Temporal Experience and Phenomenological Flow

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Abstract

This paper develops a structural account of temporal experience within a framework that treats irreversible time as primitive and commitment as persistent state-space reduction. Subjective temporal flow is not taken as an independent ontological feature, but as the internal manifestation of successive irreversible commitments. Each commitment excludes admissible future trajectories in a manner that cannot be reversed; ordered accumulation of such exclusions generates directionality, continuity, and irreversibility in experience. The distinction between externally measured duration and felt duration is explained as a divergence between metric time and commitment density. Variations in perceived temporal speed correspond to differences in the rate and magnitude of state-space contraction, while states described as timeless correspond to suspension of new binding events despite ongoing irreversible time. The account remains substrate-neutral and derives phenomenological structure directly from constraint topology under temporal irreversibility.

1 Definitions

Let S be a state space of possible system configurations.

Let T denote irreversible time, taken as primitive and strictly ordered. Time is not derived from change; it provides the ordering within which state transitions and commitments may occur.

Trajectory. A trajectory is an order-preserving mapping

$$\gamma : T \to S.$$

It represents a complete temporally ordered evolution of the system.

Admissible futures at time t. Given the system state $s_t \in S$ at time t, define

$$F_t = \{\gamma \mid \gamma(t) = s_t\}.$$

F_t is the set of all trajectories consistent with the system's current constraint structure.

Commitment at time t. A commitment is a transformation

$$C_t : F_t \to F_{t^+}$$

such that

$$F_{t^+} \subset F_t,$$

and the exclusion is persistent under continuation. If a trajectory γ is excluded at t, it cannot be reinstated at any later time.

Commitment is therefore defined as irreversible state-space reduction.

Commitment succession. An ordered sequence of commitments $\{C_{t_1}, C_{t_2}, \ldots, C_{t_n}\}$ with strictly ordered times

$$t_1 < t_2 < \cdots < t_n$$

satisfies

$$F_{t_{n+1}} \subsetneq F_{t_n}.$$

Succession produces monotonic contraction of admissible futures.

Constraint topology. Let $\mathcal{F} = \{F_t \mid t \in T\}$. The constraint topology is the partially ordered structure $(\mathcal{F}, \subseteq)$ induced by inclusion over admissible trajectory sets. Irreversible time generates a strictly descending chain

$$F_{t_{n+1}} \subsetneq F_{t_n},$$

which defines the continuation structure of the system.

Commitment magnitude. For a commitment at time t,

$$\mu(C_t) = |F_t| - |F_{t^+}|,$$

where $|\cdot|$ denotes a measure over admissible trajectories. Commitment magnitude quantifies the extent of irreversible exclusion.

Cumulative contraction over interval $[t_a, t_b]$.

$$\Delta F_{[t_a,t_b]} = |F_{t_a}| - |F_{t_b}|.$$

This represents total irreversible reduction across the interval.

Commitment rate. Let $\tau : T \to \mathbb{R}$ be an order-preserving mapping defining metric time. For interval $[t_a, t_b]$,

$$\rho = \frac{\Delta F_{[t_a,t_b]}}{\tau(t_b) - \tau(t_a)}.$$

Commitment rate measures contraction relative to metric duration.

Binding density. Binding density over an interval is the cumulative magnitude of irreversible exclusions occurring within that interval. It may be expressed as the sum or integral of commitment magnitudes.

Zero-binding interval. An interval $[t_a, t_b]$ such that

$$F_{t_b} = F_{t_a}.$$

No new commitments occur during this interval.

Clock time. Clock time is metric duration defined by τ. It measures interval length independently of state-space contraction.

Felt time. Felt time is the internal structural ordering induced by commitment succession. It

reflects accumulated irreversible exclusions rather than metric duration.

Phenomenological flow. Phenomenological flow is the stabilized internal manifestation of ordered, irreversible contraction of admissible futures across commitment succession.

2 Two Structural Forms of Time

Irreversible time is primitive and strictly ordered. It provides the condition under which trajectories and commitments may occur. Within this ordering, two structurally distinct forms of temporal description can be identified: clock time and felt time.

2.1 Clock Time

Clock time measures interval length independently of state-space contraction. Let

$$\tau : T \to \mathbb{R}$$

be an order-preserving mapping. For $t_a < t_b$,

$$\Delta\tau = \tau(t_b) - \tau(t_a)$$

defines metric duration.

Clock time continues regardless of whether commitments occur. An interval may have positive metric duration even if

$$F_{t_b} = F_{t_a}.$$

Thus clock time is insensitive to commitment structure.

