Coherent Observational Epistemology (COE): Foundational Principles, Secondary Principles, and Axiomatic System

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Abstract

Coherent Observational Epistemology (COE) is a methodological framework concerned with the structural conditions under which heterogeneous observational sequences can jointly support scientific inference. In an era of distributed measurement infrastructures—astronomical networks, climate observatories, particle detectors, biomedical laboratories—scientific practice increasingly depends on the integration of observational outputs originating from independent localities. Yet the epistemic assumptions underlying such integration often remain implicit and unexamined.

COE addresses this gap by providing: (i) foundational principles governing observation, fixation, ordering, and coherence; (ii) secondary principles describing operational constraints and methodological safeguards; and (iii) an axiomatic system that formalizes the structural requirements enabling inter-local evidential synthesis. The goal of COE is not to replace existing modelling frameworks but to clarify the epistemological preconditions that make cross-local inference scientifically justified.

1 Introduction

Coherent Observational Epistemology (COE) is a methodological framework concerned with the structural conditions under which heterogeneous observational sequences can jointly support scientific inference. In modern scientific practice, data are produced by distributed and largely independent measurement infrastructures: astronomical networks, climate observatories, particle detectors, biomedical laboratories, and many others. Each such observational locality maintains its own protocols, calibration regimes, preprocessing pipelines, and operational definitions.

Scientific models, however, often synthesize outputs from multiple independent localities into global inferential structures. This raises a foundational question: under what conditions can such heterogeneous observational sequences be regarded as jointly evidential for a single scientific claim?

COE addresses this question by:

- articulating foundational principles that govern the relation between observation, fixation, ordering, and fact construction;
- specifying secondary principles that capture operational constraints, documentation requirements, and structural safeguards;
- formulating an axiomatic system that expresses the necessary structural conditions for inter-local evidential synthesis.

The aim is not to provide a new physical theory or statistical method, but rather to illuminate the epistemological architecture that underlies distributed observation and multi-local data integration.

2 Definition of Coherence

Coherence in COE is a structural condition under which two or more observational sequences admit a non-contradictory mapping between their orderings, transformations, and operational semantics, enabling them to jointly support a single evidential claim.

Formal Definition. Let L_1, L_2 be observational localities producing sequences S_1, S_2. We call S_1 and S_2 *coherent* iff:

1. *Ordering compatibility:* there exists a monotonic or piecewise monotonic mapping

$$f : \mathrm{ord}(S_1) \to \mathrm{ord}(S_2).$$

2. *Transformational compatibility:* transformations applied in each locality admit a partial reconstruction,

$$T_1^{-1} \circ T_2 \quad \text{or} \quad T_2^{-1} \circ T_1.$$

3. *Semantic compatibility:* operational definitions allow a non-contradictory translation,

$$\sigma_1 \leftrightarrow \sigma_2.$$

4. *Trend-level compatibility:* structural tendencies (e.g., extrema, slopes, discontinuities) do not produce irreconcilable contradictions.

This definition provides the structural basis for all subsequent principles and axioms of COE.

3 Foundational Principles of COE

The foundational principles articulate the core commitments of Coherent Observational Epistemology. They express how observations become evidence and under what conditions multiple observational localities can be brought into coherent relation.

P1. **Structured Observation.** An observation becomes a scientific fact only after fixation, ordering, and stabilization; raw signals do not in themselves constitute evidence.

P2. **Local Coherence.** Each observational locality ensures its own internal methodological consistency, governed by local protocols, calibration procedures, and data-handling practices.

P3. **Locality Independence.** Independent observational localities are not *a priori* assumed to be mutually coherent or directly comparable; compatibility must be demonstrated rather than presupposed.

P4. **Inter-Local Comparability.** Cross-local inference requires structural compatibility across localities, including comparability of ordering, transformations, and semantic definitions.

P5. **Minimal Transformation.** Integrative processes must minimize irreversible distortions and ensure traceability of transformations between localities.

