

Constitutive Heterogeneity in Ethical Inquiry

A Conditional Framework for Standing, Partial Translation, and Effective Answerability

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Abstract

Ethical inquiry across differently constituted beings faces a compound difficulty. Perception, embodiment, valence, agency, temporality, communication, vulnerability, and developmental history can differ together. The observer also participates in producing the evidence through experimental design, care, confinement, training, translation, and institutional classification. A familiar response can invite projection, while an unfamiliar response can invite premature exclusion.

This position paper develops a conditional framework for this problem. Its primary empirical domain is nonhuman-animal inquiry. Hypothetical extraterrestrial first contact functions as a bounded stress test for radical underidentification. The framework defines constitutive heterogeneity as a target-, direction-, relation-, evidence-, and inquiry-indexed condition. It then separates six warrants: subject characterization, partial translation, standing, response interpretation, effective answerability, and substantive ethical judgment. A four-valued evidence register preserves support, counter-support, unresolved status, and inapplicability.

The formal analysis yields several limited results. Exact translation and moral standing are logically independent inside the model. Identical response distributions can coexist with divergent latent valence models. A controlled response can be detected while its communicative meaning remains unresolved. A simple asymmetric-error rule gives a precautionary threshold only under calibrated probabilities and commensurable complete losses. A weaker low-burden dominance rule excludes inquiry policies with weakly lower epistemic gain and weakly greater burdens on every declared coordinate. Effective answerability is represented through entry, legibility, safety, timing, effect, correction, succession, and protected opacity.

The paper connects this architecture to work on animal perceptual worlds, subjective access, comparative cognition, sentience, welfare, capability, relational and political animal ethics, multispecies inquiry, opacity, moral status beyond Earth, and planetary protection. The resulting proposal is a revisable research programme. Species-specific evidence, bridge comparison, institutional design, and empirical tests of low-burden response channels remain central future tasks.

Keywords: constitutive heterogeneity; animal ethics; moral standing; partial translation; animal agency; effective answerability; protected opacity; extraterrestrial ethics; planetary protection

Discussion Paper Note

This paper is a preliminary discussion paper intended to share an evolving idea and invite further dialogue, criticism, revision, and independent development.

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Notices

Status. This is a working draft circulated for discussion. Its definitions, propositions, bridge premises, examples, and section numbering remain open to revision.

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Statement on the use of language models. Drafting, literature search, structural review, formal reconstruction, and argumentative criticism were conducted in dialogue with ChatGPT (OpenAI). The author bears responsibility for the claims, definitions, formal constructions, selection of material, argument, and position taken. References included in the bibliography were checked against publisher, journal, university, governmental, institutional, or DOI records during preparation.

Companion papers. This paper is the fourth paper in a proposed sequence on social contract and Generative Relational Ethics. The first reconstructs social contract as a generative relational process. The second distinguishes representation, translation, and radical-heterogeneity limits. The third develops norm emergence, effective answerability, explicit bridge premises, and revisable universality. The present paper develops the branch concerning heterogeneously constituted subjects. A companion branch concerns normative transposition across heterogeneous generative environments.

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1 Introduction

This section states the motivating difficulty, the paper’s bounded research target, its central proposal, method, contribution, and sequence. The inquiry begins with nonhuman animals and uses hypothetical extraterrestrial first contact only to test whether the conceptual architecture survives radical biological and semantic uncertainty.

Human beings regularly act upon lives whose experience, interests, agency, communication, and social organization they understand only partially. Experimental animals are placed in tasks devised around human questions. Companion animals learn channels shaped by domestic dependence. Farmed animals live under institutions that influence which preferences become observable. Wild animals encounter conservation, habitat management, tourism, and monitoring. Each practice generates evidence while also changing the subject, the available response, and the relation in which response acquires meaning.

The resulting ethical problem joins two familiar dangers. Anthropomorphic projection assigns human categories too quickly. Frans de Waal’s paired term *anthropodenial* identifies the converse danger of withholding relevant continuity across species [5]. These errors lack a single scalar midpoint. A human analogy can be informative for one mechanism and misleading for another. A species-specific difference can matter for a communication claim while leaving a pain-related standing argument intact.

The historical resources for framing this problem are substantial. Jakob von Uexküll’s account of animal *Umwelten* directs attention toward species- and individual-specific perceptual and action worlds [21]. Thomas Nagel’s bat argument makes subjective point of view central to a limit of imaginative and reductive access [15]. Contemporary comparative work translates these concerns into experimental criticism: human sensory equipment, task design, and interpretation can bias the study of animal perception [4]. Animal-consciousness research also supports multidimensional profiles in place of a single scale [3]. These traditions motivate humility. Standing rules and practical institutions require an additional argument.

The central proposal is therefore an architecture of separate warrants. Ethical inquiry should state how it represents a candidate subject, what target it seeks to translate, which latent models remain observationally equivalent, which normative bridge grounds standing, how inquiry burdens are distributed, what a detected response warrants, and whether that response can effectively alter the governing relation. The proposal calls the condition that makes this architecture necessary *constitutive heterogeneity*.

Definition 1.1 (Constitutive heterogeneity). *For an inquiry involving a candidate subject and an inquirer, constitutive heterogeneity is the target-, direction-, relation-, evidence-, and inquiry-indexed condition in which ethically material differences across perception, embodiment, valence, action, temporality, communication, vulnerability, or developmental history prevent warranted comparison through a single presumed common coordinate system.*

The definition is relational and local. It yields local comparisons while withholding a universal species ladder. Two beings can be heterogeneous for reconstructing phenomenology and comparable for a narrower tissue-damage mechanism. A map from animal response to human interpretation can have a different domain and error profile from a map in the reverse direction. Heterogeneity can also be produced or amplified by institutional design.

The paper advances four claims with limited scope. First, translation, standing, response, answer-

ability, and legitimacy require separate warrants. Second, uncertainty carries ethical consequences through explicit bridges and burdens of error. Third, inquiry itself is a standing-sensitive intervention, which supports a minimal dominance rule for low-burden methods. Fourth, effective answerability can include protected opacity: ethically relevant interests can enter governance through plural channels without exhaustive inner-state recovery.

The method combines conceptual reconstruction, verified interdisciplinary literature, typed formalization, exact finite countermodels, conditional derivation, and adversarial objections. The paper’s originality claim is modest. Its main proposal lies in assembling these resources into a layered certificate that blocks common inferential shortcuts and remains applicable under changing evidence.

Section 2 locates the argument within animal ethics, comparative science, multispecies thought, opacity, and extraterrestrial ethics. Section 3 develops the conceptual structure of constitutive heterogeneity. Section 4 formalizes evidence and underidentification. Section 5 develops partial translation. Section 6 connects standing to burdens of error. Section 7 develops response and effective answerability. Sections 8 and 9 treat the animal domain and the first-contact stress test. Section 10 assembles the decision architecture. Sections 11 and 12 state objections and future work. Section 13 concludes.

2 Philosophical and Disciplinary Location

This section identifies the antecedent literatures that constrain the paper’s claims. It proceeds through subjective access and comparative science, animal standing and political voice, multispecies relation and opacity, followed by extraterrestrial moral status and planetary protection.

2.1 Subjective Worlds and Comparative Evidence

This subsection establishes the epistemic starting point. The objective is to combine recognition of differentiated subjective worlds with empirically responsible comparison.

Uexküll’s *Umwelt* approach places perception and action inside the meaningful world of an organism [21]. The present framework inherits the need to type perceptual and action interfaces. It treats those interfaces as inquiry-relative models and leaves Uexküll’s broader theoretical commitments outside its formal core. Nagel’s account adds a different constraint: objective knowledge about a species can grow while the character of its subjective point of view remains incompletely available [15]. This epistemic remainder can coexist with strong reasons for care or protection.

Comparative research supplies methods for disciplined movement beyond human intuition. Caves and Nowicki identify sensory and methodological biases that arise when humans design perceptual studies around their own modalities [4]. Birch, Schnell, and Clayton propose a profile across several dimensions of animal consciousness, including perceptual richness, evaluative richness, integration, temporal experience, and self-consciousness [3]. The profile supports a central principle of this paper: evidential coordinates can develop unevenly, and one unresolved coordinate should remain visible.

