What a Woman Is:
Reproductive Type, Expression, and Gender as Process

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Abstract

This paper develops a formal account of the concepts *woman*, *sex*, and *gender*. I argue that many difficulties in contemporary feminist philosophy arise from conflating three independent dimensions: reproductive type, expressive mode, and the normative process that enforces expectations based on perceived type. Once these are distinguished, the familiar puzzles dissolve. *Sex* is reproductive type, biologically fixed and defined by developmental organization toward gamete production. *Expression* is behavioral presentation, individually variable and socially legible. *Gender* is neither a property nor an identity but a *process*: the patterned application of normative expectations to persons on the basis of type. The structure of this process is invariant across cultures, though its content varies.

I show that the most sophisticated ameliorative account of "woman" (Jenkins 2016) fails for six independent structural reasons, each stemming from a methodological substitution of construction for analysis. In contrast, the framework developed here provides coherent definitions, clarifies the status of trans identity, resolves the pronoun question, and grounds ethical distinctions between type-based and expression-based treatment—without requiring anyone to deny biological reality or disregard lived expression. The result is a clearer conceptual schema within which ongoing social and political debates can proceed more productively.

Keywords: philosophy of gender; feminism; ameliorative inquiry; woman; sex; natural kinds; reproductive type; gender as process; social ontology; transgender.

1. Introduction

Consider how we analyze a concept. Take *harmony*. We begin with a mutually intelligible context—a pianist at the keyboard—and isolate the phenomenon by contrast: a single pitch versus a chord. Both are sound, but they differ in structure. One pitch sounding alone is melody or tone; two or more pitches sounding simultaneously is harmony. The contrast identifies the relevant structure, and from that structure we extract the definition: *harmony is the simultaneous sounding of two or more pitches*. The definition is not stipulated by fiat; it is *discovered* by attending to the phenomenon's internal organization.

Now imagine an objection: the definition "excludes" deaf musicians, since they cannot experience simultaneous pitches. Suppose the proposed remedy were to redefine harmony as "any auditory experience—including its absence—that a listener *identifies* as harmonious." This would indeed eliminate exclusion. But it would do so by severing the concept from the structure that gave it content. The result would not be a broader concept of harmony, but a structureless one. Once the structural constraint is removed, the term no longer excludes anything—and for that very reason, it no longer includes anything either. The underlying phenomenon (simultaneous pitches) would still exist; the word would simply no longer refer to it.

This illustrates a general principle: *abstraction without structure does not yield inclusion; it yields emptiness.*[1] A concept that cannot exclude anything cannot do explanatory work, ground distinctions, or support norms. It becomes a label whose extension is fixed only by preference or declaration.

This is the structure of *ameliorative analysis* in contemporary gender theory. The ordinary concept *woman* tracks a biological kind: the sexually mature human of reproductive type $(-)$, developmentally organized around the production of ova. Some persons—trans women—are not of this type. Rather than accept this as a consequence of what the concept already tracks, ameliorative theorists propose to *redefine* "woman" so that all trans women are included by definition. The maneuver mirrors the harmony case. The original concept is detached from its underlying structure, its referent is obscured, and "inclusion" is secured only by dissolving the category's content.

This paper argues that the ameliorative project fails for structural reasons that cannot be repaired by further refinement. More importantly, it shows that once three dimensions that the contemporary literature persistently conflates are distinguished, a coherent, non-circular, and ethically adequate account of sex, gender, and womanhood emerges naturally.

1. **Type** (T): reproductive organization—biological, fixed, and invariant across contexts.
2. **Expression** (E): behavioral presentation—individual, variable, and socially legible.
3. **Gender** (G): the social process by which normative expectations based on perceived type are enforced against expression— invariant in structure, variable in content.

Much contemporary confusion arises from collapsing these dimensions. Some collapse gender into type (biological determinism). Some collapse type into gender (social constructionism). Some collapse type into expression (gender identity theory). Each collapse asks a single concept to do incompatible work, and each generates predictable contradictions. The framework developed here keeps the dimensions distinct and thereby dissolves the apparent paradoxes.

The method of this paper is functional and structural rather than linguistic or purely political.

[1] The point is structural rather than semantic. The label attached to a concept is conventional, but the structure the concept tracks need not be. This distinction is familiar from natural-kind semantics: terms like *water* or *gold* are fixed by underlying structure (H_2O, atomic number 79), not by surface-level identification or normative preference. Revising a term's extension by stipulation does not alter the underlying kind; it merely severs the term from the phenomenon it once tracked. The present argument does not depend on any particular theory of reference, but it exploits this general lesson: conceptual revision that abandons structure does not broaden a concept, it empties it.

We begin with the architecture of reproduction and the epistemic conditions of social life, and from that basis derive the relevant conceptual distinctions. The result is not a conservative defense of ordinary usage, but a derivation from first principles that explains *why* ordinary usage tracks reality as well as it does.

The central claims of this paper are:

- A **woman** is a sexually mature human female—an adult human whose reproductive system is developmentally organized around the production of ova.
- **Sex** is reproductive type, defined functionally by role in the production of offspring.
- **Gender** is not a property or identity but a *process*: the operation by which normative expectations are applied to persons based on perceived type and enforced against their expression.
- This process has an **stable structure** across cultures, even when its specific norms vary.
- The most sophisticated ameliorative accounts of "woman" fail for **structural reasons**—undefined primitives, circular dependencies, reality-auditing failures, and self-referential inclusion constraints.
- A coherent framework is available that **respects trans persons** without requiring denial of biological reality or affirmation of false metaphysical claims.

The paper proceeds as follows. Section 2 situates the present account within existing debates. Section 3 establishes biological sex as a natural kind defined by reproductive function. Section 4 develops the type/expression distinction. Section 5 analyzes gender as a process. Section 6 demonstrates the structural failure of ameliorative definitions. Section 7 addresses pronoun usage. Section 8 articulates the ethical implications. Section 9 concludes.

2. Relation to Existing Literature

Before developing the positive account, it is essential to situate the present framework within the landscape of existing theories of womanhood. The question "What is a woman?" has generated several major traditions in philosophy: existential, traditional, semantic-descriptive, ameliorative, performative, and materialist. These traditions diverge sharply in method. Some attempt *analysis*—discovering the underlying structure of the concept as we actually use it. Others attempt *construction*—stipulating a revised concept designed to satisfy independent political aims. Much contemporary confusion arises from treating constructions as if they were analyses. The functional-natural-kind framework developed in this paper is strictly analytical: it recovers the structural features of the reality to which the concept "woman" in fact refers.

2.1. De Beauvoir and the Existentialist Precursor

Simone de Beauvoir's foundational claim that "one is not born, but rather becomes, a woman" [1] has shaped contemporary discourse for decades. Her thesis is often misunderstood. De Beauvoir does *not* deny the biological structure of sex; she takes it as the precondition upon which social forces operate. Her insight is that gendered existence involves a process of social shaping, constraint, and expectation applied to those marked as female.

Agreement. The present account agrees that gender is a *process*, not a property. De Beauvoir's description of becoming resonates directly with the formal notion of gender as the enforcement operation G acting upon expression E on the basis of perceived type T.

Difference. De Beauvoir did not distinguish the triad of *type*, *expression*, and *gender-enforcement* as separate analytic components. Without these distinctions, later theorists came to misread her slogan as implying that even biological sex is socially constructed. The present framework clarifies the structure that de Beauvoir intuited: sex is the biological ground (type), while gender—the social shaping of expression—is a process imposed on that ground.

2.2. The Traditional View

The traditional view, dominant in ordinary language and reflected in most legal and scientific contexts, holds that a woman is an adult human female. While correct, the traditional view typically presents this claim as a linguistic or commonsense assertion rather than as a structural explanation.

Agreement. This paper agrees with the traditional conclusion.

Difference. What the traditional view lacks is a generative account of *why* this definition is correct. The present framework supplies that account: the reproductive function $f(+,-) = Z$ grounds the binary of sex; the female type $(-)$ is defined by developmental organization toward ova production; and "woman" is the species-specific, sexually mature instance of that type. The definition is not merely reported; it is derived from the functional architecture of reproduction.

2.3. Byrne's Semantic Defense

Alex Byrne [5] defends the traditional view against revisionist alternatives. His method appeals to ordinary usage, linguistic convention, and analogy with other gendered animal terms.

Agreement. The present account agrees with Byrne's conclusion and with his placement of the burden of proof on revisionists.

Difference. Byrne's method is *semantic*: he shows what the word "woman" means in ordinary English. The present method is *structural*: it shows why that meaning is correct in virtue of the reproductive architecture governing the species. We converge in conclusion but differ in justification. Byrne's account is descriptive; this one is explanatory.

2.4. Bogardus's Critique

Tomas Bogardus [3, 4] offers the most rigorous critique of ameliorative definitions. He argues that such definitions inevitably collapse into circularity, arbitrary stipulation, or the inability to satisfy their own inclusion constraints.

Agreement. This paper agrees with Bogardus's diagnosis. The failures he identifies reappear as structural impossibility results in Section 6.

Difference. Bogardus shows that the ameliorative project *cannot succeed*. The present paper goes further: it explains why failure is inevitable (the underlying dilemma), and it supplies the positive framework that resolves the appearance of conflict (the type/expression distinction). Bogardus is diagnostic; this paper is diagnostic and constructive.

2.5. Stock's Materialist Feminism

Kathleen Stock [11] argues for the reality and importance of sex in feminist analysis, law, and social policy. She rejects gender identity theory and emphasizes the need for sex-based categories.

Agreement. The present account aligns with Stock on the biological reality and binary nature of sex and on the practical need for sex-based classification.

Difference. Stock focuses on the implications for policy and practice. The present paper provides the deeper formal grounding: the reproductive function, the type/expression distinction, and gender as process G. Stock argues that sex matters; this framework shows *why* sex has the structure it does and why gender must be understood as a derivative, not fundamental, category.