P6. **Structural Stability.** Essential structural features of observational sequences—such as trends, extrema, and correlations—must be preserved during integration.

P7. **Semantic Transparency.** Operational definitions must be formulated in a way that supports semantic mapping across observational localities.

P8. **Pre-Model Alignment.** Structural compatibility must be established prior to modelling, rather than being imposed or concealed by model construction.

P9. **Restricted Integration.** If structural incompatibility persists, integrated datasets may support heuristic exploration but not robust global inference.

P10. **Epistemic Transparency.** Scientific claims must disclose whether conclusions rely on inter-local coherence or on local model agreement within individual observational environments.

4 Secondary Principles of COE

Secondary principles refine and extend the foundational ones. They address practical, operational, and methodological dimensions of inter-local coherence.

S1. **Principle of Order Preservation.** When combining observational sequences, the original temporal, procedural, or causal ordering must be recoverable, at least partially, from the integrated representation.

S2. **Principle of Transformational Boundedness.** Any transformation applied to one locality's data should have an equivalent, interpretable, or explicitly documented counterpart in other localities, so that structural relations can be compared.

S3. **Principle of Semantic Minimality.** Only shared, operationally defined constructs should be used in inter-local comparisons; locality-specific constructs may be retained but not conflated.

S4. **Principle of Error-Propagation Awareness.** Data integration must take into account locality-specific error structures and avoid homogenizing them in a way that distorts uncertainty or creates false precision.

S5. **Principle of Provenance Sufficiency.** Adequate documentation of observational pipelines, including preprocessing and calibration, is required in order to evaluate inter-local compatibility.

S6. **Principle of Locality Preservation.** No locality should systematically dominate or erase another in the process of data integration; minor localities must not be treated as noise by default.

S7. **Principle of Interpretive Modesty.** Divergent observational sequences should be treated as indicators of limits on global inference rather than as mere deficits in measurement practice.

S8. **Principle of Multi-Scale Consistency.** Coherence should be assessed across temporal, spatial, and conceptual scales, since compatibility at one scale does not guarantee compatibility at others.

S9. **Principle of Structural Redundancy.** Multiple independent confirmations increase reliability only if the corresponding observational sequences are inter-locally coherent.

S10. **Principle of Non-Coercive Synthesis.** Cross-local coherence cannot legitimately be manufactured through excessive smoothing, averaging, or regularization that erases genuine structural discrepancies.

5 Toward an Axiomatic System of COE

The axiomatic system formalizes COE into structural constraints that can, in principle, be examined and tested within concrete scientific practices.

5.1 Ontological Axioms

Axiom O1 (Observation Ontology). Observations exist for epistemic purposes only as fixed, ordered, and contextually interpreted records.

Axiom O2 (Locality Ontology). Each observational locality constitutes a self-coherent epistemic environment, characterized by its own protocols, instruments, and interpretive practices.

Axiom O3 (Independence Ontology). Distinct observational localities produce sequences that may differ structurally, semantically, and operationally. No presumption of global compatibility is made at the outset.

6 Nature of Global Observational Structures

The introduction of global observational structures within COE does not presuppose the existence of any metaphysical or physically real "global" object. Global structures in this framework are *epistemic constructions*, generated only when independent observational localities admit sufficient structural compatibility to support their formation.

(1) Non-ontological status. A global ordering, global alignment, or global semantic space is not a feature of the world but a methodological instrument. These structures exist only insofar as they can be *constructed* from the relations between observational localities that satisfy compatibility constraints. COE therefore does not assume a universal or absolute data space.

(2) Conditional constructability. A global structure can be formed only if localities permit the necessary mapping relations: ordering compatibilities, reconstructible transformations, semantic commensurability, and preserved structural trends. When such conditions fail, global structures do not existnot as a matter of metaphysics but as a consequence of observational architecture.

