Resolution Under Degeneracy

Self-Referential Constraint Closure in Informational Ontology

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Abstract

Informational systems frequently encounter conditions in which available constraints and value relations fail to uniquely determine a future transition. Such value-degenerate states are often treated as anomalies to be eliminated through optimization, stochastic choice, or external selection rules. This paper argues instead that degeneracy is a structurally unavoidable feature of sufficiently complex informational systems.

Within the framework of Informational Ontology, resolution under degeneracy is characterized as **self-referential constraint closure**: the continued stabilization of a single trajectory under openness, constrained by informational identity without being uniquely specified by it. This account explicitly rejects selector-based explanations on the grounds that they introduce regress, randomness, or implicit executive control incompatible with informational closure.

Formal distinctions between reachability and determinacy, closure and failure, and constraint and specification are developed to clarify the limits of quantitative modeling in self-referential systems. The analysis is strictly structural and non-normative. Agency, freedom, and responsibility are not addressed here and are treated as downstream phenomena. The result is an account of how openness resolves through constraint-bound continuation without invoking selection mechanisms, probabilistic choice, or ontological indeterminism.

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1. Introduction

Complex informational systems do not always transition from one state to the next in a uniquely determined manner. In many cases, available constraints and value relations permit multiple future continuations without ranking, preference, or dominance. Such conditions—here termed

degeneracy—are frequently regarded as defects of specification to be eliminated through additional decision rules, probabilistic sampling, or hierarchical control structures.

This paper advances a different claim: degeneracy is not an anomaly but a structural feature of sufficiently complex informational systems. When constraints fail to uniquely specify a future, resolution does not require the introduction of an additional selector, rule, or stochastic process. Instead, continuation occurs through **self-referential constraint closure**: the persistence of a single informational trajectory under openness, preserving identity without invoking executive control or randomness.

The analysis proceeds within the framework of Informational Ontology (Rev 5), which is assumed as authoritative background and is neither revised nor defended here. The aim is to articulate the structural conditions under which degenerate states resolve without appeal to agency, normativity, or metaphysical choice, thereby providing a foundation for downstream analyses of agency, salience, and responsibility.

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2. Degeneracy as a Structural Condition

Degeneracy arises when an informational system's constraints and value relations permit multiple future states without uniquely determining one. Such states are not the result of ignorance, incomplete modeling, or epistemic limitation. A system may fully represent its operative constraints and still fail to achieve unique specification of a continuation.

This analysis presupposes the non-scalar conception of value developed in Informational Ontology, according to which value relations need not induce a total ordering over states. In multidimensional value spaces, optimization does not guarantee uniqueness. Degeneracy is therefore unavoidable in systems of sufficient complexity.

Degeneracy should not be equated with randomness or lack of structure. It reflects **non-closure**: constraint without specification. Increasing complexity does not eliminate degeneracy; it increases the frequency with which constraint fails to collapse a possibility space to a single outcome.

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3. The Problem of Degeneracy

Informational systems governed by constraint and value do not always yield uniquely determined state transitions. In sufficiently complex systems, it is common for multiple future states to remain equally reachable under the total set of operative constraints. We refer to such conditions as degeneracy.

Degeneracy should not be understood as epistemic uncertainty or incomplete modeling. A system may fully represent its constraints, values, and relational structure and still fail to produce a unique transition. Degeneracy arises not from ignorance, but from the structural non-closure of specification.

Value is used here in a strictly structural sense, denoting constraint-relevant differentiation rather than evaluative judgment or normative preference. Where value is not reducible to a single scalar objective, multiple trajectories may satisfy the system's constraints equally well without violating coherence or stability.

Efforts to eliminate degeneracy typically invoke external selection rules, stochastic choice, or hierarchical override. Each of these approaches introduces elements incompatible with informational closure. Randomness may generate outcomes, but it does not explain the preservation of informational identity across transitions. Selector mechanisms reintroduce regress or implicit executive control.

Within Informational Ontology, degeneracy is therefore treated as a structural feature rather than a defect. Degeneracy resolves through **endogenous constraint closure**: the continuation of informational identity under conditions where multiple transitions remain reachable.

3.1 Lemma: The Illegitimacy of "Why This Trajectory?" Questions Under Degeneracy

A common objection to non-selector accounts of degeneracy is the demand for an explanation of why one particular continuation occurs rather than another equally admissible alternative. This demand is structurally misplaced.