The LSE review of cephalopod molluscs and decapod crustaceans assessed a large body of evidence against explicit sentience criteria [2]. The Five Domains model organizes welfare assessment through nutrition, physical environment, health, behavioral interactions, and mental state [14]. These works differ in aim and method. Together they show why ethical inquiry needs a typed evidence register, scope limits, convergent indicators, and explicit movement from evidence to action.

2.2 Standing, Capability, Relation, and Political Voice

This subsection maps several normative routes from empirical characterization to ethical standing. The objective is to preserve their distinct grounds and institutional implications.

Korsgaard develops a Kantian account of obligations to fellow creatures [11]. Nussbaum extends a capabilities-oriented account of justice to nonhuman animals, directing attention toward species-specific forms of flourishing and opportunity [17]. Palmer’s contextual approach gives relationships and histories a role in specifying human responsibilities [18]. These approaches can converge on a protective judgment while supplying different grounds, bearers, and remedies.

Political animal ethics adds questions of membership, sovereignty, voice, and representation. Donaldson and Kymlicka organize differentiated political relations among domesticated animals, wild animals, and liminal animals [7]. Meijer studies political animal voice and the forms through which animals can participate in shared life [13]. Kurki and Siemienieć develop an agency-oriented turn in animal law through interest representation, listening, and empowerment [12]. The present paper draws a methodological consequence: patient standing, agency, political participation, community membership, and relational standing should appear as distinct coordinates.

Birch’s precautionary framework at the edge of sentience emphasizes decisions under uncertainty and the proportionality of responses [1]. The current paper formalizes one narrow asymmetric-loss case, then preserves a broader vector of burdens. This treatment avoids presenting a single expected-loss equation as a complete account of precaution.

2.3 Multispecies Inquiry and Protected Opacity

This subsection identifies relational resources for inquiry design. The discussion focuses on question formation, co-development, and limits on required legibility.

Despret’s work places the design of questions at the center of human–animal knowledge practices [6]. Haraway’s multispecies account emphasizes encounters, obligations, and becoming-with across species [9]. Both help illuminate a feature that a static observer model misses: an experiment or relationship can participate in forming the capacity and response it records.

The term *protected opacity* in this paper receives limited inspiration from Glissant’s right to opacity within a decolonial poetics of relation [8]. Glissant’s concept has a particular historical, political, and intellectual setting. The present operational use concerns a narrow institutional question: can interests enter a decision through protected, partial, plural, or proxy channels while the subject retains control over ethically unnecessary extraction? This is a declared conceptual transfer and remains open to criticism from Glissant scholarship and decolonial animal studies.

2.4 Extraterrestrial Moral Status and Planetary Protection

This subsection bounds the extraterrestrial branch. Its role is to stress-test the framework under radical uncertainty while preserving the hypothetical status of the case.

Persson analyzes the moral status of extraterrestrial life and the possible relevance of features such as life, sentience, and other value-bearing properties [19]. Rummel and colleagues connect ethical considerations to planetary protection and astrobiology [20]. NASA’s current planetary-protection programme addresses biological contamination in missions [16]. The International Academy of

Table 1: Antecedent resources and bounded uses in the present framework

Resource	Present use	Inheritance boundary
Uexküll and Nagel	differentiated perceptual worlds and limits of subjective access	finite inquiry signatures replace a complete ontology
Comparative cognition and welfare science	multidimensional evidence, species-appropriate methods, convergent indicators	empirical warrants remain species-, task-, and context-specific
Capability, relational, and political animal ethics	plural standing grounds, flourishing, responsibility, membership, and voice	the formal profile preserves multiple moral theories
Despret and Haraway	question design, co-development, and multispecies relation	consent and standing retain separate warrants
Glissant	limited inspiration for protected opacity	decolonial meaning exceeds the operational safeguard proposed here
Astrobiology and planetary protection	moral-status questions, contamination, restraint, and institutional context	the alien case remains hypothetical and empirically independent

Astronautics SETI Permanent Committee also maintains protocols concerning searches and potential signal handling [10].

These sources provide precedents and current institutional contexts. The paper’s first-contact restraint envelope remains an original provisional construction. It organizes model uncertainty, contamination, reversibility, critical losses, and institutional authority. Its scope is analytic and prospective. International law, planetary-protection policy, empirical science, and future first-contact deliberation retain their independent authority.

Table 1 records the paper’s main inheritance boundaries. The framework’s contribution is architectural: it places several established concerns into a dependency-ordered warrant system and tests the system through explicit countermodels.

3 Constitutive Heterogeneity

This section develops the paper’s central concept and separates it from difference, hierarchy, incommensurability, and simple informational scarcity. It proceeds through an inquiry-indexed subject signature, directional heterogeneity, coupled development, and a layered warrant taxonomy.

3.1 Inquiry-Indexed Subject Representation

This subsection specifies the finite research object. The representation types ethically material dimensions while retaining its dependence on target, method, and history.

For an inquiry $I = (i, j, q, \mathcal{U}, H, \varepsilon)$, define

$$\mathcal{S}_i^I = (X_i, O_i, A_i, V_i, T_i, C_i, B_i, H_i; \Pi_i^I). \quad (\text{F-GRE-062})$$

Here X_i is the modeled state space; O_i the perceptual interface; A_i the action repertoire; V_i the evaluative or valence structure under investigation; T_i temporal organization; C_i communication

and response channels; B_i embodiment, vulnerability, and viability; H_i developmental and relational history; and Π_i^I the observation and intervention protocol.

Assumption 3.1 (Finite representational scope). *Every subject signature is a finite, method-dependent representation for a declared inquiry. Ethical and empirical conclusions inherit its target, protocol, horizon, tolerance, and evidence limits.*

The assumption prevents an inquiry signature from becoming an essence. A laboratory task can represent discrimination under specified conditions while leaving ecological use, felt salience, social meaning, and developmental plasticity open. The same discipline applies to human observers: their perceptual equipment, conceptual repertoire, institutional incentives, and available instruments belong in the inquiry record.

3.2 Directional and Target-Relative Structure

This subsection formalizes the local and directional character of heterogeneity. The objective is to replace a global scale with a family of partial comparisons.

For each relevant component $k \in K_I$, define

$$\Gamma_{ij}^{q,k} : Z_i^k \rightharpoonup Z_j^k, \quad (\text{F-GRE-063a})$$

$$h_{ij}^{q,k} = (\text{dom } \Gamma_{ij}^{q,k}, \ell_{ij}^{q,k}, u_{ij}^{q,k}).$$

$$\mathbf{H}_{ij}^I = (h_{ij}^{q,k}, h_{ji}^{q,k})_{k \in K_I}. \quad (\text{F-GRE-063b})$$

The partial map Γ has an admitted domain; ℓ records a declared target-relevant loss; u records unresolved uncertainty. The reverse direction appears separately. One direction can be highly effective while the other remains inaccessible. A dog can discriminate patterns in human movement that remain beyond human recovery from the dog's behavioral trace. A human can detect tissue pathology while lacking access to the full character of the animal's experience.

Claim 3.2 (Local heterogeneity). *Heterogeneity material to one target yields a local comparison across subjects. Every defensible comparison specifies its target, direction, domain, loss, uncertainty, and evidence.*

The claim is methodological. It is compatible with strong local comparisons, shared mechanisms, and convergent evidence. Its purpose is to block the promotion of one observed difference into a universal rank of mind or value.

3.3 Coupled Development and Observer Participation

This subsection represents the developmental effect of inquiry. The model tracks changes to the candidate subject, the inquirer, their relation, the environment, and the protocol.

Table 2: Layered warrants in heterogeneous-subject ethical inquiry

Warrant layer	Required record	Licensed result
characterization	target, protocol, typed signature, data provenance	scoped empirical description
translation	partial map, domain, loss, tolerance, tested range, authority	bounded cross-subject comparison
identification	admissible latent models and discriminating evidence	resolved or retained model plurality
standing	empirical grounds, normative bridge, uncertainty and exceptions	plural standing profile
inquiry	epistemic gain, burdens, alternatives, authority and review	provisional protocol authorization
response	controlled contrast, error, meaning, voluntariness and burden	typed response-channel status
answerability	entry, legibility, safety, timing, effect, correction, succession and opacity	process-status certificate
substantive judgment	welfare, right, capability, care, justice and precaution premises	provisional ethical verdict

$$\begin{aligned}
x_{i,t+1} &= F_i(x_{i,t}, x_{j,t}, r_t, e_t, u_t), \\
x_{j,t+1} &= F_j(x_{j,t}, x_{i,t}, r_t, e_t, y_t), \\
r_{t+1} &= R(r_t, x_{i,t}, x_{j,t}, u_t, y_t), \\
e_{t+1} &= E(e_t, x_{i,t}, x_{j,t}, u_t), \\
\Pi_{t+1} &= G(\Pi_t, E_t, U_t, \mathcal{K}_t).
\end{aligned} \tag{F-GRE-066}$$

The variables r_t and e_t represent the relation and shared environment. Accumulated evidence E_t , unresolved uncertainty U_t , and ethical constraints $\mathcal{K}_t$ can revise the protocol. Mutual change permits strongly asymmetric power. An institution can control confinement, feeding, exposure, reproduction, classification, and the criteria through which response becomes legible.