(3) Procedural rather than descriptive. Global structures do not describe how nature "really is" across localities. Instead, they express the minimal procedural scaffolding within which cross-local inference becomes epistemically justified. If the scaffolding cannot be built, inference must remain local or stratified.

(4) Independence from theoretical models. The existence or non-existence of a global structure is orthogonal to any model that might later operate on the aligned data. COE distinguishes between the *pre-analytic* conditions that allow alignment and the *model-based* processes that follow it.

(5) Failure as information. When the construction of global structures is impossible, this outcome is not a defect but an epistemically meaningful result: it indicates that the phenomena or the observational pipelines themselves do not admit global integration. In such cases, COE prescribes stratified or locality-respecting inference.

Taken together, these points define global observational structures as conditional, instrumental, and procedurally delimited elements within COE. They arise only when warranted by cross-local relations and impose no commitment to a universal observational ontology. With this status clarified, we now formulate the Global Observational Postulates (GOP), which express the structural conditions under which global observational construction is possible.

7 Global Observational Postulates (GOP)

While the structural axioms S1S5 express the minimal compatibility conditions at the pair-wise or small-scale level, the Global Observational Postulates (GOP1GOP5) articulate the higher-order constraints required for constructing supra-local observational structures.

The following postulates articulate the structural conditions under which multiple observational localities can participate in a unified evidential space. They extend the ontological axioms by specifying when global alignment is possible and what epistemic consequences follow when it is not.

7.1 GOP1: Postulate of Global Orderability

For a set of observational localities $L_1, \ldots, L_n$ producing sequences $S_1, \ldots, S_n$, a global evidential space exists only if the local orderings admit a partial or total embedding into a common supra-local ordering:

$$\exists\, O_{\text{global}} \text{ such that } \operatorname{ord}(S_i) \hookrightarrow O_{\text{global}} \quad \forall i.$$

If no such embedding exists, global inference is not epistemically grounded.

7.2 GOP2: Postulate of Transformational Coherence

Global alignment requires that locality-specific transformations admit a shared factorization through a supra-local transformation space:

$$T_i \;=\; \Phi \circ t_i,$$

where t_i is a locality-specific component and Φ is a supra-local operator. If no such decomposition exists, transformation-level compatibility cannot be established.

7.3 GOP3: Postulate of Semantic Liftability

Operational definitions used in individual localities must admit a consistent mapping into a supra-local semantic space:

$$\sigma_i \mapsto \Sigma_{\text{global}},$$

such that the induced mappings remain non-contradictory across all i. If semantic liftability fails, global evidential meaning cannot be defined.

7.4 GOP4: Postulate of Structural Non-Contradiction

Even when orderings and semantics are alignable, global coherence exists only if structural tendencies across localities do not generate irreconcilable contradictions, including:

- persistent trend inversions,
- incompatible extrema,
- contradictory discontinuities,
- phase conflicts without admissible explanation.

If such contradictions exist, the observational system collapses into stratified inference.

7.5 GOP5: Postulate of Integrative Sufficiency

Global inference is justified only when supra-local structures preserve locality-specific information essential for the phenomena under study. A global representation is epistemically illegitimate if its construction discards structurally relevant features of any locality:

$$\exists\, i \text{ such that } I(S_i) \not\subseteq I(O_{\text{global}}) \quad \Rightarrow \quad \text{global inference is invalid.}$$

Here $I(\cdot)$ denotes the set of structurally relevant informational elements.

8 Corollaries of GOP

The following corollaries express formal consequences of GOP1–GOP5.

8.1 Corollary 1: No Global Inference Without Global Order

If GOP1 fails, then no statistical, causal, or harmonization method including Bayesian fusion, meta-analysis, machine learning, or regularization can produce epistemically justified global inference. All such methods presuppose a shared ordering space; without it, their outputs reflect modelling conventions rather than evidence.

