

Rethinking Three Structural Limits of Social Contract Theory

Representation, Translation, and Radical Heterogeneity

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Abstract

Martha Nussbaum organizes *Frontiers of Justice* around disability, justice across national boundaries, and nonhuman animals. Her analysis challenges contract pictures centered on mutual advantage among approximate equals and develops a capability-based response. This position paper takes those three frontiers as motivating cases for a narrower, paper-specific reconstruction of three possible limits in contract-centered norm generation.

The first limit concerns representation. A subject can be affected by a rule, entitled under an independent criterion, or constitutive of a shared practice while lacking an accessible, intelligible, safe, timely, efficacious, and revisable path into norm formation. The second concerns translation. Reasons can move through partial and power-laden maps across human normative systems while losing distinctions required by a declared institutional target. The third concerns identification under radical heterogeneity. Relation-conditioned observations can remain compatible with several models of another subject's interpretation, welfare, drive, or evaluative order.

The reconstruction is diagnostic and conditional. It distinguishes contract capacity, affect-ness, moral standing, constitutive contribution, and justice relevance. It treats translation as target-relative and allows bounded adequacy. It represents identification through a set of models indexed by observation and intervention. Exact finite witnesses establish four separations. Observed proxy agreement can coexist with different affected-subject influence. A many-to-one translation preserves a target exactly precisely when the target is constant on every translation fibre. Equal observable responses can coexist with reversed evaluative orderings. Separate ordinal rankings can leave a fixed interpersonal utility sum underdetermined under admissible rescaling.

Each diagnosis has a distinct countercondition. Proxy representation can supply an effective path under defended authority, fidelity, plurality, contestability, displacement, and revision conditions. Partial translation can preserve a bounded target without becoming globally invertible. Comparative, physiological, developmental, ecological, and intervention evidence can narrow a heterogeneous model set. These responses can also be combined with capability, care, rights, trust, political representation, and precautionary approaches.

The paper therefore proposes a plural audit of contract inputs and interfaces. Its formal results organize inferential burdens; justice, standing, duty, precaution, and remedy enter through separately defended normative premises. Historical reconstruction, empirical measurement, translation authority, and institutional comparison remain open parts of the research programme.

Keywords: social contract; representation; disability; normative translation; radical heterogeneity; animal ethics; identification; capability; interpersonal comparison; generative relational ethics

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, 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, authoritative digital-edition, or DOI records during preparation.

Companion papers. This paper is the second paper in a proposed sequence on social contract and Generative Relational Ethics. The first paper reconstructs social contract as a generative relational process. The present paper distinguishes representation, translation, and identification limits. The next foundational paper develops norm emergence, effective answerability, and revisable universality. Subsequent branches address heterogeneously constituted subjects and heterogeneous generative environments.

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1 Introduction

This section states the paper’s bounded target, central position, attribution boundary, contributions, method, and sequence. The discussion begins from Nussbaum’s three frontiers, separates them from the paper’s formal taxonomy, and identifies the contract procedures to which the diagnosis applies.

Social-contract arguments employ agreement for several purposes. They can explain political authority, model fair choice, derive mutually advantageous terms, test reasonable acceptability, or represent public justification. Their parties, information, bargaining positions, agreement mechanisms, and objects consequently vary across theories [4]. A structural audit should therefore name the exact procedure and input dependency under examination.

Nussbaum’s *Frontiers of Justice* supplies a demanding philosophical starting point. The book organizes three problems around people with disabilities, justice across national boundaries, and nonhuman animals. Its critique focuses especially on traditions that derive principles through mutual advantage among approximate equals. Its positive account develops capabilities, dignity, dependency, and species-specific flourishing [7]. Those arguments deserve assessment in their own terms.

The present paper proposes a related analytical reconstruction. It associates the three motivating domains with three possible failure loci in a contract-centered norm generator:

1. *representation and norm-forming access*, where a relevant subject has a weak path into the production, contestation, or revision of a rule;
2. *cross-system translation*, where a partial map between human normative systems loses a distinction needed for a declared target;
3. *radical heterogeneity and identification*, where available observations support several models of another subject’s welfare, interpretation, drive, or evaluative ordering.

The association is a proposal of this paper. Nussbaum supplies the three frontier cases and her capability argument. She supplies neither this formal trichotomy nor its one-to-one correspondence. The distinction matters because each frontier contains more than one problem. Disability concerns care, dependency, dignity, capability, equality, citizenship, and institutional design. Justice across boundaries concerns obligation, institutional capacity, power, history, distribution, and membership. Animal justice concerns sentience, capability, rights, political representation, ecological relation, and species-specific flourishing. A formal reconstruction can illuminate one cross-cutting structure while leaving these substantive arguments intact.

The paper asks a restricted research question:

Under which declared conditions do representation, translation, and identification become distinguishable limits of a contract-centered norm procedure, and which evidence and normative premises are required to move from each diagnosis to an institutional response?

The preliminary answer is plural. Representation concerns the route by which a relevant response enters norm formation. Translation concerns preservation of a target-relevant distinction across interpretive systems. Identification concerns the width of the model set compatible with relation-conditioned evidence. A procedure can repair one locus while retaining another. A proxy can be

Table 1: Nussbaum’s motivating frontiers and the paper’s proposed analytical reconstruction

Motivating main	do-	Source emphasis	Proposed diagnostic locus	Substantive questions retained
disability and dependence		dignity, capability entitlements, care, dependence, and limits of approximate equality	representation and effective norm-forming access	standing, citizenship, self-advocacy, support, trust, proxy authority, care, and capability
justice across national boundaries		global inequality, obligations, institutional structure, and limits of mutual advantage	partial translation across contested human normative systems	power, history, internal plurality, universal norms, institutional capacity, distribution, and membership
nonhuman animals	ani-	justice, sentience, capability, species-specific flourishing, and human treatment	identification under radical interpretive and evaluative heterogeneity	standing, welfare evidence, rights, political representation, precaution, ecology, and species difference

responsive while relying on a poor translation. A careful translation can preserve expressed reasons while the relevant welfare target remains underidentified. Rich evidence can identify a welfare dimension while the subject retains weak institutional access.