This model clarifies an evidential ambiguity. Suppose an animal reliably performs a task after extensive training. The response can indicate a current capacity, a learned accommodation to the task, a dependency shaped by reward, or a combination. Longitudinal history and alternative protocols are required to distinguish these interpretations. Despret’s attention to the questions posed to animals is especially relevant at this point [6].

3.4 Layered Warrant Taxonomy

This subsection organizes the transitions required for an ethical conclusion. The taxonomy makes the paper’s central separation visible before the detailed formal analysis.

Table 2 presents a dependency graph with feedback. Later evidence can revise an earlier signature or translation. A protective standing judgment can also precede detailed translation when the cost of false exclusion is sufficiently serious under a defended bridge. The key requirement is traceability: each transition identifies its evidence and normative premise.

4 Evidence and Underidentification

This section develops the evidential layer of the framework. It first defines a typed warrant register, then formalizes protocol-relative observational equivalence, constructs an exact valence countermodel, and states the resulting limits on interpretation.

4.1 Four-Valued Warrant Register

This subsection distinguishes four evidential statuses. The register preserves the difference among support, counter-support, unresolved evidence, and inapplicability.

Let

$$\mathbb{V}_4 = \{\mathbf{S}, \mathbf{C}, \mathbf{U}, \mathbf{I}\}$$

denote supported, counter-supported, unresolved, and inapplicable. For each candidate property $g \in G$, define

$$\mathbf{E}_i^I = \left(E_{i,g}^+, E_{i,g}^-, \mathfrak{M}_{i,g}^I, \text{Warrant}_{i,g}^I, \text{Scope}_{i,g}^I \right)_{g \in G}, \quad \text{Warrant}_{i,g}^I \in \mathbb{V}_4. \quad (\text{F-GRE-067})$$

The sets E^+ and E^- record supporting evidence and counterevidence; $\mathfrak{M}$ is the admissible model set; the warrant coordinate gives the current evidential status; and scope identifies species, life stage, context, task, mechanism, and horizon. The four symbols form a categorical reporting grammar separate from probabilities and ordered numerical values.

The distinction between $\mathbf{C}$ and $\mathbf{U}$ is especially important. Counter-support requires evidence against a proposition within a declared model and scope. Unresolved status can arise from sparse evidence, conflicting indicators, weak instruments, several observationally equivalent models, or an inaccessible target. Treating both statuses as zero produces a systematic exclusion bias.

4.2 Protocol-Relative Equivalence

This subsection defines the model class left open by a protocol. The purpose is to identify the precise content of an underidentification claim.

For protocol Π , tolerance ε , and latent models $m_1, m_2 \in \mathfrak{M}$, define

$$m_1 \sim_{\Pi, \varepsilon} m_2 \iff \sup_{u \in \Pi} d_{\text{TV}}(P_{m_1}(Y \mid u), P_{m_2}(Y \mid u)) \leq \varepsilon. \quad (\text{F-GRE-065})$$

The relation groups models whose observable response distributions match within total-variation tolerance under every admitted intervention. Its equivalence class is

$$[m]_{\Pi, \varepsilon} = \{m' \in \mathfrak{M} : m' \sim_{\Pi, \varepsilon} m\}.$$

For $\varepsilon = 0$, reflexivity and symmetry follow directly from the metric, and transitivity follows from equality of distributions. For positive ε , the relation as written can fail transitivity because two successive errors can sum. The paper therefore uses the term *tolerance neighborhood* for positive ε ,

or takes the transitive closure when an equivalence partition is required. This distinction keeps the mathematics exact.

Proposition 4.1 (Protocol-relative identification). *If a target functional $\theta(m)$ varies across the admissible class $[m]_{\Pi,0}$, observations generated under Π identify the response law and leave θ unidentified over that class.*

Proof. Every $m' \in [m]_{\Pi,0}$ yields the same conditional response distribution for every admitted intervention. The observed law therefore has equal likelihood under models with different $\theta(m')$. A unique value of θ requires an additional restriction, auxiliary evidence, or an expanded intervention family. $\square$

4.3 Valence Countermodel

This subsection gives a finite witness for behavioral underidentification. The example isolates the inferential gap as a formal construction, with empirical animal attribution reserved for separate evidence.

Let $u_t \in \{0, 1\}$ be a binary probe and let $y_t = u_t$. Model m_1 assigns aversive valence to the internal process generating y_t . Model m_2 treats the same response as valence-neutral regulation. Both satisfy

$$P_{m_k}(Y_{0:T} = U_{0:T} \mid U_{0:T}) = 1, \quad k \in \{1, 2\}. \quad (4.1)$$

Hence $m_1 \sim_{\Pi,0} m_2$ under the stated protocol, while their valence functionals differ. The observed response rule is fully identified. Valence remains unidentified inside the model class.

The witness supports a limited conclusion. Behavioral evidence requires an interpretive model, yet the model can receive support from physiology, phylogeny, pharmacology, learning, preference tests, ecological behavior, and cross-context convergence. Underidentification directs attention toward those additional warrants and toward empirically discriminating research on animal minds.

4.4 Model-Class Responsibility

This subsection addresses the ethical role of model selection. The objective is to place rival models, exclusions, and discriminating burdens inside the inquiry record.

An admissible model class can encode bias before statistical analysis begins. If every candidate model treats unfamiliar behavior as mechanism without valence, the study builds anthropodenial into its ontology. If every candidate model assigns familiar human motives, the study builds projection into the same stage. A responsible record therefore states:

- (i) the included latent properties and their operational meaning;
- (ii) the mechanisms and interpretations excluded from the class;
- (iii) the evidence supporting those inclusions and exclusions;
- (iv) feasible discriminating observations or interventions;

- (v) the burdens associated with acquiring them; and
- (vi) the decision consequences of residual uncertainty.

This responsibility is methodological and institutional. Researchers, funders, regulators, caregivers, advocates, and affected communities can disagree about the proper model class and the acceptable burdens of reducing uncertainty. The decision certificate developed below retains that disagreement as part of the result.

5 Partial Translation

This section defines translation as a bounded, target-specific achievement. It develops a certificate for partial maps, explains directional asymmetry, and establishes the logical independence of translation and moral standing.

5.1 Translation Certificate

This subsection specifies the content required by a cross-subject translation claim. The certificate records both mathematical performance and institutional authority.

For target (q), define

$$\text{TC}_{ij}^q = (\Gamma_{ij}^q, D_{ij}^q, d_q, \delta_q, E_{ij}^q, R_{ij}^q, A_{ij}^q), \quad (\text{F-GRE-064a})$$

where $\Gamma_{ij}^q : D_{ij}^q \rightarrow Z_j^q$ is a partial map, d_q a target-relevant discrepancy, δ_q its tolerance, E the evidence, R the tested range, and A the authority, contestation, and revision record. For test pairs $\mathcal{P}_{ij}^q$, bounded preservation requires

$$d_q(Q_i^q(z, z'), Q_j^q(\Gamma z, \Gamma z')) \leq \delta_q \quad \text{for every } (z, z') \in \mathcal{P}_{ij}^q. \quad (\text{F-GRE-064b})$$

The target functional Q^q identifies the relation to preserve. It may concern ordering, discrimination, temporal proximity, approach–avoidance, injury sensitivity, or another declared structure. A translation can preserve one structure while altering another.

Definition 5.1 (Bounded translation warrant). *A translation warrant supports use of Γ_{ij}^q only within the declared domain, target, tolerance, tested range, evidence base, and revision conditions recorded in TC_{ij}^q .*

The authority coordinate matters because translations are enacted through scientific classifications, welfare assessments, legal evidence, proxy decisions, and care practices. A technically predictive map can still have a contested domain or harmful institutional use.