8.2 Corollary 2: Model Agreement Is Not Evidence

If localities are not globally coherent, agreement between models built on different local datasets does not constitute global evidential support. Convergence may arise from regularization artifacts, smoothing effects, symmetry assumptions, or shared priors. Model-level agreement cannot substitute for inter-local observational compatibility.

8.3 Corollary 3: Pairwise Consistency Does Not Imply Global Coherence

Even if every pair of localities (L_i, L_j) is mutually consistent, the full set $\{L_1, \ldots, L_n\}$ may still be globally inconsistent (triangulation failure):

$$\text{Pairwise coherence} \not\Rightarrow \text{global coherence.}$$

Global coherence is a higher-order property that cannot be inferred from pairwise relations.

8.4 Structural Axioms

Axiom S1 (Ordering Mappability). For inter-local coherence to hold, there must exist at least one monotonic or quasi-monotonic mapping between the orderings of observational sequences from different localities.

Axiom S2 (Transformation Reversibility). Cross-local transformations must be partially reversible or reconstructible to a degree sufficient for structural comparison.

Axiom S3 (Semantic Commensurability). Local operational definitions must admit a non-contradictory mapping into a shared semantic space.

Axiom S4 (Trend Compatibility). Structural trends across localities must not exhibit irreconcilable contradictions, such as systematic inversions without explanatory context.

Axiom S5 (Integrability). Observational sequences must be combinable without discarding essential locality-specific information that is relevant to the phenomena under study.

8.5 Epistemic Axioms

Axiom E1 (Justification Requirement). Cross-local inference is epistemically justified only if structural axioms S1–S5 are satisfied to an empirically defensible degree.

Axiom E2 (Transparency Requirement). Scientific claims must specify whether they rest on inter-local coherence in the observational base or on purely local coherence within single-laboratory or single-instrument datasets.

Axiom E3 (Non-Substitutability). Agreement between models does not substitute for demonstrable observational compatibility; model-level convergence cannot override structural conflicts at the data level.

8.6 Inference Rules

Rule R1 (Coherent Integration). If O1–O3 and S1–S5 hold, then observational sequences from different localities may be integrated into a unified evidential basis for global inference.

Rule R2 (Restricted Inference). If any structural axiom S1–S5 fails in a systematic way, inferential claims must remain local or be explicitly labelled as heuristic and provisional.

Rule R3 (Conflict Preservation). When structural conflicts arise, they must be preserved and analysed, rather than smoothed away by harmonization procedures aimed solely at producing apparent agreement.

9 Synthetic Illustrative Examples

The examples presented in this appendix are not empirical case studies and are not intended as operational procedures. Their role is purely illustrative. Each example provides a minimal synthetic construction designed to highlight how specific structural conditions—such as ordering compatibility, semantic commensurability, and global alignment—manifest within the COE framework.

These illustrations serve two purposes. First, they clarify the distinctions between different classes of inter-local incompatibility, showing how violations of individual structural axioms lead to epistemically constrained inference. Second, they demonstrate that such incompatibilities can arise even in idealized noise-free settings, indicating that the challenges addressed by COE are structural rather than statistical.

The examples should therefore be read as conceptual demonstrations of the logical space defined by the COE axioms, rather than as domain-specific applications or prescriptive methodological tools.

9.1 Example A: Ordering Incompatibility

Two observational localities, L_1 and L_2, monitor the same periodic phenomenon. Locality L_1 records measurements at a uniform sampling rate (every 90 minutes), generating an ordered sequence S_1. Locality L_2 uses clustered sampling in four-hour observational bursts, generating S_2. Each locality is internally coherent, and both sequences exhibit stable periodic behavior.

However, when attempting to construct an inter-local mapping $f : \mathrm{ord}(S_1) \to \mathrm{ord}(S_2)$, no monotonic or piecewise monotonic correspondence can be established. Peaks in S_1 do not consistently align with peaks in S_2, and the irregular clustering in L_2 prevents recovery of a globally interpretable ordering relation.