Once a system continues under degenerate constraint, there is no further explanatory event corresponding to the "selection" of one alternative over another. The continued trajectory **is** the resolution. Asking why this trajectory occurred rather than another presupposes a comparison across unrealized alternatives from a vantage external to the system's continuation. Such a vantage reintroduces a selector regime already excluded by informational closure.

Resolution under degeneracy does not consist in choosing among alternatives. It consists in the persistence of a single trajectory when no constraint-internal ranking is available. The expectation of a further tie-breaking explanation is therefore a category error: it demands an external act of selection where only structural continuation is present.

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4. Why Selector Models Fail

Selector models attempt to resolve degeneracy by introducing an additional mechanism that distinguishes among equivalent futures. These models take several common forms:

1. **Deterministic selectors**, which introduce secondary decision rules or priority orderings.

2. **Stochastic selectors**, which appeal to randomness or probabilistic sampling.

3. **Executive selectors**, which posit internal control structures or homuncular decision points.

Each of these approaches violates informational closure in a distinct way. Deterministic selectors merely displace degeneracy to a higher level, requiring justification for the selector itself. Stochastic selectors abandon identity preservation, replacing structured continuation with noise. Executive selectors reintroduce regress by positing a chooser that must itself resolve degeneracy.

To illustrate the failure of selector reasoning, consider probabilistic resolution. Assigning equal probability to degenerate outcomes does not explain continuation; it merely redescribes uncertainty from an external perspective. The probability distribution does not participate causally in the system's transition and therefore cannot account for identity-preserving continuation.

Selector models fail not because they are insufficiently detailed, but because they answer the wrong question. They attempt to explain resolution as an act of choice rather than recognizing it as a condition of continued existence under constraint.

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5. Identity, Continuation, and Non-Collapse

Informational identity plays a central role in resolution under degeneracy, but its role must be carefully delimited. Identity does not resolve degeneracy, rank alternatives, or select outcomes. It functions solely as a constraint on what a system can remain as it continues.

Identity excludes collapse, incoherence, and disintegration. It does not specify which of several equally compatible continuations must occur. Multiple trajectories may preserve identity equally well. The role of identity is therefore negative rather than directive: it constrains what cannot occur, not what must.

Resolution under degeneracy should thus be understood as **identity-preserving continuation**, not identity-guided selection. The system does not consult its identity to choose among futures. It continues, and identity is preserved insofar as the continuation remains within the system's structural invariants.

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6. The Limits of Formal Specification

Formal models are effective at characterizing spaces of possibility, reachability relations, and constraint structure. However, they do not themselves perform closure. Any formalism that uniquely specifies a future transition has already eliminated degeneracy by construction.

This limitation is not accidental. Formal resolution presupposes a standpoint external to the system's continuation, from which alternatives can be enumerated and ranked. In self-referential systems, such a standpoint is unavailable without violating informational closure.

The inability to fully formalize resolution under degeneracy therefore reflects a structural boundary, not an explanatory failure. Formal models describe conditions under which degeneracy arises and constrain what continuations are admissible, but they cannot supply a selector without departing from the regime they model.

This boundary parallels other self-reference limits in logic and computation. It marks the point at which explanatory demands exceed what the system's structure can supply without contradiction.

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7. Failure Modes and Non-Closure

Not all systems resolve degeneracy successfully. Several failure modes are possible:

- **Oscillation**, where the system fails to stabilize any trajectory.
- **Collapse**, where identity coherence breaks down.
- **Rigidity**, where degeneracy is prematurely eliminated through constraint saturation.

These failure modes do not explain resolution; they clarify its absence. Successful resolution consists precisely in avoiding these outcomes while continuing under openness. The distinction between closure and failure is therefore structural rather than procedural.

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8. Conclusion

Degeneracy is an unavoidable feature of sufficiently complex informational systems. Attempts to eliminate it through selection mechanisms misunderstand its structural role and introduce elements incompatible with informational closure.

Resolution under degeneracy does not require choice, randomness, or executive control. It consists in the identity-preserving continuation of a system when constraint fails to uniquely specify a future. Demands for further tie-breaking explanations rest on category errors that presuppose external selectors where only endogenous continuation is available.

By clarifying the limits of specification and the role of identity, this account provides a structural foundation for downstream analyses of agency, salience, freedom, and responsibility without revising the core commitments of Informational Ontology.