5.2 Directional Asymmetry and Translation Atlases

This subsection replaces a single universal dictionary with a plural atlas. The atlas can combine local maps whose domains, methods, and errors differ.

Let

$$\mathfrak{T}_{ij}^q = \{\text{TC}_{ij}^{q,a} : a \in \mathcal{A}_q\}$$

be a translation atlas. One chart can use behavioral preference; another can use physiology; a third can use social response or ecological context. Overlaps provide opportunities for triangulation and conflict detection. Each chart retains its own evidential provenance.

The reverse atlas $\mathfrak{T}_{ji}^q$ is independent. Human observers can become legible to an animal through repeated routines while the animal’s experience remains only partly legible to the humans. Conversely, instruments can reveal a physiological process outside the animal’s available basis for predicting a human intervention. Symmetry is therefore an empirical achievement on a specified target.

Claim 5.2 (Partial-translatability discipline). *A successful chart licenses its bounded comparison and motivates further tests. It leaves global semantic identity, full phenomenological recovery, and reverse translation open.*

This discipline supports practical action. Veterinary care, enrichment, pain relief, habitat design, and representation often proceed through convergent partial knowledge. Ethical seriousness combines warranted partial knowledge with transparency about which claims the available atlas supports.

5.3 Standing–Translation Separation

This subsection proves a model-internal independence result. The result blocks movement in both directions between exact translation and standing.

Proposition 5.3 (Standing–translation independence). *Within the present framework, a supported patient-standing status can coexist with unresolved value translation, and exact signal translation can coexist with counter-supported patient standing under a declared sentience bridge.*

Proof. For the first witness, let convergent sentience evidence satisfy a declared patient-standing bridge, so $\text{Patient}_i = \text{S}$. Let the value-translation domain be empty, $D_{ij}^{\text{value}} = \emptyset$. Patient standing is supported while value translation remains unresolved.

For the second witness, take a deterministic thermostat with two signal states and exact map $\Gamma(z) = z$. Under the same sentience bridge, suppose the available evidence counter-supports sentience. Exact signal translation then coexists with counter-supported patient standing. Thus each status can vary while the other is held fixed. $\square$

The proposition establishes logical independence under the declared bridge; empirical standing remains a separate inquiry. Its ethical role is to prevent speech, code accuracy, or semantic familiarity from serving as an automatic standing criterion. It also prevents the failure of value translation from erasing standing supported through another route.

6 Standing and Burdens of Error

This section connects empirical evidence to standing through explicit normative bridges. It then develops a plural standing profile, derives one conditional asymmetric-error threshold, and establishes a weaker low-burden dominance rule for inquiry design.

6.1 Normative Standing Bridges

This subsection exposes the premises through which empirical properties gain ethical significance. Its structure separates grounds, evidence, thresholds, uncertainty, priorities, exceptions, and authority.

Define a standing bridge

$$\mathcal{B}_g = (G_g, \mathcal{E}_g, \tau_g, \mathcal{U}_g, \mathcal{P}_g, \mathcal{X}_g, \mathcal{A}_g), \quad (\text{F-GRE-068a})$$

and bridge-relative status

$$\text{Stand}_{i,g}^I = \mathcal{B}_g(\mathbf{E}_i^I) \in \mathbb{V}_4. \quad (\text{F-GRE-068b})$$

The ground G_g can invoke sentience, agency, capability, vulnerability, relation, community, life, or another defended source of standing. The remaining coordinates record admissible evidence $\mathcal{E}_g$, decision rule τ_g , uncertainty treatment $\mathcal{U}_g$, priority $\mathcal{P}_g$, exceptions $\mathcal{X}_g$, and authorizing argument $\mathcal{A}_g$.

This architecture permits genuine theoretical disagreement. A capability approach can emphasize the opportunity to realize species-specific forms of flourishing [17]. A Kantian approach can ground duties through the value animals place on their own good [11]. A relational view can assign histories and dependencies a role in specifying responsibility [18]. The bridge record shows where these arguments converge and where they yield different priorities or remedies.

6.2 Plural Standing Profile

This subsection preserves several forms of ethical status. Its purpose is to avoid forcing protection, agency, participation, membership, and relation into one binary predicate.

$$\mathbf{S}_i^I = (\text{Patient}_i, \text{Agent}_i, \text{Participant}_i, \text{Community}_i, \text{RelationBearer}_i) \in \mathbb{V}_4^5. \quad (\text{F-GRE-069})$$

Patient standing concerns the eligibility of a being's good or suffering for direct consideration. Agent standing concerns action, pursuit, refusal, or choice in an appropriately typed sense. Participant standing concerns entry into a shared decision process. Community standing concerns differentiated membership or sovereignty. Relational standing concerns duties arising from a history or dependency.

These coordinates can interact without collapsing. A supported patient status can justify low-burden care while agency evidence remains unresolved. An animal's refusal can be relevant before researchers settle a comprehensive theory of reflective autonomy. Political representation can become necessary because direct linguistic participation is unavailable. Donaldson and Kymlicka, Meijer, and the recent agency-turn literature provide distinct resources for developing these institutional paths [7, 13, 12].

6.3 Conditional Asymmetric-Error Threshold

This subsection derives a simple decision rule under strong assumptions. The derivation clarifies both the force and the narrow scope of expected-loss precaution.

Let $p = P(S \mid E)$ be a calibrated probability that a standing-relevant condition S obtains. Let $C_{FN} > 0$ be the loss from withholding protection when S obtains, and $C_{FP} > 0$ the loss from applying protection when S fails. Assume two actions, linear expected loss, common units, and complete loss specification. Then

$$\begin{aligned} L(\text{protect}) &= (1 - p)C_{FP}, \\ L(\text{withhold}) &= pC_{FN}. \end{aligned} \tag{F-GRE-070a}$$

Protection minimizes expected loss when

$$(1 - p)C_{FP} < pC_{FN}.$$

Adding pC_{FP} and dividing by the positive total loss gives

$$p > \frac{C_{FP}}{C_{FP} + C_{FN}}. \tag{F-GRE-070b}$$

Proposition 6.1 (Conditional precaution threshold). *Under the stated probability, action, and loss assumptions, Equation (F-GRE-070b) is necessary and sufficient for the protective action to have lower expected loss.*

The assumptions carry most of the controversy. Evidence at the edge of sentience can support intervals or qualitative confidence in place of one calibrated p . False-positive and false-negative consequences can affect different bearers and resist common units. Protective rules can restrict agency, change habitats, or create institutional burdens. Birch’s discussion of precaution and proportionality therefore remains broader than this binary illustration [1].

6.4 Low-Burden Inquiry Dominance

This subsection establishes a weaker comparison that requires less numerical structure. It excludes policies that are epistemically weaker and ethically more burdensome on the declared coordinates.

For inquiry policy π , let $g_q(\pi)$ be target-relevant expected epistemic gain. Let $\mathbf{b}_i(\pi) \in \mathbb{R}_+^d$ record burdens such as pain, stress, confinement, intrusion, contamination, coercion, habitat change, and loss of control. Define

$$\pi' \succ_I \pi \iff g_q(\pi') \geq g_q(\pi), \quad \mathbf{b}_i(\pi') \preceq \mathbf{b}_i(\pi), \quad \text{with at least one strict inequality.} \tag{F-GRE-071a}$$

Proposition 6.2 (Dominated inquiry exclusion). *Any admissible-set rule respecting epistemic-gain monotonicity and standing-sensitive burden monotonicity excludes π from the Pareto-maximal set whenever $\pi' \succ_I \pi$.*

Proof. The definition supplies weakly greater epistemic gain and weakly lower burden on every declared coordinate, with one strict comparison. By the definition of Pareto maximality, a dominated feasible element lies outside the maximal set. Therefore

$$\pi' \succ_I \pi \implies \pi \notin \text{Max}_{\succ_I}(\Pi_I). \tag{F-GRE-071b}$$

□

The rule supplies a minimal floor. Several undominated policies can trade epistemic gain, animal burden, ecological disturbance, and distribution differently. Choosing among them requires substantive ethical judgment and institutional authority. The rule also encourages experimental creativity: species-appropriate voluntary participation, remote observation, positive reinforcement, enriched settings, and reusable data can sometimes improve both evidence and burden profiles.

7 Partial Response and Effective Answerability

This section moves from observed response to an institutional relation capable of revision. It separates detection from meaning and consent, defines a typed response certificate, constructs effective answerability, and formulates a protected-opacity constraint.

