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Research Article

Relational Normativity: A Fragility-Based Account of Biological Functions

Jianhui Li[*]

School of Philosophy, Beijing Normal University, Beijing, China

Abstract

Biological systems confront philosophy with a distinct form of normativity that resists both supernaturalist and projectivist accounts. The heart ought to pump blood, the immune system ought to recognize pathogens, yet neither evolutionary history nor organizational structure, taken alone, adequately explains where this normative force comes from. Selected-effects theory traces function to natural selection's historical record; organizational theory locates normativity in the self-maintaining causal structure of the living system. These two approaches have been treated as rivals. I argue that this rivalry is illusory. Normativity, I propose, is fundamentally relational: 'X ought to do Y' is always relative to the biological system as a whole, and normative judgments exhibit a triadic structure involving an object of evaluation, a normative standard, and a systemic perspective. Understood relationally, selected-effects and organizational theories capture complementary dimensions of the same phenomenon: the historical origin and the structural realization of functional facts. I further argue that normative judgments acquire substantive force only when a system's self-maintenance is fragile: when component failure is biophysically possible, potentially irreversible, and threatens the continued existence of the system. Biological functions carry normative force, I conclude, not because normativity is imported from outside nature or projected by observers, but because the precarious, self-maintaining character of living systems makes their continued existence something that is at stake in their own operation.

Keywords

Biological Normativity, Evolution, Organizational Closure, Relational Normativity, Fragility Condition

1. Introduction

Living systems exhibit normativity from within. The heart should pump blood, the immune system should recognize pathogens, the metabolic system should maintain energy balance. These are not merely descriptions of what happens; they are judgments about what ought to happen. A heart that fails to pump blood is dysfunctional, and 'dysfunctional' is a normative term rather than a neutral observation. Physics contains no parallel: the question of how a stone should move makes no sense. Where, then, does biological normativity come from?

Hume's is-ought gap presses the question directly. If 'the heart ought to pump blood' is a normative judgment, and 'the heart pumps blood and sustains circulatory operation' is a factual description, what licences the transition from fact to norm? One answer traces function to evolutionary history: the heart was selected for pumping blood, and that selective history confers normative status on the pumping [1-3]. Another answer traces function to present organizational structure:

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[*]Correspondence: Jianhui Li (ljh@bnu.edu.cn)

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pumping blood is the heart’s causal contribution to the self-maintenance of the circulatory system, and that contribution grounds the norm [4, 5].

These two approaches have long been treated as competitors. I argue that framing them as rivals rests on a mistake. The current organization of a living system is the product of evolution: metabolic networks, gene regulatory circuits, and cellular signaling pathways all bear the marks of natural selection. To examine organization apart from evolutionary history is to sever the product from the process that produced it. Conversely, to invoke evolutionary history apart from present organizational structure is to suspend normativity in an inaccessible past rather than locating it where it operates, which is in the living activity of the organism now. The right question is not 'Does normativity derive from evolution or from organization?' but 'How do evolution and organization jointly constitute the foundation of biological normativity?'

Contemporary philosophy of biology supplies two main approaches to this question. Selected-effects theory traces function to evolutionary history: the heart ought to pump blood because the heart was naturally selected for pumping blood [1-3]. Organizational theory traces function to present causal structure: the heart ought to pump blood because pumping blood is a necessary causal contribution to the self-maintenance of the circulatory system [4, 5].

I propose three theses. First, normativity is fundamentally relational. ‘X ought to do Y’ is always relative to a biological system as a whole. The heart ought to pump blood relative to the circulatory system as a whole. The transition from functional fact to normative judgment is not a matter of building a bridge between heterogeneous kinds of proposition; it is a matter of recognizing the normative structure already present in functional facts when they are understood in their systemic context.

Second, selected-effects theory and organizational theory are complementary, not competing. Selected-effects theory explains why a trait has this function rather than another: the heart was selected for pumping, not for making sounds. Organizational theory explains why that functional contribution carries normative force now: pumping blood sustains the circulatory system’s self-maintenance, and the circulatory system’s continued operation is a condition of the organism’s survival. Without evolutionary history, we cannot specify normative content; without organizational structure, we cannot account for normative force.

Third, I introduce the fragility condition, which specifies when normative judgments acquire substantive force rather than remaining mere logical form. For a system's self-maintenance to ground genuine normative weight, it must be precarious: component failure must be biophysically possible and potentially irreversible. Without such fragility, 'ought to maintain' remains an empty logical form.

