in principle re-emerge in subtle correlations among the Hawking quanta. ER would interpret the completion of evaporation as the release of information from reality into new present existents at that later time — not a return of the original object, but the emergence of effects and records that can now be part of existence for observers in that future moment.

Information Paradoxes and the Hidden Order of Reality

By applying ER's lens, we can offer fresh perspectives on longstanding debates such as the black hole information paradox and more generally on how **order and disorder** are understood in cosmology:

- **Conservation of information:** In quantum theory, unitarity demands that information is never destroyed; it can be scrambled but in principle is recoverable. ER naturally accommodates this: because reality is defined by the total causal/informational structure, one cannot simply have chunks of reality disappearing. If something were truly destroyed in the sense of no longer being part of reality *and* leaving no trace, ER would deem it unreal to begin with (similar to how ER dismisses "undetectable objects" as not real). Thus, for ER to remain coherent in a universe with black holes, it must be that black holes *do not* destroy information in the absolute sense. Instead, information might temporarily exit the stage of existence but remain written in reality's ledger. This provides a metaphysical rationale for why physicists have confidence that some resolution (whether via holography, hidden correlations, or new physics) preserves information: reality, as we conceive it, doesn't blink things out of existence for good. Here ER

21 Smolin, Lee & Unger, Roberto Mangabeira (2015). The Singular Universe and the Reality of Time. Cambridge University Press. – An argument for the objective reality of time and a critique of the block universe, from a physicist and philosopher, suggesting that law and state evolve together and time's passage is fundamental.

aligns with the intuition behind black hole complementarity and holography – the information is *somewhere* in reality, even if no single observer can see it all at once.

- **Entropy and hidden order:** The "hidden order of time" in our title refers to the idea that increasing entropy (growing disorder in the observable world) may conceal a deeper order that isn't apparent in the present but exists at the global level. ER's reality can harbor extensive structure that is not manifest to any given observer's existence. For instance, two particles in an entangled state have a joint reality (their quantum correlation) that no single local observation reveals; only by considering them together (or by hindsight after communication) can one see the order (the perfect anti-correlation, say). In time, as entropy grows, the universe's state may become highly entangled and information widely dispersed. From within any local, present perspective, things look random – but the total state may have intricate patterns. ER suggests thinking of reality as *including those holistic patterns*, even if they are beyond the horizon of what exists for an observer here-and-now. Philosophically, this resonates with ideas of a block universe, yet without freezing the dynamics: the patterns can be built up over time. One might say that **reality has an algorithmic or informational compression** that preserves these patterns, whereas each present moment only shows a tiny excerpt. In this way, ER could potentially contribute to understanding why the universe started in a low-entropy (high-order) state and how order flows into disorder: the order is never lost, it just becomes *non-local* (spread across reality's web).

- **Causality and temporal order:** ER maintains a strong sense of causation across time because past events, though no longer existent, remain real and thus can serve as definite causes of present effects. This is how ER solved the truthmaker problem for past-tense statements in its original formulation: by allowing past entities to be real, it provided "truthmakers" for claims about them. In the black hole context, this means even after something falls in (past event), it can still be the real cause of, say, the black hole's increased mass or a particular pattern in the Hawking radiation later. We don't have to invoke mysterious present entities to account for those effects; the past entity itself (now real but not existent) can be the source. The chain of reality is unbroken even if existence flickers on and off for various pieces. This continuity is a kind of hidden order: a conservation law in ontology.

- **ER vs. block vs. informational realism:** It is worth contrasting how ER handles these issues differently. A pure block universe would say all the information is just there in the 4D spacetime – no paradox, but also no mechanism of becoming or resolution needed. Informational realism might say information is always conserved by definition, but it doesn't highlight the role of the present or how information manifests gradually. ER sits in between: like the block view it posits an underlying continuity of reality (hence it expects consistency and conservation), but like presentism it asserts a special creative role for the present (hence it deals in how information *enters* reality). In doing so, it provides a narrative for how information **flows**: from being merely possible to becoming actual, from being hidden to becoming revealed, and sometimes (in black holes) being *temporarily sequestered* only to reappear in another form.