2.2 Felt Time

Felt time is not a metric but a structural ordering induced by commitment succession. If commitments occur at $t_1 < t_2 < \cdots < t_n$, producing

$$F_{t_1} \supset F_{t_2} \supset \cdots \supset F_{t_n},$$

then directionality arises from monotonic contraction of admissible futures.

Felt time therefore reflects accumulated irreversible exclusion. Its magnitude over an interval corresponds to cumulative contraction

$$\Delta F_{[t_a,t_b]}.$$

Clock time measures interval length. Felt time measures structural change in admissible continuation.

2.3 Structural Divergence

Metric duration and contraction magnitude need not correlate. It is possible that

$$\Delta\tau \text{ is large while } \Delta F_{[t_a,t_b]} \approx 0,$$

or that

$$\Delta\tau \text{ is small while } \Delta F_{[t_a,t_b]} \text{ is large.}$$

The first case corresponds to extended metric duration with minimal state-space reduction. The second corresponds to substantial irreversible contraction within brief metric duration.

This divergence explains the distinction between measured duration and experienced temporal passage without introducing additional ontological entities.

3 Phenomenological Flow as Commitment Succession

Given commitment succession

$$F_{t_1} \supset F_{t_2} \supset \cdots \supset F_{t_n},$$

each commitment produces a persistent exclusion of trajectories. Because excluded trajectories cannot be reinstated, succession induces intrinsic orientation.

3.1 Directional Structure

Directionality follows directly from strict inclusion:

$$F_{t_{n+1}} \subsetneq F_{t_n}.$$

Reversal would require restoration of excluded trajectories, which contradicts irreversibility. The forward character of temporal flow therefore corresponds to monotonic narrowing of admissible futures. Because irreversible time forbids reinstatement of excluded trajectories, contraction induces asymmetric continuation conditions.

Proposition 1. *Under irreversible time, commitment succession induces asymmetric continuation conditions on admissible futures.*

Proof. Commitment succession produces a strictly descending chain

$$F_{t_{n+1}} \subsetneq F_{t_n}.$$

Excluded trajectories cannot be reinstated without violating irreversibility. Therefore admissible continuations at t_{n+1} are a proper subset of those at t_n, establishing structural asymmetry in continuation conditions. □

Corollary 1. *Phenomenological flow corresponds to the internally stabilized manifestation of asymmetric continuation conditions induced by commitment succession.*

Proof. Phenomenological flow was defined as the manifestation of ordered, irreversible contraction of admissible futures. By Proposition 1, commitment succession induces asymmetric continuation conditions. Therefore flow corresponds to stabilization of this asymmetry under irreversible time. □

3.2 Continuity

Although admissible futures contract, binding structure persists; each $F_{t_{n+1}}$ is constrained by F_{t_n}.

Continuity of identity across time is therefore continuity of binding topology under successive reductions.

Phenomenological flow consists not in the perception of duration but in the stabilized internal manifestation of ordered exclusion.

Identity continuity across time holds iff the constraint topology inducing $F_{t_{n+1}}$ is derived from F_{t_n} by irreversible contraction.

Identity therefore consists in preservation of constraint topology across commitment succession. A system retains identity over an interval iff its admissible future structure evolves by strictly monotonic contraction without discontinuous expansion.

3.3 Accumulation and Momentum

Let commitments occur at times $t_1, t_2, \ldots, t_n$. Cumulative contraction over the interval is

$$\Delta F_{[t_1,t_n]} = |F_{t_1}| - |F_{t_n}|.$$

As contraction accumulates, the system's admissible continuation becomes increasingly constrained. This accumulation produces the structural condition for experienced continuity and directional progression.

Temporal flow is therefore the phenomenological correlate of commitment accumulation under irreversible time.

4 Flow and Commitment Density

Let binding density over interval $[t_a, t_b]$ be D, defined as the cumulative magnitude of irreversible exclusions occurring within the interval:

$$D = \Delta F_{[t_a,t_b]} = |F_{t_a}| - |F_{t_b}|.$$

Binding density measures total state-space contraction relative to metric duration.

4.1 Low Binding Density

If few commitments occur,

$$|F_{t_b}| \approx |F_{t_a}|,$$

then contraction over the interval is minimal.

Metric duration may be large while cumulative contraction remains small. The system's admissible continuation remains largely unchanged.

Under these conditions, felt duration expands relative to clock duration.

4.2 High Binding Density

If many commitments occur,

$$|F_{t_b}| \ll |F_{t_a}|,$$

then contraction accumulates rapidly.

Substantial state-space reduction occurs within limited metric duration.

Under these conditions, felt duration compresses relative to clock duration.

4.3 Structural Interpretation

Temporal distortion is the divergence between external metric duration and internal contraction magnitude.

Clock time measures $\Delta\tau$. Felt duration scales with D.