The paper makes five contributions. First, it gives the proposed taxonomy a restricted target and an explicit attribution boundary. Second, it connects the first limit with disability, dependency, care, trust, citizenship, and self-advocacy scholarship. Third, it models translation as partial, target-relative, plural, authorized, and revisable. Fourth, it represents radical heterogeneity through partial identification and gives a finite observational-equivalence witness. Fifth, it states a four-part warrant for one fixed interpersonal sum and supplies an exact scale-sensitivity example.

The method combines charitable literature reconstruction, typed formalization, finite countermodel, and normative bridge analysis. Formal definitions identify loci and implications. Primary and authoritative sources constrain philosophical interpretation. Countermodels test proposed equivalences. Normative consequences enter through explicit premises. The paper presents conceptual mathematics at the analytical stage. Empirical estimation remains part of the research programme.

Section 2 reconstructs the source frontiers and target class. Sections 3–5 develop the three limits. Section 6 connects them to a bounded aggregation audit. Section 7 establishes their logical independence and compares response families. Sections 8 and 9 address objections and research obligations. The conclusion states the contribution and stopping point.

2 Three Frontiers and the Contract Target

This section establishes the philosophical source, the diversity of contract theories, and the exact target of the proposed diagnosis. It first reconstructs Nussbaum’s three frontiers, then defines the contract-centered norm generator, and finally states the attribution and normative boundaries.

Table 1 places the source themes beside the proposed reconstruction. The last column prevents reduction of each domain to a single formal defect.

2.1 Three Domains of Justice

This subsection reconstructs the source architecture that motivates the case order. It identifies Nussbaum’s contract critique and capability response at the level required by the present argument.

Nussbaum presents the three domains as unresolved problems for prominent social-contract accounts. The disability chapters examine parties whose physical or cognitive conditions disrupt assumptions of approximate equality, independence, and mutual advantage. The transnational chapters address deep inequality and cooperation whose fair terms can demand sacrifice from richer persons and states. The animal chapter places nonhuman animals within justice and develops capabilities in species-sensitive form [7].

The capability response has a different argumentative center from the present formalism. It treats certain capabilities as political entitlements connected with dignity. The approach asks what beings are actually able to do and to be, under material and social conditions. The proposed three-limit audit asks how responses, translated reasons, and modeled evaluations enter a norm procedure. Capability can therefore function as one normative response to diagnosed limits, one source of relevance criteria, and one target of translation or identification. It also carries philosophical commitments beyond those roles.

2.2 Contract-Theory Diversity

This subsection narrows the target across heterogeneous contract traditions. It distinguishes the function of an agreement representation from the input pathways audited by the paper.

Contemporary contract theory contains Hobbesian and Kantian families, bargaining and process models, hypothetical and actual agreement, and several objects of agreement [4]. Rawls’s original position, for example, forms one part of a larger theory that also addresses moral powers, primary goods, institutions, and stability [9]. A valid criticism must therefore avoid treating every contract device as mutual-advantage bargaining among fully informed actual speakers.

The present target is functional. It includes a procedure only when the declared output or validity depends on at least one of the following: a participant’s represented response; a reason translated across normative systems; an identified interest, capability, welfare state, or evaluative ordering; or an interpersonal comparison. The audit asks whether the required input has an adequate path and warrant.

Definition 2.1 (Contract-centered norm generator). *For participants or represented subjects I , admissible reports R , institutional background B , procedure Π , and rule set $\mathcal{Y}$, a contract-centered norm generator is*

$$\mathcal{N} : (I, R, B, \Pi) \longmapsto y \in \mathcal{Y}. \quad (\text{F-GRE-038})$$

The definition covers only the declared stage and function of the procedure.

The typing allows several conceptions of response. A report can be a vote, reason, preference, refusal, claim, proxy interpretation, bargaining position, or publicly assessable objection. It also allows procedures whose parties are hypothetical. The audit then concerns how actual subjects, interests, and reasons are represented in the construction of the hypothetical parties.

2.3 Diagnostic and Normative Registers

This subsection fixes the inferential stopping point. It separates structural input diagnosis from moral standing, injustice, duty, and remedy.

Five variables require independent treatment. *Contract capacity* concerns participation under a specified procedure. *Affectedness* concerns exposure to a rule or practice. *Constitutive contribution* concerns causal or relational participation in producing a shared system. *Moral standing* concerns whose good or claims matter directly. *Justice relevance* concerns which distributions, relations, or institutions fall under a theory of justice. One variable can supply evidence for another under an argued premise. Their meanings remain distinct.

A structural limit establishes a missing, lossy, or underidentified input relative to a declared target. A normative conclusion additionally requires a bridge such as equal status, capability entitlement, care duty, reasonable rejectability, affected-interest inclusion, freedom from domination, precaution under credible risk, or political membership. This separation supports comparison among rival normative theories.

3 Representation and Norm-Forming Access

This section develops the first limit through disability and dependency scholarship, a relevance-indexed access definition, a proxy certificate, and an exact underidentification witness. Its objective is to distinguish formal inclusion from an effective path into norm formation while preserving the possibility of defensible mediation.

3.1 Disability, Dependency, and Citizenship

This subsection locates the representation problem in substantive literature. It moves from contract capacity to care, trust, citizenship, and self-advocacy, thereby identifying the philosophical content that a channel model must respect.

Nussbaum's disability frontier examines the place of people whose dependency and cognitive or physical conditions resist a picture of contracting parties as approximate equals. Her capability response places basic entitlements and dignity at the center [7]. Kittay's dependency analysis shows how care relations and care work enter equality and social policy [6]. These accounts expand the object of justice beyond a bargaining contribution.

Silvers and Francis address disability as an outlier problem in social-contract theory and develop trust as an alternative relation [12]. Simplican traces the political work performed by cognitive-capacity thresholds and gives sustained attention to citizenship and self-advocacy [13]. The literature therefore supports a demanding interpretation of representation. A subject can require support for communication, deliberation, refusal, and revision. A theory of representation must also examine who defines competence, who appoints a proxy, and who can contest the resulting interpretation.