Section 2 examines the selected-effects and organizational approaches, identifies the difficulties each faces alone, and shows why treating them as rivals is a mistake. Section 3 develops the relational normativity framework and the transition from functional fact to normative judgment. Section 4 formalizes the fragility condition and applies it to metabolic homeostasis as an integrated case. Section 5 brings Canguilhem’s concept of normative power and McDowell’s notion of second nature into dialogue with the relational framework. Section 6 addresses objections concerning circularity, the sufficiency of theoretical integration, and the three interpretations raised by Corti. Section 7 summarizes the argument and identifies open questions.

2. Two Pathways and Their Difficulties: Why the Opposition Is Spurious

2.1. The Selected-Effects Approach

Wright [3] proposed a causal-historical analysis of function: there is a causal relation between a trait’s current existence and its function, and the trait persists because it performs that function. His argument runs: a trait T performs effect Z and is continuously preserved because it performs Z; therefore Z is the selective advantage explaining T’s existence; therefore T normatively should continue to perform Z. Normativity is injected into functional facts through the selection process itself.

Millikan [1] develops this into a more sophisticated theory of 'proper function.' Proper function differs from general function: it is the function that a trait was shaped to perform by natural selection in evolutionary history. Proper function carries intrinsic normativity: a trait in 'normal conditions' ought to execute its proper function, and if it fails to do so it is dysfunctional. Millikan further introduces the mapping between 'producer's proper functions' and 'consumer's proper functions,' explaining how a trait's current operation relates to its historical function.

Neander [2] provides the standard version of selected-effects theory: a trait's function is its selected-effect by natural selection. The heart's function is pumping blood because the heart was selected for the pumping effect. This definition is clear and powerful. On this account, normativity comes directly from the selection process: being selected means being judged as valuable.

These accounts of the source of normativity are illuminating, but selected-effects theory faces several difficulties.

The historical disconnection problem. We routinely assign functions to traits without knowing their evolutionary history. Biologists make functional judgments about novel gene products, about organisms whose evolutionary records are inaccessible, and about traits whose selection history is contested. The source of normativity, on the selected-effects account, is suspended in the past, while normative judgment operates in the present. Millikan concedes this point: evolutionary history supplies the metaphysical ground of normativity but not its epistemic warrant. But this raises a difficulty: how can a normativity whose source is epistemically inaccessible regulate present biological practice?

Evolutionary novelty. Many biological functions arise from newly evolved structures. Gene duplications, reorganized regulatory circuits, exosomes, and other emergent molecular mechanisms are routinely assigned functions and normative status in biological practice, yet their evolutionary history may be too shallow to support a selected-effects explanation. Millikan handles this through 'derived proper functions': a novel structure inherits its function from an evolutionary predecessor. But this tracing is not always successful, and even when successful it introduces a question about normative hierarchy: does a derived proper function carry the same normative status as an original one?

The normal conditions problem. Millikan appeals to 'normal conditions' to define dysfunction: a trait exhibits its proper function under appropriate conditions, and its failure to do so constitutes dysfunction. But what fixes which conditions count as normal? Answering that question seems to require a normative standard, a specification of how the system ought to operate. Yet providing that standard is precisely what selected-effects theory is supposed to do, not to presuppose. If 'normal conditions' is itself a normative notion, the selected-effects account has not discharged its explanatory burden.

Epistemological accessibility. Even if the metaphysical difficulties could be resolved, selected-effects theory faces an epistemic problem: the precise selection history of most traits is unknown. Functional attributions under the selected-effects framework thus appeal, at the metaphysical level, to a past we cannot recover, while relying, at the epistemic level, on inference from present evidence. Neander [6] has extended the selected-effects framework to mental content through informational teleosemantics, demonstrating both the ambition and the epistemic challenge of the approach.

2.2. The Difficulties of Cummins's Causal Role Theory and The Organizational Theory Approach

The second major approach in the history of functional theory is Cummins's [7] causal role theory. In Functional Analysis, Cummins argues that function is not a matter of tracing historical origins but of explaining the causal role in the system's current capacity.

Cummins’s core claim is: a trait S has function F in system C if and only if S makes a causal contribution to C’s capacities, and F describes that contribution. Unlike selected-effects theory, Cummins does not invoke evolutionary history; unlike organizational theory, he does not invoke self-maintenance. Functional judgment is explanatory: biologists assign functions to traits in order to explain how a containing system acquires certain capacities.

