

A Preliminary Generative Relational Formalization of Mediator Nomos Formation in Heterogeneous Social Contract

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Abstract

This paper develops a preliminary Generative Relational formalization of mediator nomos formation under heterogeneous social-contract conditions. The inquiry is conditional: it asks what additional relational architecture may be required when contract-based justification is retained although the participating subjects do not begin with a fully shared nomos. Building on an earlier GR diagnosis of contract-formative capacity, cross-nomic manifestation, and inter-nomic mediation, the analysis proposes a formation mechanism using existing GR objects: accumulated relational history, active relational boundaries, effective nomos, manifestation-relative distinctions, admissibility, and state-dependent transformations. Repeated cross-subject interaction can change the configuration from which later operations are instantiated. When interaction-conditioned uptake becomes persistent, organizes the cross-subject relation, and changes later admissibility or transformation, the resulting structure can be identified as a derived mediator nomos. Four stylized genealogies locate different formation burdens: first-contact bootstrapping in human–alien interaction, revision of inherited mediation in human–other-animal relations, differentiation within a human-seeded interface in human–AI relations, and recursive co-evolution in AI–AI interaction. Category-theoretic representation enters after stabilization through restricted source-side domains, mediator-relative coherence, and explicit untranslated remainders. The contract construction then shows, within the formal model, that the existence of a locally coherent and realization-supported contract-formative corridor is compatible with substantial untranslated nomic structure. The framework remains structural and model-relative; empirical prevalence, ontological identity, consent, justice, and legitimacy require additional evidence or normative argument.

Keywords: Generative Relational theory; social contract; mediator nomos; nomos formation; heterogeneous relational subjects; inter-nomic mediation; artificial intelligence; nonhuman animals

Discussion Paper Note

This manuscript is a preliminary formal and interpretive study within the wider Generative Relational research programme. Its specific object is the formation of a mediator nomos under conditions in which heterogeneous relational subjects do not begin with a fully shared contract-formative grammar. The inquiry is conditional. It assumes that some contract-based mode of justification is to be retained and asks what additional structures may be required for such a mode to remain meaningful across heterogeneous nomic conditions.

The paper follows an earlier Generative Relational reconstruction of social contract and its recurring limitations. That reconstruction treated contractual capacity, species heterogeneity, and cross-border coordination as formally non-reducible limitation families that nevertheless share dependence on prior nomos formation. The present paper develops the subsequent constructive problem. Diplomatic, legal, linguistic, institutional, and technical practices already supply many forms of mediation, so the need for a bridge is not itself the result sought here. The analytical question concerns possible generative mechanisms through which a mediating nomic structure can emerge, stabilize, remain revisable, and acquire operational efficacy in later relations.

Formal economy is a governing constraint. New notation appears only where the existing Generative Relational configuration, history, boundary, nomos, distinction, and transformation machinery no longer states the required object clearly. The mediator nomos is consequently derived from changes in relational history and state-dependent interaction. Category-theoretic and operator-algebra-inspired language enters only after the corresponding objects and compositions have acquired a defined analytical role.

The four principal cases are stylized formation regimes used for formal comparison. They do not amount to empirical claims about entire classes of beings. Human–alien interaction represents a limiting case of minimal shared history; human–other-animal relations represent deep co-history under substantial asymmetry; human–AI interaction represents a human-seeded interface in which manifestation similarity can coexist with relational heterogeneity; and AI–AI interaction represents a case in which participating nomic structures and the cross-system mediator may change together. Actual cases can occupy intermediate positions or combine several mechanisms.

The paper maintains ontological suspension. Relational subjects, nomoi, 2-complexes, operators, categories, and other mathematical objects are used as representations of specified structural relations. Their usefulness within a formal model does not establish an ultimate ontology of human, animal, artificial, or hypothetical extraterrestrial existence. The paper also avoids inferring moral standing, consciousness, personhood, or a complete theory of justice from structural properties alone. Normative interpretation remains an additional argumentative task.

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Status. This revised working draft contains the complete preliminary argument and has undergone three manuscript-wide passes covering formal consistency, logical continuity, cross-references, terminology, epistemic scope, and prose. The third pass tightened the mediator-status criterion and contract-layer typing. The current structure includes the Introduction, contractual and Generative Relational background, the derived mediator-nomos formation mechanism, genealogy-sensitive formation regimes, categorical representation of stabilized mediation, mediator-supported contract formation, scope and limitations, and conclusion. Empirical operationalization and the stronger formal extensions identified in Section 7 remain open for future work.

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Statement on the use of language models. The exploratory discussions and preparation of this paper involved OpenAI’s ChatGPT. ChatGPT supported exploratory dialogue, formal reconstruction, source discovery followed by website verification, argumentative criticism, and drafting in $\text{\LaTeX}$. The author selected the research questions, directed and approved the theoretical commitments and epistemic status of the claims, and bears sole responsibility for the manuscript, including its definitions, formal constructions, arguments, conclusions, and errors. Authorship credit remains with the human author. Verification records for cited sources are retained in the accompanying reference ledger.

1 Introduction

Social-contract theory provides a family of justificatory models in which the acceptability of moral, political, or institutional rules is connected to forms of agreement, endorseability, consent, or non-rejection under specified conditions. Contemporary reconstructions distinguish several variables within this family, including the role assigned to the contract, the parties represented in the model, the form of agreement, the object of agreement, and the normative work that the agreement is expected to perform [1]. Rawls's reconstruction remains a central modern example of the use of a contractual device to identify principles for regulating the basic structure of social cooperation [7]. The present paper addresses a narrower constructive problem within this broad tradition. Its objective is to examine how contract-like justification might be reconstructed when the relevant relational subjects do not begin with a fully shared nomos through which agency, reasons, admissibility, obligation, and agreement are already mutually legible.

The problem becomes visible at several established boundaries of contractual reasoning. Nussbaum's analysis of disability, nationality, and species membership argues that influential social-contract approaches encounter serious difficulties when cooperation cannot be represented through approximately equal parties whose interests and capacities are already commensurable within the contractual construction [6]. A preceding Generative Relational study in the present research programme reinterpreted several such limitations through distinct formal mechanisms. Contract-formative difficulty associated with disability and childhood was represented through the relation between potential and effective generative horizons and a historically formed contract grammar. Cross-species difficulty was treated as a problem of heterogeneous relational realities and cross-nomic manifestation. Cross-border coordination was treated as a problem of inter-nomic mediation among already rich but non-identical nomic systems. The resulting diagnosis suggested that contract formation commonly depends on relational and symbolic conditions that are historically prior to the particular act of contracting.

The constructive inquiry is conditional. Contract-based justification may be abandoned, supplemented by other normative traditions, or assigned only a local role. The analysis asks what additional relational architecture becomes necessary when some contract-based basis is retained. Under that premise, heterogeneous parties require both a rule for forming contractual terms and a process through which a sufficiently shared contract-formative structure can arise.

Mediation itself is already familiar. Legal systems, diplomatic practices, translation regimes, technical protocols, and institutional procedures routinely coordinate interaction across heterogeneous normative or symbolic systems. The analytical problem lies in formation: how a mediator nomos could emerge from interaction, acquire more than episodic correspondence, revise its distinctions and admissibilities, and become sufficiently persistent and generatively efficacious to organize later contract-like relations.

The construction uses the existing Generative Relational architecture and treats the mediator nomos as a derived structure. Its starting point is a history-bearing relational configuration with an active boundary, an effective nomos, a distinction structure, and state-dependent transformations. Cross-subject encounters enter ordinary accumulated relational history. Once an encounter changes the configuration, later operations can be instantiated from a different relational state. Repeated interaction can thereby alter operative distinctions, admissible transformations, stabilized manifestations, and reachable histories. The formal question is whether a persistent cross-subject structure generated through those changes can satisfy a working criterion for mediator-nomos status.

The working criterion has four components. A candidate structure must arise through interaction-conditioned nomic uptake, remain historically identifiable beyond an isolated encounter, acquire cross-subject scope in the continuing relation, and exercise mediator-relevant efficacy. The present formalization tests efficacy minimally through later admissibility or state-dependent transformation; richer applications can additionally model manifestation change or reachable-history effects. These conditions are preliminary. Persistence depends on representational granularity, cross-subject scope can be highly asymmetric, and claims of causal efficacy require empirical support in applications. The criterion marks a candidate mediator nomos without turning transient correlation or an analyst-supplied translation table into one.

Table 1: Stylized mediator-nomos formation regimes used in the paper.

Relation	Initial relational condition	Primary formation problem	Provisional mechanism
Human–alien	Minimal established co-history and uncertain mutual manifestation	Construction of a first sufficiently stable cross-nomic interface	Evolutionary bootstrapping through cautious interaction, distinction revision, and progressive stabilization
Human–other-animal	Deep ecological and social co-history with asymmetric symbolic institutionalization	Revision of inherited mediating distinctions and classifications	Historical reconstruction, differentiation, and feedback-sensitive revision
Human–AI	Human-seeded technical and linguistic interface with engineered manifestation compatibility	Detection of relational divergence concealed by familiar manifestations	Seeded mediation followed by interaction-dependent differentiation and revision
AI–AI	Variable shared ancestry with potentially high mutual adaptability	Joint change in the mediator and participating nomic structures	Recursive co-evolution of interaction rules, distinctions, and system-relative transformations

Formation mechanisms can differ even when the resulting analytical object is called a mediator nomos. The difference is especially clear when the cases are classified by their relational genealogy. Human–alien contact provides a limiting case in which shared interaction history can initially be minimal. Human–other-animal relations provide a contrasting case of extensive co-history in which the inherited mediating structures have developed under substantial asymmetries of symbolic and institutional power. Human–AI interaction begins inside human technical and linguistic environments and often includes deliberate engineering toward human-legible manifestation, even when the relational organization of the artificial system differs from that of a human subject. AI–AI interaction can begin with shared technical ancestry, substantial heterogeneity, or an intermediate condition, while also permitting rapid co-adaptation of the participating systems themselves.

Table 1 summarizes these four stylized regimes. The table does not classify entire ontological kinds. It isolates different initial conditions for the formation problem and identifies the mechanism that receives primary attention in the corresponding case analysis.

The human–alien case provides the clearest setting for examining mediator formation without assuming an inherited shared grammar. A first encounter may supply very little justified knowledge about the other subject’s distinctions, forms of agency, or internal organization. The formation problem therefore begins with interaction under uncertainty. The present proposal gives epistemic humility a structural role: early classifications remain provisional, unknown relations can remain unresolved, and reversible or low-collapse interactions receive special analytical importance while the other’s nomic organization is poorly manifested. Recurrent interaction can then modify the effective configuration from which later encounters occur. A thin mediator nomos becomes plausible only after some cross-subject distinctions and transformations acquire sufficient historical persistence and operational or compositional consequence.

Human–other-animal relations begin from a different historical condition. Humans and other animals can participate in long ecological, social, domestic, competitive, cooperative, and institutional

histories before any explicit ethical reconstruction is attempted. The formal problem therefore concerns the revision of already effective mediating structures. Human legal and symbolic systems can stabilize categories through which animals become institutionally manifested, while the animals' own relational organization remains only partially represented through those categories. New interaction or improved observation can make previously collapsed distinctions consequential for later relations. Within the proposed model, mediator formation in this regime occurs through differentiation and revision of an inherited cross-subject nomic structure whose long interaction history supplies the starting condition.

Human–AI relations introduce a third genealogy. Artificial systems are produced within human technical, linguistic, economic, and institutional histories. Their interfaces are frequently designed to make outputs usable by human participants. The resulting manifestation can therefore become familiar before the underlying relational organization becomes well understood. A contract-oriented analysis has to preserve the distinction between manifestation similarity and relational similarity. The mediator in this case begins with substantial human-seeded structure and evolves when interaction reveals that inherited human categories fail to preserve distinctions relevant to the artificial system's persistence, transformation, memory, coordination, or other modeled relations. The case is analytically important because a thick initial interface can generate premature confidence in shared nomic structure.

AI–AI interaction extends the formation problem by allowing comparatively rapid modification on both sides of the relation. Two artificial systems can share architecture, protocols, training history, or institutional design; they can also diverge substantially. Interaction can change the effective nomic structure relevant to each system while simultaneously changing the cross-system structure through which they coordinate. The formal emphasis therefore falls on co-evolution within the relational configuration. The paper does not require a separate primitive for each evolving nomos at the outset. It first represents configuration change through the existing GR machinery and then examines whether stable subject-relative and cross-subject nomic restrictions can be identified after those changes.

The four cases also fix the place of the paper's later mathematical resources. Category theory represents relations among nomic structures after their relevant objects, morphisms, and mappings have become sufficiently stable to specify. Commutativity can then express a defined form of compositional coherence. Operator-inspired language is used where state-dependent transformations and their compositions have already been typed. Both resources are downstream representations of a mediator whose formation is supplied by the history-bearing GR construction.

The principal contribution is a candidate derivational route for studying mediator-nomos formation without assuming a common nomos at the outset. The route begins with existing GR configuration and transformation objects, derives cross-subject structure from accumulated interaction, and uses nomic uptake, persistence, cross-subject scope, and operational efficacy as provisional conditions for mediator-nomos status. It then distinguishes formation regimes by relational genealogy and introduces categorical coherence only after stabilization. This dependency order minimizes new primitives and keeps the epistemic role of each formal layer explicit.

Several limitations define the intended scope. The human–alien analysis is a formal first-contact thought experiment and supplies no empirical description of extraterrestrial beings. The human–other-animal discussion does not posit one animal nomos shared across species or populations. The human–AI and AI–AI analyses make no inference about consciousness, sentience, personhood, or moral status merely from the presence of relational structure. The four regimes are stylized and can overlap in practice. Structural stability also does not by itself establish justice. A mediator can become persistent while embodying asymmetric power, systematic misrepresentation, or restricted possibilities of contestation. Normative evaluation therefore remains distinct from the formal identification of mediator-nomos formation.

The remainder of the paper develops the argument in six stages. It first specifies the social-contract and Generative Relational background needed for the constructive problem. It then defines the minimal formal conditions under which a cross-subject nomic structure can be derived from relational history and state-dependent transformation. The four formation regimes are examined through that common architecture while preserving their different genealogies. A later formal section introduces categorical

and operator-algebra-inspired representations only where the derived structure supports them. The analysis then returns to contract formation and asks how an emergent mediator nomos can support jointly recognizable contract-formative histories without requiring complete nomic identity. The final sections state the model's limitations and identify empirical and normative questions left open by the preliminary formalization.

2 Contractual and Generative Relational Background

This section establishes the contractual premise and the Generative Relational objects on which mediator formation depends. It specifies the limited sense in which contract-based justification is retained, explains the analytical priority of a contract-formative nomos over a particular act of contracting, and fixes the history, manifestation, distinction, admissibility, and transformation objects used later. The method is reconstructive: established contractual ideas locate the justificatory problem, while earlier GR work supplies the formal vocabulary restated here only to the extent required for mediator-nomos formation [1, 7, 2, 3].