The formal model begins after an independent relevance criterion has been declared. This ordering prevents an institution from using its own access standard to decide whose response matters. A capability criterion, standing criterion, affected-interest principle, membership rule, or rights theory can supply the relevance relation. The access audit then asks whether the institution carries the relevant response.

3.2 Effective Response Paths

This subsection defines norm-forming access as a plural path condition. It specifies six coordinates, a threshold rule, and the resulting limit witness.

Let $\mathcal{P}_i$ contain the direct and mediated paths by which subject i 's response can reach the procedure. A path can include communication support, a trusted person, an advocate, a deliberative group, an ombudsperson, behavioral evidence, or a revisable institutional proxy.

Definition 3.1 (Effective norm-forming access). *For each path $p \in \mathcal{P}_i$, define*

$$\rho_{ip} = (a_{ip}, \ell_{ip}, s_{ip}, t_{ip}, e_{ip}, v_{ip}) \in [0, 1]^6,$$

where the coordinates report access, intelligibility, safety from retaliation, timeliness, causal effect, and revision capacity. For declared thresholds τ ,

$$\text{ENA}_i(\tau) = 1 \iff \exists p \in \mathcal{P}_i : \rho_{ip} \succeq \tau. \quad (\text{F-GRE-039})$$

The definition uses a path certificate that retains several coordinates. Excellent access with severe retaliation risk fails the declared conjunction. Perfect intelligibility with zero causal effect also fails it. Thresholds depend on the decision's stakes, reversibility, urgency, and distribution.

Let $J_i^q \in \{0, 1, ?\}$ record whether independently defended criterion q makes i 's response relevant. The first limit has a witness when

$$\text{L}_1(i, q, \tau) = [J_i^q = 1] \wedge [\text{ENA}_i(\tau) = 0].$$

The unknown value preserves disagreement or insufficient evidence about relevance. It prevents the diagnostic from converting uncertainty into silent exclusion.

3.3 Proxy Representation

This subsection develops a positive mediated response model. It identifies a multidimensional proxy certificate and then separates observed agreement from effective subject influence.

Direct unaided speech provides one route among several. Some subjects prefer or require supported communication. Some interests appear through repeated behavior, trusted interpretation, long-term care knowledge, or specialist evidence. Animal political theory also develops forms of dedicated representation [5, 3]. The relevant contrast therefore lies between auditable and weak mediation. Direct voice and proxy support can each supply an auditable path.

Definition 3.2 (Proxy-representation certificate). *For proxy p acting for subject i , define*

$$\text{Proxy}_{p \rightarrow i} = (A_{pi}, F_{pi}, P_{pi}, C_{pi}, D_{pi}, V_{pi}), \quad (\text{F-GRE-040})$$

where the coordinates record authority, fidelity to available evidence, plurality of interpretive routes, contestability, displacement or removal, and revision.

Authority can arise through the subject's choice, a justified institutional mandate, or a carefully specified protective role. Fidelity concerns the evidence and target used by the proxy. Plurality reduces dependence on one interpreter. Contestability supplies review by the subject or other qualified participants. Displacement supports removal of a failing proxy. Revision allows the represented interpretation to change with evidence and development.

Proposition 3.3 (Proxy-agreement separation). *Observed proxy agreement at one input fails to identify affected-subject influence across the model class below.*

Proof. Let $r_i \in \{x, y\}$ be the subject response, r_p the proxy report, and $Y = r_p$ the selected rule. Compare

$$\begin{aligned} \mathcal{M}_A : \quad & r_p = r_i, \quad Y = r_p, \\ \mathcal{M}_B : \quad & r_p = x, \quad Y = r_p. \end{aligned} \tag{F-GRE-041}$$

At $r_i = x$, both models yield $(r_p, Y) = (x, x)$. Under $do(r_i = y)$, model $\mathcal{M}_A$ yields $Y = y$, while $\mathcal{M}_B$ yields $Y = x$. The observed agreement is equal and the interventional influence differs. $\square$

The witness is intentionally small. It establishes a logical separation. Empirical prevalence remains open. Longitudinal response, disagreement, revision, and proxy-change episodes provide more informative evidence than a single aligned outcome.

3.4 Institutional Consequences

This subsection states the first limit’s bounded practical implications. It connects access diagnostics with supported participation while retaining independent questions of standing and justice.

Institutions can report response paths as an auditable profile: available communication modes, comprehension support, retaliation safeguards, decision timing, demonstrated influence, appeal, and revision. Proxy systems can report authorization, evidence sources, interpreter disagreement, review, removal, and succession. These records make representation a continuing institutional relation.

The diagnostic supplies a reason to examine exclusion whenever an independent criterion establishes relevance and every path falls below threshold. The remedy can include communication support, environmental accommodation, supported decision-making, plural advocacy, independent review, altered decision timing, or changes to the procedure itself. Selection among remedies depends on capability, rights, care, trust, democratic equality, resources, and the risks of paternalism.

4 Translation Across Normative Systems

This section develops the second limit as target-relevant loss across partial translations. It combines global-justice and cultural-plurality literature with an exact factorization criterion, a finite loss witness, and a plural translation atlas that records authority and contestation.

4.1 Boundaries, Cultures, and Internal Plurality

This subsection establishes the philosophical conditions of translation. It connects justice across boundaries with institutional obligations and treats normative systems as internally contested and historically revisable.

Nussbaum’s transnational frontier challenges mutual-advantage approaches under global inequality and develops capability obligations across national boundaries [7]. O’Neill emphasizes the relation among rights, obligations, institutional capacities, states, non-state actors, and the justification of boundaries [8]. These accounts show that cross-boundary justice concerns allocation of responsibility as well as interpretation.

Benhabib contests models of cultures as clearly bounded wholes. Her account emphasizes internal conflict, re-creation, deliberative contestation, egalitarian reciprocity, voluntary self-ascription, and freedom of exit and association [1]. Tully similarly describes identities as overlapping, interacting, and negotiated, with forms of recognition worked out through democratic discussion, agreement, and periodic review [14]. The translation problem therefore lacks one fixed source voice and one fixed target voice.