7.1 Response-Channel Certificate

This subsection specifies the elements hidden by the phrase “the subject responded.” The certificate preserves causal, semantic, voluntariness, burden, and institutional dimensions.

$$\text{RC}_{ij}^c = (U_c, Y_c, \Delta_c, \alpha_c, \beta_c, \text{Meaning}_c, \text{Voluntary}_c, \text{Burden}_c, \text{Retaliation}_c, \text{Revision}_c), \quad (\text{F-GRE-072})$$

where U_c is the intervention, Y_c the response, Δ_c a controlled response contrast, and α_c, β_c false-positive and false-negative profiles. The remaining coordinates record meaning, voluntariness, burden, retaliation, and revision.

Proposition 7.1 (Response–communication separation). *A supported controlled response contrast can coexist with unresolved communicative meaning. A previously supported communicative channel can also coexist with a zero response on a particular trial.*

Proof. For the first witness, take $\Delta_c > 0$ with small detection error and retain reflex, conditioning, injury, and communication models in the identified class. Then response detection is supported and $\text{Meaning}_c = \text{U}$. For the second witness, take a validated channel and a trial on which the subject withholds response, lacks opportunity, or encounters channel failure. The trial contrast is zero while the prior channel warrant remains supported within its scope. $\square$

The result places silence and fluency under the same discipline. Silence can have several causal explanations. Fluency can arise under training, conditioning, or strategic adaptation. Meaning, consent, and standing retain separate warrants in both cases.

7.2 Effective-Answerability Vector

This subsection defines the process conditions through which a response can alter a governing relation. The vector extends response detection into entry, protection, consequence, correction, and succession.

$$\mathbf{A}_{ij}^I = (a^{\text{entry}}, a^{\text{legibility}}, a^{\text{safety}}, a^{\text{timing}}, a^{\text{effect}}, a^{\text{correction}}, a^{\text{succession}}, a^{\text{opacity}}) \in \mathbb{V}_4^8. \quad (\text{F-GRE-073})$$

Entry concerns access to a response channel. Legibility concerns warranted interpretation across plural modes. Safety concerns burdens and retaliation. Timing concerns whether the response arrives before irreversible action. Effect concerns causal influence on the decision or relation. Correction concerns repair of misinterpretation. Succession concerns durability across personnel, organizational, and generational change. Opacity concerns the ability to protect interests without exhaustive disclosure or assimilation.

A strict summary is

$$\text{Ans}_{ij}^I = S \iff a_{ij}^{I,k} = S \quad \text{for every } k \in K_A. \quad (\text{F-GRE-074})$$

The vector remains the principal result. A counter-supported coordinate yields a failed strict certificate. An unresolved or inapplicable coordinate retains an unresolved summary until the inquiry defends a reduced coordinate set.

Claim 7.2 (Effective answerability). *A governing relation is effectively answerable to a candidate subject for a declared inquiry when at least one protected response path has warranted entry, sufficient interpretation, temporal adequacy, causal effect, correction, succession, and an appropriate opacity condition.*

This claim concerns process quality. Welfare, right, capability, justice, care, and legitimacy require additional substantive premises. An institution can respond efficiently while distributing burdens unjustly or pursuing an unacceptable end.

7.3 Protected Opacity

This subsection formulates a bound on demanded legibility. Its objective is to make participation compatible with partial knowledge, proxy channels, and control over ethically unnecessary extraction.

For a disclosure or extraction demand (d), define

$$\mathcal{D}_i^{\text{adm}}(I) = \left\{ d : \begin{array}{l} \text{Relevant}_q(d) = 1, \\ \mathbf{b}_i(d) \preceq \bar{\mathbf{b}}_i, \\ \text{Reversible}(d) = 1, \\ \text{ControlRetained}_i(d) = 1, \\ \text{MinNecessary}_q(d) = 1 \end{array} \right\}. \quad (\text{F-GRE-075})$$

The five conditions require target relevance, bounded burden, reversibility, retained subject control, and minimal necessity. They express a procedural ideal, with case-specific interpretation for dependent beings, emergency care, legal guardianship, conservation, and scientific observation.

Protected opacity has two ethical functions. First, standing can be warranted through one bridge while detailed translation remains incomplete. Second, institutions can represent interests through plural evidence, habitat conditions, vetoes, independent advocates, and correction procedures. The subject's value then exceeds the information that an institution can extract or render familiar.

The safeguard also creates risks. A proxy can claim opacity to avoid scrutiny. An institution can romanticize unknowability while ignoring available evidence of suffering. The proper constraint is therefore protected and answerable opacity: limited extraction combined with independent review, plural interpretation, and accessible remedy.

7.4 Answerability–Legitimacy Separation

This subsection gives a finite process counterexample. The example places a strict answerability certificate beside a rejected substantive distribution.

Consider an institution with supported entry, legibility, safety, timing, effect, correction, succession, and opacity. Let an independent rule assign every resulting burden to one vulnerable group without adequate justification. Then $\text{Ans}_{ij}^I = S$ while the distributive judgment is rejected.

Proposition 7.3 (Process–verdict independence). *Strict effective answerability is insufficient for complete legitimacy inside the present framework.*

The proposition preserves the value of answerability. It shows its structural role as a process condition whose normative force depends on standing, substantive principles, authority, and distribution. The same separation protects animal consultation from becoming a symbolic substitute for habitat, welfare, freedom, or justice.

8 Animal Inquiry

This section applies the framework to its primary empirical domain. It organizes animal inquiry around species-appropriate characterization, multidimensional evidence, standing under partial translation, low-burden response design, and institutional representation.

8.1 Species-Appropriate Characterization

This subsection turns constitutive heterogeneity into a research-design obligation. The objective is to align stimuli, response modes, temporal scales, and contexts with the candidate animal’s perceptual and action world.

An inquiry should begin with the target (q), followed by the animal’s relevant sensory capacities, action repertoire, ecological setting, developmental history, social organization, and prior relation with human observers. Caves and Nowicki’s analysis of human perceptual bias supports this methodological priority [4]. A visually obvious stimulus to a human can be weak for another species; an ecologically meaningful chemical, vibrational, tactile, or temporal cue can remain invisible to the experimenter.

Species-appropriate design also concerns response. A forced binary choice can compress graded attraction, hesitation, vigilance, social reference, or exploration. Group-living animals can respond through collective spacing or coordination. Some responses unfold across developmental or seasonal time. The subject signature in Equation (F-GRE-062) makes these dimensions visible before interpretation.

The qualifier *species-appropriate* remains incomplete by itself. Individuals differ by age, sex, health, personality, disability, experience, domestication, social status, and local ecology. The proper scale can therefore be species-, population-, group-, relation-, or individual-specific. The inquiry record should state which level its evidence supports.

Table 3: Animal-inquiry registers and standing-sensitive design obligations

Register	Illustrative evidence	Principal attribution risk	Design obligation
perceptual world	sensory physiology, discrimination, ecological cue use	human modality treated as universal	match stimuli and instruments to relevant modalities
valence and welfare	motivational trade-offs, analgesic response, physiology, preference, behavior	reflex or performance assigned a unique felt meaning	triangulate mechanisms and contexts
agency	learning, planning, innovation, refusal, social coordination	trained compliance treated as autonomous preference	vary opportunity, history, and withdrawal conditions
communication	signal production, reception, context and repair	response detection treated as semantic equivalence	audit sender, receiver, meaning, error, and voluntariness
relation	attachment, dependence, care history, conflict and trust	present behavior detached from formative relation	preserve longitudinal and institutional provenance
political voice	refusal, approach, habitat use, proxy testimony, collective effects	proxy preference substituted for represented interests	provide independent, plural, contestable representation

8.2 Multidimensional Consciousness and Welfare Evidence

This subsection connects the typed evidence register to current animal consciousness and welfare research. The objective is to retain convergence and disagreement across indicators.

Birch, Schnell, and Clayton’s dimensions approach supports profile-based comparison across several aspects of consciousness [3]. The LSE review of cephalopods and decapods shows how multiple evidence criteria can be assessed systematically across taxonomic groups [2]. The Five Domains model supplies a related but distinct welfare framework that joins nutrition, environment, health, behavioral interactions, and mental-state inference [14].