Cummins’s theory has the advantage of broad scope: it accommodates function talk in non-biological systems and evolutionary novelties without waiting for selection history. But it faces a difficulty. Cummins’s functional judgments are relative to the explanatory interests of the interpreter: an investigator designates a causal effect as a ‘function’ for explanatory purposes. On this picture, normativity is not a feature of the biological system itself but something projected by the observer.

This relativist consequence means Cummins's theory cannot address the core problem of biological normativity: functional dysfunction is a real biological phenomenon, not an interpreter's preference. Heart failure is pathological whether or not an observer interprets it as dysfunction. Garson [8] argues that Cummins's theory should be understood as a theory of how we epistemically access functional facts, not as a theory of what constitutes those facts. Relativity of access need not entail relativism about the facts accessed: the same trait can have different functions in different systemic contexts, but for a given system, normativity is objective. This aligns with the relational framework I develop below. Garson [9] has further argued that the normative dimension of biological function requires careful disambiguation from mere causal role attribution. I take up this point in Section 3.

Organizational theory was developed and systematically formulated by Mossio, Saborido, and Moreno [4] building on earlier work in autopoiesis and systems theory. Its core claim is: a function is a trait that makes a causal contribution to the system's self-maintenance, and its normativity derives from the relational structure internal to the organization.

A trait C has function F in system S if and only if: (C1) C makes a causal contribution to S's self-maintenance; (C2) C is produced and maintained by the system because of this contribution [4].

Condition (C2) carries the main argumentative weight: the trait's existence is itself a result of organizational operation, not an independent external fact. This means organizational theory bypasses the historical problem: functional judgment requires no recourse to selection history, only analysis of the current organizational causal structure.

Mossio and Montévil [5] further develop this into "closure of constraints" theory. Constraints are variables that restrict a system's possible states. In living systems, these constraints are products of the system's own activity, forming a closed network of causal dependencies: constraint A regulates B, B regulates C, C regulates A in turn. This closed network constitutes the core structure of organization.

Moreno and Mossio [10] provide a systematic account of how biological autonomy generates normativity through organizational closure. Mossio [11] has more recently offered a comprehensive treatment developing the closure of constraints framework. The normative argument of organizational theory relies on a form of counterfactual reasoning: if a constraint is removed, the system's self-maintenance collapses; therefore that constraint ought to be maintained. This counterfactual structure is meant to carry normative force. But as

Corti [12] has shown, this move faces a serious difficulty. Corti argues that the connection between organizational closure and normativity cannot be established through any of three candidate interpretations—causal dependency, teleology, and counterfactual reasoning—without either presupposing what needs to be shown or falling into circularity. I return to Corti's challenge in Section 6 and argue that the relational framework, through the fragility condition, supplies what organizational theory alone lacks.

3. The Relational Normativity Framework

3.1. Core Theses

The selected-effects and organizational approaches illuminate different aspects of biological normativity, but each is incomplete on its own. I propose the relational normativity framework as an integration of the two approaches, designed to capture what each gets right while compensating for what each misses. The framework rests on two theses.

Thesis One: Normativity is a relational category. ‘X ought to do Y’ is not an absolute judgment but is relative to a biological system as a whole. The complete semantic content of ‘the heart ought to pump blood’ is: relative to the circulatory system as a whole to which the heart belongs, pumping blood is the heart’s appropriate mode of operation. Normative judgments in biology exhibit a triadic structure: an object of evaluation (the heart), a normative standard (the normal operation of the containing system), and a perspective of evaluation (the system’s own perspective).

This structure mirrors the general form of evaluative judgment. When we say a good teacher ought to explain clearly, the judgment is relative to the function of education as a system. Detached from that systemic context, the normative force evaporates. The same holds for biological function: ‘the heart ought to pump blood’ is not a free-floating normative pronouncement but a judgment anchored in the heart’s role within the circulatory system.