Under the COE framework, Structural Axiom S1 (Ordering Mappability) is violated. Consequently, only local inference is justified; inter-local synthesis or construction of a global periodic model lacks epistemic grounding. This example demonstrates that incompatibility may arise even when all measurements are accurate and noise levels are low: the structure of fixation itself may obstruct inter-local coherence.

9.2 Example B: Semantic Incommensurability

Two climate-monitoring localities report "temperature anomalies." Locality L_1 defines anomaly as

$$\Delta T_1 = T - T_{\mathrm{avg}(1980\text{–}2000)},$$

while locality L_2 defines

$$\Delta T_2 = T - T_{\mathrm{median}(1990\text{–}2020)}.$$

Both definitions are internally coherent and operationally valid within their respective localities. However, the constructs are semantically non-commensurate: the choice of baseline, averaging method, and temporal window alters the meaning of the anomaly in ways that do not admit a non-contradictory semantic translation

$$\sigma_1 \leftrightarrow \sigma_2.$$

Under the COE framework, Structural Axiom S3 (Semantic Commensurability) is violated. Inter-local synthesis is therefore inappropriate; only local or stratified reporting is epistemically justified.

This example illustrates how semantic drift—rather than measurement error or noise—can block inter-local coherence, even when both localities operate with high methodological precision.

Example C: Global Misalignment

Consider three observational localities L_1, L_2, L_3 measuring the same phenomenon under different operational schedules. Each locality produces a sequence of ordered observations:

$$S_1 = \{1, 2, 3, 4\}, \qquad S_2 = \{A, B, C, D\}, \qquad S_3 = \{\alpha, \beta, \gamma, \delta\}.$$

Pairwise comparisons across localities yield monotonic mappings:

$$f_{12} : S_1 \to S_2 \quad \text{is monotonic}, \qquad f_{23} : S_2 \to S_3 \quad \text{is monotonic}.$$

However, the induced global mapping f_{13} fails to be monotonic.

$$f_{12}(1) = A, \quad f_{23}(A) = \alpha; \qquad f_{12}(2) = B, \quad f_{23}(B) = \gamma;$$
$$f_{12}(3) = C, \quad f_{23}(C) = \beta; \qquad f_{12}(4) = D, \quad f_{23}(D) = \delta.$$

Thus,

$$\alpha < \gamma < \beta < \delta,$$

which is incompatible with the original ordering $1 < 2 < 3 < 4$. Pairwise coherence holds, but global coherence does not:

$$\text{pairwise coherence does not imply global coherence.}$$

This synthetic construction shows that even when every locality is individually coherent and pairwise alignments exist, the system as a whole may fail to admit a globally consistent ordering. Such cases fall directly under GOP2 (Non-Emergent Global Order) and demonstrate why global alignment cannot be assumed from pairwise agreements alone.

10 Discussion

The COE framework provides a systematic foundation for evaluating when heterogeneous observational sequences can be jointly interpreted. It extends classical philosophy of science by focusing not on theory choice or model realism, but on the structural preconditions required for observational evidence to be coherently combined.

COE is compatible with Bayesian, structuralist, empiricist, and pragmatist approaches to scientific reasoning, while introducing a distinct methodological dimension: coherence constraints between distributed observational systems. Rather than replacing existing accounts of confirmation, causation, or explanation, COE supplies a set of structural conditions on the observational substrate upon which such accounts operate.

The foundational and secondary principles, together with the axiomatic system, offer a vocabulary for diagnosing where cross-local inference is well-supported, where it is underdetermined, and where it may be methodologically misleading. In particular, COE helps to distinguish between: (i) genuine multi-local evidential support; and (ii) merely apparent support arising from harmonization or aggregation techniques that enforce agreement rather than demonstrating it.

COE does not undermine established methodological standards such as double-blind protocols, randomization, or statistical harmonization. These standards remain essential for controlling locality-specific sources of bias. What COE adds is a complementary layer of analysis focused on the compatibility of independently produced observational lineages.