The present evidence register places these sources in a common audit grammar without merging their constructs. A physiological marker can support one mechanism; flexible learning can support another; motivational trade-offs can support a valence interpretation; ecological and social responses can delimit scope. Conflicting evidence remains explicit. A judgment can also be provisional and action-guiding while research continues.

Table 3 connects each register to a design obligation. The table organizes inquiry; species-level evidential verdicts require domain expertise and case-specific validation.

8.3 Standing under Partial Translation

This subsection develops the practical significance of standing–translation independence. Its objective is to explain how action can proceed under epistemic limits while remaining corrigible.

A being can warrant patient standing through sentience-related evidence even when humans lack a detailed translation of its values. This structure supports pain relief, avoidance of severe distress, and preservation of viable activity without claiming phenomenological equivalence. A capability

bridge can add species-specific opportunities and forms of flourishing [17]. A relational bridge can add responsibilities arising from domestication, dependence, or prior intervention [18].

Partial standing can also support differentiated inquiry rights. A candidate subject may receive a low-burden protocol, an independent advocate, a presumption favoring voluntary participation, or a review threshold. These measures can be justified through explicit error costs and bridge premises. Their proportionality and effects remain reviewable.

The framework therefore resists two epistemic temptations. Complete subjective access becomes unnecessary as a precondition for all protection. Familiar communication becomes unnecessary as a precondition for direct ethical consideration. At the same time, uncertainty remains visible and can motivate additional evidence where inquiry burdens are justified.

8.4 Refusal, Preference, and Co-Developed Response

This subsection places animal agency inside a developmental relation. It distinguishes a detected response, its interpretation, and its institutional effect.

An animal can approach, avoid, interrupt, persist, disengage, solicit, or redirect interaction. Such behavior can become ethically relevant before it meets a human ideal of propositional speech. Its warrant depends on context, alternatives, learning history, coercion, health, and the reliability of the response channel. Repetition across conditions can strengthen interpretation; response suppression under dependency can weaken it.

Co-developed channels deserve particular care. Companion animals and human caregivers can learn mutually responsive routines. Laboratory animals can learn task conventions. These relations create real capacities while also shaping dependency and the range of legible choices. Equation (F-GRE-066) therefore treats learned response as a joint history and retains untouched preference as one rival interpretation requiring evidence.

Despret’s account of asking animals appropriate questions provides a strong methodological antecedent [6]. The present addition is an audit of burden, voluntariness, retaliation, and correction. A clever task can reveal a capacity and still impose an ethically unacceptable relation.

8.5 Representation and Institutional Answerability

This subsection moves from individual response to governance. It examines proxy representation, political voice, and the conditions under which animal interests can alter institutional decisions.

Many animals enter human legal and administrative procedures through mediated channels. Institutions use caregivers, scientists, veterinarians, advocates, guardians, trustees, ecological indicators, and statutory duties. The need for a proxy creates a second translation problem: the institution must distinguish the animal’s evidence and interests from the proxy’s incentives, theory, and organizational role.

Effective answerability requires several safeguards. Representation should be independent from the institution whose conduct is reviewed. Multiple forms of evidence and advocacy should remain available. Interpretations should be contestable. Decisions should record how animal-relevant evidence changed the outcome. Correction, succession, and remedy should survive turnover. Kurki and Siemienieć’s agency-oriented legal criteria concerning interest representation, listening, and

empowerment provide a valuable contemporary point of comparison [12].

Political animal theory extends the horizon beyond welfare consultation. Domesticated animals, wild communities, and liminal animals can stand in different relations to human polities [7]. Animal voice can enter shared practices through embodied and relational forms [13]. The current framework remains neutral among complete political theories, while requiring every proposed arrangement to declare its standing bridge, proxy authority, response path, distribution, and remedy.

9 Extraterrestrial First-Contact Stress Test

This section tests the framework under a hypothetical case with unusually high biological, semantic, ecological, and strategic uncertainty. It defines the domain boundary, develops a provisional restraint envelope, and identifies institutional obligations that arise before rich translation becomes available.

9.1 Radical Underidentification

This subsection states the epistemic role of the extraterrestrial case. Its purpose is to reveal assumptions that familiar terrestrial life can keep hidden.

A candidate extraterrestrial entity could differ in substrate, scale, individuality, metabolism, environment, temporal organization, reproduction, communication, and relation to habitat. Initial evidence could arise through remote biosignatures, technosignatures, instrument-mediated signals, artifacts, or direct encounter. Each mode creates a different protocol and model class.

The first question therefore concerns characterization: which observable regularities warrant the labels life, organism, subject, agent, community, or artifact? A second question concerns standing bridges: which grounds apply to life, sentience, agency, vulnerability, ecological organization, or cultural existence? Persson’s work provides a direct philosophical precedent for moral status beyond Earth [19]. The present framework adds a typed uncertainty and action architecture.

Radical uncertainty also affects the observer. Instruments can filter signals; institutional mandates can privilege scientific discovery, security, prestige, or mission success; human temporal scales can hide slow response; and a seemingly inert environment can contain life processes beyond current detection. These possibilities expand the model class and increase the value of reversible inquiry.

9.2 First-Contact Restraint Envelope

This subsection defines a provisional admissible action set. The envelope combines critical-loss bounds, contamination control, reversibility, and low-burden dominance.

Let $\mathfrak{M}^{FC}$ be an admitted first-contact model set and $\mathcal{L}_r(a, m)$ a family of standing-sensitive losses. Define

$$\mathcal{A}_{FC}^{\text{rest}} = \left\{ a \in \mathcal{A}_{FC} : \begin{array}{l} \sup_{m \in \mathfrak{M}^{FC}} \mathcal{L}_r(a, m) \leq \rho_r \quad \forall r \in R_{\text{crit}}, \\ \text{Contamination}(a) \leq \kappa, \\ \text{Reversibility}(a) \geq \eta, \\ a \text{ is undominated under } \succ_I \end{array} \right\}. \quad (\text{F-GRE-076})$$

The critical-loss family can include destruction of candidate life, contamination of an environment or evidence base, coercive exposure, irreversible signaling, and serious terrestrial harm. The thresholds ρ_r, κ, η require public, scientific, ethical, and legal authority. Their values arise from those external processes.

Claim 9.1 (Provisional first-contact restraint). *Under radical underidentification and potentially irreversible loss, first-contact inquiry should privilege actions within a publicly authorized, model-plural, contamination-bounded, reversible, and reviewable restraint envelope.*

The claim is pro tanto and conditional. Security emergencies, evidence decay, unavoidable contact, or conflicting duties can change the feasible set. An empty envelope calls for redesign, delay, or minimization of irreversible exposure, together with scrutiny of whether thresholds or model classes are poorly specified.

9.3 Planetary Protection and Signal Governance

This subsection connects the formal envelope to current institutional precedents. The objective is to identify relevant structures while preserving the distinction between existing policy and the paper’s proposal.

Planetary protection already addresses forward and backward biological contamination in space missions. NASA describes this responsibility within its official safety and mission-assurance framework [16]. Rummel and colleagues explicitly connect planetary protection with ethical considerations in astrobiology [20]. These practices show that epistemic preservation, ecological integrity, and safety can converge in restraining intervention.

Signal governance has a different structure. The IAA SETI Permanent Committee maintains declarations and protocols for searches and possible detections [10]. A standing-sensitive extension would add questions of interpretive plurality, response authority, irreversible disclosure, cross-generational consequence, and remedy. The institutional burden is global because one actor’s transmission or contamination can change the relation for others.

The current paper therefore treats planetary protection and SETI protocols as institutional antecedents. Full recommendations require current COSPAR policy, international space law, security analysis, scientific consultation, and global political legitimacy. Those tasks remain beyond this position paper’s present scope.

9.4 Domain Separation

This subsection formalizes the boundary between animal inquiry and the extraterrestrial stress test. The shared architecture provides audit questions, while empirical content remains independent.

Table 4 states the permitted transfer. Both domains use typed signatures, partial translation, plural standing, burden-sensitive inquiry, and answerability. Animal empirical findings support terrestrial claims within their scope; extraterrestrial biology and subjectivity require independent evidence. The extraterrestrial case also must avoid treating earthly animals as mere metaphors for radical otherness.