2.6. Haslanger's Social Position Account

Sally Haslanger [6, 7] defines women as those in a socially subordinate position on the basis of perceived female sex.

Partial Agreement. This paper agrees that gender has a social dimension and that gender oppression targets those perceived as female.

Disagreement. Haslanger relocates the category "woman" into the social-position layer. This paper locates womanhood in reproductive type, with gender as a process applied to that type. Haslanger makes womanhood derivative of oppression; here, oppression is derivative of type and the enforcement of norms surrounding it.

2.7. Jenkins's Ameliorative Account

Katharine Jenkins proposes to define "woman" in terms of gender identity, via an internal "map" that guides one through social realities as a member of that gender.

Disagreement. This paper argues that Jenkins's model fails for six independent structural reasons explored in Section 6: undefined primitives, non-auditable cognition, circular dependence, inclusion self-reference, severance from reproductive kind structure, and conflation of analysis with construction. These failures stem from method: Jenkins begins with a political aim (unconditional inclusion) and reverse-engineers a "definition." This is conceptual construction masquerading as analysis.

2.8. Butler's Performativity Theory

Judith Butler [2] argues that gender is performative: constituted by repeated acts that produce the illusion of a stable identity. She also claims that sex itself is socially constructed.

Partial Agreement. This paper agrees with Butler that gender is dynamic and involves doing.

Disagreement. Butler mislocates the doing. Gender is not performed by the subject but imposed by the system: it is an operation applied to persons on the basis of perceived type. And sex is not constructed; it is the natural-kind structure encoded by the reproductive function $f(+,-)$. Butler collapses type into expression; this paper separates them.

2.9. Summary: The Present Contribution

Position	Sex is...	Woman is...	Gender is...	Method
Traditional	biological	adult human female	(not theorized)	analysis (implicit)
Byrne	biological	adult human female	(not theorized)	semantic analysis
Bogardus	biological	adult human female	(critiques revisions)	diagnostic
Stock	biological	adult human female	social/psychological	applied analysis
Haslanger	biological (perceived)	social position	structural hierarchy	ameliorative construction
Jenkins	bracketed	internal-map bearer	identity	ameliorative construction
Butler	constructed	performance-effect	performance	genealogical construction
This paper	functional natural kind $f(+,-)$	type $(-)$ (adult)	process G	structural analysis

The present contribution is distinctive in several respects:

1. **Functional-natural-kind grounding**: sex is defined by its role in the reproductive function, not by anatomy or stipulation.
2. **The type/expression distinction**: separating biological kind from expressive behavior dissolves the apparent "inclusion problem."
3. **Gender as process**: an invariant enforcement mechanism G acting on expression based on perceived type.
4. **Structural clarity**: explanation of why gender is both universal in structure and variable in content.
5. **Pronoun resolution**: principled recognition without falsehood.
6. **A coherent alternative**: one that respects trans persons while preserving conceptual and biological reality.

In short: traditionalists are right about what a woman is, but they lack the framework that explains why. Revisionists attempt to save inclusion by destroying the concept. The present paper recovers the concept and shows how to honor both truth and dignity without conceptual collapse.

3. What a Woman Is: A Functional Definition

Philosophical analysis proceeds by identifying the structural invariant that organizes a domain. The concept *woman* is no exception. When I think of a woman, I think of my mother, my grandmother, my wife, and my sisters. These individuals differ in personality, role, expression, and history, yet they share a single invariant property: they instantiate the same reproductive type. The concept is not a free-floating linguistic label; it is an abstraction from this shared structure.

Just as mathematicians isolate invariants that define a structure, so too we identify the category "woman" by isolating the invariant that partitions the human population into two reproductive types.[2]

This invariant is the *reproductive function*. Mammalian reproduction requires two distinct and complementary gamete types. The biological sexes are the organism-level instantiations of these complementary reproductive roles. The definition that follows is not stipulated but derived: it is read off the structure of reproduction itself.

[2] The structural analogy is with the parity partition of the natural numbers. Let $\mathbb{N} = \{0, 1, 2, \dots\}$ and define the successor function $s(n) = n + 1$. Parity is given by the equivalence relation $n \equiv m \pmod 2$, whose classes are the evens $[0]_2 = \{0, 2, 4, \dots\}$ and odds $[1]_2 = \{1, 3, 5, \dots\}$. These classes are defined by an invariant: behavior under repeated application of s. Applying s toggles between classes, while s^2 preserves membership. Thus "even" and "odd" are not defined by surface features but by membership in an invariant equivalence class. Sex is structurally analogous: humans form two classes under developmental organization toward gamete production. No surface-level transformation—expression, clothing, social role, or surgery—alters developmental type. The abstraction "woman" tracks membership in one of these invariant equivalence classes.

3.1. Derivation of the Binary Structure

We do not assume that sex is binary; we derive binarity from the functional architecture of sexual reproduction. The derivation is conditional: it applies to sexually reproducing species whose reproduction proceeds via pairwise fusion of differentiated gametes, as in mammals.

Definition 3.1 (Reproductive Function)**.** Let X be the set of sexes (cardinality unknown), and let

$$f : X \times X \to \{0, 1\}$$

be the *reproductive function*, where $f(x, y) = 1$ iff the pairing (x, y) is fertile (i.e. capable of producing offspring), and $f(x, y) = 0$ otherwise. Ordered pairs are used to allow for asymmetric reproductive roles.

Remark 3.2 (Pairwise Reproduction vs. Number of Sexes)*.* The use of the Cartesian product $X \times X$ does *not* assume that there are exactly two sexes. It fixes only the *arity* of reproduction: that successful reproduction requires two participants.

At this stage, the cardinality of X is left entirely open. The framework allows, in principle, for any number of sex types. What is fixed is not how many distinct reproductive roles exist, but only that reproduction proceeds via pairwise interaction. In ordinary terms: it takes two to reproduce, but it is not yet specified how many distinct reproductive roles there are.

The restriction to exactly two sexes is not an assumption but a result derived below from structural constraints on the reproductive function.

Definition 3.3 (Offspring Set)**.** Let O be the set of offspring produced by fertile pairings under f.

Remark 3.4*.* The set O abstracts away from demographic facts such as population size, fertility rates, or survival. It functions only as a bookkeeping device to track whether reproduction can propagate the role-structure over time.

Definition 3.5 (Sex Assignment)**.** Let $\sigma : O \to X$ assign to each offspring, upon maturation, a sex drawn from X.

axiom 3.6 (Closure)**.** *For all $o \in O$, $\sigma(o) \in X$. Offspring must be of a kind that can, in principle, occupy one of the same reproductive roles as their parents.*

Remark 3.7*.* Closure expresses a minimal continuity condition: reproduction must regenerate the same role-structure over time. It does *not* require that every offspring be fertile, only that offspring belong to a reproductive type.

axiom 3.8 (Complementarity)**.** *$f(x, y) = 1$ only if x and y occupy complementary reproductive roles. Same-role pairings are infertile.*

Remark 3.9*.* Complementarity captures the biological fact that reproduction requires two *different* roles. Each fertile reproductive event therefore contains exactly two role-positions, one per participant. The axiom does not yet specify what those roles are or how many sex types might exist overall; it rules out only same-role reproduction.

Lemma 3.10 (Role Individuation)**.** *Two elements $x, y \in X$ are the same sex if and only if they occupy the same reproductive role in all* possible *fertile pairings under f.*

Remark 3.11*.* This lemma individuates sex functionally rather than anatomically. Sexes are distinguished by the role they play in reproduction in principle, not by surface features, token performance, or contingent population structure.

Theorem 3.12 (Binary Structure of Sex)**.** *Given Axioms 3.6 and 3.8 and Lemma 3.10, the set X contains exactly two sexes.*

Proof. If $|X| = 1$, the only possible pairing is (x, x), which is infertile by Complementarity. Hence no offspring exist, violating Closure.

If $|X| > 2$, consider any additional element beyond two. Such an element must fall into one of three cases:

1. it occupies the same reproductive role as an existing element and therefore does not constitute a distinct sex by Lemma 3.10;
2. it forms a reproductively disjoint subsystem, splitting the population into separate reproductive graphs rather than a single unified system; or
3. it is reproductively inert, participating in no fertile pairings.

Only the first case preserves a unified reproductive system, but in that case no new sex is introduced. In no case does a single unified pairwise reproductive system contain more than two distinct reproductive roles.

Hence $|X| = 2$. □

Example 3.13 (Why $|X| = 3$ Cannot Yield Three Sexes in a Unified Pairwise System)**.** Suppose, for illustration, that the set of sexes has three elements:

$$X = \{a, b, c\}.$$

Since reproduction is pairwise, every fertile event (if it occurs at all) involves an ordered pair from $X \times X$. By Complementarity,

$$f(a, a) = f(b, b) = f(c, c) = 0.$$

Assume a is complementary to b. Then a and b must occupy opposite reproductive roles. Without loss of generality, let a occupy role $+$ and b role $-$.

Now suppose a is also complementary to c. Then c must occupy the role opposite a, i.e. role $-$. But then b and c occupy the same role and cannot be complementary to each other. Thus $f(b, c) = f(c, b) = 0$.

So c either duplicates the role of b (and is not a distinct sex by role individuation), is infertile with the rest of the system, or induces a disconnected reproductive structure. In no case does it introduce a third distinct reproductive role.

Remark 3.14 (Graph-Theoretic Intuition)*.* The fertility relation induced by f must be bipartite: fertile pairings occur only between opposite roles. A three-node clique cannot be bipartite. This graph-theoretic constraint mirrors the biological impossibility of three mutually complementary sexes in a single pairwise reproductive system.

Remark 3.15*.* The binarity of sex is therefore not stipulated but derived. It follows from the minimal structural conditions required for reproduction to propagate through time in a unified system governed by pairwise complementarity.

