

Human Temporal Metacognition: An Explanatory Hypothesis

On the shoulders of giants “por los siglos de los siglos”

History becomes possible when at least three natural cycles repeat with incommensurate periods, producing configurations whose relative phases continually drift and never exactly repeat.

The Earth–Sun–Moon system presents observers with a particular sort of temporal environment: a set of stable but incommensurate cycles whose relative phases continually drift and admit comparison. Meanwhile, the objects traveling in these cycles (the Sun, Moon, and Earth) interact in complex ways—through tides, energy transfer, and other processes—that become crucial for biological life. Human temporal metacognition develops in response to this structured signal.

Human temporal metacognition emerges from the interaction of four recurrent processes experienced by an Earth-bound observer: the solar day, the lunar phase cycle, the solar year, and the circadian sleep–wake rhythm. The three celestial cycles possess incommensurate periods, generating quasi-periodic patterns—stable motions whose relative phases continually drift. This underlying structure makes the development of counting, memory, and inductive estimation advantageous, since empirical estimates of ratios between characteristic constants of these quasi-periodic processes accumulate through repeated observation rather than diverging without bound or collapsing into exact repetition. Moreover, the interactions between the objects whose relative motion is interpreted cyclically—which largely determine Earthly patterns such as biological adaptations—depend on their underlying relative positions, making explicit modeling of such cyclical patterns advantageous for the control of terrestrial systems.

Societies historically come to represent relations between characteristic constants of these cycles through ratios between them (e.g., ~365 solar days per solar year), calendars, and continuous real-valued models of time. The circadian rhythm simultaneously segments subjective experience into discrete episodes through the sleep–wake cycle. The result is a dual conception of time: discrete lived intervals embedded within continuously modeled celestial motion. Each human life becomes entrained into this dynamical scaffold.

Change appears as aperiodic variation within an underlying pattern of stability. Because the relative phases of the celestial cycles continually drift, accounting for such variation benefits from the abstraction of recursively nested temporal demarcations—days within months, months within years, and so on, extended ad infinitum “inward” and “outward”—together with the maintenance of records across cycles.

Epistemically, the ratios governing these cycles are inductive approximations derived from observation and record-keeping. Their numerical values are refined through repeated measurement and expressed as real-valued quantities in continuous temporal models. Human symbolic systems thereby impose numerical structure on a multi-body procession whose precise relative phases are never exactly and fully known. The structural relationships between cycles are partially knowable—stable real-valued ratios of

characteristic constants can be estimated empirically—yet the relationships between the interacting objects never collapse into exact repetition. There remains novelty amidst structure.

With each birth the process repeats: a new observer gradually entrains to Earth's dynamical rhythms and inherits the temporal framework accumulated by prior generations.

History becomes the maintenance of physical records—demarcations, such as pencil on paper, pressure waves in air generated by moving membranes, or light emitted by diodes arranged in standardized fonts—of possible continuations of universal relative motion under a particular superimposed continuous and cyclic temporal model. It is, in other words, a stochastic process of sampling-through-externalization within the world-process, enacted through acts of demarcation: an intractable flux viewed through an ever-finer grate and compared as discrete instances of abstract units, recursively interpreted and reinterpreted interpersonally through (1) abstraction, which enables compressive projection; (2) analogy, which allows domain transfer of hypotheses; and (3) communication among agents.