Table 4: Empirical separation of animal inquiry and extraterrestrial first contact

Dimension	Nonhuman-animal domain	First-contact stress test	Shared obligation
status	existing organisms with heterogeneous evidence bases	hypothetical life, intelligence, or subjectivity	declare the target and model class
access	behavior, physiology, ecology, development and relation	remote signal, instrument, artifact, planetary context or encounter	type observation and intervention
principal burden	pain, stress, confinement, dependency and habitat change	contamination, irreversible exposure, strategic and planetary risk	identify bearers, horizons and alternatives
response	species-appropriate behavior, physiology, refusal and social change	initially unknown or mediated signals and environmental change	separate detection, meaning and voluntariness
standing routes	sentience, agency, capability, vulnerability, relation and membership	life, sentience, agency, vulnerability, ecology and possible civilization	expose each normative bridge
institutions	research, care, agriculture, conservation, law and advocacy	science agencies, planetary protection and international coordination	audit authority, revision and remedy

10 Formal Consequences and Audit Architecture

This section assembles the earlier definitions into a decision certificate. It states the dependency order, collects the separation results, and identifies the exact output that the framework can responsibly provide.

10.1 Layered Decision Certificate

This subsection defines the synthesis object. Its purpose is to preserve the evidence and argument supporting every movement from characterization to action and review.

$$DC_{ij}^I = (\mathcal{S}_i^I, \mathbf{H}_{ij}^I, \mathbf{E}_i^I, \mathbf{TC}_{ij}^q, \mathbf{S}_i^I, \mathbf{RC}_{ij}^c, \mathbf{A}_{ij}^I, \mathcal{B}, \mathcal{N}, \mathcal{R}), \quad (\text{F-GRE-077})$$

where $\mathcal{N}$ contains substantive normative premises and $\mathcal{R}$ contains the action, monitoring, revision, and remedy record. Each component can carry supported, counter-supported, unresolved, or inapplicable coordinates. The certificate therefore reports a multi-coordinate epistemic and normative state.

Table 5 makes the architecture operational. A missing gate can sometimes justify provisional protective action through an explicit asymmetric-error bridge. The omission remains recorded, and the decision acquires a review obligation.

10.2 Separation Results

This subsection consolidates the finite witnesses. Their role is to identify inferential shortcuts that fail within the formal system.

Table 5: Decision gates and licensed outputs

Gate	Minimum inputs	Licensed output	Revision trigger
characterization	inquiry target, protocol, signature and provenance	scoped empirical description	protocol change or contradictory evidence
translation	characterization, partial map, loss and tested range	bounded comparative claim	range breach, reverse-map failure or rival model
standing	typed evidence, defended bridge and uncertainty rule	plural standing profile	bridge objection, threshold sensitivity or new evidence
inquiry	standing, gains, burdens, alternatives and authority	dominated-policy exclusion or protocol authorization	harm signal or lower-burden alternative
response	controlled contrast, errors, channel and rivals	typed response status	artifact, coercion or contextual reversal
answerability	response, protected path and institutional effect	process certificate	retaliation, delay, proxy capture or failed correction
substantive action	answerability, ethical premises and distribution	provisional action or restraint	irreversible risk, failed outcome or new bearer
continuation	monitoring, correction, succession and remedy	continued or modified authorization	scheduled review or threshold breach

Table 6 collects six results. The first four are logical independence or underidentification witnesses. The fifth shows incompleteness of Pareto ordering. The sixth is a methodological restriction declared by the framework.

10.3 Dependency Order

This subsection states the continuous derivation from an inquiry declaration to a provisional decision. The sequence supports auditing and permits feedback to earlier stages.

D1. Declare $I = (i, j, q, \mathcal{U}, H, \varepsilon)$.

D2. Construct $\mathcal{S}_i^I$ and $\mathcal{S}_j^I$ with evidential provenance.

D3. Localize directional heterogeneity through $\mathbf{H}_{ij}^I$.

D4. Certify every translation through TC_{ij}^q .

D5. Retain the protocol-relative model class under Equation (F-GRE-065).

D6. Track subject, observer, relation, environment, and protocol through Equation (F-GRE-066).

D7. Populate the typed evidence register $\mathbf{E}_i^I$.

D8. State each standing bridge $\mathcal{B}_g$ and plural profile $\mathbf{S}_i^I$.

D9. Compare inquiry policies through asymmetric losses where warranted and low-burden dominance generally.

D10. Certify response through RC_{ij}^c .

Table 6: Exact and conditional separation results

Separation	Witness	Methodological consequence
standing and translation	supported sentience bridge with empty value-map domain; exact thermostat code with counter-supported sentience	state each standing bridge independently of map accuracy
behavior and latent valence	identical binary response law under aversive and neutral latent models	retain the model class and seek discriminating evidence
response and communication	positive controlled contrast with unresolved meaning; validated channel with a silent trial	separate detection, semantics, opportunity and voluntariness
answerability and legitimacy	complete process vector with an unjustified burden distribution	add substantive ethical and distributive premises
uncertainty and unique policy	two burden vectors, $((1,3))$ and $((3,1))$, with equal gain	report the undominated choice set and remaining value conflict
animal and extraterrestrial evidence	shared certificate grammar with disjoint empirical model sets	transfer audit structure while rebuilding domain evidence

D11. Evaluate $\mathbf{A}_{ij}^I$ and protected opacity.

D12. Add substantive principles $\mathcal{N}$, select provisional action, and record monitoring, correction, succession, and remedy in $\mathcal{R}$.

The ordering exposes the location of disagreement. Researchers can agree on a response contrast and disagree about meaning. Ethical theories can agree on sentience evidence and disagree about its standing bridge. Institutions can agree on standing and disagree about proportional protection. A transparent certificate turns those differences into revision targets.

10.4 Mathematical and Normative Status

This subsection identifies which parts of the framework are exact and which remain proposals. The distinction calibrates the paper’s claims.

The algebraic precaution threshold is exact under its assumptions. The dominance result follows exactly from Pareto maximality. The finite countermodels establish logical independence inside the declared formal system. The typed signatures, translation certificates, standing profiles, answerability vectors, and restraint envelope are proposed models. Their empirical usefulness and normative adequacy require validation.

The equations diagnose dependencies around consciousness, intrinsic value, and moral status while leaving their empirical and normative warrants visible. They reveal where a bridge premise, model restriction, authority claim, uncertainty rule, or burden assignment enters. A formalism that obscures those decisions would defeat the paper’s purpose.

11 Objections and Counterconditions

This section tests the framework against conceptual, methodological, political, and cross-domain objections. Each objection identifies a possible failure and a corresponding revision condition.

11.1 Formal Capture of Radical Difference

This subsection addresses the concern that typed models domesticate the very difference they seek to respect. A signature selects coordinates, a metric selects discrepancies, and a model class selects possible interpretations.

The objection succeeds against any claim of exhaustive representation. The framework responds by indexing every representation to an inquiry and by retaining unresolved and inapplicable statuses. Protected opacity also limits the demand for complete capture. Yet these safeguards remain internal to a human-designed system. External criticism, alternative taxonomies, and subject-responsive revision are therefore constitutive requirements of the framework.

11.2 Anthropomorphism and Anthropodenial

This subsection tests the balance between similarity and difference. Excessive human analogy can project familiar motives; excessive emphasis on difference can exclude well-supported continuity.

The directional, target-relative structure offers a local response. A shared nociceptive mechanism can support one bridge while phenomenological detail remains uncertain. A species-specific sensory capacity can require a new experimental chart while shared learning principles remain relevant. De Waal's paired diagnosis remains important because the two errors require separate evidence and can occur together [5].

11.3 Precautionary Paternalism

This subsection addresses protective action that restricts agency, relation, or habitat. Precaution can impose burdens on the very beings whose standing it recognizes.

The asymmetric-error threshold is deliberately conditional. A complete audit adds the bearers of false-positive burdens, reversibility, distribution, agency, and alternative policies. Low-burden dominance excludes some inferior methods while leaving genuine trade-offs open. Sunset clauses, monitored outcomes, independent review, and remedy provide further constraints.

11.4 Opacity and Evidence Avoidance

This subsection considers institutional misuse of protected opacity. A proxy or organization can invoke unknowability to resist investigation of suffering, capture, or neglect.

Equation (F-GRE-075) links opacity to relevance, burden, reversibility, retained control, and minimal necessity. Independent review and plural evidence remain essential. Protected opacity should preserve subjects from excessive extraction while preserving evidence needed for urgent care, accountability, and remedy. The balance requires case-specific institutional authority alongside the formal audit.