Thesis Two: Functional facts, when properly understood in their systemic context, are already normatively structured. This requires careful statement. I am not claiming that every use of 'function' in biology necessarily carries normative content. Cummins has shown that function can be used in a purely descriptive, interest-relative sense. My claim is that the concept of biological function, as deployed in contexts where a system's self-maintenance is at stake, functions as a thick concept: its descriptive content (identifying the causal contribution a trait makes to the containing system) and its evaluative content (identifying that contribution as what the trait ought to perform for the system to persist) are not independently specifiable components but mutually entangled aspects of a single act of conceptual judgment. To grasp that the heart's function is to pump blood, in the context of the circulatory system's self-maintenance, is already to grasp that pumping blood is what the heart ought to do relative to that system. The relationship between 'S's function in T is F' and 'S ought to do F relative to T' is therefore not an inference from one independent proposition to another but an explication of what the functional attribution already involves. This entanglement explains why Cummins-style purely descriptive functional attributions, while legitimate for certain explanatory purposes, do not capture the full normative force of functional judgments in biological practice: they abstract away from the very dimension that makes the concept normatively thick: the system's dependence on the trait's contribution for its continued existence. This view aligns with Aristotle's concept of natural purpose: a thing's function, understood in relation to the whole whose existence depends on it, is its good. Deacon [13] has offered a complementary analysis of how molecular processes acquire sign-like normative properties through their organizational context, providing independent support for the claim that normative structure can emerge within natural systems without being externally imposed.

3.2. The Transition from Fact to Norm: A Legitimate Path

Taken together, these two theses clarify what is at stake in the transition from functional fact to normative judgment.

(P1) S is a component of system T, and S makes a causal contribution to T’s self-maintenance. This is a factual description of functional contribution.

(P2) S's function in T is F. This follows from P1 together with the rules of functional attribution within T. Specifically, T's self-maintenance provides the relevant frame for identifying which of S's causal contributions count as functions.

(P3) S ought to do F, relative to T. This follows from P2: to say that S's function in T is F is already to identify F as what S must do for T to maintain itself, and to recognize that T's continued existence is normatively relevant. Because the concept of function at work here is thick, with its descriptive and evaluative dimensions inseparable, the move from (P2) to (P3) does not add a new normative ingredient but makes explicit the evaluative content that (P2) already carries.

The organizational approach to functional attribution has been extended to ecological contexts by Nunes-Neto, Moreno, and El-Hani [14], illustrating the broader applicability of the relational framework beyond organism-level biology.

The transition turns on how we understand the concept of function itself. When we ask 'what is S's function in T?' we are not asking a purely descriptive question of the form 'what causal effects does S have on T?' We are asking what role S plays in T's self-maintenance. Since the concept of function, applied within a self-maintaining system, is thick, with its descriptive and evaluative dimensions entangled, answering that question already involves identifying certain causal contributions as normatively significant. From (P2) to (P3) is therefore not a leap from fact to norm; it is the recognition that functional attribution within a self-maintaining system already carries normative structure.

This transition is legitimate because the concept of function in biology, understood as a thick concept, is not exhausted by causal description. If 'function' were synonymous with 'causal effect,' then (P2) would reduce to 'S has causal effect F on T,' and (P3) would not follow. But the functional concept, applied within a self-maintaining system, identifies a causal contribution without which the system would degrade or collapse. Such a contribution is not merely a cause; it is a condition of the system's persistence. Where persistence is at stake, normative language is already in play. The normative force of functional judgments in biology does not come from outside the functional concept; it is already present whenever function is attributed in the context of a system whose continued existence depends on that function being performed.

The argument risks relocating rather than resolving the problem: why should the system’s continued existence carry normative weight? The answer lies in what it means for a living system to exist at all. A living system, unlike a rock or a flame, maintains itself through the coordinated activity of its components. When a component fails and the system’s self-maintenance is threatened, the system does not simply change state; it risks ceasing to be the kind of thing it is. That risk is not an observer’s projection but a fact about the system’s mode of existence. The fragility condition (developed in Section 4) makes this precise: the normative content of functional attributions is grounded in the real possibility of irreversible systemic failure. Without fragility, functional attribution would carry only formal normativity; with fragility, it carries substantive force.

3.3. Relation to Hume's Problem

Hume observed that normative conclusions cannot be validly derived from purely descriptive premises. A gap appears between 'is' and 'ought.' This paper does not claim to have refuted Hume's principle. Rather, I claim that the gap does not arise here, because the premises in the biological case are not purely descriptive in the sense Hume's principle requires.

The derivation from 'the heart pumps blood and sustains circulatory operation' to 'the heart ought to pump blood' is possible not by bridging heterogeneous proposition types but because the functional premise already carries the normative structure that the conclusion makes explicit. Hume's worry presupposes that factual and normative propositions are categorically distinct; the claim of the relational framework is that functional facts in biology do not fit neatly on either side of that divide. They are facts about what a system requires for its own continuation, and they are already normatively inflected for that very reason.

I am not, therefore, offering a ‘solution’ to Hume’s problem. I am arguing that in the biological domain, the problem takes a different shape than it does in domains where the facts in question carry no inherent connection to the persistence conditions of the entities they describe. Whether this argument generalizes beyond biology is a further question I do not address here.