From this perspective, traditional standards function as safeguards within observational localities, while inter-local coherence concerns the structural conditions under which outputs from multiple localities can legitimately be integrated into a single evidential basis. The two levels are therefore complementary rather than competing.

Scope and Limitations

The framework of Coherent Observational Epistemology is intended as a methodological supplement to existing practices of data collection, harmonization, and modelling, rather than as a replacement for them. COE focuses on the structural conditions under which independently produced observational sequences can be treated as jointly evidential.

Several limitations should be noted. First, COE does not claim that inter-local coherence is always achievable; in many real-world settings, structural incompatibilities may be irreducible, and the appropriate outcome is local or stratified inference rather than global integration. Second, the axioms and metrics proposed here are minimal in the sense of being sufficient for diagnosing structural compatibility, but they are not presented as uniquely necessary or exhaustive. Third, COE is pre-model in character: it does not prescribe specific statistical techniques, causal frameworks, or physical theories, but aims to clarify the conditions under which such techniques can be responsibly applied across multiple observational localities.

Accordingly, COE should be read as an evolving methodological layer that can be refined, extended, or restricted in dialogue with domain-specific practices, rather than as a definitive criterion system for all scientific inference.

11 Conclusion

Coherent Observational Epistemology unifies foundational principles, secondary operational safeguards, and a rigorous axiomatic system. Its objective is to illuminate the epistemic architecture underlying modern scientific practice and to strengthen the reliability of cross-local inference.

Future work includes: (i) developing formal metrics corresponding to each structural axiom; (ii) designing coherence audits for multi-instrument datasets in specific scientific domains; and (iii) integrating COE principles into data governance and documentation frameworks.

By making explicit the conditions under which heterogeneous observational sequences can be treated as a coherent evidential base, COE aims to support more transparent, robust, and accountable scientific inference in a distributed observational world.

A Appendix A. COE Observational Pipeline

The COE Observational Pipeline

In Coherent Observational Epistemology (COE), the formation of scientific evidence proceeds through a structured sequence of stages:

Locality → Fixation → Local Ordering → Global Alignment → Global Ordering → Transformations → Operational Meaning → Coherence → Integrability → Inference

Each stage introduces a distinct structural layer. No stage can be omitted without compromising the validity of cross-local inference.

Table 1: Stages of the COE Observational Pipeline

Stage	Name	Definition	Purpose in COE	Failure Mode if Absent
1	**Locality**	Epistemic environment generating observations through its own instruments, protocols, and rhythms.	Establishes independence and pluralism of observational sources.	Data are treated as homogeneous; hidden local biases propagate unnoticed.
2	**Fixation**	Conversion of raw signals into stable records with timestamps, context, and metadata.	Creates the first durable trace from which evidence can be constructed.	Ordering and comparison become impossible; records lack stability.
3	**Local Ordering**	Internal ordering of fixed records (temporal, procedural, causal).	Provides the structural basis for intra-local coherence.	Trends and internal patterns cannot be defined; sequence becomes opaque.
4	**Global Alignment**	Construction of correspondences between local orders (window matching, rhythm matching, index mapping).	Creates the mapping required to compare independent observational sequences.	Local sequences remain incomparable; cross-local analysis is invalid.

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Stage	Name	Definition	Purpose in COE	Failure Mode if Absent
5	**Global Ordering**	Integration of aligned sequences into a shared ordering framework (global index or tick-grid).	Constructs the supra-local structure required for multi-local evidence.	Global inference collapses to local-only; no unified evidential basis.
6	**Transformations**	Operations applied to sequences under documented, partly reversible constraints.	Prepares data for semantic interpretation while preserving structural invariants.	Distorted or incompatible sequences; false agreement or disagreement.
7	**Operational Meaning**	Assignment of operational definitions (σ) under shared semantic rules.	Ensures constructs are comparable across localities.	Semantic incompatibility; cross-local terms refer to different phenomena.
8	**Coherence**	Verification of structural compatibility across ordering, transformations, and semantics.	Determines whether independent sequences jointly support a claim.	Apparent convergence created by harmonization hides contradictions.
9	**Integrability**	Decision whether coherent sequences can be merged into a single evidential base.	Controls when global inference is epistemically justified.	Overgeneralization; unsupported global claims.
10	**Inference**	Drawing scientific conclusions from an integrated or stratified evidential base.	Produces claims with transparent epistemic foundations.	Claims lack defensible observational grounding.