Remark 3.16 (Why Three Sexes Would Require More Than Pairwise Reproduction)*.* A genuine three-sex system would require at least three distinct reproductive roles. In sexually reproducing organisms, reproductive roles are individuated by gamete type. Thus three sexes would minimally require three distinct gamete types.

However, if reproduction remains pairwise, each reproductive event provides only two role-positions. At most two gamete types can participate, leaving the third role either redundant,

infertile, or confined to a disconnected subsystem. To sustain three distinct sexes in a unified system, reproduction would therefore have to be at least ternary—requiring the coordinated fusion of three distinct gametes in every reproductive event.

The absence of such n-ary reproductive architectures in animals explains why biological sex stabilizes at two roles rather than three or more.

3.2. The Reproductive Graph

The reproductive function introduced above specifies which pairings are fertile. The present subsection reformulates that information in graph-theoretic terms in order to make explicit the temporal and structural constraints governing reproduction across generations.

Definition 3.17 (Reproductive Graph)**.** Let $G = (V, E, \tau)$ be a directed graph where:

- V is the set of individuals across time,
- $E \subseteq (V \times V) \times V$ is the set of directed edges from parent pairs to offspring,
- $\tau : V \to \mathbb{R}$ assigns each individual a time of maturation.

An edge $((u, v), w) \in E$ exists iff $f(\sigma(u), \sigma(v)) = 1$.

Remark 3.18 (What the Graph Represents). An element $((u, v), w) \in E$ represents a single completed reproductive event: a fertile pairing of individuals u and v that results—after whatever developmental interval is appropriate—in an offspring w.

The graph abstracts away from the internal temporal stages of reproduction (e.g. mating, gestation, birth). These processes are collapsed into a single structural relation linking a parent pair to an offspring. The graph therefore does not encode reproductive frequency, timing, or population size. It records only which parent-pairings are structurally capable of producing offspring under the reproductive function.

Remark 3.19. One could refine the model by introducing intermediate event nodes (e.g. conception) or by representing reproduction via two parent–child edges $u \to w$ and $v \to w$. Nothing in the present analysis depends on such refinements. The ternary relation $((u, v), w)$ is chosen solely to make the role-structure of reproduction explicit.

Definition 3.20 (Sex Partition)**.** Let $V^+ \subset V$ denote individuals of type $(+)$ and $V^- \subset V$ individuals of type $(-)$, with $V^+ \cap V^- = \varnothing$.

Remark 3.21. The partition $\{V^+, V^-\}$ is induced by the binary structure derived in Theorem 3.12. No further assumptions about anatomy, fertility, or social role are introduced here.

Proposition 3.22 (Bipartite Fertility)**.** *Every fertile edge in G connects nodes from opposite partition classes.*

Remark 3.23. This proposition restates complementarity in graph-theoretic terms. Fertile edges always run between V^+ and V^-; there are no fertile edges within a partition. The bipartite structure of G is therefore a structural consequence of the reproductive function, not an independent assumption.

Proposition 3.24 (Hereditary Closure)**.** *Every offspring node belongs to exactly one partition class.*

Remark 3.25. Hereditary closure expresses the fact that offspring re-enter the same two-role structure as their parents. Reproduction regenerates the sex partition rather than creating new roles.

Definition 3.26 (Generational Slice)**.** For discrete generations, let $V_n \subset V$ be the set of individuals maturing in generation n.

Proposition 3.27 (Forward Propagation)**.** *The reproductive graph extends forward in time only if each generation contains at least one individual from each partition class.*

Remark 3.28. This is a structural necessity, not a demographic claim. It does not assert that real populations always satisfy this condition, only that failure to do so prevents further reproduction. The result explains why the persistence of a sexually reproducing population requires the continued presence of both reproductive roles.

Definition 3.29 (Terminal Node)**.** An individual is *terminal* if it participates in no outgoing fertile edge.

Full formal statements and proofs of the propagation properties appear in Appendix A.

Remark 3.30 (Terminal Nodes and Sex). Terminal nodes include individuals who are infertile, developmentally atypical, or otherwise unable to participate in reproduction. Their existence does not introduce additional sex classes. Terminality represents an exit from the reproductive structure, not a third role within it.

Remark 3.31 (Sex as Structural Role). Sex is not a property an individual *has* but a role an individual *plays* within the structure of G. The binary emerges from the constraints required for reproduction to persist over time, not from any assumption about individual traits.

Example 3.32 (A Minimal Reproductive Graph)**.** Consider a population whose reproductive graph consists of two partition classes V^+ and V^-. Fertile edges exist only between these classes, and offspring inherit one of the two roles upon maturation.

Some individuals may have no outgoing edges: they do not reproduce. Others may have many. These differences affect population dynamics but not the underlying structure. The graph remains bipartite so long as reproduction occurs at all.

This example illustrates that sex classification tracks participation in a two-role reproductive system, not individual reproductive success. The existence of non-reproducing individuals is compatible with, and expected under, the binary structure of sex.

3.3. The Reproductive Function (Canonical Form)

Definition 3.33 (Reproductive Function, Binary Case)**.** Let $f : \{+,-\} \times \{+,-\} \to \{0,1\}$ satisfy:

$$f(+,-) = f(-,+) = 1, \qquad f(+,+) = f(-,-) = 0.$$

3.4. Female, Male, Woman, and Man

Definition 3.34 (Female)**.** An organism is *female* iff its reproductive system is developmentally organized around the $(-)$ pathway.

Definition 3.35 (Male)**.** An organism is *male* iff its reproductive system is developmentally organized around the $(+)$ pathway.

Definition 3.36 (Woman)**.** A *woman* is a sexually mature human female.

Definition 3.37 (Man)**.** A *man* is a sexually mature human male.

Remark 3.38. Nothing in this account entails claims about social role, psychological experience, or moral standing. The claim is narrower: that "female" and "male" are objective biological types, and that any coherent account of "woman" must reckon with this structure.

3.5. Interpretation of the Formal Results

The preceding sections establish a functional account of sex and derive a definition of "woman" from that structure. This subsection summarizes the results in non-technical terms.

Sex is a biological classification grounded in reproductive function. In sexually reproducing mammals, reproduction requires two complementary reproductive roles corresponding to the production of two distinct gamete types. These roles define two biological sexes. An individual's sex is fixed by the developmental organization of their reproductive system toward one of these roles, not by surface anatomy, current fertility, or social presentation.

Within the human species, the terms "female" and "male" denote the organism-level instantiations of these two reproductive types. The terms "woman" and "man" denote the sexually mature human instantiations of those same types. On this account, a woman is a sexually mature human female.

This definition is not stipulated by linguistic convention. It is obtained by successive refinement of an antecedently defined biological structure: from reproductive function, to sex type, to species-specific instantiation, to sexually mature instantiation. The formal machinery introduced above makes explicit the binary and role-defined character of this structure, as well as its stability across generations. The definition of "woman" therefore tracks that structure rather than imposing new criteria upon it.

3.6. Clarifications, Objections, and Scope

This subsection addresses several common mischaracterizations and clarifies the scope of the claims defended here.

3.6.1. Derivation, Not Stipulation

The definition "woman = sexually mature human female" is not a semantic preference or a stipulation imposed by convention. It follows by refinement from the functional architecture of sexual reproduction established in the preceding sections:

1. Two complementary reproductive types, $(+)$ and $(-)$, are defined by their role in the reproductive function $f(+,-) = Z$.
2. "Female" denotes the organism-level instantiation of type $(-)$.
3. "Human female" is the species-specific instantiation of that type.
4. "Woman" is the sexually mature instantiation of the human $(-)$ pathway.

Each step narrows an antecedently defined structural role. No step introduces new criteria by fiat. The concept is discovered rather than chosen.

3.6.2. Ordinary Understanding and Anatomical Evidence

Critics often portray the ordinary understanding of sex as fixated on anatomy: penises, vaginas, and uteri. This mischaracterizes everyday reasoning. Ordinary speakers typically treat anatomical features as *evidence* of underlying reproductive organization, not as *constitutive* of sex. In practice, ordinary usage tracks reproductive roles—implicitly and imperfectly—rather than surface anatomical traits.

The charge that the folk concept of sex is "essentialist" conflates anatomy with the functional asymmetry that anatomy reliably signals. Ordinary understanding is better described as rough functional realism than as naive anatomical essentialism.

3.6.3. Static Anatomy and Surgical Modification

If sex were defined by current anatomical configuration, implausible consequences would follow. For example:

- a man who loses his penis would cease to be male;
- a woman who undergoes hysterectomy would cease to be female;
- atypical or ambiguous genitalia would constitute additional sexes.

These implications conflict with both biological practice and ordinary judgment. They show that anatomy is downstream of developmental type, not constitutive of it. Surgical or hormonal interventions can modify phenotype; they do not alter the developmental organization that fixes reproductive role.

3.6.4. Disorders of Sexual Development

Conditions such as complete androgen insensitivity syndrome (CAIS), Turner syndrome, or Klinefelter syndrome are disorders of sexual development, not additional sexes. Developmental anomalies presuppose normative developmental pathways; they do not dissolve them. The existence of dawn and dusk does not undermine the distinction between day and night.

The binary structure of sex is robust because the reproductive function it instantiates is binary. Atypical development is compatible with, and expected given, an underlying two-type architecture.

Remark 3.39 (Intersex Conditions and the Binary Structure). It is sometimes argued that the existence of intersex individuals undermines the binary character of biological sex. This objection rests on a conflation of *developmental anomalies* with *developmental pathways*. As Sax [10] shows, most conditions commonly grouped under the label "intersex" (e.g. Klinefelter syndrome, Turner syndrome, late-onset congenital adrenal hyperplasia, and variants of androgen insensitivity) do not introduce additional sex classes. They are atypical instances of the same two reproductive pathways.