4. Fragility Condition and Biological Case

4.1. Formal Definition of the Fragility Condition

The fragility condition supplies the substance of normative content within the relational framework. It can be formalized as follows.

For a biological system S, if there exists a closed constraint structure C that enables S to self-maintain, then S possesses fragility if and only if:

(F1) S's continuation depends on C's continuous operation;

(F2) Failure of any component of C can lead to S entering a state change from which S cannot recover through its own organizational resources (a state where S cannot self-maintain);

(F3) This failure is biophysically possible (not merely theoretically contingent, but genuinely possible under realistic conditions).

The three conditions jointly distinguish cases where normative language has substantive content from cases where it reduces to mere logical form. Consider an engineered automaton whose components can be replaced without threatening the system's continued operation. Its components have functions in a Cummins-style descriptive sense, and removing a component may temporarily disrupt operation. But because the automaton's persistence does not depend directly on those specific components, since they are externally replaceable, the normative dimension is attenuated. By contrast, in a living system, the constitutive dependence of the whole on its parts, combined with the real possibility of irreversible failure, generates normative force that is not merely formal. Whether a particular engineered system approaches the fragility thresholds of living systems is an empirical question; the fragility condition provides the criteria for answering it.

4.2. Integrated Case: Metabolic Homeostasis

Metabolic homeostasis provides a case integrating evolution, organization, and normativity while demonstrating the fragility condition's operation. Blood glucose concentration is maintained in a narrow range through the antagonistic interaction of insulin and glucagon. This regulatory system simultaneously exhibits evolutionary history, organizational structure, and normativity.

Evolutionary dimension: The complexity of the insulin-glucagon system results from natural selection. Both excessively high and low blood glucose create fitness disadvantages. Hyperglycemia causes tissue damage and osmotic imbalance; hypoglycemia causes energy supply insufficiency and nervous system dysfunction. Natural selection preserved metabolic circuits that precisely regulate blood glucose. Evolutionary history explains why this threshold and not another.

Organizational dimension: Metabolic control's current realization depends on negative feedback closure. When blood glucose rises, it stimulates insulin secretion, which then promotes cellular glucose uptake, causing glucose concentration to fall. Conversely, when blood glucose drops, it stimulates glucagon secretion, which promotes glycogen breakdown and glucose release, raising glucose concentration. This negative feedback loop forms causal closure: blood glucose concentration is both controlled and controls the secretion of control factors. The constraint closure ensures blood glucose concentration remains stable. Bich and Bechtel [15] have recently examined how integrated control in living organisms requires organizational closure, providing empirical grounding for the kind of constraint closure operative in metabolic regulation.

Normative dimension: the judgment that blood glucose ought to be maintained within a specific range derives simultaneously from both evolutionary and organizational dimensions. The evolutionary dimension determines the content of the 'ought' range (both high and low have fitness disadvantages); the organizational dimension realizes and maintains this range. Normative judgment is neither purely historical nor purely structural but their unified realization in current life activity.

Fragility in the metabolic case. The insulin-glucagon regulatory circuit is fragile in the precise sense defined above [16]. Insulin production failure, glucagon receptor mutation, and deficiency in hepatic glycogenolytic enzymes are each local failures that can cause blood glucose concentration to lose control, with cascading effects on whole-body metabolism and neural function, ultimately threatening organismal survival. Medicine diagnoses these as metabolic dysfunction, and the diagnosis carries normative force precisely because the failures are biophysically real and system-threatening. The fragility condition thus demonstrates how the normative content of functional judgments is anchored in the concrete, empirically accessible vulnerabilities of living systems rather than in abstract logical form.

5. Integration: Evolution, Organization, and Normativity

5.1. How Selected-Effects and Organizational Theories Complement Each Other

Selected-effects and organizational theories each capture different dimensions of biological normativity, not competing accounts.

Selected-effects theory explains historical origin. The content of the normative judgment 'the heart ought to pump blood,' and more specifically why pumping blood rather than making sounds, is determined by evolutionary history. The heart was selected for pumping, so pumping rather than sound production constitutes the heart's proper function. Selected-effects theory provides explanation of normative content and answers 'why this rather than that.'

Organizational theory explains current realization. The force of the normative judgment, the reason it possesses normative power rather than being merely descriptive, is determined by organizational structure. The heart's blood-pumping contribution to circulatory system self-maintenance makes 'ought to pump blood' a substantive normative demand rather than empty formal assertion. Organizational theory provides explanation of normative force and answers 'why does this norm compel.'