The paper uses *normative system* in a modest sense: a context in which some distinctions, reasons, practices, evaluations, and authorities are organized sufficiently for a declared comparison. It can refer to an institution, movement, community, profession, or other interpretive practice. Its use keeps cultural closure open for investigation.

4.2 Target-Relative Preservation

This subsection defines partial translation by a declared domain and target. It distinguishes exact preservation, bounded approximation, reverse translation, and global equivalence.

Let X_A and X_B be source and target spaces of expressions, practical distinctions, reasons, or evaluated states. A translation $T_{AB} : X_A \dashrightarrow X_B$ can be undefined for some source states and many-to-one for others. Let $D \subseteq \text{dom } T_{AB}$ be the declared domain.

Definition 4.1 (Target-relative translation). *For a target codomain Q , source target $q_A : D \rightarrow Q$, and target-system interpretation $q_B : T_{AB}(D) \rightarrow Q$, exact preservation holds when*

$$q_A = q_B \circ T_{AB} \quad \text{on } D.$$

When Q has a warranted discrepancy d_Q , bounded preservation at tolerance ε_q holds when

$$\Delta_q(T_{AB}; D) = \sup_{x \in D} d_Q(q_A(x), q_B(T_{AB}x)) \leq \varepsilon_q. \quad (\text{F-GRE-042})$$

The definition permits modest success. A translation can preserve eligibility for one service while losing a ceremonial distinction. Another translation can preserve a legal category while distorting lived cost or social meaning. Each claim of adequacy therefore states the target, domain, discrepancy, tolerance, and authority that fixed them.

Reverse translation forms a separate test. A low discrepancy for T_{AB} gives limited information about T_{BA} . Institutional power can also determine which direction becomes mandatory, whose categories define the codomain, and who bears the cost of clarification.

4.3 Translation Factorization

This subsection supplies the central exact result for the second limit. It characterizes when a target can be recovered after a many-to-one translation.

Proposition 4.2 (Target factorization through translation). *Let $T : D \rightarrow X_B$ and $q_A : D \rightarrow Q$. A function $\bar{q} : T(D) \rightarrow Q$ satisfying*

$$q_A = \bar{q} \circ T \quad \text{on } D \quad (\text{F-GRE-043})$$

exists exactly when q_A is constant on every fibre of T :

$$T(x) = T(x') \implies q_A(x) = q_A(x') \quad \text{for all } x, x' \in D.$$

Proof. Assume the factorization exists. Equality of translation images gives

$$q_A(x) = \bar{q}(Tx) = \bar{q}(Tx') = q_A(x'),$$

so fibre constancy follows. For the converse, assume fibre constancy. For each $z \in T(D)$, choose any $x \in D$ with $T(x) = z$ and set $\bar{q}(z) = q_A(x)$. Fibre constancy makes this value independent of the representative. The resulting function satisfies the displayed factorization. $\square$

The proposition supports both diagnosis and defense. If two source states collapse to one translated state while differing on the declared target, the target is unrecoverable from that translation output. If every collapsed pair agrees on the target, the many-to-one map remains adequate for that target. Global invertibility and preservation of every source distinction impose a stronger burden than the present inquiry requires.

Remark 4.3 (Finite loss certificate). *Let $D = \{x, x'\}$, $T(x) = T(x') = z$, and $q_A(x) \neq q_A(x')$. The proposition rules out a factorization of q_A through T . Any downstream rule receiving only z lacks the distinction recorded by q_A .*

4.4 Translation Atlas and Authority

This subsection represents plurality within source and target systems. It adds evidence, authorization, contestation, and revision to the map itself.

Definition 4.4 (Translation atlas). *A translation atlas from A to B is*

$$\mathfrak{T}_{AB} = \{(D_k, T_{AB}^k, \omega_k, \alpha_k, \chi_k)\}_{k \in K}, \quad (\text{F-GRE-044})$$

where D_k is a partial domain, ω_k an evidential weight, α_k an authorization record, and χ_k a contestation and revision route.

An atlas preserves disagreement about interpretation and the right to interpret. It can include official translations, community-led accounts, minority positions, historical readings, professional interpretations, and records of refusal. Overlap permits comparison. Gaps identify unresolved domains. Divergent target values identify institutional stakes.

Authority belongs inside the audit because a semantically accurate translation can still be imposed through domination, while an authorized translation can still lose a target-relevant distinction. Evidence and legitimacy therefore remain separate coordinates. A responsible institution reports who selected the map, whose testimony supports it, which alternatives were excluded, which losses remain, and how revision occurs.

4.5 Institutional Consequences

This subsection states the second limit's practical implications. It organizes bounded comparison, plural translation, burden allocation, and continued contestability.

Cross-system governance can proceed through target-limited agreements. Parties may converge on a safety threshold, procedural protection, or distributional floor while retaining distinct deeper reasons. The formal criterion asks only whether the declared target survives the chosen translation. This modesty can support cooperation under pluralism.

Institutions should also preserve the translation record. A useful record contains source domain, target, excluded distinctions, uncertainty, reverse map, translators, authorization, dissent, power relation, cost allocation, review date, and revision path. O’Neill’s focus on obligation and institutional capacity adds a further question: which actor has the competence and duty to maintain this infrastructure [8].

5 Radical Heterogeneity and Identification

This section develops the third limit as target-specific underidentification under relation-conditioned observation. It uses nonhuman animals as the primary stress test, defines an admissible model set, constructs an exact evaluative-equivalence witness, and separates inquiry from precautionary and political responses.

5.1 Animal Justice and Political Representation

This subsection locates radical heterogeneity within animal ethics. It distinguishes empirical sentience and welfare evidence from institutional questions of membership, representation, and justice.

Nussbaum’s animal frontier argues that human relations with nonhuman animals belong within justice and connects flourishing with species-sensitive capabilities [7]. The political turn in animal ethics adds categories of democracy, citizenship, membership, sovereignty, and the public good [5]. Cochrane develops a sentience-based interspecies political theory with representative institutions [3].

These approaches place the communication gap inside a wider ethical domain. Humans possess behavioral, physiological, evolutionary, ecological, and comparative evidence about many animals. Institutions can represent interests under uncertainty. The identification problem concerns which target is supported at which resolution by which relation-conditioned evidence.