On a principled definition—according to which "intersex" refers only to cases where sexual differentiation is sufficiently atypical to generate genuine ambiguity in assigning the individual to type (+) or (−)—the prevalence is approximately 0.018%, not the frequently cited 1.7%.

Even if the broader figure is granted, it presupposes a 98.3% norm. The very calculation of an "intersex" prevalence requires a prior binary reference class. The statistic therefore does not undermine the binary; it presupposes it. Moreover, genuinely ambiguous conditions are typically associated with infertility: the reproductive function itself excludes configurations that do not resolve into one of its two roles. Such anomalies no more refute the binary structure of sex than polydactyly refutes the fact that humans typically have five fingers.

3.6.5. Scope of the Claim

Nothing in this account entails claims about social role, legal classification, psychological experience, personal identity, or moral standing. The claim defended here is narrower: that "female" and "male" are objective biological types grounded in reproductive function, and that any coherent account of "woman" must reckon with this fact.

4. The Type/Expression Distinction

4.1. Two Orthogonal Dimensions

A central source of confusion in contemporary gender discourse is the failure to distinguish two logically independent dimensions of human classification.

Definition 4.1 (Type and Expression)**.** Let T : Persons $\to \{+, -\}$ assign each person their *reproductive type*, determined by developmental organization toward gamete production. Let E : Persons $\to \mathcal{E}$ assign each person their *expressive mode*—their manner of dress, comportment, speech, and social presentation.

- T is biological and stable: fixed by developmental pathway and not alterable by self-identification, social role, or surgical intervention.
- E is behavioral and variable: modifiable across contexts, situations, and stages of life.

These dimensions are *orthogonal*. A person's type does not determine the way they express themselves, and a person's expression does not alter their type. Much conceptual confusion stems from asking one dimension to perform the work of the other.

4.2. Type and Token

A familiar objection to functional accounts of sex is that they appear to exclude sterile females, postmenopausal women, or individuals whose reproductive organs never functioned. This objection rests on a conflation between *type*-level and *token*-level properties.

Definition 4.2 (Type and Token)**.**

- Type(p): the reproductive *kind* to which p belongs, determined by developmental design.
- Token(p): the actual reproductive *performance* or history of p.

Membership in a sex category is determined entirely by *type*, not by present capability or past performance. The relevant question is not whether a person:

- has reproduced,
- can reproduce now, or
- will ever reproduce,

but rather:

Is this person of the reproductive type whose developmental pathway is organized around the production of ova or sperm?

A sterile woman, a postmenopausal woman, and a woman who has undergone a hysterectomy are all type $(-)$: their organismal organization is that of the female reproductive pathway, even if token-level functionality is absent. Token-level facts do not determine type; sterility does not erase femaleness, it presupposes it.

Remark 4.3. The distinction mirrors all functional kind classifications. A broken heart is still a heart; a bird that cannot fly is still a bird. Dysfunction does not dissolve kind. Thus sterility is to sex as blindness is to sight: a token-level impairment, not a reclassification.

4.3. The Structure of Expression

The expressive space $\mathcal{E}$ is not primitive. Expression is built from acts situated within contexts.

Definition 4.4 (Acts and Contexts)**.** Let $\mathcal{A}$ be the space of all acts—behaviors, choices, presentations, utterances. Let $\mathcal{C}$ be the space of social contexts, varying by culture, time, and situation.

Acts are not intrinsically gendered. Drinking coffee, choosing a hobby, or wearing a color have no inherent gender significance.

Definition 4.5 (Gendering Function)**.** Let $\gamma : \mathcal{A} \times \mathcal{C} \to \{\text{masculine}, \text{feminine}, \text{neutral}\}$ be the *gendering function* assigning a gender valence to an act relative to a context.

The same act may be gendered differently across contexts:
- $\gamma(\text{drinking black coffee}, C_1) = \text{masculine}$,
- $\gamma(\text{drinking black coffee}, C_2) = \text{neutral}$,
- $\gamma(\text{pink clothing}, C_{1900}) = \text{masculine (for infants)}$,
- $\gamma(\text{pink clothing}, C_{2020}) = \text{feminine}$.

Definition 4.6 (Valenced Acts and Expression)**.** For a person p in context C, let $\text{acts}(p) \subseteq \mathcal{A}$ denote the acts performed by p in C. Define:

$$\Lambda(p, C) = \{\, (a,\, \gamma(a, C)) : a \in \text{acts}(p) \,\},$$

the set of valenced acts, and

$$\Gamma(p, C) = \{\gamma(a, C) : a \in \text{acts}(p)\},$$

the aggregate expressive profile.

Remark 4.7 (Projection and Information Loss). The passage from $\Lambda(p, C)$ to $\Gamma(p, C)$ is a projection: it forgets the particular acts and retains only their gendered valences. Formally,

$$\Gamma(p, C) = \pi_2(\Lambda(p, C)),$$

where $\pi_2(a, v) = v$ is the projection onto the second coordinate. This reflects a central sociological fact: observers typically do not track the fine-grained details of a person's behavior, but instead track the pattern of valences those behaviors are taken to express. Expression is thus an *interpretive abstraction*—a lossy summary of behavior shaped by the gendering function γ and the context C.

Remark 4.8 (Adolescent Policing of Valence). A familiar example of the gendering function γ comes from 1990s American adolescent culture, in which boys routinely labeled certain behaviors as "gay." The term functioned not as a claim about sexual orientation but as a crude gendered valence: liking romantic comedies, expressing emotion, or showing interest in fashion were treated as feminine-coded acts. Formally, $\gamma(a, C_{90\text{s}}) = \text{fem}$ for a wide range of behaviors that violated the local masculine norm.

Peers did not track the underlying acts; they tracked the pattern of valences. The aggregate profile $\Gamma(p, C_{90\text{s}})$ was then collapsed into a single global social judgment ("he's gay") which triggered enforcement. This is a paradigmatic instance of gender as process: a punitive response that pressures expression toward the local normative mapping $N(T(p), C_{90\text{s}})$.

This example also illustrates that gender enforcement operates on both types: type $(+)$ individuals are pressured toward $N(+, C)$ just as type $(-)$ individuals are pressured toward $N(-, C)$. The structure of G is symmetric even when the cultural content of N is not.

Example 4.9 (Composite Cues and Cross-Cultural Valence)**.** Consider a behavior composed of two components:
- the *base act*: $a_1 =$ drinking tea,
- the *expressive modifier*: $a_2 =$ extending the pinky while drinking.

These constitute a single observable behavior, but social interpretation treats them as distinct cues: one concerns *what* is done; the other concerns *how* it is done.

American context. Let p_{US} be a person in an American context C_{US}, and suppose:

$$\gamma(a_1, C_{\text{US}}) = \text{feminine}, \quad \gamma(a_2, C_{\text{US}}) = \text{feminine}.$$

Given that $\text{acts}(p_{\text{US}}) = \{a_1, a_2\}$ in this situation, the set of valenced acts is:

$$\Lambda(p_{\text{US}}, C_{\text{US}}) = \{(a_1, \text{feminine}),\ (a_2, \text{feminine})\}.$$

Projecting to valence alone yields the aggregate expression:

$$\Gamma(p_{\text{US}}, C_{\text{US}}) = \{\text{feminine}, \text{feminine}\},$$

and an observer will typically infer $\widehat{T}(p_{\text{US}}) = (-)$.

British context. Let p_{UK} be a person performing the *same* physical behavior in a British context C_{UK}, where tea-drinking is culturally unmarked. Suppose:

$$\gamma(a_1, C_{\text{UK}}) = \text{neutral}, \quad \gamma(a_2, C_{\text{UK}}) = \text{feminine}.$$

With $\text{acts}(p_{\text{UK}}) = \{a_1, a_2\}$, we obtain:

$$\Lambda(p_{\text{UK}}, C_{\text{UK}}) = \{(a_1, \text{neutral}),\ (a_2, \text{feminine})\},$$

and hence

$$\Gamma(p_{\text{UK}}, C_{\text{UK}}) = \{\text{neutral}, \text{feminine}\},$$

yielding a weaker, less reliable inference to type.

Moral. The same physical behavior yields different valence profiles in different contexts:

$$\Gamma(p_{\text{US}}, C_{\text{US}}) = \{\text{feminine}, \text{feminine}\} \quad \text{vs.} \quad \Gamma(p_{\text{UK}}, C_{\text{UK}}) = \{\text{neutral}, \text{feminine}\}.$$

A single behavior may thus produce multiple gendered cues, and what an observer infers about type depends not on the behavior itself but on how the local interpretive community genders its components via γ.

This explains:

1. **Context-dependence**: Gendering varies with C.
2. **Non-necessity**: Most acts are neutral.
3. **Arbitrariness**: Valence lies in γ, not in the act.
4. **Historical mutability**: Norms change by changing γ.

4.4. The Four Combinations

Because T and E are independent, they yield a two-by-two cross-classification:

	Masculine Expression	**Feminine Expression**
Type $(+)$	Typical man	Trans woman
Type $(-)$	Trans man	Typical woman

Each cell describes a real and coherent human configuration. None is pathological; all are structurally intelligible once type and expression are distinguished.

4.5. Non-Binary Profiles

Remark 4.10 (Non-Binary Identities). A non-binary person is one whose expressive profile $\Gamma(p, C)$ is

- not dominated by masculine or feminine valence, or
- deliberately resistant to the local normative mapping N.

Type remains + or −; non-binary variance occurs at the expressive and norm-response levels, not the type level.

4.6. Trans Identity Clarified

Definition 4.11 (Trans Woman)**.** A *trans woman* is a person such that $T = (+)$ and E lies predominantly in $\mathcal{E}_{\text{fem}}$.

Definition 4.12 (Trans Man)**.** A *trans man* is a person such that $T = (-)$ and E lies predominantly in $\mathcal{E}_{\text{masc}}$.