Finally, let us speculate on a grander picture suggested by ER when combined with holography. If the universe is holographically encoded, one might imagine the ultimate "boundary" that records reality is something like the cosmic horizon or the quantum gravity degrees of freedom of spacetime itself. ER would then imply that this boundary record *grows* with time – much like a growing film reel that is recording the history of the universe. Black holes, which are like sub-horizons, are complications in the record: they segment off portions of the information for a while. But from the godlike view of the universal boundary, perhaps even those portions eventually reintegrate (when black holes evaporate or when one considers the entirety of space including the interior as a part of the hologram). The hidden order of time could then be literal: the boundary might exhibit a pattern or an order that is not obvious from within spacetime, encoding every nuance of the story that unfolds. In this sense, the distinction between existence and reality maps to two "views" of the universe: the interior view where we experience an ephemeral now and incomplete information, and the exterior (or transcendent) view where all information is laid out (but not statically as in a block, rather cumulatively as on a growing sheet). ER

doesn't claim we can actually attain the transcendent view – but it allows us to reason *as if* there is a consistent reality that such a view would see, without denying the specialness of the present for those inside.

Conclusion

Cracks in the Projection has attempted to weave together cutting-edge physical theories with a novel metaphysical framework to illuminate the nature of reality, time, and information. We began by examining how black hole physics and the holographic principle challenge our naïve notions of space and reality, suggesting that the universe may fundamentally be an information structure that projects the world of appearances we inhabit. We then surveyed how different philosophies of time – eternalism's block universe, the process of becoming in presentism, and ontologies like informational realism – interpret these discoveries, each capturing part of the truth but missing aspects that others emphasize. Finally, we introduced Existential Realism as a two-tier ontology that distinguishes existence (the present, experienced world) from reality (the underlying informational cosmos), and we explored how this view can uniquely accommodate the holographic, "projected" universe idea.

In the ER perspective, the present is the ever-moving spotlight that renders reality's information into concrete existence. Black holes in this picture are not just astrophysical curiosities but profound ontological laboratories: they reveal where our normal projection of reality reaches its limits, hinting at a deeper order beyond. By seeing black holes as cracks in the projection, we underscore how they expose the gap between what is real and what is accessible or existent. ER's framework suggests that even if a part of the universe is out of sight (beyond a horizon or in the deep past or far future), it remains part of reality's totality. This helps reframe the information paradox and similar puzzles – not as absolute paradoxes, but as signs that we need to broaden our concept of reality to include the unseen and the not-yet. The hidden order of time, as ER portrays it, is that the world *makes sense as a whole* even if locally we perceive disorder and loss. Every event that *becomes* leaves an imprint in reality's fabric; every bit of information has a place in the accounting, though we may never decode the full ledger.

We emphasize again that the ideas presented here are *highly speculative*. Many strands remain loose. For instance, a full synthesis of ER with a precise holographic model of the universe is beyond our scope – it would require a detailed matching of ER's "reality" to a physical information repository (be it a holographic screen or the quantum state of the universe), and "existence" to something like an emergent classical world or observational slice. Similarly, the treatment of black hole interiors and the fate of information pushes at the boundaries of known physics; our ER interpretation is at best an analogy awaiting a rigorous theory of quantum gravity to confirm or refute it. Nonetheless, by engaging in this interdisciplinary thought experiment, we hope to have shown the *plausible coherence* of the narrative: that one can imagine a cosmos where **black holes, holographic information, and an evolving present** all fit together in a single ontological picture.

In closing, if reality is indeed a projection, then understanding the projector (the hidden mechanisms and structures that produce the world of our experience) becomes a paramount scientific and philosophical task. Existential Realism offers one possible conceptual toolkit for this task. It reminds us that reality might far exceed existence – that much of what is real is not immediately visible in the now, yet is no less important. As we advance in both theoretical physics and metaphysical inquiry, frameworks like ER can help translate between the language of quantum information and the language of human temporal experience. They allow us to ask meaningfully: *Where (and when) are we in the grand scheme of things?* The answers remain elusive, but the questions guide us toward a deeper understanding. The cracks in the projection – those edge-cases like black holes and quantum mysteries – are not flaws to be lamented; they are windows into the fundamental workings of the universe. By studying them under a dual lens of physics and philosophy, we inch closer to glimpsing the hidden order that underlies time and reality.

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Existential Realism

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Tenzin C. Trepp

trepp@tenz.in