11.5 Proxy Capture and Silent Subjects

This subsection tests representation where direct correction is limited. Guardians, experts, advocates, and institutions can mistake their own preferences for those of a represented subject.

The answerability vector requires independent entry, plural legibility, correction, succession, and opacity. Additional safeguards include conflict disclosure, multiple proxies, empirical records, adversarial review, removal procedures, and remedies for misrepresentation. Some subjects will remain unable to audit proxies directly. This residual asymmetry is a reason for institutional humility and stronger external scrutiny.

11.6 Animal–Extraterrestrial Overextension

This subsection addresses the danger that the stress test turns terrestrial animals into symbols of alien otherness or transfers animal findings into an unknown domain.

The objection establishes a strict boundary. Nonhuman animals are existing, diverse terrestrial beings with rich and uneven evidence bases. Extraterrestrial subjects remain hypothetical. Table 4 shares only an audit grammar: typed constitution, partial translation, explicit standing bridges, burden-sensitive inquiry, and answerability. Every empirical model, mechanism, threshold, and institution must be rebuilt for its domain.

11.7 Decolonial Transfer and Opacity

This subsection tests the paper’s use of Glissant. A decolonial concept formed in histories of colonial classification and forced transparency can lose its political force when generalized into an abstract ethical coordinate.

The paper accepts this risk and limits the transfer. Glissant remains an antecedent for the normative significance of opacity in relation [8]. Equation (F-GRE-075) is the paper’s own operational proposal for controlling disclosure and extraction in a different research problem. Future revision requires engagement with Glissant scholarship, decolonial animal studies, Indigenous thought, and concrete histories of classification and extraction.

11.8 Institutional Feasibility

This subsection addresses administrative burden and conflicting expertise. The full certificate can appear too demanding for routine decisions.

A tiered implementation can match scrutiny to stakes, uncertainty, irreversibility, and power. Low-stakes reversible care can use a compact record. Invasive research, major habitat transformation, species-wide policy, or irreversible contact requires deeper review. Reusable evidence registers, standardized provenance, independent representation, and scheduled correction can reduce administrative cost. Compression should preserve the location of open warrants.

12 Research Programme

This section specifies the work required to evaluate, revise, or abandon the framework. It divides future research into philosophical comparison, empirical animal studies, institutional design, formal development, and extraterrestrial governance.

12.1 Philosophical Bridge Comparison

This subsection identifies the normative work required beyond the present architecture. The central task is a primary-text comparison across standing grounds and their action implications.

Future analysis should compare sentience, rights, capability, care, relationship, agency, community, life, and ecological integrity through common cases. Each comparison should state bearer domain, threshold, uncertainty, priority, exception, authority, and remedy. Korsgaard, Nussbaum, Palmer, Donaldson and Kymlicka, and contemporary political-animal work provide initial sources [11, 17, 18, 7, 12]. Utilitarian, rights, virtue, care, disability, Indigenous, and decolonial traditions require further verified treatment.

12.2 Comparative Empirical Programme

This subsection specifies empirical tests for the main constructs. The programme prioritizes model discrimination, ecological validity, low-burden response channels, and longitudinal co-development.

Candidate studies can compare human-centered and species-appropriate protocols on predictive accuracy, stress, voluntary participation, cross-context generalization, and correction. Longitudinal designs can examine how trust, training, dependency, enrichment, and withdrawal alter response. Model-class audits can test whether rival latent interpretations yield different predictions under ethically admissible interventions.

The evidence programme should retain negative findings and scope boundaries. Open data and preregistration can help, subject to welfare, habitat, location, and protected-opacity constraints. Species expertise and direct care knowledge should complement laboratory measures.

12.3 Institutional Representation Programme

This subsection develops governance forms for effective answerability. Its objective is to move from individual response evidence to durable influence, correction, and remedy.

Comparative cases can include animal-research ethics, veterinary consent-like practice, sanctuary governance, farm regulation, habitat management, conservation, guardianship, and legal advocacy. Measures should include proxy independence, plurality of evidence, decision effect, correction success, retaliation risk, succession durability, and remedy.

Institutional experiments can also compare forms of animal participation: voluntary entry, refusal, preference testing, habitat choice, representative advocacy, and ecological indicators. Each form should record who authorizes interpretation and how the represented interests can challenge it.

12.4 Formal and Computational Development

This subsection identifies extensions required for greater mathematical and decision-theoretic adequacy. The priority lies in uncertainty, dynamics, networked representation, and irreversible action.

The four-valued register can be extended with imprecise probabilities or sets of priors while preserving unknown and inapplicable statuses. Translation atlases need composition-error bounds, conflict

detection, and revision rules. Coupled dynamics need causal identification of training, trust, stress, and observer effects. Burden vectors need temporal distribution, multiple bearers, and irreversible losses.

Effective answerability can be modeled as a network of response paths with gate reliability, delay, correction, and proxy dependence. Formal verification can test whether every high-stakes decision has a protected path and scheduled review. The semantic and standing bridges remain philosophical and empirical objects even when the path audit is computational.

12.5 Extraterrestrial Governance Development

This subsection defines the evidence and legitimacy gates for the stress-test branch. The work requires interdisciplinary and international authority.

Priority tasks include a current reading of COSPAR policy, the Outer Space Treaty and related law, astrobiological contamination models, SETI signal governance, irreversible-message analysis, security risks, global public reason, and representation of future generations. NASA and IAA materials provide current institutional starting points [16, 10].

The extraterrestrial branch should remain separate from animal empirical research. Its success condition is architectural: the framework should expose model assumptions, standing bridges, irreversible burdens, authority, and review before action. Failure to improve those decisions would justify narrowing or abandoning the branch.

Open Problem 12.1 (Protected response under severe underidentification). *Construct an institutionally feasible response architecture that permits a candidate subject’s interests to alter decisions under severe translation uncertainty, while bounding projection, proxy capture, extraction burden, and irreversible error.*

Open Problem 12.2 (Comparative standing bridges). *Determine which standing bridges converge on shared cases, which yield different duties or remedies, and which empirical findings discriminate among their practical implications.*

Open Problem 12.3 (Co-developed response identification). *Identify conditions under which a response formed through training, care, or long interaction supports agency or preference attribution, together with conditions under which dependency, coercion, or observer constitution remains the stronger explanation.*

13 Conclusion

This section consolidates the paper’s conceptual, formal, ethical, and practical contributions. It also states the conditions under which the framework should be revised.

Constitutive heterogeneity names a local structure of ethical inquiry. Perception, embodiment, valence, action, temporality, communication, vulnerability, and history can differ together, and the relation of inquiry can participate in forming the evidence it later interprets. This structure is indexed to a target, direction, relation, protocol, evidence base, horizon, and tolerance. It supports local comparisons while withholding a universal ranking.

The paper has proposed a sequence of separate warrants. Subject characterization precedes bounded translation. Protocol-relative model classes make underidentification visible. Empirical properties

enter ethical standing through explicit normative bridges. Inquiry design records epistemic gain and standing-sensitive burdens. Response detection receives separate semantic, voluntariness, and error coordinates. Effective answerability extends response through entry, legibility, safety, timing, effect, correction, succession, and protected opacity. Substantive judgment adds welfare, right, capability, care, justice, relation, precaution, authority, and distribution.

Several formal consequences clarify the architecture. Standing and translation vary independently inside the model. Identical behavior can arise under divergent latent valence assignments. Detected response and communication also vary independently. Effective answerability can coexist with a rejected substantive distribution. The asymmetric-error threshold is exact under calibrated probabilities and complete commensurable losses. Low-burden dominance offers a weaker and more general exclusion of epistemically inferior, burden-heavier inquiry policies.

For animal inquiry, the framework supports species-appropriate design, multidimensional evidence, standing under partial translation, low-burden response channels, and independent plural representation. For hypothetical extraterrestrial first contact, it supplies a bounded stress test through model plurality, contamination control, reversibility, critical-loss limits, and institutional review. The shared element is the audit architecture. The empirical models remain separate.

The proposal is provisional. Its value depends on philosophy that defends or revises its standing bridges, science that tests its evidential distinctions, institutions that make response consequential, and criticism that identifies hidden human categories. If the certificate becomes bureaucratic ornament, if protected opacity shields neglect, if formalization obscures power, or if the architecture duplicates existing work without diagnostic gain, substantial revision or abandonment is appropriate. Its present contribution is a traceable grammar for inquiry, protection, response, and correction across difference.

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