Rethinking Time and Spacetime as Epistemic Structures

Author: itzhexen

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Abstract:
This paper explores a novel conceptualization of time and spacetime not as fundamental entities or independent dimensions, but as emergent frameworks arising from the unfolding of interaction and the gradual resolution of incomplete knowledge. By analyzing common uses of time and revisiting physical notions of spacetime from this epistemic perspective, the paper proposes that time is best understood as the structure of “need more to know,” an interval of unresolved interaction. Spacetime, then, emerges as a combined relational construct describing how knowledge gaps unfold and resolve across both spatial and temporal dimensions, inherently tied to observer-dependent frames.

Introduction:

Traditional views treat time as a universal dimension flowing independently, measurable and continuous. Physics unites space and time into a four-dimensional spacetime fabric with objective metrics. However, a closer look at how time functions in everyday language and cognition reveals it as a marker of epistemic states—specifically, the tension between not knowing and knowing. This paper builds on this insight and examines how time as an epistemic structure integrates with the physical concept of spacetime, emphasizing relational and observer-dependent aspects.

Time as an Epistemic Structure:

When we say “over time,” we usually imply that something gradually becomes known or resolved. Time, in this sense, is not a thing but a label for the unfolding of incomplete knowledge. For example, waiting for the moon’s phases to reveal its full cycle is not about an independent time passing, but about gathering enough interactional data to form a complete mental model. Similarly, durations such as “three hours” only become meaningful retrospectively, once a task or event reaches completion and its complexity is resolved.

Language provides multiple uses of time—measurement, coordination, duration, waiting, cause-effect ordering, and more. All of these can be reframed epistemically: they are labels for intervals where information or interaction remains incomplete or in flux. Scheduling a meeting at 5 pm is an agreement to synchronize two incomplete frames of knowledge at a projected point of resolution. Narrative pacing controls the flow of revealing information. Emotional experiences of time reflect the density of unresolved or resolved interaction.

Space, Time, and Spacetime:

In physics, spacetime combines spatial and temporal dimensions, and events are located within this fabric. The ordering and measurement of events depend on observer frames, mirroring the epistemic model where knowledge and interaction are frame-dependent. Space can be seen as relational difference—how far apart interaction points are—while time is the measure of the gap in understanding or resolution along an unfolding interaction.

Relativity’s light cone can be interpreted as the maximum speed of knowledge or interaction transfer, limiting how quickly systems can resolve. Observers disagreeing on simultaneity correspond to different frames of knowledge and interaction unfolding.

Implications and Conclusion:
This epistemic perspective reframes time and spacetime from immutable structures to emergent features of interaction and knowledge resolution. It accounts for observer dependence and the asymmetry between the known and unknown, shedding light on the nature of causality, memory, and experience. Time, as the “need more to know,” is the tension space that structures how events become meaningful.

The paper suggests further research exploring how this view aligns with or challenges current physics interpretations and cognitive science frameworks, and how it can influence models of information, causality, and perception.

References:
This paper is a conceptual exploration inspired by epistemic and phenomenological analysis, integrating basic insights from physics relativity and cognitive linguistics.