B Appendix B. Coherence Events and LocalGlobal Dynamics

This notion echoes broader philosophical frameworks in which coherence marks the stabilization of relations between autonomous units, but here it functions strictly as a methodological criterion for data integration.

B.1 Local and Global Coherence Rhythms

Each observational locality maintains its own "rhythm": sampling rates, fixation tempos, preprocessing cycles, and transformation pipelines. These rhythms are independent and may diverge in structure and temporal resolution.

Inter-local coherence requires the existence of a mapping between such rhythms. When such a mapping exists, a temporary epistemic resonance occurs: the outputs of multiple localities can jointly support inference without distorting their internal structures.

This provides a methodological analogue to frameworks in which localities possess internal cycles of self-consistency, while higher-order structures emerge only when such cycles admit partial alignment.

B.2 Partial Observational Pipelines

COE acknowledges that the full observational pipeline

Locality $\rightarrow$ **Fixation** $\rightarrow$ **Local Ordering** $\rightarrow$ **Global Alignment** $\rightarrow$ **Global Ordering** $\rightarrow$ **Transformations** $\rightarrow$ **Operational Meaning** $\rightarrow$ **Coherence** $\rightarrow$ **Integrability** $\rightarrow$ **Inference**

is an idealized sequence describing the structural conditions under which independent observational lineages can, in principle, support global inference.

This idealization does not assume that global structures exist; it only provides the conceptual frame within which their possibility or impossibility can be assessed.

In many real scientific settings, however, one or both global stages **Global Alignment** or **Global Ordering** may be unattainable. Structural incompatibilities, non-commensurable operational definitions, irreversible local transformations, or divergent ordering conventions may prevent the construction of a shared global structure.

COE therefore treats the absence of these stages not as a defect, but as an empirically meaningful outcome. In such cases, inference must proceed through a *partial observational* *pipeline*, in which integrability and cross-local justification are evaluated relative to the attainable structural layers.

Subsequent publications will introduce two complementary mechanisms for verifying and comparing observational lineages: (i) a full-pipeline verification procedure, applicable when global alignment and global ordering are constructible; and (ii) a shortened-pipeline procedure, designed for settings in which global structures cannot be formed but meaningful inter-local comparisons remain possible.

This distinction between full and partial observational pipelines will serve as the structural foundation for the forthcoming operational COE framework, in which verification procedures and cross-local compatibility tests will be developed for both cases.

B.3 Postulate of Relative Coherence

Absolute coherence across all localities—perfect alignment of orderings, transformations, trends, and semantic assignments—is an epistemic limit state in which observational diversity collapses. In such a limit, localities provide no independent constraints, and global inference loses its evidential grounding.

Thus, COE adopts the **Postulate of Relative Coherence**:

Scientific inference operates on relative, not absolute, coherence. Absolute inter-local coherence is trivial and uninformative; meaningful evidence arises only when localities remain partially independent while still permitting structural comparability.

This postulate preserves the role of observational plurality and prevents methodological collapse into oversimplified global harmonization.

Coherent Observational Epistemology unifies foundational principles, secondary operational safeguards, and a rigorous axiomatic system. Its objective is to illuminate the epistemic architecture underlying modern scientific practice and to strengthen the reliability of cross-local inference.

Future work includes developing formal metrics for each structural axiom, designing coherence audits for multiinstrument datasets, and integrating COE principles into data governance frameworks.

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