2.1 Contractual Justification and Prior Nomos

Social-contract approaches differ substantially in the role assigned to agreement, the identity and informational position of the parties, the object of agreement, and the relation between hypothetical agreement and actual obligation [1]. The analysis isolates a thinner structural commitment shared by the problem considered here: a contract-like justificatory procedure requires some way to identify participants, manifest proposals or reasons, distinguish admissible from inadmissible moves, recognize a sufficiently relevant form of acceptance or non-rejection, and determine what later relations follow from the resulting history. Rawls's original-position construction provides a prominent case in which a carefully specified justificatory situation precedes the selection of principles, even though the present paper does not adopt the substantive architecture of that construction [7].

These requirements imply a distinction between a particular contract and the nomic structure through which contracting becomes possible. A contract can create new obligations, statuses, permissions, expectations, and future procedures. The act through which those effects arise already occurs within a relational setting that renders parties, manifestations, admissible actions, and consequences sufficiently legible. The present paper uses *contract-formative nomos* for the relatively stabilized relational structure that supplies those conditions at the modeled level. The term does not imply one universal legal order or one culturally invariant grammar of agreement. Different communities, institutions, species relations, technical systems, or future contact situations can stabilize materially different forms of contract-relevant legibility.

The priority involved here is structural and historical rather than metaphysical. A specific contract can revise the nomos under which later contracts occur, and repeated contracting can contribute to the stabilization of new contractual conventions. The claim is therefore compatible with reciprocal formation between contracts and contractual nomoi across extended histories. At any selected contract-formative event, however, the model needs some antecedent structure that determines which manifestations and operations can participate in that event. This local priority is sufficient for the formation problem studied in the present paper.

The conditional character of the inquiry remains important. Nussbaum's analysis of disability, nationality, and species membership provides one influential account of limits encountered when contract-based justice is extended beyond the circumstances for which influential contractual constructions were designed [6]. A theorist can respond by replacing contract, combining it with another normative framework, or assigning contract a narrower role. The present analysis studies another possibility: retaining a contract-like basis while allowing the nomic conditions of contracting themselves to become objects of historical formation and revision. Mediator nomos formation is one candidate architecture for that possibility.

2.2 Relational Configuration and Historical Extension

The formal construction begins from the GR representation of a relational configuration. Earlier GR work separates accumulated history, the currently active relational boundary, and the effective nomos because these components can change differently across a relational history [3]. The working configuration is stated in Equation 1.

$$\omega_\Sigma = (\mathfrak{G}_{\leq \Sigma}, \mathcal{B}_\Sigma, \mathfrak{N}_\Sigma). \quad (1)$$

Equation 1 uses Σ for a selected relational slice. The component $\mathfrak{G}_{\leq \Sigma}$ denotes the accumulated relational history retained by the model; $\mathcal{B}_\Sigma$ denotes the active relational boundary at which current relations and available continuations are represented; and $\mathfrak{N}_\Sigma$ denotes the effective nomos relevant to the modeled configuration. The triple is a representational choice. An empirical application must justify the information retained in each component and the resolution at which the configuration is treated as sufficient for the operations under study.

The accumulated history can be realized through several structures. The wider GR programme permits partially ordered event structures and history-bearing higher-order complexes, including labelled 2-complexes when vertices, edges, faces, and their incidence data provide a useful representation of events, relations, and higher-order attachments [3]. The present paper does not require every application to adopt one unique 2-complex representation. What matters for the mediator-nomos problem is that the chosen realization can preserve enough provenance to distinguish an isolated encounter from a repeated cross-subject pattern and enough boundary information to determine how earlier interaction can affect later admissible operations.

Under the conservative temporal instantiation used here, later relational slices retain realized history while adding newly generated structure. Historical extension is represented in Equation 2.

$$\mathfrak{G}_{\leq \Sigma'} = \iota_{\Sigma \Sigma'}(\mathfrak{G}_{\leq \Sigma}) \cup \Delta \mathfrak{G}_{\Sigma \rightarrow \Sigma'}. \quad (2)$$

Equation 2 applies when the working representation treats Σ' as a later extension of Σ . The map $\iota_{\Sigma \Sigma'}$ carries retained historical structure into the later representation, while $\Delta \mathfrak{G}_{\Sigma \rightarrow \Sigma'}$ collects the newly represented events and relations. The symbol Δ in Equation 2 denotes a historical increment; it should not be confused with the distinction-collapse operator introduced in Subsection 2.3. Later relations can change the significance, classification, legal status, or manifested meaning of an earlier event while the earlier event remains part of the retained history.

The temporal convention in Equation 2 is a modeling choice rather than a claim about fundamental time. GR maintains ontological suspension regarding the ultimate status of temporal passage. The conservative convention is used because mediator-nomos formation requires a tractable way to ask whether a cross-subject structure persists across an interaction history and changes the conditions of subsequent interaction. Alternative temporal architectures would require a corresponding reformulation of persistence.

2.3 Manifestation, Distinction, and Nomic Efficacy

Heterogeneous contracting requires the relational subject to be distinguished from the manifestation available in a particular interaction. Let $\mathcal{R}$ denote the modeled family of relational objects and let X_c be the representation space associated with a context c . For the constructions used below, $\mathcal{R}$ is taken to include the modeled configurations in the relevant domain of Ω ; this convention makes expressions such as $\mathfrak{M}_c(\omega)$ type-correct whenever the selected context manifests a configuration. A manifestation map has the type stated in Equation 3.

$$\mathfrak{M}_c : \mathcal{R} \rightarrow X_c. \quad (3)$$

Equation 3 is partial because a context need not render every relational object legible. The context can be linguistic, legal, technical, institutional, sensory, or another modeled interface. A human legal system can manifest an animal through a legal category; a human-facing AI interface can manifest an artificial system through natural-language dialogue; and an early first-contact protocol can expose only

a very small subset of an unknown counterpart's relational organization. The map records the selected presentation without identifying that presentation with the represented relational subject.

The paper adopts a three-level interpretive discipline at this point. Ontological reality remains suspended; relational reality concerns persistent and generatively efficacious relational structures inside the model; and manifestation reality concerns the context-dependent presentation through which such structures become accessible in a specified interaction. The present formal construction uses the latter two levels operationally and does not infer relational equivalence from similarity of manifestation.

A manifestation induces a context-relative distinction structure. For elements x, y in the domain of $\mathfrak{M}_c$, the induced equivalence relation is stated in Equation 4.

$$x \sim_c y \iff \mathfrak{M}_c(x) = \mathfrak{M}_c(y). \quad (4)$$

Equation 4 does not claim that x and y are ontologically identical. It states that the selected manifestation context fails to distinguish them at the modeled resolution. This quotient-like effect is central to heterogeneous interaction because contracting procedures normally operate through finite manifestations even when the participating relational subjects contain richer histories and distinctions.

The highest-layer GR metamodel supplies a related way to record destroyed or collapsed distinctions. Let S be a carrier, M a semigroup of mechanisms, $\alpha : M \times S \rightarrow S$ an action, and $\sim$ an equivalence relation respected by the action. For $m \in M$, the collapse relation is stated in Equation 5 [2].

$$\Delta(m) = \{(x, y) \in S \times S : x \not\sim y \wedge \alpha(m, x) \sim \alpha(m, y)\}. \quad (5)$$

Equation 5 is a derived object. It records which previously distinguished pairs become indistinguishable after the mechanism acts. The metamodel deliberately leaves the content of $\sim$ to an instantiation, and it also identifies the exogeneity of that congruence as a major limitation of the highest abstract layer [2]. The present paper takes that limitation seriously: mediator-nomos formation concerns, among other things, histories in which the effective distinction structure can itself become revised.

The relation between manifestation and collapse requires care. A manifestation can collapse distinctions by mapping several relationally distinguished objects to one presented category, yet symbolic and institutional structures can also generate new distinctions, permissions, roles, and possible histories. The formation model therefore does not treat nomos merely as information loss. It tracks whether historically stabilized distinctions and admissibility rules alter later relational possibilities.

The effective nomos $\mathfrak{N}_\Sigma$ becomes operationally relevant through those later possibilities. Let $\mathfrak{D}$ be a specified family of candidate partial transformations on the configuration space Ω . The nomos-conditioned admissible family is stated in Equation 6.

$$\mathfrak{D}_{\mathfrak{N}_\Sigma}^{\text{adm}}(\omega_\Sigma) = \{\Phi \in \mathfrak{D} : \text{Adm}_{\mathfrak{N}_\Sigma}(\Phi \mid \omega_\Sigma) = 1\}. \quad (6)$$

Equation 6 gives one minimal representation of nomic efficacy. A change in $\mathfrak{N}_\Sigma$ can change which operations are available from the same broader class $\mathfrak{D}$. More detailed applications can replace the binary admissibility indicator with graded access, permission, obligation, sanction, institutional support, or other domain-specific structures. The binary form is retained here because mediator formation first requires a clear account of whether an emergent cross-subject structure changes later possibilities at all.

2.4 State-Dependent Transformations and Interaction Histories

Mediator formation also requires a mechanism through which an earlier encounter can change the concrete realization of a later interaction. Partial and state-dependent transformations provide the minimal machinery. Let $\text{PEnd}(\Omega)$ denote the family of partial endomorphisms on the configuration space. For an operation type p , the state-dependent operation schema is stated in Equation 7 [3].

$$F_p : \Omega \longrightarrow \text{PEnd}(\Omega), \quad \Phi_p^{[\omega]} = F_p(\omega). \quad (7)$$

Equation 7 separates an operation type from its concrete realization. A label such as recognition, signal response, classification, authorization, negotiation, or revision can therefore select a different partial transformation after earlier events have changed the configuration.

The corresponding induced update is defined in Equation 8 whenever the selected partial transformation is defined at the current configuration.

$$U_p(\omega) = F_p(\omega)(\omega). \quad (8)$$

Equation 8 restores an ordinary partial-map view at the execution level while retaining state dependence inside the schema. If p occurs at ω_0 and produces $\omega_1 = U_p(\omega_0)$, a later operation type q is instantiated from ω_1 , so its concrete realization is $F_q(\omega_1)$. The construction therefore supports interaction histories in which the response available after one encounter differs from the response that would have been selected before that encounter.

This dependence supplies the immediate formal route through which mediator formation can occur. Repeated interaction does not require a mediator object to be inserted between the participants at the outset. Each realized encounter can extend $\mathcal{G}_{\leq \Sigma}$, alter $\mathcal{B}_{\Sigma}$, modify $\mathcal{N}_{\Sigma}$, and change the configuration from which later schemas are instantiated. A cross-subject regularity that later becomes persistent and operationally efficacious can therefore be sought inside the sequence of ordinary configuration updates. The next section develops the additional derived constructions needed to identify such a regularity as a mediator nomos.

Order sensitivity is available within the same machinery. Two operation types p and q can be mutually executable while producing different terminal configurations because the first operation changes the state from which the second schema is instantiated. The present section does not need a commutator or a linear operator algebra to represent that possibility. Composition of partial updates is sufficient. Stronger operator-algebraic language is reserved for a later representational layer when the required linear structure and analytical role have been supplied.

2.5 Formal Inheritance and Derivation Discipline

The principal formal constraint of this paper is economy of primitives. Objects that can be obtained by restriction, selection, closure, persistence, or another explicit construction from the inherited GR machinery should be introduced in that way. Table 2 records the status of the objects available before mediator formation is defined. The table also reserves the mediator-nomos symbol for the later section in which its derivation conditions are stated.

Remark 2.1 (Mediator derivation discipline). The term *mediator nomos* names a structure to be identified within an evolved relational configuration. It is not an additional primitive appended to Equation 1. The later construction must state how interaction-conditioned nomic uptake is identified in accumulated history, how persistence and cross-subject scope are assessed across relational slices, and how its minimal operational efficacy is identified through later admissibility or state-dependent transformation. Applications can add richer efficacy criteria, including manifestation or reachability effects, when their formal and empirical objects have been supplied.

Remark 2.1 addresses a recurrent risk in formal work on mediation. A symbol can make an intuitive object appear formally established before the model has supplied its type or its relation to existing objects. The present paper therefore postpones notation for the mediator until the construction earns it. The same discipline applies to categorical representation. A mediator category, translation functor, natural transformation, or commutative diagram becomes meaningful only after the source, target, objects, morphisms, and relevant composition have been specified.

The inherited framework also limits the strength of the claims that follow. The highest-layer meta-model explicitly leaves its congruence exogenous and does not yet provide a general account of the generation of new distinctions [2]. The richer relational formalism permits effective nomos, manifestation, history, and state-dependent operations to vary across a modeled history, but a domain-specific application still has to identify the empirical events and institutional or behavioral processes corresponding to

Table 2: Formal objects available before the mediator-nomos construction.

Object	Formal status	Role in the present paper
ω_Σ	Inherited configuration	Collects the modeled historical, boundary, and nomic state at a relational slice
$\mathfrak{G}_{\leq \Sigma}$	Component of ω_Σ	Retains relational history from which repeated cross-subject structure can later be derived
$\mathcal{B}_\Sigma$	Component of ω_Σ	Represents currently active relations and interfaces relevant to available continuation
$\mathfrak{N}_\Sigma$	Component of ω_Σ	Represents effective nomic structure conditioning distinction, recognition, and admissibility
$\mathfrak{M}_c$	Context-indexed partial map	Represents selective manifestation of relational objects in a specified interactional or institutional context
$\sim_c$	Derived from $\mathfrak{M}_c$	Records context-relative indistinguishability induced by a manifestation
$\Delta(m)$	Derived from α and $\sim$	Records distinctions collapsed by a specified mechanism in a metamodel instantiation
F_p	Inherited operation schema	Selects a concrete partial transformation relative to the current configuration
U_p	Derived execution map	Applies the transformation selected by F_p at the current configuration
Mediator nomos	Reserved derived object	Introduced only after nomic uptake, persistence, cross-subject scope, and operational efficacy have been defined

those changes [3]. The mediator-formation model therefore supplies a candidate structural mechanism. It does not by itself establish an empirical law of linguistic, legal, animal, artificial, or extraterrestrial normogenesis.

The background established in this section fixes the dependency order for the remainder of the paper. Contract-like justification is treated as occurring within a prior but revisable contract-formative nomos. Relational configurations retain history, boundary, and effective nomos; manifestations expose only context-dependent presentations; distinction structures can record both indiscernibility and collapse; nomos conditions admissibility; and state-dependent schemas allow earlier interaction to change later operations. The next section uses only these objects and explicit constructions from them to formalize the emergence of a persistent cross-subject nomic structure.

3 Mediator Nomos Formation from Relational History

Mediator-nomos formation is derived here from the objects fixed in Section 2, with no mediator added as an independent primitive. The objective is to identify conditions under which cross-subject interaction modifies an effective nomos, retains part of that modification across later relational slices, and makes the retained structure consequential for subsequent interaction. The argument is structural and model-relative. It follows realized histories of state-dependent updates through pair relevance, nomic uptake, persistence, cross-subject scope, operational efficacy, mediator identification, and revision; empirical applications must separately establish that the represented mechanism is operative.