Radical heterogeneity is therefore relative to an observer, protocol, and target. A human observer may identify nociception more strongly than a long-horizon preference ordering. A welfare intervention can have observable short-term effects while leaving species-specific flourishing less certain. Another observer, sensor, environment, or relationship can change the evidence. The model retains this indexical structure.

5.2 Relation-Conditioned Model Sets

This subsection defines partial identification. It records the model family that remains admissible under a declared observation and intervention protocol.

Let $\theta \in \Theta_B$ encode a candidate model of subject or system B . Depending on the application, it can include behavioral dynamics, perceptual structure, welfare indicators, interpretation, drives, temporal integration, or an evaluative ordering. Let O_{AB} be observations produced through coupling K_{AB} and protocol π_A .

Definition 5.1 (Relation-conditioned identified set). *For loss or discrepancy ℓ and tolerance η ,*

define

$$\Theta_B(O_{AB}; \eta) = \left\{ \theta \in \Theta_B : \ell(\theta; O_{AB}, K_{AB}, \pi_A) \leq \inf_{\vartheta \in \Theta_B} \ell(\vartheta; O_{AB}, K_{AB}, \pi_A) + \eta \right\}.$$

For target $q : \Theta_B \rightarrow Q$,

$$\text{Ident}_q(O_{AB}; \eta) = 1 \iff |q(\Theta_B(O_{AB}; \eta))| = 1. \quad (\text{F-GRE-045})$$

The singleton condition represents exact identification. A metric target can use a defended diameter tolerance. The result depends on the candidate model class and admissibility constraints. A narrow set can result from informative evidence or an artificially narrow model family. Model criticism therefore belongs inside the inquiry.

5.3 Evaluative Observational Equivalence

This subsection constructs the third limit’s exact witness. It shows how equal observable behavior can coexist with opposite target orderings.

Proposition 5.2 (Behavioral-fit and evaluative-order separation). *There exists a finite observation protocol under which two models fit every available observation equally and reverse the evaluative ordering of the available interventions.*

Proof. Let the interventions be a, b and the observed response be $o = 0$. Define two models by

$$P_{\theta_1}(o = 0 \mid a) = P_{\theta_1}(o = 0 \mid b) = P_{\theta_2}(o = 0 \mid a) = P_{\theta_2}(o = 0 \mid b) = 1,$$

with target orderings

$$q_{\theta_1}(a) > q_{\theta_1}(b), \quad q_{\theta_2}(b) > q_{\theta_2}(a). \quad (\text{F-GRE-046})$$

Both models match every observation available to the protocol. Their target images differ, so the target ordering is underidentified. $\square$

The witness establishes an information limit for the declared protocol. Universal and permanent opacity remain separate propositions. A new intervention that elicits different responses, a physiological measure connected to welfare, a longer developmental history, or a revised model class can break the equivalence. The proposition also applies beyond animal cases, including early infancy, severe communication barriers, artificial agents, and possible alien subjects. Each application requires its own ontology and evidence.

5.4 Inquiry, Precaution, and Revision

This subsection separates the epistemic diagnosis from action under uncertainty. It connects identified sets with evidence expansion, precautionary premises, and revisable institutional representation.

Birch proposes an animal-sentience precautionary principle that combines a credible evidential indicator with a policy response [2]. The structure is instructive because uncertainty alone leaves action direction open. A precautionary conclusion additionally requires a candidate bearer of standing, a credible signal, a possible loss, an action burden, a treatment of false positives and false negatives, and a revision process.

The identified-set model can support several responses. Institutions can fund discriminating research, choose robust protections across admissible models, adopt reversible interim rules, appoint plural representatives, monitor outcomes at several timescales, and revise the model class. The choice among these responses depends on stakes and costs. A wide set under catastrophic and irreversible potential loss creates a different practical problem from a wide set under mild, reversible, and symmetric consequences.

Epistemic humility also has a reciprocal requirement. Institutions should avoid treating model plurality as a license for indefinite inaction. They should state what evidence would narrow the set, who bears the cost of uncertainty, and when review occurs. This requirement remains procedural until connected with a substantive theory of standing and obligation.

6 Aggregation and Contract Procedure

This section connects the three limits to a bounded audit of one fixed interpersonal aggregation rule. It states the required warrants, proves a finite scale-sensitivity result, and preserves the larger space of social choice and normative procedures.

6.1 Four Input Warrants

This subsection defines the information required by the displayed fixed-sum procedure. It maps each structural limit onto a distinct prerequisite and adds horizon-relative stability.

Consider

$$a^* \in \arg \max_{a \in \mathcal{A}} \sum_{i \in I} u_i(a).$$

The notation appears simple, while its interpretation requires decisions about whose evaluations enter, how they are known, how scales compare, and how long they remain relevant. Sen's work on interpersonal comparability and aggregation demonstrates that these informational questions admit structured and varied answers [10, 11].

Definition 6.1 (Fixed-sum aggregation warrant). *The displayed interpersonal sum has the four-part warrant*

$$W_U = \text{Rep} \wedge \text{Ident} \wedge \text{Comp} \wedge \text{Stab}, \quad (\text{F-GRE-047})$$

where **Rep** records justified inclusion, **Ident** records target identification, **Comp** records interpersonal comparison, and **Stab** records horizon-relative stability or an explicit update rule.

Representation concerns the bearer set and response routes. Identification concerns the evaluations assigned to each bearer. Comparison concerns units, levels, differences, or order across bearers. Stability concerns endogenous preference, capability, interpretation, and welfare change. Failure of one conjunct leaves the displayed maximizer underwarranted for its declared meaning.

6.2 Interpersonal Scale Sensitivity

This subsection gives an exact finite witness. It separates individual ordinal rankings from a unique maximizing action under a fixed interpersonal sum.