When D and $\Delta\tau$ diverge, experienced temporal flow diverges from measured duration. No additional temporal structure is required beyond irreversible contraction.

5 Suspension and the Absence of Flow

Consider interval $[t_a, t_b]$ where no new commitments occur:

$$F_{t_b} = F_{t_a}.$$

Irreversible time continues, and metric duration satisfies

$$\Delta\tau = \tau(t_b) - \tau(t_a) > 0,$$

but admissible futures remain unchanged.

Binding density over the interval is therefore

$$D = |F_{t_a}| - |F_{t_b}| = 0.$$

The constraint topology is preserved without further narrowing of admissible futures.

Phenomenological flow attenuates because no additional contraction occurs. Directionality remains structurally present in irreversible time, but it does not manifest as progressive narrowing of admissible futures.

In the limiting case of sustained zero-binding intervals, internal experience lacks accumulated contraction despite continued metric duration.

Thus suspension of commitment formation does not suspend time. It suspends flow.

6 The Structural Present

Define the present as the boundary condition at which commitment formation is active.

Formally, let

$$\text{Now} = \{t \in T \mid C_t \text{ produces } F_{t^+} \subset F_t\}.$$

The present is not a duration but a structural boundary between admissible futures and excluded trajectories.

6.1 Active Contraction Window

Let T be strictly ordered. For any $t \in T$, if a commitment C_t occurs, it produces

$$F_{t^+} \subsetneq F_t.$$

The structural present corresponds to the set of times at which such irreversible reduction occurs.

6.2 Relation to Memory and Anticipation

Memory corresponds to preserved binding structure:

$$F_{t_{\text{past}}} \supset F_t.$$

Anticipation corresponds to structured admissible futures:

$$F_t.$$

The present is the active transformation linking preserved exclusions to pending admissible continuations.

6.3 No Extended Ontology

The present does not require an independent temporal substance. It is defined entirely by ongoing commitment formation under irreversible time.

Thus, the structural present is the locus of active irreversible contraction.

7 Objections and Structural Replies

Objection 1: Reduction of Time to Commitment

If phenomenological flow is identified with commitment succession, then time itself appears reduced to commitment. However, irreversible time continues even during zero-binding intervals. Therefore flow cannot simply be identical with time.

Reply. Irreversible time is primitive ordering. Commitment is a transformation defined over that ordering. During a zero-binding interval,

$$F_{t_b} = F_{t_a},$$

time advances ($t_b > t_a$), but no admissible futures are excluded. Metric duration accumulates while binding density remains zero.

Phenomenological flow depends on contraction:

$$F_{t_{n+1}} \subsetneq F_{t_n}.$$

Time does not. The framework distinguishes temporal order from state-space reduction.

Objection 2: Directionality Without Commitment

One might argue that directionality could be experienced purely from temporal ordering, even if no commitments occur.

Reply. Temporal order alone provides sequence but not structural asymmetry. If

$$F_{t_b} = F_{t_a},$$

then the admissible continuation set is unchanged. No irreversible asymmetry accumulates. Without contraction, there is ordering but no progressive narrowing.

Directionality in experience corresponds to accumulated exclusion, not mere ordering.

Objection 3: Continuity Requires Memory, Not Commitment

It may be claimed that continuity of flow depends on retained past states rather than on ongoing contraction.

Reply. Memory is preservation of prior binding structure. However, preservation alone does not generate directionality. Continuity emerges from monotonic inclusion:

$$F_{t_{n+1}} \subsetneq F_{t_n}.$$

Each new state inherits constraints from prior exclusions. Commitment succession binds preservation and contraction into a single topology. Memory without new exclusion yields static structure, not flow.

Objection 4: Flow Might Be Independent of State-Space Size

It could be argued that phenomenological flow does not depend on the magnitude of contraction and therefore cannot be derived from binding density.

Reply. The framework does not equate flow with absolute size reduction, but with ordered irreversible exclusion. Even minimal contraction, if persistent and monotonic, induces directionality. Binding density modulates felt duration, but flow itself arises from succession, not magnitude alone.

8 Conclusion

Temporal experience is not an independent temporal substance and does not require a flowing property added to irreversible time. It arises from ordered, irreversible exclusion within admissible futures.

Clock time measures interval length through an order-preserving metric. Felt time reflects cumulative exclusion within that ordering.

Directionality corresponds to monotonic contraction:

$$F_{t_{n+1}} \subsetneq F_{t_n}.$$

Temporal distortion is explained by divergence between metric duration and binding density. Suspension of commitment formation attenuates phenomenological flow without suspending irreversible time.

Time does not flow. Commitment succession generates the structure experienced as flow.