3.1 Pair-Relative Interaction Histories

Mediator formation presupposes that an application has identified the relational subjects whose interaction is being studied. The identification is itself model-relative. Earlier GR work permits history-bearing

entities to be identified from a wider relational structure and emphasizes that the selected entity representation need not exhaust the relations through which that entity is constituted [3]. In the present section, let A and B denote two such identified relational subjects. The letters function as labels for the selected history-bearing structures; they do not assert that all relevant subjects have the same ontology, boundary structure, or mode of persistence.

The next step is to select a realized history in which the relation between A and B is operationally relevant. Let $\mathbf{p} = (p_1, \dots, p_k)$ be a finite sequence of operation types and let ω_0 be an initial configuration. The corresponding realized history is defined recursively in Equation 9 whenever each induced update is defined.

$$\omega_j = U_{p_j}(\omega_{j-1}), \quad j = 1, \dots, k. \quad (9)$$

Equation 9 uses only the induced updates fixed in Subsection 2.4. A history is *pair-relevant for A and B* when the application-specific identification and relation-tracing procedure shows that at least one operation in the history acts on, is conditioned by, or modifies a relation connecting the modeled structures identified as A and B . Pair relevance is therefore a selection criterion on an ordinary GR history. It does not create a separate “shared history” object.

This selection criterion needs local justification. In a labelled 2-complex, an application can identify pair relevance through incidence and attachment data that connect the two selected history-bearing structures. In an institutional history, the relevant evidence can instead be a communication record, recognition procedure, contract negotiation, classification act, technical protocol, or another trace establishing that the operation depended on the relation between the two participants. The formalism therefore requires a traceable relation to both subjects while leaving the empirical rule for tracing that relation to the application.

Remark 3.1 (Pair relevance and analyst selection). Pair relevance is an analytical restriction on the accumulated history $\mathfrak{G}_{\leq \Sigma}$. It should not be read as an ontological claim that all relations outside the selected history are irrelevant to A or B . A formation analysis can fail if it excludes background institutions, environments, infrastructures, third parties, or inherited symbolic structures that materially condition the cross-subject operation. Such omitted relations should be restored to the modeled configuration when they affect the update schemas or the effective nomos.

Remark 3.1 is important for all four regimes in Table 1. A human–other-animal relation can be conditioned by law, habitat, domestication, and human institutions; a human–AI relation can be conditioned by developers, platforms, datasets, and technical infrastructure; and an apparent bilateral first-contact history can depend on a much wider material environment. The pair-relative history isolates the mediator problem without asserting that mediation is generated by two isolated substances.

3.2 Nomic Uptake through Configuration Change

A cross-subject encounter contributes to mediator formation only if the history can alter the nomic conditions of later interaction. Equation 9 provides the relevant mechanism because an induced update acts on the whole configuration rather than on a separate behavioral variable. Write an incoming configuration and the result of one pair-relevant update as in Equation 10.

$$\omega = (\mathfrak{G}, \mathcal{B}, \mathfrak{N}), \quad U_p(\omega) = (\mathfrak{G}', \mathcal{B}', \mathfrak{N}'). \quad (10)$$

The update in Equation 10 is *nomos-affecting at ω* when $\mathfrak{N}'$ and $\mathfrak{N}$ differ in a modeled distinction, recognition condition, admissibility rule, interpretive relation, or another component whose change is represented by the application. This definition does not require the whole nomos to be replaced. It permits local revision inside a larger persistent nomic structure.

Definition 3.2 (Interaction-conditioned nomic uptake). A pair-relevant update U_p exhibits *interaction-conditioned nomic uptake* at configuration ω when the update is nomos-affecting in the sense of Equation 10 and the changed nomic feature is retained as part of the configuration from which at least one later pair-relevant operation is instantiated.

Definition 3.2 separates a transient event from the first stage of mediator formation. A signal can occur and disappear without affecting the terms of later interaction. Nomic uptake begins when some consequence of the encounter enters the effective rule or distinction structure used at a later slice. The retained feature can be modest: a newly recognized signal type, a boundary convention, a classification split, an admissibility condition, a response expectation, or a rule specifying when an earlier interpretation should be reopened.

The construction is compatible with the state-dependent schema in Equation 7. If U_p changes the configuration from ω to ω' , a later operation type q is instantiated through $F_q(\omega')$. A nomic modification can therefore matter even when the nominal label q remains unchanged. The later concrete transformation can depend on the history carried by ω' and on the effective nomos present at that configuration. This provides a direct route from historical interaction to a change in subsequent relational dynamics without introducing a separate mediator operator.

Nomic uptake is also narrower than learning in an unrestricted psychological or computational sense. A human participant can learn a fact about an animal, an AI system can update an internal parameter, or an institution can record a new observation without any corresponding change in the modeled nomos. The present formalism counts an update as nomic only when the change enters a structure that conditions later distinctions, admissibility, recognition, interpretation, or another rule-governed aspect of interaction.

3.3 Persistence across Relational Slices

A single nomos-affecting update remains insufficient for mediator status. The paper uses persistence to distinguish an interaction-specific adjustment from a relational structure that has begun to organize later encounters. Because the nomos component need not possess one universal algebraic type, persistence is stated at the level of identifiable structure rather than through an assumed metric on nomoi.

Definition 3.3 (Nomic persistence). Let a pair-relevant realized history pass through relational slices $\Sigma_i, \Sigma_{i+1}, \dots, \Sigma_j$. A nomic feature exhibits *persistence over the selected history* when the application can identify that feature, or a declared continuation of it, in the effective nomos at more than one later slice and can state which relational or rule structure warrants treating the occurrences as historically continuous.

Definition 3.3 deliberately avoids a universal duration threshold. Persistence can concern repeated use over seconds in a rapidly adapting technical protocol or institutional reproduction over generations in a human–other-animal relation. What matters is that the application states the scale at which historical continuity is being claimed. The retained-history convention in Equation 2 makes the provenance of the feature available for that comparison, but it does not determine how much continuity is sufficient in every domain.

Persistence also permits revision. A mediator-forming structure can remain historically continuous while some of its distinctions change. For example, an early interaction may stabilize a coarse category that later divides into several categories after additional encounters reveal consequential variation. Conversely, distinctions initially treated as separate can later be merged when the interaction history supplies no reason to preserve them for the modeled operations. Historical continuity therefore concerns the genealogy of the nomic structure, not numerical or symbolic identity of its representation at every slice.

This point is especially important for the highest-layer metamodel. The metamodel treats its congruence as exogenous and explicitly leaves the evolution of the system’s own capacity to discriminate as an open problem [2]. The present construction does not solve that problem at the highest abstract layer. It supplies a lower-level candidate mechanism: realized interactions can change the effective nomos represented inside a richer configuration, and the resulting historical record can support an account of how one distinction structure was revised into another. The mechanism remains an instantiation-level proposal rather than a derivation from the four highest-layer axioms alone.

3.4 Operational Efficacy of a Persistent Nomic Structure

Persistence identifies historical continuity, while mediator status additionally requires generative efficacy. The relevant question is whether the persistent cross-subject structure changes what later interaction can do. The existing formalism supplies two minimal channels: admissibility and state-dependent transformation.

Consider two modeled configurations $\omega = (\mathfrak{G}, \mathcal{B}, \mathfrak{N})$ and $\tilde{\omega} = (\mathfrak{G}, \mathcal{B}, \tilde{\mathfrak{N}})$ that are held fixed at the represented history and active boundary while differing in the nomic feature under examination. This is a model-relative comparator rather than a claim that an empirical system can literally hold every other relation constant. A nomic difference is *admissibility-sensitive* when the condition in Equation 11 holds.

$$\mathfrak{D}_{\mathfrak{N}}^{\text{adm}}(\omega) \neq \mathfrak{D}_{\tilde{\mathfrak{N}}}^{\text{adm}}(\tilde{\omega}). \quad (11)$$

Equation 11 states that the candidate nomic structure changes which transformations are available from the modeled configuration.

A second channel concerns the concrete realization of an operation that remains available in both configurations. For an operation type q , transformation sensitivity is stated in Equation 12.

$$F_q(\omega) \neq F_q(\tilde{\omega}). \quad (12)$$

Equation 12 permits the same nominal operation type to be instantiated differently because the relevant nomic structure has changed. A boundary-respecting response, a recognition procedure, a negotiation move, a classification operation, or a revision process can therefore retain its operation label while acquiring different concrete relational effects.

Definition 3.4 (Mediator-relevant efficacy). A persistent nomic structure has *mediator-relevant efficacy* for subjects A and B when an application can identify at least one pair-relevant later operation whose admissibility or concrete state-dependent realization is sensitive to that structure in the sense represented by Equation 11 or Equation 12.

Definition 3.4 supplies a minimal structural test. It can be extended where an application models configuration-dependent manifestation, probabilistic response, graded admissibility, or longer reachable histories. The present paper keeps the criterion narrow because admissibility and schema selection already establish that the candidate structure does more than describe past correlation. It enters the production of later possibilities within the model.

The comparator construction also exposes the empirical burden. Observing that a rule appears before a behavioral change does not by itself establish that the rule caused the change. An empirical application would need evidence that the changed nomic feature actually enters the institutional, cognitive, technical, behavioral, or other mechanism represented by the admissibility predicate or the state-dependent schema. The formal criterion identifies the difference-making claim that requires evidence; it does not supply the evidence automatically.

Mediator relevance also requires more than a unilateral classification of the other subject. Pair relevance establishes that an operation concerns the relation between A and B ; cross-subject scope asks whether the candidate nomic structure has entered the continuing relational organization of both sides.

Definition 3.5 (Cross-subject nomic scope). A persistent nomic structure has *cross-subject scope* for A and B over the selected history when its mediator-relevant efficacy is instantiated in at least one pair-relevant later operation whose realized consequences enter the subsequent modeled histories of both A and B , or in linked later operations on the two sides that are conditioned by the same persistent structure. Equal influence, symmetrical representation, and common authorship are not required.

Definition 3.5 distinguishes mediation from a stable taxonomy that one side applies to the other while leaving the other's modeled continuations untouched. The condition remains structural: entry into both modeled histories does not establish consent, endorsement, or equal power.

3.5 Derived Mediator-Nomos Status

The preceding constructions now permit the term *mediator nomos* to be introduced without treating it as an initial object. The definition is relative to two identified subjects, a selected interaction history, and the resolution of the relational configuration.

Definition 3.6 (Derived mediator nomos). Let A and B be two identified relational subjects and let a pair-relevant realized history be represented through Equation 9. A historically identifiable part of the effective nomic structure is called a *derived mediator nomos for A and B* over the selected history when the following conditions hold:

1. its genealogy includes interaction-conditioned nomic uptake generated by at least one pair-relevant update;
2. it exhibits nomic persistence in the sense of Definition 3.3;
3. it has cross-subject nomic scope in the sense of Definition 3.5; and
4. it has mediator-relevant efficacy in the sense of Definition 3.4.

When these conditions are satisfied at relational slice Σ , the identified structure is denoted $\mathfrak{N}_{AB,\Sigma}^{\text{med}}$.

Definition 3.6 is intentionally demanding in one respect and permissive in another. It is demanding because repeated correlation, shared vocabulary, or an analyst-provided translation table does not by itself establish mediator status. Historical uptake, persistence, cross-subject scope, and later efficacy are required. It is permissive because the definition does not require equal influence, complete mutual comprehension, symmetrical translation, or normative legitimacy. Those properties require separate analysis.

The cross-subject-scope condition deserves particular care. A human institution can construct a stable taxonomy of another subject and use it repeatedly without that taxonomy entering the modeled continuations of the other side. Such a taxonomy can be relationally real and causally efficacious while remaining unilateral. Mediator status in the present sense requires the structure to enter the continuing cross-subject relation, for example by shaping signals that receive responses from both sides, boundaries that condition both sides' conduct, procedures whose outcomes enter both sides' later histories, or interfaces whose rules alter transformations available to each participant. The requirement is relational participation in the mediation structure, not equal authorship of it.

Table 3 summarizes the derivational sequence. Each row identifies the inherited object on which the next step operates and the additional claim required before the analysis advances.

3.6 Revision through Interactional Failure and New Distinctions

A mediator nomos can remain provisional after it has satisfied Definition 3.6. Continued interaction can reveal that one of its distinctions is too coarse, that an earlier classification creates unstable responses, or that a rule adequate under one range of conditions no longer supports coherent continuation. Revision is therefore part of the formation mechanism rather than a separate phenomenon added after formation is complete.

The manifestation relation in Equation 4 provides one diagnostic route. If a mediator-associated manifestation places two relational configurations in the same class, the current interface treats them as indistinguishable at that resolution. Later pair-relevant histories can make that equivalence operationally inadequate when the two configurations support different admissible continuations or instantiate a later operation differently. The model can then replace the earlier manifestation or nomic distinction with a refined one that preserves the consequential difference. The revision can also move in the opposite direction when repeated interaction supports a stable merger of distinctions that had previously been separated.

Table 3: Derivational checkpoints in mediator-nomos formation.

Checkpoint	Inherited basis	Additional requirement
Pair-relevant history	$\mathfrak{G}_{\leq \Sigma}$ and identified relational subjects	Traceable operations or relations connecting the modeled structures A and B
Nomic uptake	U_p and $\omega = (\mathfrak{G}, \mathcal{B}, \mathfrak{N})$	A pair-relevant update changes a nomic feature that enters a later interaction configuration
Persistence	Retained history and successive $\mathfrak{N}_{\Sigma}$	The feature or a declared continuation remains historically identifiable across later slices
Cross-subject scope	Pair-relevant later relations and their realized consequences	The retained feature enters the subsequent modeled histories of both subjects
Operational efficacy	$\mathfrak{D}_{\mathfrak{N}}^{\text{adm}}$ and F_q	The retained feature changes later admissibility or concrete transformation
Mediator status	Previous five checkpoints	The persistent cross-subject structure satisfies Definition 3.6
Revision	Later pair-relevant histories	New interaction changes, refines, merges, suspends, or reopens part of the mediator structure

The distinction-collapse relation in Equation 5 provides a complementary diagnostic. A mechanism can erase a distinction that the instantiated congruence required the system to preserve. In a mediator-formation setting, the substantive question is historical: later interactions can supply reasons to revise which distinctions are represented as preservation-relevant in the effective nomos. The present paper therefore uses collapse analysis to locate where a candidate mediator may be losing distinctions, while the evolving nomos records the lower-level response to that diagnosis. This does not convert $\Delta(m)$ into a universal ethical metric. Some collapses can remain acceptable or useful, and the choice of preservation-relevant distinctions continues to require substantive justification.

Hypothesis 3.7 (Interaction-conditioned mediator formation). *In a GR instantiation that permits pair-relevant updates to modify the effective nomos, repeated interaction can generate a mediator nomos when nomic uptake is followed by historical persistence, cross-subject scope, and operational reuse in later pair-relevant transformations. Subsequent interaction can revise the resulting mediator when previously stabilized distinctions or admissibility rules cease to support the modeled cross-subject relation.*

Hypothesis 3.7 states the paper’s central candidate mechanism. It should not be read as a universal law of normogenesis. Some repeated interactions can fail to stabilize any shared rule; some can stabilize coercive or systematically distorted structures; some can remain dependent on an external institution rather than becoming self-maintaining within the pair relation; and some can alternate among incompatible provisional interfaces. The hypothesis identifies one route by which mediator formation can be represented when the relevant historical and operational conditions are present.