Proposition 6.2 (Positive-scale reversal). *Separate ordinal rankings can support opposite maximizing actions under positive interpersonal rescalings of a fixed sum.*

Proof. For actions x, y and subjects 1 and 2, let

$$(u_1(x), u_1(y)) = (1, 0), \quad (u_2(x), u_2(y)) = (0, 1).$$

Under positive scales λ_1, λ_2 , the aggregate values are

$$U(x) = \lambda_1, \quad U(y) = \lambda_2.$$

The sum selects x when $\lambda_1 > \lambda_2$ and y when $\lambda_2 > \lambda_1$. Both transformations preserve each subject's ordinal ranking. The ordinal inputs therefore underdetermine the fixed sum. $\square$

The proposition states a familiar structural burden through the paper's notation. It targets a fixed interpersonal sum with an undeclared scale. It leaves open cardinal and partially comparable information, dominance, quasi-orderings, rights constraints, capability thresholds, contractualist tests, deliberative procedures, care obligations, and robust decision rules.

6.3 Endogeneity and Horizon

This subsection adds the temporal part of the aggregation warrant. It shows why an identified and comparable evaluation at one stage can still require an update rule.

Rules can change capabilities, preferences, interpretation, dependency, and the options through which later values are expressed. A time-indexed model can write

$$u_{i,t+1} = \mathcal{U}_i(u_{i,t}, x_{i,t}, K_t, \Gamma_t),$$

where K_t records relational coupling and Γ_t the rule environment. The stability conjunct can then mean invariance over a declared horizon, a bounded drift condition, or a procedure for updating the social evaluation.

Endogeneity varies in moral significance. Education, care, manipulation, adaptation, injury, and collective learning can all change evaluation. The formal point concerns the identity of the object being aggregated. Normative assessment requires a theory of acceptable formation and influence.

6.4 Bounded Scope of the Audit

This subsection states the positive and negative space of the result in affirmative form. It identifies the exact model class and the richer alternatives left available.

The audit applies to procedures that use a fixed interpersonal sum as though representation, identification, comparison, and stability were already settled. A sophisticated theory can supply those warrants, weaken the required comparability, incorporate uncertainty, use plural objectives, impose rights or capability floors, or select through another justificatory procedure.

The three structural limits remain useful under those alternatives because every procedure has some input pathway. A rights theory must identify bearers and relevant protections. A capability approach must determine whose capabilities, which dimensions, and which evidence. A contractualist

Table 2: Formal loci, counterconditions, and retained normative burdens

Limit family	Formal witness	Countercondition	Normative burden retained
representation	relevant subject with every response path below the declared effective-access threshold	direct or mediated path meets access, intelligibility, safety, timeliness, effect, and revision thresholds; proxy certificate is defended	relevance, standing, citizenship, authority, care, paternalism, justice, and remedy
translation	two source states share a translation image while differing on the target	target factors through the map exactly or within tolerance; plural atlas preserves authority and contestation	acceptable loss, universal norms, historical power, institutional duty, distribution, and review
identification	admissible models fit the observation protocol and disagree on the target	target image becomes singleton or sufficiently bounded; action rule handles remaining uncertainty	standing, evidential threshold, precaution, reversibility, representation, and burden allocation
aggregation	admissible interpersonal scales or horizons yield different selected actions	representation, identification, comparison, and stability warrants are supplied or another procedure is declared	justification of the social rule, distribution, rights, capability, care, and uncertainty

process must represent reasons and rejection. A care account must interpret needs and relations. The audit is therefore portable at the level of declared inputs, while its aggregation result stays bounded.

7 Comparative Diagnosis and Response Families

This section compares the three limits by locus, witness, countercondition, and normative residue. It then proves their logical independence and relates the resulting audit to capability, care, rights, trust, representation, and precautionary responses.

Table 2 makes the asymmetry among repairs explicit. Better translation gives limited information about political access. Better access gives limited information about an unexpressed welfare structure. Better identification gives limited information about authority to decide.

7.1 Non-Scalar Limit Profile

This subsection defines the comparative object. It preserves witness sets and allows overlap without forcing a severity score.

Definition 7.1 (Structural-limit profile). *For a declared target and thresholds, define*

$$\mathbf{L}(\mathcal{N}) = (\mathcal{W}_1, \mathcal{W}_2, \mathcal{W}_3), \quad (\text{F-GRE-048})$$

where $\mathcal{W}_1$ contains representation-limit witnesses, $\mathcal{W}_2$ contains failed target-preservation certificates, and $\mathcal{W}_3$ contains targets with non-singleton identified images.

The profile preserves cases where one subject, statement, or institution appears in several coordinates. It also allows an empty witness set for a declared domain. A scalar can be added only after a defended weighting and comparison rule.

7.2 Logical Independence

This subsection demonstrates that the taxonomy marks distinct formal loci. It constructs one case for each limit while satisfying the counterconditions of the other two.

Proposition 7.2 (Three-limit independence). *For each $k \in \{1, 2, 3\}$, there exists a finite contract-centered norm model with a witness in $\mathcal{W}_k$ and empty witness sets for the other two limits under the declared targets.*

Proof. For $k = 1$, use identity translation and a singleton identified target, then include one relevant subject whose response paths all fall below threshold. For $k = 2$, give every relevant subject an effective path and use singleton identified states, then let $T(x) = T(x')$ with $q_A(x) \neq q_A(x')$. For $k = 3$, provide effective response paths and identity translation for observed reports, then use the two observationally equivalent models in (F-GRE-046). Each construction has exactly the selected formal witness. $\square$

Logical independence supports a modular audit. Empirical independence remains an open question because real institutions can couple the mechanisms. Weak access can degrade the data used for identification. Translation authority can shape who gains access. Misidentification can determine which communication support an institution offers.

7.3 Capability, Care, Rights, and Political Response

This subsection situates the diagnostic in relation to substantive normative frameworks. It identifies complementary roles and preserves disagreement about final standards.

The capability approach can supply a relevance criterion, a multidimensional target, and a substantive floor. Its attention to actual opportunities also tests whether formal representation converts into practical participation [7]. Dependency and care theory can reveal the relations that sustain response and the burdens placed on caregivers [6]. Trust can organize non-bargaining relations with people treated as outliers under an equality-of-power picture [12].

Rights can protect basic interests across uncertain preference reports. Democratic and citizenship approaches can provide institutions for voice, membership, representation, and contestation. Deliberative pluralism can keep cultural identities and interpretations open to internal challenge [1, 14]. Precaution can govern action while evidence remains incomplete [2].