Remark 4.13 (Gender Identity and Dysphoria). What is called "gender identity" can be modeled as the internalization of (a) a stable expressive profile and (b) the enforcement patterns generated by G. Dysphoria arises when $N(T(p), C)$ persistently conflicts with a person's preferred expression.

4.7. Perception and Apprehension

Two epistemic modes govern gender attribution:

- **Perception**: Expression E is directly observable.
- **Apprehension**: Type T is inferred from E via $\widehat{T}(p)$ and may diverge from it.

Misapprehension of type does not undermine the reality of type; it shows only that type and expression are distinct concepts.

4.8. Why the Distinction Matters

The type/expression distinction dissolves the apparent conceptual conflict in gender discourse:

1. The category "woman" (type −) remains intact and biologically grounded.
2. Trans women are recognized without conceptual distortion: type (+) with feminine expression.
3. No one is required to deny biological reality.
4. No one is denied recognition of expressive identity.

The conflict is not conceptual but architectural: the wrong concepts were asked to do incompatible work. Distinguishing type and expression restores clarity and makes genuine pluralism possible.

Remark 4.14 (The Geometric Source of Conceptual Confusion). The persistent difficulty in contemporary debates arises because the term "woman" is routinely asked to denote a position on *two orthogonal axes* simultaneously. Biological type T provides one coordinate; expressive mode E provides another. A trans woman occupies the position $(T = (+), E \in \mathcal{E}_{\text{fem}})$: she[3] has the biological coordinate of type (+) while navigating the social world with feminine expression. The ameliorative

[3]Pronouns in English do not and cannot semantically refer to reproductive type, because type is *epistemically opaque*: one cannot perceive T directly in others. What is perceptually available is expression E, and so the third-person pronouns "he" and "she" function by tracking the *expressive axis*, not the biological one. Their apparent type presuppositions arise only because, in the modal case, E reliably correlates with T. When that correlation fails—as in divergence cases—the presupposition becomes unstable, and singular "they" serves as the non-presuppositional alternative. By contrast, the term "woman" does not derive its content from what is perceptually available but from the *ontological structure* it denotes: the type (−) reproductive pathway. Thus pronoun usage and category membership diverge because they track fundamentally different kinds of information: one epistemic and surface-level, the other metaphysical and type-level.

insistence that "woman" apply to her treats the expressive coordinate as if it determined the biological coordinate—a collapse of a two-dimensional space into one. The axes are independent; no single term can coherently track both. Recognizing this orthogonality removes the apparent paradox and restores conceptual clarity.

5. Gender as Process

5.1. The Derivation of Gender

Why does gender exist at all? On this account, it arises as a socially constructed response to an epistemic asymmetry generated by sex.

Type and its visibility. Let $T(p) \in \{+, -\}$ denote a person's reproductive type. In ordinary cases, agents have privileged access to facts about their own body and development, whereas the type of others is not directly accessible and must be inferred. Sex type is therefore typically first-person salient but third-person opaque.

The inference demand. Because type is socially salient—relevant to reproduction, kinship, vulnerability, and role expectations—observers face a practical demand to classify. Let $\widehat{T}(p) \in \{+, -\}$ denote the type as inferred by others in context $C \in \mathcal{C}$. The gap between $T(p)$ and $\widehat{T}(p)$ is the opening in which gender operates.

Primary cues. The most reliable cues for $\widehat{T}(p)$ are physiological and developmental correlates of type: skeletal dimorphism, secondary sex characteristics, and (intermittently) reproductive signs such as pregnancy and lactation. These features are typically observable and supply high-confidence evidence for classification.

Extension to expression. Physiology is not always visible, and reproductive signs are intermittent. Societies therefore extend the inference system to expression: dress, comportment, speech, posture, and social role. Let $\gamma : \mathcal{A} \times \mathcal{C} \to \mathcal{V}$ be a social "gendering" function mapping acts in context to valences (e.g. *masculine*, *feminine*, *neutral*). The normative mapping N specifies which valences are expected of each type in context. Expression becomes a proxy for type.

Gender as stabilization. Because expression is plastic, it is an unreliable cue unless stabilized. Gender, in the sense at issue here, is the enforcement process that pressures expression to remain correlated with inferred type. By pressuring expression to conform to $N(\widehat{T}(p), C)$, the system maintains legibility over time. Gender is thus a socially constructed *solution* to an epistemic problem created by the third-person opacity of sex type.

Remark 5.1 (Why Gender Is Widespread). Where there is sexually differentiated reproduction, there is socially salient type; where type is socially salient, there is demand for inference; and where inference is demanded, there is pressure to stabilize public cues. The general form of gender systems is therefore expected to recur widely even when their specific norms differ across cultures and contexts.[4]

[4]There is a structural parallel with racialization: both associate socially salient types with valences and enforce norms accordingly. A salient difference is that racialized categories are often treated as directly perceptible, whereas sex type is commonly inferred from a mixture of cues. Gender systems therefore tend to involve not only regulation of behavior but also stabilization of legibility. These claims are structural rather than evaluative: they concern mechanisms of classification and enforcement, not comparative moral weight.

5.2. The Phenomenon

Consider a person p offered a choice between two gifts, X and Y. p expresses a preference for X. The giver, having inferred $\widehat{T}(p) = (-)$ in context C, overrides p's preference and gives Y on the grounds that Y is "more appropriate."

This override *is* the phenomenon of gender: the patterned, context-sensitive operation through which socially enforced expectations are applied to people on the basis of their *perceived* type.

5.3. The Normative Mapping

In the gift scenario, the giver applies a socially shared expectation: persons perceived as women *should* prefer Y. This is modeled by the normative mapping:

Definition 5.2 (Normative Mapping)**.** Let $N : \{+, -\} \times \mathcal{C} \to \mathcal{P}(\mathcal{V})$ assign, for each type and context, the valences socially expected of that type.

The "ought" here is not moral but descriptive: it records what expectations are in fact enforced, not what ought to be enforced. Typically:

$$N(+, C) \approx \{\text{masculine}, \text{neutral}\}, \qquad N(-, C) \approx \{\text{feminine}, \text{neutral}\}.$$

5.4. No Intrinsic Gender Valence

A common but mistaken assumption in gender discourse is that certain acts are *intrinsically* masculine or feminine. This subsection shows that no act has gender valence in itself. Gendered valence arises only relationally, from patterns of contrast between populations, and is therefore context-dependent, historically mutable, and eliminable under conditions of distributional convergence.

Acts and internal structure. Every act belongs to a domain with its own internal standards of comparison. Swimming admits of faster and slower performances; weightlifting admits of greater or lesser loads; baking admits of better or worse outcomes; musical performance admits of accuracy, expressiveness, and technical skill. These comparisons are *intra-domain*: they concern excellence or ranking within a class of acts and make no reference to sex or reproductive type.

Nothing about swimming fast, lifting heavy weights, baking well, or playing piano skillfully is, in itself, sexed. These properties are intelligible without any appeal to sexual classification.

Dimorphism and perceived clustering. Let $P_+(a, C)$ and $P_-(a, C)$ denote the performance distributions of types $(+)$ and $(-)$ with respect to act a in context C. In many domains, these distributions differ in their means, variances, or tails. When such differences are salient, observers treat high or low performance as a probabilistic cue for type.

For example, if $E[P_+(a, C)] > E[P_-(a, C)]$ in some athletic domain, then superior performance in that domain becomes associated with type $(+)$ in that context. The association does not arise because the act is inherently masculine, but because it correlates with type in the observed population.

From correlation to valence. Once an act functions as a cue for type inference, it acquires gender valence. Observers reify the correlation into an interpretive category: the act is coded as *masculine* or *feminine* depending on which type it is taken to signal. This coding is implemented by the gendering function $\gamma(a, C)$.

Crucially, the act itself has not changed. Only its *position* within a contrastive distribution has. Gendered valence is therefore a function of population structure and inference practices, not an intrinsic property of behavior.

Contextual and historical variability. Because performance distributions depend on material conditions, technology, division of labor, and cultural norms, gendered valences are unstable across contexts and time. Acts routinely shift valence when the underlying contrast structure changes:

- long hair was masculine-coded in early modern Europe and feminine-coded in contemporary Western contexts;
- cooking is feminine-coded in domestic contexts and masculine-coded in professional ones;
- skincare has shifted from masculine to feminine coding over time.

These shifts do not reflect changes in the intrinsic nature of the acts, but changes in who typically performs them and under what conditions.

The contrastive nature of gendering. Gendered valence is essentially contrastive. An act is coded masculine because it contrasts with what type $(-)$ individuals are expected to do; it is coded feminine because it contrasts with what type $(+)$ individuals are expected to do. Where no reliable contrast exists—because distributions overlap substantially—acts tend to be gender-neutral. This explains why:

- gendering weakens in single-sex contexts,
- technological equalization reduces gender coding,
- many everyday acts remain unvalenced.

Theorem 5.3 (No Intrinsic Gender Valence)**.** *Let $a \in \mathcal{A}$ be an act and $C \in \mathcal{C}$ a context. Gender valence does not inhere in a itself. An act acquires gender valence in virtue of its role as a cue for type inference within a population and context. No act is intrinsically masculine or feminine.*

Remark 5.4 (Origin vs. Persistence of Valence). Some acts may remain gendered by convention even when their current distributional contrast is weak or nonexistent (e.g. inherited dress codes or ritualized norms). Such cases reflect the persistence of historically generated valence under cultural inertia and enforcement, rather than its original source. The theorem concerns the *origin* of gender valence, not its maintenance in the absence of ongoing inferential utility.

Implications. This result has three immediate consequences. First, it explains why gendered valence varies across cultures and historical periods without implying arbitrariness. Second, it shows why gendered norms weaken as performance distributions converge. Third, it reinforces the central claim of this paper: outside of reproduction itself, sex is never constitutive of action. Gendered meaning arises downstream, through inference and enforcement, not through the acts themselves.