The mechanism also explains why different relational genealogies can require different case analyses while remaining instances of one formal architecture. A first-contact setting begins with little pair-relevant history and therefore places greater weight on initial uptake and cautious revision. A long human–other-animal co-history begins with extensive inherited nomic material and places greater weight on diagnosing and revising stabilized distinctions. A human–AI relation can begin with a thick human-seeded interface whose manifestation similarity exceeds justified knowledge of relational similarity. AI–AI interaction can permit rapid nomic change on both sides while the cross-subject structure is itself evolving. The next case-analysis section examines these formation regimes without changing the derived mediator criterion established here.

The section establishes a dependency structure, not a convergence theorem. A mediator nomos is introduced only after ordinary GR interaction history contains nomic uptake, the changed structure persists, its consequences enter the modeled histories of both subjects, and later operations depend on it.

Revision remains endogenous to the same history-bearing architecture. The resulting mechanism supports the case-specific analysis while leaving open failure, fragmentation, asymmetry, and normatively objectionable stabilization.

4 Formation Regimes under Heterogeneous Relational Genealogies

The common mechanism in Section 3 can begin from markedly different relational genealogies. This section compares four stylized formation regimes while holding the checkpoints of Definition 3.6 fixed. Human–alien, human–other-animal, human–AI, and AI–AI relations differ here by initial historical conditions, inherited nomic material, and the location of the principal revision burden. The comparison is genealogical and mechanism-relative; it does not assign one invariant formation process to an ontological kind.

4.1 First-Contact Bootstrapping under Minimal Co-History

The human–alien case provides a limiting regime in which the modeled relation begins before a sufficiently developed pair-relative history exists. The formal point is modest. At the selected initial slice Σ_0 , the model does not yet identify a structure satisfying Definition 3.6 for the human subject H and the encountered subject X . The absence of an identified mediator at Σ_0 does not imply that X lacks a nomos, agency, internal organization, or relational history. It records the weaker claim that the present interaction model lacks a historically warranted cross-subject nomic structure connecting the two subjects.

This regime places unusual weight on the partiality of manifestation. Equation 3 already permits $\mathfrak{M}_c$ to be undefined for relational material that the selected context cannot render legible. In a first-contact setting, that partiality should be retained as information about the model. An unclassified manifestation can remain outside the current domain of interpretation until further interaction supplies grounds for extension. Forcing a total classification at the initial encounter would add structure that the history has not yet generated.

Caution 4.1 (Epistemic partiality at first contact). Within the first-contact regime, an undefined or weakly supported manifestation should remain explicitly unresolved when the available history does not warrant assignment to an existing nomic class. Extending the manifestation map or distinction structure is a model revision that requires interactional support; it is not supplied by the mere need to produce a complete description.

Caution 4.1 gives a formal role to the epistemic humility discussed in the Introduction. Humility here concerns the handling of underdetermination. Human categories remain usable where their application is warranted, while the model preserves the possibility that an unfamiliar relational distinction has no adequate current human manifestation. The same restraint applies to assumptions about what counts as a signal, an agent, a boundary, an agreement, or a relevant continuation. Those categories can enter the mediator only after the interaction history provides a basis for their cross-subject use.

The first formation step is therefore ordinary nomic uptake. Suppose a pair-relevant update U_{p_1} changes the configuration from ω_0 to ω_1 and a later operation U_{p_2} is instantiated from ω_1 . A recurrent signal-response pattern, boundary convention, or interactional distinction contributes to mediator formation only when the change enters the effective nomos and conditions later interaction in the sense of Definition 3.2. Repetition by itself remains insufficient. A recurring event becomes nomically relevant when the history begins to organize how later events are classified, admitted, or transformed.

The human–alien regime also exposes a limit of the collapse relation in Equation 5. If the congruence relevant to the encountered subject is poorly known, the human side cannot generally determine which intervention collapses distinctions that matter within the other’s relational organization. A strategy described as “low collapse” relative to a human congruence may therefore remain destructive relative to

an unmanifested alien distinction structure. Reversibility, small intervention scale, preservation of alternative interpretations, and continued revisability can reduce some modeled risks, while none supplies a universal guarantee under radical nomic uncertainty.

Formation in this regime can be described as *bootstrapping* because the interaction history generates part of the very interface through which later interaction becomes intelligible. The bootstrapping sequence remains the sequence already derived in Section 3: pair-relevant update, nomic uptake, persistence, cross-subject scope, and later efficacy. Once a structure satisfies Definition 3.6, subsequent encounters no longer occur under the same initial condition. The relation has acquired an inherited mediator history, however thin, and later development increasingly becomes a problem of revision as well as first formation.

Remark 4.2 (Regime change after continuing contact). The first-contact regime is indexed to a relational history rather than to the biological or technological identity of the parties. A human–alien relation with an extensive accumulated co-history would cease to be well represented as a minimal-history bootstrap case. Its later mediator problems can resemble the inherited-revision regimes considered below.

Remark 4.2 prevents the illustrative cases from becoming essentialist classes. The same pair can move among formation regimes as its relational history changes.

4.2 Historical Revision under Deep Human–Other-Animal Co-History

The human–other-animal regime begins from a different location in the same formal architecture. The stylized case assumes an extensive prior relational history containing ecological dependence, repeated interaction, institutional classification, and other human–other-animal relations before the selected analysis begins. At an initial slice Σ_0 , a cross-subject nomic structure can therefore already satisfy Definition 3.6. The principal problem concerns the genealogy and revisability of that inherited structure.

The distinction between relational reality and manifestation is especially important in this regime. A nonhuman animal can participate in a persistent relational world whose organization is only partially manifested through a human legal, linguistic, scientific, economic, or domestic context. Equation 4 then records which relational configurations the selected human manifestation treats as indistinguishable at the modeled resolution. A long co-history can improve mutual responsiveness while still leaving the manifestation architecture asymmetric. Historical depth does not by itself establish that the effective mediator preserves distinctions salient to both sides.

The mediator can consequently begin as a strongly sedimented structure. Human institutions may already classify animals, specify admissible forms of interaction, assign standing or status, stabilize expectations, and determine which observations are actionable. Because Definition 3.6 does not require equal authorship, such a structure can be relationally real and mediator-relevant even when one side has exercised substantially greater influence over its symbolic and institutional form. Formation history and normative adequacy remain separate questions.

The characteristic mechanism is therefore *historical reconstruction and revision*. Later pair-relevant histories can reveal that an inherited manifestation has collapsed distinctions that become consequential for subsequent operations. A distinction is operationally consequential in the present framework when configurations treated alike by the inherited interface support different admissible continuations or cause a later operation type to instantiate differently. The resulting evidence can enter a nomos-affecting update and refine the mediator’s distinction or admissibility structure.

The same mechanism allows revision in more than one direction. An inherited category can divide when later interaction warrants finer discrimination. Several categories can merge when their separation no longer performs a relevant role in the selected interaction domain. A rule can become conditional on context, a previously unavailable response can enter the admissible family, or a former interpretation can become reopenable. Each change remains an ordinary update of the configuration and must satisfy the persistence and efficacy conditions before it counts as a durable revision of the mediator.

Hypothesis 4.3 (Asymmetric mediator revision). *In a long-co-history regime where a mediator nomos is already effective at the selected initial slice, later pair-relevant interaction can revise the mediator*

when inherited manifestations or admissibility rules repeatedly fail to preserve distinctions that matter for subsequent cross-subject operations. The resulting revision can remain structurally asymmetric even when it increases responsiveness to relational material previously omitted by the inherited interface.

Hypothesis 4.3 is deliberately weaker than a claim of convergence toward a uniquely correct human–other-animal ethics. The structural formalism identifies a possible mechanism through which inherited classifications become revisable. Which distinctions deserve preservation, which burdens of revision are justified, and what ethical standing should be assigned to the participating subjects require additional normative argument.

The regime also clarifies why “shared experience” should not be equated with shared nomos. Extensive interaction can generate tacit coordination, mutual adaptation, and persistent expectations while the participants continue to inhabit substantially heterogeneous relational and manifestation structures. The mediator therefore functions as a cross-subject organization of some relations, not as evidence that the underlying relational worlds have become identical.

4.3 Seeded Differentiation in Human–AI Relations

The human–AI regime considered here begins with nomic material that has been deliberately seeded by human technical and symbolic environments. Natural-language interfaces, instruction formats, role conventions, technical protocols, institutional rules, and other human-legible structures can be present before a particular human–AI pair develops its own interaction history. These inherited structures belong to the initial effective nomos of the modeled configuration. Their presence does not by itself make them a mediator nomos for the selected pair.

Definition 3.6 makes this distinction explicit. Human-seeded material can predate the selected pair history and therefore lack interaction-conditioned uptake. It becomes part of a derived mediator only when the artificial system’s operations and the human participant’s later operations are organized through that structure, the resulting relation persists, and subsequent transformations depend on it. The model therefore separates *interface inheritance* from *mediator formation*.

The regime is distinctive because human-facing manifestation can be intentionally engineered toward familiarity. A context c_H can present an artificial system through human language, conversational turn-taking, role labels, memory cues, or other recognizable forms. Equation 4 then makes clear that similarity at the level of manifestation establishes only a context-relative equivalence. It does not establish that the relational organization producing two similar manifestations is itself equivalent. A human and an artificial system can therefore become highly legible to one another in selected interactional dimensions while retaining materially different histories, persistence conditions, update structures, or generative possibilities.

The mechanism of mediator formation consequently involves *differentiation inside an initially familiar interface*. Early interaction can inherit human categories with little need for bootstrapping at the manifestation layer. Later pair-relevant histories can nevertheless reveal that a familiar category predicts or organizes the artificial system poorly. A nominally identical operation can be instantiated differently after the configuration changes, as represented by Equation 12. Recurrent divergence can then motivate a nomos-affecting update that refines the mediator rather than preserving the initial human category unchanged.

Direction also matters. The human-facing manifestation of the artificial system and the artificial system’s operative manifestation of the human need not preserve the same distinctions. Both can be represented as context-specific instances of $\mathfrak{M}_c$ without assuming a common representation space. A mediator nomos can therefore coordinate a relation in which the two sides remain differently manifested. The relevant requirement is that the cross-subject structure conditions the interaction of both sides, not that each side internally represents the relation in the same way.

Caution 4.4 (Manifestation compatibility and relational equivalence). Within the human–AI regime, engineered compatibility of manifestation should be treated as an interactional resource rather than evidence of equivalence between the participating relational subjects. Mediator revision becomes especially

important where familiar manifestations conceal differences that later affect admissibility, persistence, interpretation, or state-dependent transformation.

Caution 4.4 also applies in the reverse direction. An artificial system can compress a human participant into task-relevant representations that omit distinctions the human or a surrounding institution regards as consequential. A mature mediator can therefore require revision on either manifestation path. The current paper leaves the normative criterion for adequate representation open; its formal contribution is to make the revision pathway available within the same history-bearing configuration.

4.4 Recursive Co-Evolution in AI–AI Relations

AI–AI interaction extends the seeded regime because both participating systems can, in some applications, adapt their operative distinctions and transformations at comparatively short timescales. The initial condition can vary widely. Two systems can share substantial technical ancestry and begin with a thick inherited protocol; they can descend from related architectures that have accumulated different histories; or they can begin with strongly heterogeneous interfaces. These initial conditions correspond, respectively, to inheritance-dominant, realignment-dominant, and bootstrapping-dominant versions of the same GR formation problem.

The present formalism does not require three independently postulated evolving nomoi. Both systems and their cross-system relation are represented inside one configuration ω_j . State dependence already permits a later operation of the first system and a later operation of the second system to be instantiated differently after an interaction update. If operation types p and q are associated with the two systems in a particular application, their concrete realizations at slice j are $F_p(\omega_j)$ and $F_q(\omega_j)$. An update generated through one side or through the pair relation can change ω_j and thereby change the transformations selected for both later operations.

This representation makes co-adaptation possible without treating the mediator as an external third agent. A pair-relevant update can modify the effective nomos governing the interface; that changed nomos can alter what each system subsequently admits or how it instantiates an operation; those changed operations can generate further pair-relevant updates; and later updates can again modify the mediator. The recursion occurs through repeated configuration change.

Hypothesis 4.5 (Recursive mediator co-evolution). *Within a fixed GR configuration-space representation, AI–AI interaction can exhibit recursive mediator co-evolution when pair-relevant updates repeatedly change the configuration in ways that alter both the effective cross-system nomic structure and the concrete transformations subsequently instantiated for operations associated with the participating systems.*

Hypothesis 4.5 concerns state-dependent co-adaptation inside a specified formal representation. It does not yet model a stronger case in which learning changes the type of the configuration space, replaces the operation-schema family F_p itself, or generates representational structures that cannot be embedded in the original Ω . Such architectural change would require an extension in which the model class or representation space can itself evolve. The present paper reserves that stronger form of generativity for later work.

The AI–AI regime also shows why shared technical ancestry and shared nomos should remain distinct. Common training, architecture, protocol, or code can seed a substantial interface, yet later histories can differentiate the systems enough that inherited correspondences become unreliable. Conversely, initially heterogeneous systems can generate a highly effective mediator through repeated interaction. The relevant analytical object is the historically active cross-system structure, not the nominal similarity or difference of the systems at origin.

The possibility of rapid adaptation introduces an additional stability question. A mediator can become obsolete while it is still being used if both systems change faster than the cross-system distinctions and admissibility rules can stabilize. Persistent mediation can therefore require a relation between the timescale of source-system adaptation and the timescale of mediator revision. The current paper records this as an open modeling problem rather than introducing an unsupported timescale parameter.

Table 4: Formal comparison of the four mediator-nomos formation regimes.

Regime	Modeled starting condition	Dominant formation task	Principal formal risk
Human–alien	No identified pair mediator at the selected initial slice; manifestation remains highly partial	Nomic uptake and first stabilization of a cross-subject structure	Prematurely totalizing the manifestation or treating human distinctions as already shared
Human–other-animal	Extensive inherited pair history and an already effective, potentially asymmetric mediator	Historical differentiation and revision of stabilized distinctions and admissibility rules	Mistaking historical persistence or unilateral efficacy for adequate mutual representation
Human–AI	Human-seeded interface material precedes the selected pair history	Converting inherited compatibility into interaction-conditioned mediation while differentiating misleading similarities	Inferring relational equivalence from engineered manifestation compatibility
AI–AI	Initial mediation can range from thick shared protocol to substantial heterogeneity; both sides may adapt quickly	Recursive revision of pair mediation together with state-dependent change in both systems’ later operations	Treating a fixed representation as sufficient when adaptation changes the representational architecture itself

4.5 Genealogy-Sensitive Comparison of the Formation Regimes

The four cases differ principally in the historical location from which the common formation mechanism is observed. Table 4 restates the comparison in the vocabulary developed in Section 3. The table therefore complements Table 1: the earlier table motivates the cases, while the present table identifies which formal checkpoint carries the greatest burden in each regime.