These theories can disagree about standing, metric, threshold, authority, and priority. The structural profile provides a common audit surface: which subject or reason enters, through which path, under which translation, with which identified target, and through which revision process. It offers a grammar for comparison while leaving final normative principles open.

8 Objections and Model Boundaries

This section tests the reconstruction against its strongest conceptual and formal objections. It addresses attribution, contract diversity, proxy paternalism, cultural essentialism, animal evidence, uncertainty, and the scope of aggregation.

Table 3: Principal objections, present responses, and residual burdens

Objection	Present response	Residual burden
Nussbaum reduction	source frontiers and capability argument are reconstructed separately from the paper-specific taxonomy	chapter-level interpretation and comparison with capability scholarship
contract-theory overreach	target is a declared input-dependent procedure; entire traditions stay outside the target	author-specific analysis of parties, stages, and justificatory roles
proxy paternalism	certificate records authority, fidelity, plurality, contestability, displacement, and revision	theory and evidence of supported, authentic, and accountable representation
cultural essentialism	translation atlas retains internal plurality, overlap, dissent, authority, and historical change	decolonial and translation-studies literature plus case-specific participation
permanent animal opacity	identification is target-, protocol-, and model-relative; evidence can shrink the set	comparative cognition, welfare science, ecological context, and species-specific validation
uncertainty paralysis	inquiry, robust protection, reversibility, monitoring, and review form distinct responses	defended standing, loss, burden, probability, and precaution premises
aggregation overreach	finite witness targets one fixed interpersonal sum under undeclared scales	comparison with richer social-choice and uncertainty-sensitive models
formal ornament	every formula carries a target, witness, countercondition, and measurement obligation	operational semantics and empirical discrimination

Table 3 summarizes the safeguards and open burdens. The following subsections develop the objections that directly affect the central position.

8.1 Source Fidelity and Analytical Reconstruction

This subsection addresses the risk of attributing the formal taxonomy to its motivating source. The response relies on explicit genealogy and claim separation.

Nussbaum’s three frontiers provide the case order and a substantive critique of contract approaches centered on mutual advantage among approximate equals. Her capability account develops dignity, political entitlements, dependency, global justice, and animal flourishing [7]. The present representation–translation–identification correspondence is a secondary reconstruction. Its value depends on conceptual clarity and case analysis. Textual attribution remains confined to the verified source account.

The reconstruction could require revision if a frontier is better modeled by several interacting limits or by another locus entirely. That possibility is compatible with the paper’s status. The non-scalar profile already permits overlap; future work can alter the taxonomy while preserving its genealogy.

8.2 Contract Heterogeneity

This subsection addresses the objection that sophisticated contract theories already include representation, public reasons, trusteeship, or duties beyond mutual advantage. The response narrows the claim to a procedural audit.

The objection correctly identifies internal resources and major theoretical differences. The contract-centered norm generator is therefore indexed to a stage and declared input. A theory satisfies the audit when it supplies an adequate response path, translation, identification argument, or comparison warrant. The paper offers criteria for demonstrating that success.

The diagnosis can also apply specifically to implementation. An idealized procedure may represent reasons adequately in principle while an administrative institution excludes the people whose reasons the theory recognizes. Theoretical validity and institutional realization then require separate records.

8.3 Proxy Authority and Paternalism

This subsection addresses the possibility that representation reproduces the exclusion it claims to remedy. It distinguishes supportive mediation from unchecked substitution.

A proxy can amplify a subject's response, interpret uncertain evidence, protect an interest, or impose the proxy's own view. One observed agreement distinguishes none of these mechanisms, as Proposition 3.3 shows. Longitudinal evidence, disagreement cases, plural interpreters, appeal, proxy replacement, and subject-accessible review provide stronger information.

Conventional authorization or contestation can be unavailable to some subjects. The certificate then requires a substantive account of authority and best interpretation, plus safeguards against self-dealing and institutional convenience. Care, trust, capability, rights, and political-representation theories offer rival resources. The model organizes their questions while leaving the choice among them open.

8.4 Translation Power and Cultural Closure

This subsection addresses the danger of representing cultures as singular geometric objects. The response replaces one total map with a contested atlas.

Benhabib and Tully provide strong reasons to treat identities and cultures as internally disputed, interacting, and revisable [1, 14]. The formal atlas can represent this plurality only at the resolution supplied by its charts and participants. It remains vulnerable to omitted voices and colonial classifications.

Every application should therefore state who proposed each source domain, translation, target, discrepancy, and tolerance. It should preserve refusals and untranslatable residues where participants identify them. A factorization certificate establishes target preservation for a map; authority for that map's use remains a separate question.

8.5 Animal Evidence and Radical Difference

This subsection addresses the concern that radical heterogeneity invites skepticism about animal minds. The response interprets heterogeneity through partial identification and leaves generalized unknowability aside.

The model set should incorporate the strongest available behavioral, physiological, evolutionary, developmental, ecological, and comparative evidence. A broad set created by ignoring such evidence has little epistemic value. A narrow set created by excluding plausible rivals has the same defect. Application therefore requires transparent model construction and sensitivity analysis.

Radical difference can also coexist with identified dimensions. Evidence can support pain or sentience while leaving a complete preference ordering open. Policy can protect an identified dimension while researching others. Birch’s proposal illustrates one bounded bridge from credible evidence to precaution [2]. Political representation and capability theories provide additional institutional and substantive responses [5, 3, 7].

8.6 Formal Semantics and Measurement

This subsection addresses the distance between conceptual notation and institutional measurement. It states the minimum semantic record for an application.

An application should declare the norm procedure, subjects, relevance criterion, response-path coordinates, thresholds, proxy structure, translation domains, targets, discrepancies, tolerances, observation protocols, model class, identification target, interpersonal comparison, horizon, uncertainty, rival models, normative bridge, and review conditions. Missing fields preserve the status of the result as a heuristic diagnosis.

The finite countermodels prove logical separations within declared classes. Empirical promotion requires observations that distinguish the proposed mechanism from alternatives. The most valuable early applications may therefore be audits that expose missing declarations, followed by carefully designed longitudinal and intervention studies.