5.5. Gender as Enforcement

Gender is the operation that takes:

- a perceived type $\widehat{T}(p)$ in context C,
- an expressive profile $\Gamma(p, C)$,
- the expectations $N(\widehat{T}(p), C)$, and
- a gendering function γ,

and produces:

- pressure toward conformity,

- penalties for deviation, and
- reshaping of future expression (an updated profile $\Gamma'(p, C)$).

Definition 5.5 (Expressive Profile)**.** Let $\text{acts}(p, C) \subseteq \mathcal{A}$ be the acts performed by p in context C. Define the expressive profile

$$\Gamma(p, C) \;=\; \{\gamma(a, C) \;:\; a \in \text{acts}(p, C)\} \subseteq \mathcal{V}.$$

Definition 5.6 (Gender as a Higher–Order Operator)**.** Let $\widehat{T}(p) \in \{+, -\}$ be the perceived type of person p in context $C \in \mathcal{C}$. Let $\gamma : \mathcal{A} \times \mathcal{C} \to \mathcal{V}$ map acts to social valences, and let $N : \{+, -\} \times \mathcal{C} \to \mathcal{P}(\mathcal{V})$ assign the valences socially expected of each type in context C.

Let $\Gamma(p, C) \subseteq \mathcal{V}$ be as in Definition 5.5. Then *gender* is the higher–order operator

$$G : \big(\widehat{T}(p), \Gamma(p, C), N, \gamma, C\big) \longmapsto \mathcal{E}_{p,C},$$

where $\mathcal{E}_{p,C} : \mathcal{A} \to \{\text{reward}, \text{punish}, \text{correct}, \text{ignore}, \ldots\}$ is an enforcement function acting on p's acts in context C. The cumulative operation of $\mathcal{E}_{p,C}$ over time reshapes p's subsequent expression toward conformity, yielding an updated profile $\Gamma'(p, C)$.

Gender is not a property one has. It is an *activity* performed by a system upon persons because of their perceived type.

Remark 5.7 (Why G Is a Higher–Order Operator). Gender does not act on persons directly but through the mediating structure of norms and valences. Since the normative mapping N and the gendering function γ are themselves functions, the enforcement process must take these as inputs. The output of G is therefore not a state but a regulatory mechanism: an enforcement function whose operation reshapes expression over time. In this sense, gender is a higher–order operator: a system-level process acting on persons via other functions, rather than a property they possess.

Example 5.8 (Gender as Process in Action)**.** Let p be a person of type $T(p) = (+)$ in context C. Suppose that

$$\text{acts}(p, C) = \{a_1 = \text{“drinking tea”},\ a_2 = \text{“drinking tea with pinky extended”}\}.$$

Assume that the gendering function assigns:

$$\gamma(a_1, C) = \text{neutral}, \qquad \gamma(a_2, C) = \text{feminine}.$$

Then the aggregate expressive profile is

$$\Gamma(p, C) = \{\text{neutral}, \text{fem}\}.$$

Assume that in this context the normative mapping expects, for perceived type $(+)$,

$$N(+, C) = \{\text{masculine}, \text{neutral}\}.$$

A typical observer now performs the gender process:

1. **Classification:** infers a perceived type $\widehat{T}(p) = (+)$.
2. **Norm retrieval:** activates the expectations $N(\widehat{T}(p), C) = N(+, C)$.
3. **Comparison:** checks $\Gamma(p, C)$ against $N(+, C)$:

$$\Gamma(p, C) = \{\text{neutral}, \text{fem}\} \not\subseteq N(+, C).$$

4. **Enforcement:** applies pressure via the enforcement function $\mathcal{E}_{p,C} = G(\widehat{T}(p), \Gamma(p, C), N, \gamma, C)$, e.g. ridicule, shaming, or social distancing.
5. **Outcome:** either p's subsequent expression shifts to some $\Gamma'(p, C)$ closer to $N(+, C)$ (e.g. suppressing the gesture), or p incurs ongoing social cost for resisting.

On this account, gender is not a property p *has*, but the process G that, via enforcement, regulates expression in light of type-indexed norms.

Remark 5.9 (What "What Is Your Gender?" Asks). Ordinary "gender" questions compress three inquiries: (i) What is your expressive profile $\Gamma(p, C)$? (ii) How is that profile read under the local gendering function γ and normative mapping N? (iii) What enforcement pressures and social positioning follow from that reading? Thus "gender" is not a possession but a relational position within an expression–interpretation–enforcement structure.

Remark 5.10 (Ubiquity of Gender). Not every act is gendered, but every person performs at least some socially legible acts. Because type distinction $(+/-)$ is universal and socially salient, everyone becomes a potential target of G. Gender feels omnipresent because its *structure* is stable even when its *content* varies.

5.6. The Ontology of the Process

English expresses gender as a noun, encouraging reification. But the phenomenon is processual:

- Sex is what you *are* (type).
- Expression is what you *do* (publicly legible acts).
- Gender is what is *done to you* (enforcement).

To say someone "has a gender" is like saying a river "has a flow." The flow is not a possession but an ongoing activity.

5.7. Process Structure

Gender proceeds as a continuous feedback loop:

1. **Classification**: infer $\widehat{T}(p)$ from available cues, including $\Gamma(p, C)$ and other physiological signals.
2. **Norm retrieval**: activate $N(\widehat{T}(p), C)$.
3. **Comparison**: check $\Gamma(p, C)$ against $N(\widehat{T}(p), C)$.
4. **Enforcement**: apply $\mathcal{E}_{p,C}$ (pressure or penalty).
5. **Outcome**: expression shifts to $\Gamma'(p, C)$ (or costs are incurred).

This loop is ongoing; gender is not a one-time assignment but a dynamic regulatory system.

5.8. Invariant Structure, Variable Content

Across cultures, the *structure* of gender is stable:

Component	Status	Variation
T	Invariant	Biological kind
G	Invariant	Functional structure
γ	Variable	Cultural valences of acts
N	Variable	Social expectations

Every culture has types, expressions, norms, and enforcement; what differs is which acts are gendered and how.

5.9. Gender-Based Oppression

Definition 5.11 (Gender-Based Oppression)**.**

$$\text{Oppression}(p, C) = \mathbf{1}\Big[\,\Gamma(p, C) \not\subseteq N(\widehat{T}(p), C)\,\Big] \cdot \text{Penalty}(p, C).$$

Oppression occurs when expression deviates from socially enforced expectations and a cost is imposed.

This unifies:

- the person whose preferences are overridden on gendered grounds,
- the man punished for vulnerability,
- the trans woman attacked for feminine presentation,
- the non-binary person resisting $N(\widehat{T}(p), C)$.

Remark 5.12 (Predictive Implication). As enforcement weakens, expressive variance should increase. Oppressive systems suppress variation in $\Gamma(p, C)$ and force conformity; relaxed systems reveal otherwise suppressed preferences. This prediction is testable across cultures and time.

5.10. Resolution of Confusions

Claim	**Error**
"Gender is a social construct"	Reifies a process as a thing
"Gender is innate"	Confuses gender with type
"Gender is identity"	Confuses gender with expression and social position
"Gender is performance"	Nearly right: mislocates the performer

Remark 5.13 (Gender as Passive Voice). Butler was nearly right: gender involves doing. But the relevant doing is in the *system*, not the individual. Gender is performed *on* people, not *by* them.

6. The Failure of Ameliorative Analysis

The most developed attempt in recent feminist philosophy to define "woman" without appealing to biological sex is Katharine Jenkins's ameliorative account. Jenkins presents her proposal as an analysis of the concept "woman" that is (i) suitable for feminist political aims, (ii) inclusive of all trans women, and (iii) respectful of gender self-identification. This section argues that her framework fails for six independent structural reasons. These failures are not remediable by refinement; they arise from the project's architecture.

6.1. Jenkins's Map-Based Model

Jenkins adapts Haslanger's account of racial identity, treating identity as an embodied, habitual, largely unconscious orientation toward social realities. Drawing on Haslanger's metaphor of an internal "map," Jenkins defines:

> S has a gender identity of X iff S's internal 'map' is formed to guide someone classed as a member of X gender through the social or material realities that are, in that context, characteristic of Xs as a class.

When specialized to women:

> S has a female gender identity iff S's internal map is formed to guide someone classed as a woman through the social or material realities characteristic of women.

As Bogardus observes, this definition presupposes the very category it is meant to analyze. The "realities characteristic of women" exist only because persons of type $(-)$ are treated in recurrent, structured ways across cultures. The map's content therefore depends on a prior class whose experiences supply the material it is supposed to represent.

Theorem 6.1 (Parasitism)**.** *A definition of a social category C that uses the social realities of C to fix the content of the definition presupposes a prior extension of C and therefore cannot serve as an analysis of C.*

Proof. If determining whether $x \in C$ requires appeal to the social or material realities of C, then the procedure requires antecedent knowledge of which experiences are characteristic of members of C. These experiences exist only because some individuals were already treated as C. Thus the definiens presupposes the extension it purports to define. □

This structural dependency is not accidental. The six failures that follow show why ameliorative analysis cannot avoid it.

6.2. Failure 1: The Undefined Primitive

The account relies essentially on the notion of an "internal map," yet the term is never defined. It lacks any specification in psychology, cognitive science, or philosophy of mind that could support the definitional weight placed upon it.

Theorem 6.2 (Undefined Primitive)**.** *A definition employing an undefined primitive P in an essential role fails to define.*

Proof. If $D(x) \Leftrightarrow \phi(P, x)$ and P has no content, then $\phi(P, x)$ cannot be evaluated for any x. Thus D fixes no extension. □

Jenkins provides no formation, correctness, or correspondence conditions for the supposed map. Without these, the posit is explanatorily inert.[5]

6.3. Failure 2: Reality-Auditing Failure

Even if internal maps existed, Jenkins offers no procedure to detect them.