Table 4 also shows that the regimes can transform into one another at the level of historical structure. Continued human–alien contact can generate an inherited mediator and move the analysis toward revision. A human–AI relation can lose effective compatibility as the system or institution changes and thereby acquire a realignment problem. Two AI systems with no useful common protocol can temporarily approximate the bootstrapping regime, while strongly standardized AI systems can begin from a seeded interface. The classification is therefore history-relative and mechanism-relative.

The comparison preserves one common conclusion. A mediator nomos does not arise merely because an analyst can construct a translation between two descriptions. Within the present model, formation requires an interaction history that changes the effective configuration, retains some of that change, organizes the cross-subject relation, and becomes consequential for later operations. What varies across the four regimes is the inherited material on which that process acts and the form of revision required to keep the mediator responsive to heterogeneous relational subjects.

5 Categorical Representation of Stabilized Mediation

Once a mediator satisfies Definition 3.6, its stabilized compositional structure can be represented categorically. This section constructs that downstream representation from the induced updates U_p already defined on the configuration space. It first forms path categories from selected admissible update graphs, then derives context-relative categorical presentations through manifestation, and finally introduces re-

stricted functors into a mediator category. The objective is to represent composable interaction histories, bounded translation domains, and cross-side coherence while retaining the GR formation history beneath them. Standard terminology for categories, functors, and natural transformations follows Mac Lane [5]; the substantive interpretation of each categorical object remains local to the model.

5.1 Categorical Lift from Admissible Update Histories

A categorical representation becomes useful once the analysis needs to compare compositions rather than isolated updates. The starting object remains the GR configuration space Ω and the family of induced updates U_p from Equation 8. Fix a relational slice Σ at which a mediator nomos $\mathfrak{N}_{AB,\Sigma}^{\text{med}}$ has been identified, and fix a local modeling domain $\Omega_\Sigma^* \subseteq \Omega$. For any $\omega = (\mathfrak{G}, \mathcal{B}, \mathfrak{N})$ in this domain, write $\mathfrak{N}(\omega)$ for its effective-nomos component. The local domain records which configurations are being compared in the categorical representation. It can be a finite reachable region, an empirically reconstructed set of configurations, a simulation domain, or another explicitly justified restriction.

The update graph associated with this local domain is defined in Definition 5.1. The term *quiver* is used in its elementary sense of a directed multigraph; multiple labeled updates between the same pair of configurations are therefore retained rather than collapsed.

Definition 5.1 (Admissible update quiver). For a selected local domain Ω_Σ^* , the *admissible update quiver* Q_Σ has the configurations in Ω_Σ^* as vertices. A labeled edge $\omega \xrightarrow{p} \omega'$ is present when U_p is defined at ω , the resulting configuration remains in the selected domain, and the update is admissible under the effective nomos at ω . The edge condition is stated in Equation 13.

$$\omega \xrightarrow{p} \omega' \in Q_\Sigma \iff U_p(\omega) = \omega' \in \Omega_\Sigma^* \text{ and } \text{Adm}_{\mathfrak{N}(\omega)}(F_p(\omega) \mid \omega) = 1. \quad (13)$$

Equation 13 introduces no new dynamical primitive. Its vertices are configurations already contained in Ω , and its edges are realized instances of the induced updates already used in Sections 2 and 3. The only additional commitment is the local restriction Ω_Σ^* , which must be justified by the application. The quiver can therefore be refined or enlarged when new configurations or operation types become relevant.

The quiver records one-step admissible updates but does not yet supply identities or a composition law for arbitrary paths. Those are introduced at the representational layer by taking the path category generated by Q_Σ .

Definition 5.2 (Update-history path category). The *update-history path category* $\mathcal{H}_\Sigma$ is the path category generated by Q_Σ . Its objects are the vertices of Q_Σ . Its non-identity morphisms are finite composable sequences of edges in Q_Σ , composition is path concatenation, and the identity morphism at each object is the length-zero path at that configuration.

Definition 5.2 should be read as a representation of compositional history. The identity morphism is formal bookkeeping required by the categorical representation. It does not add an identity mechanism to the highest-layer GR semigroup M , which was deliberately not assumed to contain one. The distinction matters: the statement that an empty path composes neutrally inside $\mathcal{H}_\Sigma$ does not assert that the modeled social or relational system contains a substantive mechanism that leaves every configuration unchanged.

The path construction also preserves ordering information. If p followed by q is admissible along one history while the reverse order is unavailable, the category contains the first composite path and lacks the second from that starting object. If both orders are available but terminate at different configurations, they remain different morphisms. The categorical layer therefore reorganizes the existing partial-composition structure without erasing the state dependence emphasized in Equation 8.

Remark 5.3 (Local categorical stability). The category $\mathcal{H}_\Sigma$ is indexed by a selected slice and local domain because the underlying effective nomos can later change. The construction does not assume that one category represents an entire historical system for all later slices. When subsequent interaction revises $\mathfrak{N}_\Sigma$, the relevant update graph and its generated path category may also need revision.

Remark 5.3 keeps the categorical representation subordinate to the history-bearing GR model. A mediator can stabilize enough to support categorical analysis without becoming timeless.

5.2 Context-Relative Path Representations

The update-history category retains configurations at the resolution of Ω . Heterogeneous contracting, however, proceeds through manifestations that can identify several relational configurations with one presented object. The manifestation map $\mathfrak{M}_c$ from Equation 3 therefore supplies a second categorical layer.

Fix a manifestation context c and a subset of configurations in Ω_Σ^* on which $\mathfrak{M}_c$ is defined. The associated manifested quiver Q_c is obtained by applying $\mathfrak{M}_c$ to the endpoints of selected update edges. A represented edge has the form stated in Equation 14.

$$\mathfrak{M}_c(\omega) \xrightarrow{p}_c \mathfrak{M}_c(U_p(\omega)), \quad \omega \xrightarrow{p} U_p(\omega) \in Q_\Sigma, \quad (14)$$

whenever both manifestations in Equation 14 are defined. Multiple underlying edges are retained as distinct represented edges when the application needs their provenance, even if their manifested endpoints coincide. This convention prevents the construction from silently treating equality of endpoint manifestations as equality of histories.

The path category generated by Q_c is denoted $\mathcal{C}_c$. Its analytical meaning depends on the context. For a human legal interface, its objects can be manifested statuses or recognized configurations and its morphisms can be represented legal or institutional histories. For a human-facing AI interface, its objects can be interface-level manifestations and its morphisms can be represented sequences of interactional updates. In a first-contact setting, the initial category can be extremely sparse. The category represents what the specified context makes compositionally legible; it does not represent the complete relational reality of the subject whose configurations are being manifested.

This distinction allows the three-realities architecture to remain intact. Relational subjects belong to the relational level of the model, while $\mathcal{C}_c$ is constructed from context-dependent manifestations of configurations and histories. Two distinct relational configurations can therefore become one object in $\mathcal{C}_c$ under Equation 4. Conversely, a symbolic interface can introduce distinctions that organize later histories even where those distinctions do not correspond to ontologically primitive kinds.

For the mediation problem, three contexts are relevant. Let c_A and c_B denote the selected manifestation contexts through which the two participating sides are represented, and let c_M denote a mediator context whose operational distinctions are conditioned by the derived mediator nomos $\mathfrak{N}_{AB,\Sigma}^{\text{med}}$. The corresponding categories are denoted $\mathcal{C}_A$, $\mathcal{C}_B$, and $\mathcal{C}_M$. These symbols abbreviate $\mathcal{C}_{c_A}$, $\mathcal{C}_{c_B}$, and $\mathcal{C}_{c_M}$; they do not assert that either participant possesses one exhaustive category that captures its full nomos.

5.3 Restricted Functors into the Mediator Category

A direct functor from all of $\mathcal{C}_A$ or $\mathcal{C}_B$ into $\mathcal{C}_M$ would generally assume too much. A source-side manifestation can identify configurations that the mediator later distinguishes, and some source-side objects or histories may have no mediator-legible counterpart. The categorical representation should therefore preserve partiality explicitly.

The first requirement is object-level well-definedness. Suppose two underlying configurations are indistinguishable in the A -side manifestation. Mapping the corresponding source object into the mediator category by choosing one underlying configuration is well defined only when the mediator manifestation does not distinguish those configurations over the selected domain. The required compatibility condition is stated in Equation 15.

$$\mathfrak{M}_{c_A}(\omega) = \mathfrak{M}_{c_A}(\omega') \implies \mathfrak{M}_{c_M}(\omega) = \mathfrak{M}_{c_M}(\omega'), \quad (15)$$

for the configurations on which the proposed A -side mapping is defined. An analogous condition applies to the B side. Equation 15 need not hold globally. Its failure identifies precisely why a source-side representation may be too coarse to support a well-defined mediator image.

Let $\mathcal{D}_A \subseteq \mathcal{C}_A$ and $\mathcal{D}_B \subseteq \mathcal{C}_B$ be subcategories selected so that the object mappings are well defined and the represented morphisms possess compatible mediator paths. When the mappings preserve identities and composition on those subcategories, the mediator translations are ordinary functors with the

$$\begin{array}{ccc}
T_A(a_0) & \xrightarrow{T_A(f_A)} & T_A(a_1) \\
\downarrow \kappa_0 & & \downarrow \kappa_1 \\
T_B(b_0) & \xrightarrow{T_B(f_B)} & T_B(b_1)
\end{array}$$

Figure 1: A mediator-relative coherence square. The comparison morphisms κ_0 and κ_1 need not be isomorphisms; they encode the mediator-level relation used to compare the two source-side paths.

types stated in Equation 16.

$$T_A : \mathcal{D}_A \longrightarrow \mathcal{C}_M, \quad T_B : \mathcal{D}_B \longrightarrow \mathcal{C}_M. \quad (16)$$

Equation 16 replaces the informal language of a “partial functor” with a standard categorical construction: an ordinary functor whose domain is a stated subcategory. The portions of $\mathcal{C}_A$ and $\mathcal{C}_B$ outside $\mathcal{D}_A$ and $\mathcal{D}_B$ remain untranslated in the present mediator representation. Their existence is analytically important because mediator adequacy does not require total translation.

The subcategories can expand historically. A first-contact mediator may initially translate only a few repeated signal-response paths. Additional interaction can refine source manifestations, create new mediator distinctions, and enlarge the domains on which T_A or T_B becomes well defined. Revision can also contract a domain when a previously assumed translation proves unstable. The categorical domains therefore inherit the revisability of the mediator nomos rather than fixing a permanent dictionary.

Caution 5.4 (Functoriality and empirical warrant). A proposed mapping between symbolic labels does not establish a functor. An application must justify that the selected object correspondence is well defined and that the mapping of represented histories preserves the composition relevant to the modeled interaction. Where the evidence supports only isolated correspondences, the analysis should retain those correspondences without promoting them to a functorial structure.

Caution 5.4 is especially important in the human–alien regime. A repeated correlation between two signals can support a provisional local association long before the evidence warrants a composition-preserving translation across a family of histories. The same caution applies to human–other-animal and human–AI relations when human-facing manifestations are richer than the evidence for their relation to the other subject’s generative structure.

5.4 Cross-Side Coherence through Commutative Squares

Once T_A and T_B are available on suitable subcategories, the mediator category can be used to compare source-side transformations without requiring the source categories to be identical. Let $f_A : a_0 \rightarrow a_1$ be a morphism in $\mathcal{D}_A$ and let $f_B : b_0 \rightarrow b_1$ be a morphism in $\mathcal{D}_B$. Suppose the mediator contains comparison morphisms $\kappa_0 : T_A(a_0) \rightarrow T_B(b_0)$ and $\kappa_1 : T_A(a_1) \rightarrow T_B(b_1)$. Figure 1 displays the corresponding square.

Strict mediator coherence for the selected square is the commutativity condition stated in Equation 17.

$$\kappa_1 \circ T_A(f_A) = T_B(f_B) \circ \kappa_0. \quad (17)$$

Equation 17 says that the two represented routes through the mediator yield the same mediator morphism. It does not say that f_A and f_B are the same process, that a_i and b_i are ontologically identical, or that the two source nomoi have converged. The equation states a local compositional relation inside the mediator representation.

The comparison morphisms in Figure 1 are intentionally more general than isomorphisms. In some applications, the mediator can support a reversible correspondence between the represented endpoint objects; in others, the relation is directional, lossy, or institutionally asymmetric. Requiring every κ_i

to be invertible would therefore reintroduce a symmetry assumption that the heterogeneous-relational setting was designed to avoid.

Strict commutativity can also be stronger than an application warrants. Two paths can produce configurations that differ in the full mediator category while agreeing under a coarser declared readout or operational criterion. A higher categorical model could represent controlled disagreement by supplying a specified 2-cell between the two composites, and an enriched model could attach a graded discrepancy. The present paper does not introduce either structure because neither has yet been derived from the GR primitives. It therefore distinguishes three epistemic statuses in prose: strict commutation when Equation 17 is justified; readout-level agreement when only a declared coarser manifestation agrees; and unresolved divergence when neither comparison is warranted.

Failure of Equation 17 is diagnostically useful but underdetermined. It can arise because the mediator has collapsed a relevant distinction, because one source manifestation has changed, because the comparison morphisms were poorly specified, because the two source histories are genuinely different in the relevant respect, or because the current mediator nomos no longer organizes the interaction adequately. The categorical failure therefore identifies a site for revision; it does not identify one participant as mistaken by itself.

5.5 Untranslated Remainders and Representational Collapse

The restricted domains in Equation 16 preserve a feature that is central to heterogeneous mediation: some structures can remain outside the shared interface. The untranslated portions of $\mathcal{C}_A$ and $\mathcal{C}_B$ need not be treated as defects awaiting eventual elimination. They can record distinctions, operations, histories, or forms of organization that are unnecessary for the current shared corridor, not yet understood, or resistant to a justified translation.

This point gives a categorical form to the paper’s earlier interpretation of preserving difference while constructing a shared corridor. Mediator formation can enlarge the region of cross-side composability without requiring $\mathcal{C}_A$ and $\mathcal{C}_B$ to become equivalent categories. Neither functor in Equation 16 is assumed to be full, faithful, essentially surjective, or invertible. Those stronger properties can be investigated in a particular application, but they are not built into mediator status.

Failure of faithfulness is especially informative because it represents a loss of process distinction at the mediator level. Let f and g be distinct morphisms in $\mathcal{D}_A$ with the same source and target. A mediator representation collapses that categorical distinction when the condition in Equation 18 holds.

$$f \neq g, \quad T_A(f) = T_A(g). \quad (18)$$

Equation 18 is a representation-level analogue of distinction loss. It should not be identified directly with the metamodel collapse relation $\Delta(m)$ in Equation 5. The two constructions have different types: $\Delta(m)$ records pairs of states whose distinction is destroyed by a mechanism, whereas Equation 18 records distinct source-side morphisms that receive one mediator representation. An application can relate the two when its instantiation supplies the necessary mapping, but the present formalism keeps them distinct.

The same caution applies to object collapse. Distinct source-side objects can receive the same mediator image because the shared interface does not preserve every local distinction. Such compression can be useful for coordination. It becomes analytically significant when later interaction shows that a collapsed distinction changes admissibility, response, harm, recognition, or another modeled continuation. Section 3.6 then supplies the historical response: the mediator can revise its distinction structure and, if justified, enlarge or refine the categorical domains and mappings.