9 Research Programme

This section converts the unresolved burdens into a staged programme. It organizes historical, formal, empirical, normative, and institutional tasks, then states the dependency into the next paper on Generative Relational Ethics.

9.1 Historical and Comparative Reconstruction

This subsection defines the source work required to refine the target. It prioritizes author-specific and tradition-specific analyses over a unified label.

The first task is a close comparison of Nussbaum’s three frontier arguments with her capability response and with later capability scholarship. The second is a stage-specific study of Rawls and other contract traditions: modeled party, information, object, agreement mechanism, background institutions, implementation, and treatment of excluded or represented subjects. The third is a

genealogy of disability, feminist, racial, colonial, and animal critiques of contract, with each position presented in its own vocabulary.

9.2 Formal Refinement

This subsection states the next mathematical tasks. It moves from exact finite witnesses toward approximate, stochastic, dynamic, and institutionally testable models.

Priority tasks include a theory of approximate factorization for partial translations; sensitivity of target recovery to domain and discrepancy; causal identification of proxy influence under feedback; model-set construction under misspecification; dynamic identification when preferences and capabilities change; and decision rules over plural, partially ordered targets.

Open Problem 9.1 (Joint repair under coupled limits). *Characterize conditions under which improving one response path changes the translation map or identified model set, and determine when sequential repair converges to a stable profile. Construct finite cases in which local repair improves one coordinate while worsening another.*

Open Problem 9.2 (Approximate translation factorization). *For a partial map, target, discrepancy, and weighted domain, derive sharp bounds connecting within-fibre target variation to the best achievable downstream reconstruction error. Extend the result to several contested charts with uncertain authority.*

9.3 Empirical Research Designs

This subsection proposes bounded empirical families. Each design links one formal witness to observable variation and an ethics protocol.

Representation studies can compare recorded inclusion with communication support, retaliation protection, response timing, causal effect, appeal, and revision. Proxy studies can use disagreement and proxy-change episodes to test affected-subject influence. Translation studies can elicit target-relevant distinctions across multiple participant-led charts and examine which distinctions survive institutional coding. Identification studies can compare behavioral, physiological, developmental, and ecological evidence under several interventions.

Research ethics requires accessible consent or justified alternative authorization, privacy, non-retaliation, participant access to interpretation, and correction procedures. Animal research additionally requires welfare protection, scientific necessity, harm minimization, and species-appropriate design. High-stakes institutional tests should begin with observational and reversible interventions.

9.4 Normative Comparison

This subsection specifies the philosophical work required after structural diagnosis. It compares bridge premises and remedies across normative theories.

Capability theory can define substantive opportunities and thresholds. Care and dependency theories can define relational duties and caregiver burdens. Trust can define a non-bargaining basis for relation. Rights can protect interests under uncertain preference reports. Democratic and citizenship theories can define membership, voice, and representation. Precautionary theories can

relate evidence, possible loss, and action burden. Contractualist and public-reason approaches can test which reasons and rejections require representation.

The comparison should use matched cases. For each case, the theories should state bearer, relevance criterion, evidence, response path, target, distribution, duty bearer, remedy, uncertainty, and revision. The result can be a plural map of convergence and disagreement.

9.5 Institutional Prototypes

This subsection translates the audit into revisable governance components. It organizes records and procedures that can be evaluated independently.

Candidate components include a response-path register, supported-communication budget, plural proxy panel, translation atlas, dissent record, model-set ledger, uncertainty review, capability floor, precaution trigger, appeal, and sunset or revision clause. Each component should have an owner, evidential standard, review interval, and correction mechanism.

The prototypes can be studied in disability services, health decisions, school governance, migration and cross-border administration, Indigenous and multilingual consultation, environmental regulation, and animal-welfare institutions. Domain transfer requires fresh relevance criteria and evidence.

9.6 Generative Relational Ethics Dependency

This subsection identifies the conceptual bridge into the next foundational paper. It explains how the three limits motivate a recursive account of norm emergence and answerability.

The current paper treats a norm procedure as an object with response, translation, and identification inputs. A static audit can still leave a temporal question: how do the subjects, relations, interpretive charts, and response capacities change through the norm itself? The companion generative paper has already shown that contract-capable agency and effective freedom can depend on relational history. The next paper will examine provisional norm formation as a recursive and revisable interface.

This dependency remains conditional. Generative Relational Ethics must still defend its account of standing, answerability, universality, and revision. The three-limit audit supplies problems and formal interfaces; it grants no automatic priority to the successor theory.

10 Conclusion

This section restates the paper's bounded position, formal results, response families, and stopping point. It closes with the evidential and normative discipline required by the proposed reconstruction.

Nussbaum's frontiers of disability, nationality, and species membership identify deep limits in prominent mutual-advantage and approximate-equality contract pictures and motivate a capability response. This paper has used those frontiers to propose a distinct three-part diagnostic: representation and norm-forming access, translation across contested normative systems, and identification under radical heterogeneity. The taxonomy belongs to the present reconstruction.

The three limits occupy different formal loci. Effective access concerns a path from a relevant subject

into rule formation. Translation concerns preservation of a declared target across a partial map. Identification concerns the target image of a model set compatible with relation-conditioned evidence. The corresponding finite results separate proxy agreement from subject influence, characterize exact target recovery through fibre constancy, separate behavioral fit from evaluative order, and expose the scale burden of one fixed interpersonal sum.

The positive results are equally important. Direct or mediated response paths can meet an effective-access threshold. Proxy representation can be audited through authority, fidelity, plurality, contestability, displacement, and revision. Partial translation can be adequate for a bounded target. Multiple charts can preserve internal disagreement and authority. Evidence can narrow an identified set. Precaution, representation, capability, care, trust, rights, and democratic institutions can govern remaining uncertainty through different normative bridges.

The paper's conclusion is therefore conditional and revisable. A contract-centered procedure should declare whose response enters, how it enters, which distinctions survive translation, which target is identified by the evidence, how interpersonal comparison is warranted, and how the result can be contested and revised. A structural failure in one field creates a specific burden of inquiry and justification. Moral standing, injustice, duty, authority, and remedy remain substantive philosophical questions.

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