Definition 6.3 (Reality-Auditable)**.** A property P is *reality-auditable* iff there exists a procedure π that determines $P(x)$ for any x independently of x's self-report.

Biological type is auditable; "internal maps" are not. No procedure determines what someone's map is "formed to guide." In practice:

$$x \text{ is a woman iff } x \text{ says so.}$$

The definition collapses into self-ascription.

[5]Consider the definition: "x is a cuckoobaloo bird iff x is aware of its own terrificalus feature." If "terrificalus" is an undefined primitive, Terrificalus(x) has no content and the definiens has no truth-conditions. Jenkins's "map" functions identically.

6.4. Failure 3: Circular Dependence

Jenkins states:

> S is a woman iff S's map is formed to guide someone *classed as a woman*.

Theorem 6.4 (Circularity)**.** *A definition $W(x)$ is circular if W appears essentially in its own definiens.*

Proof. If W appears in $\phi(W, x)$, then evaluating $W(x)$ requires antecedent knowledge of the extension of W. No analysis is given. □

The phrase "classed as" simply conceals the circularity: the classification is either self-referential (self-ID) or depends on an external criterion (which then does the real definitional work).

6.5. Failure 4: Inclusion Self-Reference

Jenkins requires that all trans women count as women. But "trans woman" is defined as "identifies as a woman." Thus:

$$W = \{x : x \text{ identifies as } W\}.$$

Theorem 6.5 (Inclusion Self-Reference)**.** *Any definition requiring that all self-identifiers of C be included in C collapses into self-ascription and becomes analytically empty.*

Proof. If $x \in C$ iff x asserts $C(x)$, then C imposes no constraints on membership. The term loses substantive content. □

6.6. Failure 5: Severance from Reproductive Ground

Gender norms, vulnerabilities, and social positionings across cultures are not arbitrary. They track the reproductive asymmetry encoded in $f(+, -)$. Detaching "woman" from type $(-)$ leaves the concept unable to explain its own extension or cross-cultural invariance.

Remark 6.6. This is not biological determinism; it is biological anchoring. Social elaborations presuppose the natural kind they elaborate.

6.7. Failure 6: Conflation of Analysis and Construction

- *Analysis* uncovers the structure a term already has.
- *Construction* stipulates a structure for normative aims.

Jenkins labels her project analysis but performs construction: she stipulates a concept designed to achieve unconditional inclusion under the name of "definition."

Remark 6.7 (Analysis vs. Construction). Discovered definitions track real structure (water = H_2O). Stipulated definitions create structure (sphinx = lion with human head). The term "woman" is of the first kind: the label is conventional, but the reproductive type it denotes is not. Treating it as stipulable erases this distinction.

Remark 6.8 (Methodological Dislocation). The ameliorative project purports to clarify lived experience but proceeds by ideological desideratum: the result must include all who self-identify as women. Real persons—women and trans women alike—become abstractions serving a preselected conclusion. This is not analysis but conceptual fabrication.

6.8. The Underlying Dilemma

The ameliorative project faces an unavoidable dilemma:

1. If "woman" has substantive content, some self-identified women fall outside it.
2. If "woman" has no content beyond self-identification, the category collapses into emptiness and cannot support feminist analysis.

No definition satisfies both.

6.9. The Axiom-by-Fiat

Jenkins resolves the dilemma by stipulation:

> "The proposition that trans women are women is a foundational premise of my argument, which I will not discuss further."

This is axiom-by-fiat: the conclusion is made immune to scrutiny, and dissent is framed as harm.

6.10. The Asymmetry of Epistemic Authority

The account assigns dispositive authority to self-report while disregarding all other sources of category knowledge. No justification is provided for this epistemic asymmetry, which is unique among classificatory domains.

6.11. Summary of the Six Failures

Jenkins's ameliorative account fails for six independent structural reasons:

1. **Undefined primitive**: the "internal map" has no content.
2. **Reality-auditing failure**: no procedure for detection.
3. **Circular dependence**: uses "woman" to define "woman."
4. **Inclusion self-reference**: collapses into self-ascription.
5. **Severance from reproductive ground**: loses explanatory anchor.
6. **Conflation of analysis and construction**: substitutes political stipulation for discovery.

These failures follow from the architecture of ameliorative analysis itself and cannot be repaired by refinement.

Remark 6.9 (The Simplicity of Gender and the Cost of Ideological Construction). Gender, as the enforcement process G acting on expressive valence relative to perceived type, is real and conceptually simple. The opacity lies not in the phenomenon but in attempts to engineer the concept to satisfy ideological aims. Explanatory power is lost when inquiry is constrained by predetermined conclusion. Clarity is restored only when analysis begins with the structure of the phenomenon itself.

7. The Pronoun Resolution

7.1. Pronouns as Type-Presuppositional Devices

In ordinary communication, pronoun choice follows a three-step inference:

$$E(p) \longrightarrow \widehat{T}(p) \longrightarrow \pi(p),$$

where $E(p)$ is the perceived expression of a person p, $\widehat{T}(p)$ is the speaker's inferred reproductive type, and $\pi(p)$ is the selected pronoun. Because E and T are strongly correlated in the modal case,

the inference is usually reliable: feminine expression typically signals type $(-)$, masculine expression type $(+)$.

The English pronouns "he" and "she" are therefore *type-presuppositional*: each encodes a tacit reproductive-type commitment. This is not an ideological artifact; it is a normal feature of natural language. Reference presupposes facts, and speakers must rely on defeasible commitments to communicate at all. What matters is that these presuppositions are *revision-friendly*: they may be withdrawn when new information arrives.

7.2. Divergence Cases

Trans people are precisely the cases in which E and T diverge. For a trans woman, $E(p)$ belongs to $\mathcal{E}_{\text{fem}}$ while $T(p) = (+)$. The usual inference $E \to \widehat{T}$ therefore misfires. The pronoun that tracks expression ("she") conflicts with the type-presupposition the speaker may not accept.

Nothing in this mismatch is disrespectful or defective. It is a predictable consequence of the type/expression independence established in Section 4.

7.3. Singular "They" as the Precision Pronoun

English already contains a pronoun that avoids type-presupposition entirely: *singular* "they." Its use for unknown referents ("Someone left their phone") shows that it is fully grammatical when type is either unknown or irrelevant. It is therefore the minimal semantic extension needed to accommodate divergence cases.

This yields a principled selection rule:

Definition 7.1 (Type-Sensitive Pronoun Selection)**.**

$$\pi(p) = \begin{cases} \text{"she"} & \text{if } E(p) \text{ reliably signals } T = (-), \\ \text{"he"} & \text{if } E(p) \text{ reliably signals } T = (+), \\ \text{"they"} & \text{if } E(p) \not\Longrightarrow T(p) \text{ with high reliability.} \end{cases}$$

Applied to the four T/E combinations:

Case	Expression	Type	Pronoun	Rationale
Typical woman	fem.	$(-)$	she	Expression reliably signals type
Typical man	masc.	$(+)$	he	Expression reliably signals type
Trans woman	fem.	$(+)$	they	Divergence of expression and type
Trans man	masc.	$(-)$	they	Divergence of expression and type
Unfamiliar person	?	?	they	Type not yet inferred

This preserves the semantics of "he" and "she" while using an existing, fully grammatical resource to handle uncertainty and divergence.

7.4. Simplicity, Precision, and Respect

The binary system (he/she) is optimized for modal reliability. Adding singular "they" yields a ternary system that is *minimally* more complex but far more precise. "They" is not a political invention; it is the *optimal semantic tool* for cases where expression fails to be a reliable proxy for type.

This resolves the Assumption Paradox:

- speakers need not assert a type they do not believe;
- trans people are not referred to with a pronoun whose presupposition contradicts their expressive presentation;
- communication proceeds without presuppositional distortion.

Remark 7.2 (Institutional Mandates). Some trans individuals prefer binary pronouns that match their expressive presentation, and many institutions mandate compliance with stated pronoun preferences. The semantic analysis offered here does not settle the political question of whether such mandates are permissible. That question—concerning compelled speech, institutional authority, and the elimination of legitimate semantic options—is addressed in a subsequent paper.

7.5. Adaptive, Not Procrustean

Systems can respond to outliers in two ways:

1. **Procrustean**: distort categories to force outliers into them.
2. **Adaptive**: refine distinctions to accommodate outliers while preserving categorical integrity.

Ameliorative accounts adopt the Procrustean strategy: they redefine "woman" so that all trans women fit, thereby dissolving the category. The present framework is adaptive: it preserves the meaning of "woman" and uses the independently motivated semantics of "they" to handle divergence cases.

Precision is not exclusion. Precision is respect.

8. Ethical Implications

8.1. Two Questions, Not One

Once type and expression are distinguished, ethical questions become tractable because they separate into two:

1. **How should we treat people based on expression?** Social courtesy, forms of address, access to gendered social spaces where expression is what matters.
2. **How should we treat people based on type?** Medical care, reproductive rights, sex-segregated spaces where type is what matters (shelters, prisons, sports, intimate care).

The ameliorative project rendered these questions unanswerable by collapsing the distinction between type and expression. The present framework makes them answerable by preserving it.

8.2. Expression-Based Treatment

For many social purposes, expression is what matters:

- Forms of address and social courtesy
- Dress codes and presentation norms
- Social spaces organized by presentation
- Informal gendered interactions

In these contexts, treating people according to their expression is appropriate. A trans woman presenting femininely may be addressed with feminine social forms without anyone asserting anything about her type. The treatment tracks expression, which is what the context requires.