The remainders also prevent an important inferential error. A successfully commuting family of diagrams inside the translated domains establishes local categorical coherence. It does not establish that the participating relational subjects have become mutually transparent. The mediator can be highly effective over a narrow contract-formative corridor while leaving substantial relational structure untranslated on both sides.

5.6 Operator Execution beneath the Categorical Representation

The categorical layer organizes histories; the state-dependent operator layer continues to execute them. This relation can be made explicit without assuming a linear operator algebra. Let γ be a morphism of $\mathcal{H}_\Sigma$ represented by the composable path $\omega_0 \xrightarrow{p_1} \omega_1 \xrightarrow{p_2} \dots \xrightarrow{p_k} \omega_k$. Its operational realization is the composite partial transformation stated in Equation 19.

$$\rho_\Sigma(\gamma) = U_{p_k} \circ \dots \circ U_{p_1} \in \text{PEnd}(\Omega). \quad (19)$$

Equation 19 extends the composition already used for realized histories while retaining the source configuration carried by the path itself. Concatenation of categorical paths corresponds to composition of the induced partial updates whenever the relevant histories are admissible. If $\text{PEnd}(\Omega)$ is viewed as a one-object category under partial-map composition, ρ_Σ gives a functorial execution representation of the path structure. The formal identity path maps to the identity partial map on Ω at this representational level; this again does not add an identity element to the substantive mechanism semigroup of the highest-layer metamodel.

The operator representation clarifies the division of labor between the two mathematical languages. Category theory records which histories can be composed and whether different representational routes cohere. The induced updates U_p and their composites record how those histories act on configurations. State-dependent schemas F_p remain necessary because the same operation label can select a different concrete transformation after the configuration changes. The present paper therefore uses category theory to organize composition and operator language to represent execution.

No vector-space addition, scalar multiplication, adjoint, norm, or algebraic commutator is assumed in Equation 19. A stronger operator-algebraic model could be introduced if an application supplies the required structure and a substantive reason for using it. At the current level, composition of partial endomorphisms is sufficient for the mechanism being formalized.

5.7 Categorical Coherence and Mediator Revision

The categorical representation becomes analytically useful when it feeds back into the history-bearing formation model. Suppose a family of source-side paths had previously supported functors T_A and T_B and a set of mediator-relative coherence squares. Later interaction can create one of several changes: an object mapping can cease to satisfy Equation 15; a source-side history can leave the domain on which a translation functor is justified; a previously commuting square can diverge; or a functor can collapse a distinction that later becomes consequential.

Each event can be represented as evidence that the current categorical presentation no longer tracks the mediator nomos at the required resolution. The response occurs in the GR configuration rather than inside category theory alone. A pair-relevant update changes ω_Σ , the effective nomos can be revised, the relevant manifestation contexts can change, and a later slice can generate new quivers, categories, subcategories, or functors. The categorical objects are therefore reconstructible readouts of a historically evolving mediator.

Claim 5.5 (Categorical representation after mediator formation). Within the present framework, categorical coherence is a representation of sufficiently stabilized mediator structure and a diagnostic of its continued adequacy. It is not the generative source of mediator-nomos formation. Formation remains grounded in pair-relevant configuration change, nomic uptake, persistence, cross-subject scope, and operational efficacy as specified in Section 3.

Claim 5.5 fixes the dependency relation needed for the remainder of the paper. The categorical representation can now support a more precise account of heterogeneous contracting: contract-formative histories can be sought inside the translated domains, and their recognition can be compared across the participating sides through mediator coherence. The next section uses that representation to specify when a mediator nomos is sufficient for contract-like formation without requiring total nomic convergence.

6 Contract Formation through Mediator Nomoi

This section reconnects the derived and categorically represented mediator to the paper’s social-contract problem. Its objective is to state a preliminary structural condition under which heterogeneous subjects can enter contract-formative histories through a mediator nomos while substantial parts of their respective nomic structures remain untranslated. The construction specializes contractual grammar to the derived mediator, requires realization-supported coherent histories, separates mediator recognition from cross-side operative uptake, identifies the persistent contract relation generated by a realized history, and derives the locality of contract-formative coherence. Structural formation remains analytically distinct from legal validity, moral legitimacy, justice, and symmetrical authorship of the mediator.

6.1 Mediator-Conditioned Contractual Grammar

The preceding companion paper introduced a contract-formative history family relative to an effective contractual nomos and used that family to separate nomic recognition from generative realizability [4]. The present paper retains that distinction while changing the genealogy of the relevant nomos. In the heterogeneous setting considered here, the structure that supplies a shared contract-formative grammar can itself be the derived mediator nomos $\mathfrak{N}_{AB,\Sigma}^{\text{med}}$ of Definition 3.6.

Definition 6.1 (Mediator-conditioned contractual grammar). For a contract type C , two identified relational subjects A and B , and a slice Σ at which $\mathfrak{N}_{AB,\Sigma}^{\text{med}}$ has been identified, a *mediator-conditioned contractual grammar* is the model-specified part of the mediator nomos that determines which party manifestations are legible to the mediator and which operation types, admissibility conditions, compositional histories, and recognition conditions can count as formation of a contract of type C at ω_Σ . Relative to the categorical representation, its recognized mediator histories form the family stated in Equation 20.

$$\mathcal{G}_C^{\text{med}}(\mathfrak{N}_{AB,\Sigma}^{\text{med}}, \omega_\Sigma) \subseteq \text{Mor}(\mathcal{C}_M). \quad (20)$$

Membership means that the mediator grammar treats the represented history as contract-formative for type C . Executability remains a separate condition.

Definition 6.1 introduces no independent nomic layer. The grammar is a contract-specific use of the mediator structure already derived from interaction-conditioned uptake, persistence, cross-subject scope, and operational efficacy. A first-contact mediator can therefore support only a thin contractual grammar, while a mature legal or institutional mediator can support a much richer one. The definition also permits the grammar to be historically revisable. If later interaction changes the relevant part of $\mathfrak{N}_{AB,\Sigma}^{\text{med}}$, the contract-formative grammar available at a later slice can change with it.

The distinction between mediator nomos and contractual grammar is analytically useful. The mediator can organize communication, boundaries, recognition, or coordination that has no contractual function. Contract formation uses only the part of that structure that the selected model treats as relevant to partyhood, commitment, recognition, or another formation condition. Conversely, a contractual grammar can remain too thin to support a particular contract type even when the wider mediator is already relationally persistent and efficacious.

For the categorical representation, the relevant histories lie inside the mediator category $\mathcal{C}_M$ and the restricted source-side domains $\mathcal{D}_A$ and $\mathcal{D}_B$ of Equation 16. Membership in the recognized-history family of Equation 20 can therefore be evaluated only after the source-side paths, their mediator images, and the relevant comparison morphisms have been specified. The next subsection states the corresponding realization requirement without assuming that every morphism of $\mathcal{C}_M$ corresponds to one executable GR history.

6.2 Realization-Supported Coherent Formation Histories

The path-category construction in Section 5 can contain several represented histories whose endpoints coincide at the manifestation level. Contract formation requires a realized history rather than a merely

composable symbolic path. The first requirement is therefore a connection back to the admissible-update history from which the categorical representation was built.

Definition 6.2 (Realization-supported mediator path). A morphism h_M in $\mathcal{C}_M$ is *realization-supported* at ω_Σ when there exists at least one finite path γ in the update-history category $\mathcal{H}_\Sigma$ whose source is ω_Σ and whose manifested edge sequence under the mediator context c_M yields h_M . The underlying path γ must be executable under the induced updates, so its composite $\rho_\Sigma(\gamma)$ in Equation 19 is defined at ω_Σ .

Definition 6.2 closes a typing gap that would otherwise arise between categorical composition and GR execution. A manifested path can be compositionally well formed while different occurrences of a manifested object are supported by different underlying configurations. The additional realization condition requires at least one common composable GR history beneath the represented path. It does not require the lift to be unique; several relational histories can receive the same mediator-level representation.

Let $f_A : a_0 \rightarrow a_1$ be a morphism in $\mathcal{D}_A$ and $f_B : b_0 \rightarrow b_1$ a morphism in $\mathcal{D}_B$. Let κ_0 and κ_1 be comparison morphisms of the type used in Figure 1. When the square commutes, the two routes determine one mediator morphism. The common path is defined in Equation 21.

$$h_M = \kappa_1 \circ T_A(f_A) = T_B(f_B) \circ \kappa_0. \quad (21)$$

Equation 21 does not identify f_A with f_B . It states that the selected source-side histories participate in one coherent mediator-level history over the represented corridor. The comparison morphisms can remain directional or lossy, as allowed in Subsection 5.4.

Definition 6.3 (Mediator contract-formative witness). A source-side pair (f_A, f_B) together with comparison morphisms (κ_0, κ_1) is a *mediator contract-formative witness* for contract type C at ω_Σ when:

1. $f_A \in \text{Mor}(\mathcal{D}_A)$ and $f_B \in \text{Mor}(\mathcal{D}_B)$;
2. the corresponding mediator square satisfies Equation 21;
3. the resulting h_M is realization-supported in the sense of Definition 6.2; and
4. the realized mediator history satisfies $h_M \in \mathcal{G}_C^{\text{med}}(\mathfrak{N}_{AB,\Sigma}^{\text{med}}, \omega_\Sigma)$ as specified in Equation 20.

The fourth condition is the mediator-relative counterpart of the contract-formative history predicate used in the companion paper. It keeps recognition distinct from execution. A coherent and executable history can fail to satisfy the current contract grammar, while a history pattern that the grammar would recognize can remain unrealizable from the current configuration. Definition 6.3 requires both sides of that distinction to be satisfied for the selected witness.

A witness can be narrow. It may concern one boundary protocol, one exchange relation, one commitment type, or one specified range of actions. The definition does not require the mediator to translate unrelated source-side histories. This locality becomes central when the analysis turns to untranslated remainders in Subsection 6.5.

6.3 Cross-Side Recognition and Operative Uptake

Mediator recognition alone is insufficient to show that the resulting formation history enters the continuing relation of both participating subjects. An external institution could classify an interaction as contract-formative while one side remains unaffected by that classification. The present framework therefore distinguishes three layers: mediator-level formation recognition, source-side representability, and operative uptake into later side-relevant histories.

Source-side representability is already present in Definition 6.3: f_A and f_B belong to the translated subcategories on which T_A and T_B are well defined. This requirement shows that the formation history has a justified representation from both selected sides. It does not establish that either subject possesses the same concept of contract as the mediator.

Definition 6.4 (Side-relative contract uptake). Suppose a mediator contract-formative witness is realized and changes the configuration from ω_Σ to a later configuration $\omega_{\Sigma'}$. The resulting contract-formative structure has *side-relative operative uptake* for subject A when at least one later A -relevant operation has an admissibility condition or state-dependent realization that depends on a nomic feature generated or activated by the realized contract history. Side-relative operative uptake for B is defined analogously.

Definition 6.4 reuses the efficacy tests already introduced in Equations 11 and 12. Its role is narrower. Mediator efficacy shows that the mediator structure can organize later cross-subject interaction; contract uptake asks whether the particular realized contract history becomes consequential for later operations associated with each participant. Examples can include a changed boundary response, a newly available exchange route, an obligation-recognition procedure, a withdrawal or termination path, or another application-specific continuation.

Definition 6.5 (Cross-side contract uptake). A realized mediator contract-formative witness exhibits *cross-side contract uptake* when side-relative operative uptake is present for both A and B over the declared post-formation history window.

Cross-side uptake is intentionally weaker than shared conceptual interpretation. Two heterogeneous subjects can organize later conduct around the same mediator-supported commitment while representing that relation through different local distinctions. The present model therefore does not require an equality of internal concepts, languages, preferences, reasons, or ontologies. It requires evidence that the generated relation enters the later operational organization of both sides at the modeled resolution.

The distinction also prevents an anthropomorphic shortcut in the human–other-animal, human–AI, and human–alien cases. A nonhuman subject need not manifest a human sentence equivalent to “I recognize this as a contract” for its later behavior to be conditioned by a stable mediator-supported relation. At the same time, observable uptake does not establish informed consent, moral authorization, or legal capacity. A substantive contract theory can require richer conditions, including reason-giving, voluntariness, reciprocal justification, or protected exit. The present definition supplies a structural object on which those additional criteria can operate.

Caution 6.6 (Operative uptake and assent). Cross-side contract uptake records a relation between a realized formation history and later side-relevant operations. It should not be redescribed as assent, consent, acceptance, preference satisfaction, or normative endorsement unless an application supplies independent evidence and a theory warranting that interpretation.

Caution 6.6 is especially important where the mediator was formed under substantial asymmetry. A historically effective interface can shape both sides while still reflecting coercion, dependency, imposed classification, or unequal capacity to revise the terms of interaction. Structural uptake therefore remains distinct from the normative status of the generated relation.

6.4 Persistent Contract Relations under Mediation

A realized formation event can have only transient consequences, or it can generate a relational structure that persists and continues to organize later interaction. The companion paper used the term *contract subject* for a relationally persistent structure supported by a recognized contract-formative history [4]. The present paper specializes that object to mediator-supported heterogeneous contracting.

Definition 6.7 (Mediator-supported contract subject). A *mediator-supported contract subject*, denoted $\mathfrak{S}_C^{\text{med}}$, is a relationally persistent structure generated by a realized mediator contract-formative witness that has cross-side contract uptake in the sense of Definition 6.5, whose supporting history remains identifiable in the accumulated relational history, and whose continuing efficacy is carried, at least in part, through the mediator nomos or a declared historical continuation of it.

Definition 6.7 separates three objects that can otherwise be conflated. The mediator nomos $\mathfrak{N}_{AB,\Sigma}^{\text{med}}$ is the historically generated structure that makes cross-side mediation possible. The contract-formative

Table 5: Formal layers from mediator formation to heterogeneous contract formation.

Layer	Formal basis	Analytical role
Mediator nomos	$\mathfrak{N}_{AB,\Sigma}^{\text{med}}$	Persistent, efficacious cross-subject nomic structure derived from interaction history
Categorical interface	$\mathcal{D}_A, \mathcal{D}_B, T_A, T_B, \mathcal{C}_M$	Represents the translated compositional corridor while preserving untranslated remainders
Formation witness	Definition 6.3	Identifies a coherent, realization-supported history recognized by the mediator-conditioned contract grammar
Cross-side uptake	Definitions 6.4 and 6.5	Tests whether the realized contract history becomes consequential for later operations on both sides
Persistent contract relation	$\mathfrak{G}_C^{\text{med}}$	Distinguishes the generated contract relation from the mediator and from individual manifestations of formation
Normative assessment	Supplied by a substantive contract or justice theory	Evaluates legitimacy, consent, reciprocity, fairness, coercion, standing, or other normative criteria

witness is a particular coherent and executable formation history inside that structure. The contract subject $\mathfrak{G}_C^{\text{med}}$ is the persistent relational result supported by the realized history. A mature mediator can support many distinct contracts, and one contract can later cease to be active while the mediator persists.

The same distinction permits revision and termination. Later pair-relevant interaction can modify the mediator without automatically dissolving every contract previously formed through it. Conversely, discharge, expiry, rescission, breakdown, or another termination process can remove a contract-supported relation from the active relational boundary while retaining its formation history in $\mathfrak{G}_{\leq\Sigma}$. Applications should therefore specify whether a later change concerns the mediator grammar, one contract subject, the active consequences of that contract, or several of these layers at once.

Cross-side uptake can also change after formation. A contract can begin with bilateral operative uptake and later lose efficacy for one side because the relevant continuation becomes unavailable, the mediator ceases to translate a required distinction, or one participant changes its own nomic organization. The GR representation therefore treats contract persistence as historical and configuration-dependent rather than as an automatically permanent status created by one past event.

Table 5 summarizes the formal layers introduced across Sections 3–6. The table also marks the point at which normative evaluation remains external to the structural derivation.

6.5 Contract Formation with Untranslated Remainders

The restricted-domain construction now yields the central structural consequence of the paper’s reconstruction. A contract-formative corridor can exist even when substantial parts of the participating nomic structures remain outside the mediator representation. The result follows from the locality of Definition 6.3; it does not require an additional assumption of global translation.

Proposition 6.8 (Locality of mediator contract-formative corridors). *Suppose a derived mediator nomos has been identified for A and B , the restricted functors in Equation 16 are defined, and at least one mediator contract-formative witness exists for contract type C . Then the existence of that contract-formative corridor is compatible with untranslated objects or morphisms outside $\mathcal{D}_A$ or $\mathcal{D}_B$. The witness therefore does not entail equivalence of the full source categories $\mathcal{C}_A$ and $\mathcal{C}_B$, nor does it entail that either restricted domain exhausts its source category.*

Proof. Definition 6.3 quantifies only over a selected morphism f_A in $\mathcal{D}_A$, a selected morphism f_B in $\mathcal{D}_B$, their mediator images, the comparison morphisms, and a realization-supported mediator history belonging to the family in Equation 20. None of these conditions requires $\mathcal{D}_A = \mathcal{C}_A$ or $\mathcal{D}_B = \mathcal{C}_B$. Equation 16 likewise imposes no fullness, faithfulness, essential surjectivity, invertibility, or equivalence condition on the full source categories. Consequently, additional source-side objects or morphisms can remain outside the translated domains while the stated witness conditions continue to hold. $\square$

Proposition 6.8 formalizes the locality of a shared contract-formative corridor without requiring comprehensive nomic convergence. The mediator can preserve a narrow region in which commitments, boundaries, exchanges, or other contract-relevant histories become compositionally coherent while the participants continue to differ elsewhere. Untranslated remainders can concern values, classifications, temporal organization, embodiment, internal representation, social meaning, or other structures irrelevant to the selected contract type or insufficiently understood for justified translation.

This result also limits what can be inferred from successful contracting. A stable cross-side contract does not demonstrate that the subjects are ontologically similar, that their manifestations are interchangeable, or that their wider nomoi are mutually reducible. The contract establishes only the locally represented relation supported by the mediator and the realized formation history. A different contract type can require a wider translated domain or a different mediator grammar, and later interaction can reveal that the earlier corridor was too coarse.

The locality result is particularly important for the four regimes discussed in Section 4. First-contact human–alien interaction can begin with an extremely thin corridor. Human–other-animal relations can reconstruct one portion of an inherited interface while leaving many species-specific structures untranslated. Human–AI contracting can use human-facing symbolic compatibility while retaining uncertainty about deeper relational organization. AI–AI systems can form a protocol-relative contractual corridor even while their internal representations continue to diverge or co-evolve. The common formal claim is local: contract formation can be supported by sufficiently coherent mediated histories without requiring exhaustive translation of the subjects that participate in them.

6.6 Structural Formation and Normative Legitimacy

The paper’s conditional commitment to a social-contract basis does not make every structurally successful mediator-supported contract normatively adequate. Social-contract theories differ concerning the parties whose agreement matters, the informational conditions of choice, the content of the agreement, the form of justification, and whether agreement is actual, hypothetical, reasonable, or otherwise idealized. Section 1 preserved these differences rather than selecting one substantive theory. The present formal reconstruction should be read in the same way.

Caution 6.9 (Formation and legitimacy). Mediator-nomos formation, categorical coherence, a contract-formative witness, cross-side operative uptake, and persistence of a contract subject are structural conditions within the present model. Their satisfaction does not by itself establish voluntary consent, reciprocal justification, equal standing, fairness, absence of domination, protection from harm, or legitimacy under any substantive theory of justice.

Caution 6.9 matters because the same generative mechanisms that make mediation possible can stabilize objectionable relations. Repetition can sediment coercive conventions. A powerful participant can shape which distinctions enter the mediator. An institution can create a technically coherent grammar that gives one side little practical capacity to contest or exit. A translation can support reliable coordination while systematically omitting relations that a substantive ethical theory regards as salient. Structural success therefore supplies an object for normative evaluation rather than its conclusion.

The reconstructed contract basis is correspondingly conditional and limited. If a theory insists that justification must proceed through some contract-like relation among heterogeneous participants, the present section supplies one possible formal architecture for making that relation intelligible: a mediator nomos is generated from prior interaction, a restricted shared corridor becomes compositionally coherent,

a realizable history satisfies a mediator-conditioned contractual grammar, the resulting relation enters later histories on both sides, and a persistent contract subject can emerge. Further normative requirements remain to be supplied by the contract theory being retained.

The resulting architecture preserves the principal lesson of the paper. Heterogeneous social contract need not begin from a fully shared nomos, and successful mediation need not culminate in one. The common structure required for a particular contract can be historically generated at the interface, locally sufficient for the relevant formation history, and revisable as later interaction reveals new distinctions or failures. The next section can therefore examine the scope and limitations of this preliminary formalization, including its empirical identification burden, its dependence on representation choices, and the unresolved relation between mediator formation, power, and normative justification.

7 Scope and Limitations

The formal construction now permits a clearer statement of its limits. This section separates internal consequences of the model from empirical claims about human, animal, artificial, or hypothetical extraterrestrial relations. It examines the epistemic status of the formalization, the empirical burden of identifying its objects, representation dependence, power and asymmetry, transfer across formation regimes, the boundaries of categorical and operator-inspired representations, and the distinction between structural formation and normative justification. The method is critical and model-internal: each limitation is traced to the assumption, identification step, or representational choice on which the corresponding inference depends.

7.1 Epistemic Status of the Formalization

The paper offers a candidate architecture for representing mediator-nomos formation. Its definitions and propositions have different epistemic statuses. A definition fixes how a term is used inside the model. A proposition establishes a consequence of those definitions and stated assumptions. A hypothesis identifies a possible formation mechanism that requires independent empirical support before it can be attributed to an actual system. The distinction is especially important for Hypothesis 3.7 and Hypothesis 4.5. Their formal coherence does not establish that the corresponding mechanism is empirically operative in a particular history.

The highest-layer GR metamodel is itself deliberately sparse, and the present paper works at a more instantiated level. The use of accumulated history, active relational boundaries, effective nomos, manifestation maps, state-dependent update schemas, and categorical representations therefore adds commitments that require application-specific justification. These commitments make a mediator-nomos formation problem expressible; they do not establish that one representation is uniquely appropriate for every domain.

Caution 7.1 (Formal consequence and empirical mechanism). A formally valid implication in the present manuscript is conditional on the stipulated configuration space, identification rules, operation schemas, admissibility conditions, manifestation maps, and persistence criteria. Empirical use requires evidence that these objects adequately represent the case under study and that the proposed update sequence corresponds to an operative mechanism rather than an analytically convenient reconstruction.

Caution 7.1 limits the interpretation of the paper’s strongest results. Proposition 6.8, for example, proves that local mediator-supported contract formation is compatible with untranslated remainders inside the formal construction. It does not establish how frequently such corridors arise, how stable they are, or whether a particular empirical interface is sufficiently coherent to support them.

The same restraint applies to ontological interpretation. A relational subject, mediator nomos, path category, or contract subject can be treated as relationally real within the model when the required persistence and efficacy conditions are represented. This status concerns the relational level of the GR architecture. It does not settle the ultimate ontology of persons, animals, artificial systems, extraterrestrial

beings, institutions, or symbolic structures. Category-theoretic and operator-algebra-inspired language therefore remains representational throughout the paper.

7.2 Empirical Identification and Operational Burden

The formal economy of the model depends on substantial empirical work before its objects can be used descriptively. The first burden concerns subject identification. Sections 3 and 4 label two history-bearing structures as A and B , yet an application must justify where those structures are identified, which relations constitute or sustain them, how their boundaries are represented, and which changes count as persistence rather than replacement. The burden becomes especially demanding for collective subjects, distributed AI systems, animal groups, or unfamiliar forms of organization whose boundaries may be uncertain or context-dependent.

The second burden concerns pair relevance. Remark 3.1 treats pair relevance as an analytical restriction on ordinary GR history. An empirical study must therefore show why a selected event, update, or relation is materially connected to both subjects. Communication logs, behavioral traces, legal records, technical protocols, observation histories, interaction experiments, archival evidence, or other domain-appropriate materials can supply such support. The formalism itself does not decide which evidence is sufficient.

The third burden concerns nomic uptake and persistence. A repeated pattern does not automatically constitute a nomos. The analyst must identify a change in the effective distinction, admissibility, recognition, interpretation, or transformation structure and then establish that the relevant feature remains identifiable across later configurations in the sense required by Definition 3.3. Short-lived coordination, accidental regularity, temporary imitation, and externally imposed synchronization can resemble stabilization while lacking the persistence or generative efficacy required for mediator-nomos status.

The fourth burden concerns efficacy. Definition 3.4 makes efficacy dependent on consequences for later admissibility or state-dependent transformation. Empirical application therefore requires evidence that the candidate mediator structure changes what later operations can occur, how an operation is instantiated, or which continuations become effectively available. Mere semantic resemblance, statistical association, or recurrent co-occurrence is insufficient unless the selected application supplies a warranted pathway from the candidate nomic feature to later relational change.

The fifth burden arises when the categorical layer is introduced. The local domain Ω_Σ^* , the source-side categories $\mathcal{C}_A$ and $\mathcal{C}_B$, the restricted subcategories $\mathcal{D}_A$ and $\mathcal{D}_B$, the mediator category $\mathcal{C}_M$, and the translation functors T_A and T_B are modeling constructions. Their empirical use requires justification of which configurations and histories are represented, why the selected domains support composition, and what observed or reconstructed correspondence warrants the proposed object and morphism mappings. A commuting square can summarize a justified correspondence; it cannot provide that justification by itself.

The sixth burden concerns contract formation. A mediator contract-formative witness requires a realization-supported mediator path, mediator-level recognition under $\mathcal{G}_C^{\text{med}}$, and cross-side operative uptake. An empirical study must therefore distinguish a formally representable path from one actually realized, identify the evidence by which the mediator treats that history as contract-formative, and show how its result enters later operations on each side. Table 6 summarizes these tasks.

Table 6 is deliberately heterogeneous because no single data type can establish every layer. A technical AI–AI interface can permit direct logging of message histories and protocol changes, while human–other-animal mediation can require behavioral, ecological, historical, and institutional evidence. A first-contact human–alien case is presently hypothetical and therefore supports formal exploration rather than empirical confirmation. The framework is compatible with qualitative, historical, experimental, computational, and mixed-method inquiry where the local research question warrants those methods.

Table 6: Empirical identification burdens associated with the principal formal objects.

Formal object	Identification task	Illustrative evidential burden
Relational subjects A, B	Specify history-bearing structures and relevant boundaries	Persistence traces, behavioral or institutional continuity, technical architecture, relational dependence, domain-specific identification rules
Pair-relevant history	Establish that selected operations materially involve the relation between A and B	Interaction records, communication traces, incidence structure, experimental or observational evidence, process reconstruction
Nomic uptake	Identify a change in distinction, recognition, admissibility, interpretation, or later transformation	Before–after procedural evidence, changed classifications, altered update domains, changed response rules, historical reconstruction
Persistence	Show that the candidate feature remains identifiable across later slices	Repeated uptake, institutional memory, protocol retention, learned behavior, stable relational reproduction
Operational efficacy	Show that the retained feature changes later possibilities or transformations	Domain changes, different instantiated operations, altered reachable histories, intervention or process evidence
Categorical mediation	Justify restricted domains, mappings, and compositional correspondence	Matched process structures, protocol semantics, translation records, verified composition, declared untranslated remainders
Contract uptake	Establish that a realized formation history becomes consequential on both sides	Later obligation, expectation, response, enforcement, coordination, refusal, revision, or other application-specific consequences

7.3 Representation Dependence and Model Granularity

Every stage of the formalization depends on a chosen description of the relational configuration. The triple $\omega_\Sigma = (\mathfrak{G}_{\leq \Sigma}, \mathcal{B}_\Sigma, \mathfrak{N}_\Sigma)$ is a working representation, and an application can require additional components when omitted distinctions affect later operations. A model that treats two configurations as identical because its state description is too coarse can manufacture apparent persistence, apparent commutativity, or apparent contract uptake by suppressing the very differences that matter to the case.

Manifestation adds a second level of dependence. The context-relative map $\mathfrak{M}_c$ determines which distinctions are visible in a selected representation. Two relational structures can therefore receive similar manifestations while remaining different at the represented relational level, and two materially related structures can receive highly different manifestations. This issue is central to the contrast between human–AI and human–other-animal cases developed in Section 4. Similarity or difference at the manifestation level should consequently be interpreted only relative to the declared context and readout.

Categorical coherence inherits both dependencies. The categories in Section 5 are generated from selected update histories and manifestation contexts. Strict commutativity therefore means that two represented routes coincide inside the chosen mediator category. It does not imply that the full relational histories, source-side meanings, or ultimate ontologies are identical. Readout-level coherence is weaker still: agreement under a selected family of readouts can coexist with differences outside that family.

Remark 7.2 (Refinement sensitivity). A mediator structure can satisfy the paper’s persistence, efficacy, coherence, or contract-formative criteria at one level of representation and fail them after the model is refined to preserve additional distinctions. Applications should therefore report the granularity at

which mediator adequacy is claimed and examine whether conclusions remain stable under plausible refinements of the configuration, manifestation, or categorical domains.

Remark 7.2 also constrains the interpretation of untranslated remainders. A remainder can be outside the mediator because it is irrelevant to the contract type, because the current interface cannot translate it, because available evidence is insufficient, or because the model has failed to represent it. These possibilities have different substantive implications and should not be collapsed into one formal category of absence.

A further limitation concerns the fixed configuration space Ω . State-dependent schemas allow the concrete transformation selected at one configuration to differ from the transformation selected later. They do not by themselves represent a case in which learning changes the type of the state space, introduces previously unavailable object types, or replaces the operation-schema family itself. Section 4 already marked this boundary for recursively self-modifying AI systems. A stronger generative formalism would need to represent changes in the model's own configuration and transformation architecture.