8.3. Type-Based Treatment

For other purposes, type is what matters:

- Medical care (dosages, screening, reproductive health)

- Sports categories (where type-based physical differences affect competition)
- Sex-segregated spaces where vulnerability correlates with type (shelters, prisons)
- Intimate care where physical configuration matters
- Statistical tracking and epidemiology

In these contexts, treating people according to their type is appropriate. Pretending type does not exist can cause harm. A trans woman may need type-appropriate medical care. Sex-segregated spaces exist because type correlates with vulnerability in specific ways. Ignoring type in the name of inclusion can undermine the very purposes these distinctions serve.

8.4. Embodied Asymmetry and the Limits of Symmetric Expectation

A further ethical insight follows from the structure of type. Sexed bodies generate *asymmetric phenomenologies* that are irreducible to socialization or expression. There are experiences available only to type (−) bodies—menstruation, ovulation, pregnancy, childbirth, lactation— and physiological profiles available only to type (+) bodies. These differences shape not only physiology, but also mood, agency, dependency, and social position throughout the life course.

Ethical confusion often arises from a discomfort with these asymmetries: there is a mistaken assumption that acknowledging structural difference implies normative inequality. But asymmetry does not entail hierarchy. It entails only that different bodies generate different forms of lived experience, each with its own burdens, affordances, and vulnerabilities.

A coherent ethical framework must therefore resist the pressure toward *false symmetry*—the expectation that justice requires treating male and female bodies as though they were interchangeable. Justice requires the opposite: accurate recognition of asymmetry so that institutions, norms, and forms of care respond to the realities of human embodiment. Sex-specific experiences generate sex-specific needs; to ignore this is not progressive but obscurantist.

8.5. Respect Without Confusion

The framework permits full respect for trans persons without requiring conceptual incoherence:

- Trans people's *expression* is real and can be honored.
- Trans people's *type* is also real and need not be denied.
- Social accommodation of expression is a matter of courtesy and context.
- Recognition of type is a matter of biology and, where relevant, policy.

Ordinary people grasp this intuitively. They are willing to use preferred forms of address, to treat trans people with dignity, to accommodate expression. What they resist is the demand that they deny what they know about type—that they affirm, as a metaphysical truth, something they perceive to be false.

The type/expression framework removes this demand. It asks only for acknowledgment of expression, which most people are happy to provide. It does not ask for denial of type, which generates resistance and resentment.

8.6. The Tragic Irony Dissolved

It is important to acknowledge the moral impulse motivating ameliorative approaches. Jenkins's stated aim is to promote inclusion and to avoid marginalizing trans women—a commendable and entirely appropriate aspiration. Nothing in the critique offered here is directed at that aim. The difficulty is that the specific method of amelioration—revising the content of "woman" so that it includes all who identify as women—produces definitional paradoxes that no amount of refinement can resolve.

This leads to a regrettable rhetorical dynamic. When the category "woman" is treated as revisable by stipulation, many women respond defensively; that defensiveness is then often directed at trans people themselves, who bear the cost of a philosophical project they did not design. While it is difficult to trace sociopolitical causality with precision, the resulting polarization is at least a plausible and predictable consequence of trying to secure inclusion by redefining a natural-kind term. The present framework aims to avoid this dynamic altogether by decoupling recognition from literal identity claims.

Within the type/expression framework, the perceived conflict dissolves:

1. The category "woman" (type −) remains intact, biologically grounded, and semantically coherent.
2. Trans women are recognized within a distinct and fully intelligible expressive category: type (+) with feminine expression.
3. No one is asked to deny biological reality.
4. No one is denied recognition of expressive identity.
5. The supposed zero-sum conflict—where inclusion for one group requires the erasure of conceptual structure for another—never arises.

On this view, women need not fear the dissolution of their category, and trans women need not be placed in the impossible position of defending a conceptually incoherent redefinition. The framework restores conceptual clarity while preserving the ethical aims that motivate ameliorative theorists: truth is not pitted against dignity, and recognition does not require collapsing natural kinds.

8.7. Dignity Without Dogma

The central ethical thesis is simple. Within this framework, we can:

- Tell the truth about sex.
- Recognize and accommodate expression.
- Treat trans people with dignity and respect.

without requiring anyone to affirm a metaphysical claim they believe is false.

The ameliorative project failed because it demanded that respectful interaction be conditioned on accepting the identity-based metaphysical claim that "trans women are women" (in the type sense). This was unnecessary. Respect does not require metaphysical agreement; it requires decent treatment. And decent treatment is fully available within a framework that keeps type and expression distinct.

The alternative to incoherent inclusion is not exclusion. It is clarity: recognizing what things are, treating them accordingly, and allowing disagreement about contested metaphysical questions without making such disagreement a barrier to civil coexistence.

9. Conclusion

The question "What is a woman?" has generated enormous controversy and remarkably little clarity. The difficulty, this paper has argued, arises from a three-way conflation: reproductive type, expressive mode, and the social process that enforces normative expectations. Once these dimensions are distinguished, the familiar paradoxes dissolve.

The framework developed here provides:

1. **A functional definition of sex**: reproductive type defined by developmental organization toward gamete production.
2. **A definition of woman**: an adult human instantiating type (−).

3. **A definition of gender**: the process G by which normative expectations N are applied to persons based on perceived type and enforced against expression.
4. **A clarification of trans identity**: trans women are type (+) with feminine expression—aligned with women on the expressive dimension but not on type.
5. **A principled pronoun framework**: "he" and "she" track inferred type; "they" functions as the precision pronoun when expression fails to signal type reliably.
6. **A coherent ethical structure**: type-based and expression-based treatment are distinct questions with distinct answers.

The ameliorative project fails not through lack of subtlety but through structural impossibility. A substantive category cannot simultaneously be defined independently of self-identification and be required to include all self-identifiers. Attempts to escape this contradiction through undefined psychological primitives, circular dependencies, or axiomatic stipulations collapse into empty extensions. The paradoxes are not accidental; they are inherent in the method.

The account offered here is not a compromise between competing theories but a dissolution of the false problem. Once type, expression, and gender-as-process are analytically separated, there is no "inclusion problem" to solve. There is only the task of describing reality accurately and treating persons accordingly. The framework respects trans expression without erasing biological facts, and it preserves the category "woman" without denying the lived experiences of those whose expression diverges from their type.

Of course, conceptual clarity does not by itself resolve all political or practical disputes. But it provides a sharper schema within which those disputes can be addressed more productively. By identifying the natural joints in the phenomenon and distinguishing them from the norms we impose upon it, the analysis allows gender discourse to move forward with reduced confusion and reduced conflict.

Philosophy serves both truth and dignity. Neither requires denying the facts of biological type, and neither requires ignoring the realities of expressive life. What they require is clarity—and clarity requires distinguishing what has too often been conflated. In that sense, the present account fulfills the promise set out at the beginning: the puzzles surrounding sex, gender, and womanhood do not need to be solved by stipulation. They can be dissolved by analysis.

A. Propagation Properties of the Reproductive Graph

This appendix records several structural properties of the reproductive graph introduced in Section 3.2. These results are not required for the main derivation of the binary structure of sex; they make explicit how that structure constrains propagation across generations. All results presuppose the axioms and definitions established in Section 3.1.

A.1. Hereditary Structure

Proposition A.1 (Hereditary Closure)**.** *If* $((u, v), w) \in E$*, then* $\sigma(w) \in \{+, -\}$*.*

Proof. By definition of the reproductive graph, $f(\sigma(u), \sigma(v)) \neq \varnothing$. By Axiom 3.6, $\sigma(w) \in X$, and by Theorem 3.12, $X = \{+, -\}$. □

This proposition expresses that offspring re-enter the same two-role structure as their parents. The reproductive graph is therefore closed under sex assignment.

A.2. Generational Decomposition

Definition A.2 (Generational Slice)**.** Let $V_n \subset V$ be the set of individuals whose maturation time satisfies $\tau(v) \in [n, n + 1)$, for discrete generation index $n \in \mathbb{N}$.

The reproductive graph G decomposes into ordered slices $\{V_0, V_1, V_2, \ldots\}$, with edges directed from pairs in V_n to individuals in V_{n+1}.

Remark A.3. This discretization is a modeling convenience. The structural results below do not depend on any particular biological account of overlapping or continuous generations.

A.3. Forward Propagation

Proposition A.4 (Necessary Condition for Forward Propagation)**.** *If, for some generation* n*, either* $V_n \cap V^+ = \varnothing$ *or* $V_n \cap V^- = \varnothing$*, then no fertile edges extend from* V_n *to* V_{n+1}*.*

Proof. By Proposition 3.22 (Bipartite Fertility), every fertile edge requires one parent from V^+ and one from V^-. If either partition class is absent from V_n, no fertile parent pair can be formed, and no offspring nodes appear in V_{n+1}. □

Corollary A.5 (Structural Fragility)**.** *The reproductive graph cannot propagate beyond a generation lacking representation from both sex classes.*

A.4. Terminal Nodes

Definition A.6 (Terminal Node)**.** An individual $v \in V$ is *terminal* if there exists no $w, z \in V$ such that $((v, w), z) \in E$ or $((w, v), z) \in E$.

Proposition A.7. *Terminal nodes may exist in any generation without altering the bipartite structure of the reproductive graph.*

Proof. Terminality concerns outgoing edges only. The existence of nodes with no outgoing fertile edges does not affect the partition of V into V^+ and V^-, nor the conditions governing fertile pairings among non-terminal nodes. □

Remark A.8. Terminal nodes include individuals who are infertile, developmentally atypical, or otherwise unable to occupy either reproductive role. Their presence is compatible with, and expected under, the binary structure of sex. They do not constitute additional sex classes.

A.5. Interpretive Summary

The results in this appendix show that the binary structure of sex is not merely a classificatory convenience but a necessary condition for the persistence of a sexually reproducing population over time. The reproductive graph propagates only insofar as each generation contains representatives of both complementary reproductive roles. Individuals who fall outside those roles are accommodated as terminal nodes, not as members of further partitions.

These properties are consequences of the functional architecture described in the main text; they do not introduce additional assumptions.

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