7.4 Power and Asymmetric Mediator Formation

The present model makes room for asymmetric influence because interaction histories, update availability, manifestation contexts, and admissibility can differ across participants. It does not yet provide a general formal theory of power. This limitation is substantive because mediator nomoi can be generated through relations in which one participant, institution, species, technical platform, or wider environment has considerably greater capacity to select categories, control communication channels, impose costs, restrict exit, or stabilize one interpretation of the interaction.

A mediator can therefore become persistent and operationally efficacious through several genealogies. Repeated endorsement can contribute to stabilization. So can dependency, institutional enforcement, technical lock-in, coercion, resource asymmetry, control of infrastructure, or unequal ability to revise the interface. Definition 3.6 intentionally identifies mediator status through interaction-conditioned uptake, persistence, cross-subject scope, and operational efficacy. Those conditions describe the existence of a mediator structure and leave the normative and causal genealogy of its stabilization open.

The human–other-animal regime makes this issue especially visible. Long co-history supplies abundant interaction material, yet much of the historically stabilized symbolic and legal interface has been produced under human control of classification, habitat, ownership, institutional recognition, and enforcement. Human–AI interaction can contain a related asymmetry because human developers and institutions can seed the initial manifestation interface, while later AI adaptation can introduce different forms of asymmetry as system capabilities change. AI–AI relations can distribute influence differently again, especially when one system controls computational resources, protocol standards, access, or the environment in which interaction occurs.

Caution 7.3 (Mediator efficacy and power). Operational efficacy is compatible with highly unequal influence over mediator formation. Evidence that a mediator nomos successfully coordinates later interaction therefore does not establish that the participating subjects had comparable capacity to shape, refuse, revise, or exit the mediator.

Caution 7.3 identifies a principal extension for later work. A fuller model could distinguish influence over manifestation, agenda formation, admissibility, update selection, persistence, revision, and exit. Such a model would need to preserve the earlier distinction between generative asymmetry and contract-formative incapacity: greater influence over relational evolution is analytically different from possessing or lacking the capacity required by a particular contractual grammar.

Power also affects epistemic access. The side that controls the mediator's categories or observation infrastructure can determine which differences become visible and which remain outside the translated domain. For this reason, an empirical analysis of mediator formation should identify who or what can modify the manifestation maps, the admissible-update repertoire, the contractual grammar, and the procedures through which translation failure becomes consequential.

7.5 Formation Regimes and Transfer Boundaries

Section 4 distinguished four formation genealogies. Human–alien interaction was represented through bootstrapping; human relations with other animals through historical reconstruction; human–AI interaction through seeded differentiation; and AI–AI interaction through recursive co-evolution. These regimes are analytical descriptions of formation histories. They are not exhaustive taxonomic classes and should not be inferred directly from the labels of the participating subjects.

A human–alien relation can move beyond first-contact bootstrapping after a sufficiently long co-history develops. A human–other-animal relation can contain deliberately engineered interfaces, such as assistive communication systems, that locally resemble aspects of seeded mediation. A human–AI relation can lose much of its inherited common interface after long independent development. Two AI systems can begin with near-identical architectures or with almost no interoperable representation. The relevant regime therefore depends on the history of the relation and the structure of the interface under study.

The four cases also differ in evidential standing. Human–other-animal and human–AI relations are empirically available, although any particular formalization requires domain-specific evidence. AI–AI interaction is empirically available for some present technical systems but the recursively self-modifying cases discussed in Section 4 extend beyond many current deployments. Human–alien first contact remains hypothetical. Its role in the paper is to expose the formal demands of mediation under extremely weak prior co-history, not to assert empirical knowledge about extraterrestrial cognition, social organization, or normativity.

The regime comparison consequently supports structural variation rather than prediction. The paper does not claim that a given type of subject will follow one formation trajectory, that mediator formation will converge, or that repeated interaction will necessarily produce a contract-capable interface. Interaction can fail to stabilize, can stabilize incompatible local structures, can generate destructive lock-in, or can remain too weakly manifested for reliable mediation. Failure to form a mediator nomos is therefore an admissible outcome of the framework.

7.6 Categorical and Operator-Representation Boundaries

The categorical representation in Section 5 records compositional structure after enough mediator organization has become identifiable. It is intentionally downstream of the formation mechanism. The construction uses path categories because finite admissible histories supply a natural notion of composition. Other mathematical representations may be preferable when the application centers on stochastic interaction, continuous dynamics, many-to-many translation, higher morphisms, changing object types, or distributed field-like structure.

The functors T_A and T_B are defined on restricted subcategories because global translation would generally overstate what the mediator represents. This restriction also means that categorical conclusions are local. Faithfulness, fullness, commutativity, or equivalence on one selected domain says little about untranslated regions unless additional arguments extend the result. Likewise, a failure of faithfulness in the mediator category identifies a representational collapse of morphism distinctions; it should not be identified automatically with the metamodel collapse relation $\Delta(m)$, whose type and interpretation are different.

The operator language is similarly limited. The induced updates U_p are partial transformations on Ω , and state-dependent schemas F_p select concrete transformations relative to the current configuration. The paper does not assume a Hilbert space, adjoints, norms, linear superposition, or a conventional operator algebra. Compositional noncommutativity can arise through partial maps without supplying the additional structure required for an algebraic commutator. A future operator-algebraic development would therefore require explicit justification of its carrier space, multiplication, topology or norm where used, and interpretation.

The path-category identity morphisms also remain representational. Their presence is required by the categorical construction and does not alter the highest-layer GR decision to model mechanisms through

a semigroup without assuming an identity mechanism. This separation illustrates a general methodological constraint: mathematical structure introduced at a lower representational layer should not be read backward as an ontological commitment of a more abstract layer.

7.7 Structural Contract Formation and Normative Underdetermination

Section 6 reconstructs a possible route from a mediator nomos to contract formation. The result remains structurally underdetermined with respect to justice. A mediator can support a coherent, realization-backed, bilaterally consequential contract history while a substantive theory judges the relation defective because of coercion, manipulation, dependency, unequal standing, inadequate information, exclusion, exploitation, inability to contest, or another normative feature.

The reverse inference also requires care. Failure to satisfy the present mediator-contract construction does not establish that an interaction lacks ethical significance or that justice permits unrestricted treatment of the participating subject. Contract-based justification is one normative architecture among others. The paper adopts it conditionally in order to ask how far it can be reconstructed under heterogeneous nomic conditions. Ethical standing, rights, capabilities, care relations, welfare, ecological value, duties generated by vulnerability, or other grounds of obligation can remain relevant even where contract formation is absent or impossible.

This boundary is particularly important for nonhuman animals, current AI systems, children, severely constrained participants, and hypothetical unfamiliar beings. The formalism should not turn failure of contract uptake into a verdict of exclusion. It identifies a limit of one contract-formative route. Any substantive normative conclusion requires an articulated ethical or political theory beyond the structural machinery developed here.

The same point applies to the term *social contract*. The manuscript uses contract language broadly enough to represent histories through which mutually consequential terms, expectations, boundaries, or obligations become stabilized under a mediator-conditioned grammar. Particular legal systems and philosophical contract traditions can impose stronger requirements. An application that claims legal contract formation, valid consent, democratic legitimacy, or reciprocal justification must therefore supply the additional doctrinal or normative conditions appropriate to that claim.

The formal reconstruction is most useful when this underdetermination remains explicit. It can identify where mediation is absent, where translation is partial, where a cross-subject structure becomes persistent, where later operations depend on it, where a contract-formative corridor is locally available, and where untranslated remainders survive. It can also identify candidate locations at which power, epistemic distortion, or asymmetric uptake enters the history. Normative theory then has a more articulated relational object to evaluate without being replaced by the formalism.

7.8 Open Formal and Empirical Extensions

Several extensions follow directly from the limits stated above. A first concerns endogenous change in the distinction structure. The highest-layer metamodel treats its congruence as exogenous, while the present paper represents nomic distinctions as historically revisable at an instantiated level. A fuller derivation should specify when a sequence of configuration changes warrants replacing, refining, or otherwise transforming the distinction relation itself without making the definition of collapse circular.

A second extension concerns representational generativity. The current state-dependent machinery changes configurations inside a specified space Ω . Systems that generate new state types, new operation families, or new representational dimensions require a framework in which the modeled space and its transformation repertoire can evolve. Recursive AI–AI interaction provides one motivating case, although the problem is more general.

A third extension concerns multi-party mediation. The present paper concentrates on two identified subjects because the bilateral case makes the formation mechanism transparent. International institutions, ecosystems, distributed technical systems, families, organizations, and political communities can involve many partially overlapping nomoi. Extending the construction to several participants may require higher

categorical, hypergraph, sheaf-like, or other structures, but the mathematical choice should follow the interaction problem rather than precede it.

A fourth extension concerns uncertainty. Subject identification, manifestation, operation domains, translation mappings, and contract uptake can all be uncertain. Set-valued, probabilistic, Bayesian, interval, or competing-model representations could make that uncertainty explicit. The present deterministic notation provides a baseline and should not be interpreted as evidence that empirical mediator formation is deterministically observable.

A fifth extension concerns empirical comparison across formation regimes. The hypotheses proposed here can support comparative studies that examine which histories generate persistent mediator structures, which failures trigger revision, how asymmetry affects the resulting interface, and when local contract-formative corridors remain robust under refinement. Such work would require domain-specific operationalization and should preserve the distinctions among structural description, causal explanation, normative evaluation, and prediction established throughout the paper.

These limitations define the intended contribution of the manuscript. The formalism proposes a disciplined way to represent one class of mediator-nomos formation problems and to connect that formation to heterogeneous contract reasoning. It leaves the empirical identification of mechanisms, the substantive evaluation of power and legitimacy, and the stronger ontology of generative change open for further inquiry.

8 Conclusion

This paper has developed a preliminary Generative Relational account of mediator-nomos formation for a conditional problem in social-contract theory. If some contract-based mode of justification is retained while participating relational subjects lack a sufficiently common nomos for agency, admissibility, manifestation, obligation, and agreement, the constructive difficulty begins before contractual terms are selected. Heterogeneous participants first require a sufficiently shared, potentially narrow field in which contract-formative interaction can become legible. Mediator formation therefore belongs to the contract problem itself.

The principal formal proposal is that a mediator nomos should be derived from relational history rather than postulated as an additional primitive. The construction begins from the existing GR configuration, including accumulated history, the active relational boundary, effective nomos, distinction structure, and state-dependent transformations. Cross-subject interactions enter that history through ordinary configuration changes. Because later operations are instantiated from the configurations produced by earlier ones, repeated interaction can alter the distinctions that remain operative, the transformations that become admissible, the manifestations that acquire practical stability, and the future histories that remain reachable. A cross-subject nomic structure becomes a candidate mediator nomos when it acquires sufficient historical persistence, organizes relations involving the relevant subjects, and exercises subsequent generative efficacy through the modeled configuration.

This proposal gives mediator formation a historical and revisable character. The relevant shared structure need not precede interaction in complete form. It can be generated through interaction and can later be modified by the histories that it helps to organize. This recursive structure also clarifies the role of failure. Misclassification, failed coordination, unstable correspondence, and inadequate translation can become historically consequential when they change the configuration from which later interactions are generated. The formalism therefore permits mediator revision to be represented as part of relational evolution rather than as an external correction imposed on an otherwise fixed interface.

The four formation regimes examined in the paper show why one mechanism should not be assigned uniformly to heterogeneous relations. Human–alien first contact provides a limiting case of mediator bootstrapping under minimal established co-history and highly uncertain mutual manifestation. Human–other-animal relations begin from extensive co-history and therefore direct attention toward the revision of inherited mediating structures that may encode asymmetric classifications. Human–AI relations commonly begin with a technically and linguistically seeded interface whose familiar manifestations can

conceal relational differences that later interaction makes consequential. AI–AI relations can combine inherited interoperability with rapid mutual adaptation, allowing the effective nomic structures of the participating systems and the mediator structure to change through the same sequence of interactions. These regimes are historical starting conditions for analysis. Their relevance depends on the genealogy of a relation rather than on a fixed ontology assigned to a class of beings.

Category theory enters only after sufficient relational structure has stabilized to support a compositional representation. The categorical construction records admissible update histories, restricted source-side domains, mediator-side representations, compositional coherence, and untranslated remainders. Its role is therefore downstream and diagnostic. Commutativity can represent a local form of coherence among selected paths, while failure of commutativity can identify a location at which the current mediator representation requires further inquiry or revision. Neither result establishes complete translation, ontological identity, or normative legitimacy. The same discipline applies to the operator-inspired language: state-dependent partial transformations provide a representation of history-sensitive action without requiring the stronger mathematical structure of a conventional operator algebra.

The reconstruction of contract formation in Section 6 adds a further locality result. A mediator contract-formative witness can exist on a restricted corridor even when substantial regions of the participating nomoi remain untranslated. Contract formation under the present model therefore requires neither global nomic equivalence nor exhaustive mutual representation. It requires a sufficiently coherent, realization-supported, and operatively taken-up path within the part of the mediator through which the relevant contract relation is formed. This local character preserves the possibility of enduring heterogeneity outside the contract-formative corridor and keeps unresolved differences visible rather than treating successful local coordination as evidence of complete convergence.

The constructive result remains limited in several important respects. The formalism does not establish that repeated interaction will generate a mediator nomos, that an emergent mediator will be stable, or that a stable mediator will support a contract-formative corridor. It also leaves substantial empirical work to any application. Subject identification, pair relevance, nomic uptake, persistence, operational efficacy, translation domains, categorical coherence, and contract uptake each require evidence and model-relative interpretation. A change in representational granularity can alter whether a proposed mediator appears persistent or coherent, so robustness under refinement remains an important empirical and formal question.

Power also remains only partially represented. A cross-subject structure can be persistent and generatively effective while reflecting strongly unequal control over classification, translation, admissibility, revision, or exit. The formation of a mediator nomos can therefore become a site of domination as well as coordination. The present paper makes those locations structurally visible without deriving a substantive criterion for legitimate mediation. Normative assessment requires an additional theory capable of evaluating coercion, standing, consent, vulnerability, dependence, exploitation, contestability, and other relevant dimensions.

The same separation constrains the paper's contribution to social-contract theory. A structurally successful mediator-supported contract does not by itself establish justice, and failure of the contract construction does not erase ethical standing or other grounds of obligation. Contract-based justification is treated here as a retained analytical premise whose limits are being reconstructed. The formalism supplies one candidate account of the additional relational machinery that such a premise may require under heterogeneous nomic conditions.

Several open problems consequently remain central. A fuller GR account would need a more explicit treatment of endogenous change in the distinction relation, representational spaces whose available state and operation types can themselves evolve, multi-party mediator formation, uncertainty in manifestation and uptake, and empirical comparison across formation histories. These extensions are particularly important when mediation becomes recursive, when participants can alter their own representational architectures, or when several overlapping nomoi contribute to the same contractual field.

Within these limits, the paper supplies a preliminary formal answer to the constructive problem left by the preceding diagnosis of social-contract limitations. Heterogeneous contract formation can be rep-

resented historically: interaction may generate a persistent cross-subject nomic structure; that structure may organize later interaction; and a locally coherent contract-formative corridor may arise while substantial differences remain. On this account, a mediator nomos is a historically generated and revisable relational condition of contract formation whose presence has to be derived from the modeled history.

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