This complementarity is not a static division of labor. Evolutionary history shapes present organization, but present organization also constrains the direction of future evolution: the organizational structures that have already developed define the evolutionary possibilities that are most accessible in subsequent generations. Normative content and normative force thus exhibit feedback over time. Changes in organizational structure, whether through development, injury repair, or pathological adaptation, alter the conditions under which normative judgments apply. The fragility condition itself takes different specific forms as organization evolves. Normativity is thus neither locked in the evolutionary past nor fixed in the present structure, but continuously constituted through the ongoing interplay between evolution and organization.

Each without the other makes normativity incomplete. With selected-effects theory alone, normativity is suspended in an unknowable past, unable to explain current judgment's normative force. With organizational theory alone, normative judgment's content lacks explanation. The relational normativity framework integrates the two: normative judgment's content is explained by functional fact's evolutionary history, and normative judgment's force is guaranteed by functional fact's current realization in organizational structure.

5.2. Canguilhem's Contribution: The Power of Normativity

Living beings do not merely instantiate normative structures; they actively practice normativity as living subjects. The relational framework, focused on the logical form of normative judgment, needs to account for this phenomenological dimension. Canguilhem's [17] concept of "the power of normativity" fills this critical gap.

Canguilhem's core thesis in The Normal and the Pathological is: life is not merely self-maintenance (homeostasis) but also self-normativity. Living individuals do not passively conform to pregiven norms but actively establish, create, and maintain norms. Three aspects bear directly on the relational framework.

First, life establishes norms. A living individual's mode of existence constitutes its own normative standard. The normal state is not a statistical average but the state in which life activity proceeds normally. It includes the capacity to respond appropriately to environmental changes, the maintenance of internal stability, and the continuation of individual development and species reproduction. This standard is determined by the living individual itself, not imposed by external observers. The relational framework captures this structure, but Canguilhem emphasizes: the establishment of this standard is living practice, not theoretical analysis alone.

Second, life creates norms. In adapting to new environments and developing new capacities, life creates new normative standards. This refines rather than contradicts the relational framework: the framework's core lies in "system whole's self-maintenance," but life achieves new normativity precisely by changing its own structure. Evolution adjusts system structure over long timescales; development reorganizes structure within an individual's life history; both involve creative change in normative standards.

Third, pathology is normative failure, not statistical deviation. Canguilhem points out that disease is not deviation from statistical "normalcy" but a mode of existence where the individual's normative capacity is damaged, unable to maintain its normative standard in particular environments. Saborido and Moreno [18] develop this insight from an organizational perspective, arguing that biological pathology consists in the impairment of the system's organizational capacity for self-maintenance, thereby grounding pathological judgment in the same relational normative framework. This grounds the normative dimension of medical practice: treatment's purpose is not to restore statistical mean but to help recover normative power [19]. Kingma [20] similarly argues from a naturalistic perspective that health and disease cannot be reduced to statistical norms, supporting the view that pathology represents a genuine normative failure in the organism's capacity for self-maintenance.

The relational framework and Canguilhem’s analysis offer complementary perspectives. The framework provides the logical form of normative judgment in biology. Canguilhem provides what the framework by itself cannot: an account of how normativity is concretely enacted in living practice. The fragility condition bridges the two: it is precisely because life is fragile that normative practice is necessary, that damage to the organism’s normative power (pathology) is possible, and that medical intervention carries normative significance. Without fragility, there would be nothing at stake in the distinction between normal and pathological; with it, Canguilhem’s claim that pathology is not statistical deviation but normative failure gains a precise structural underpinning.

5.3. Dialogue with McDowell: "Second Nature"

McDowell [21], in Mind and World, introduces the concept of 'second nature' to address a problem about the naturalization of rational norms. His argument concerns how human beings acquire responsiveness to the norms of inference, perception, and action through education and socialization (Bildung). Rational norms become 'second nature': internalized aspects of the agent's practical orientation rather than impositions from outside nature. McDowell addresses the apparent tension between the normative structure of rational thought and the causal structure of the natural world. His core argument is that Bildung, the process of education and socialization, constitutes a legitimate natural process through which rational norms are internalized, becoming genuine normative competences without ceasing to be natural.

I adapt McDowell's insight, not his specific argument, to the biological case. The connection is structural, not substantive. Just as McDowell argues that rational norms need not be supernatural to be genuinely normative, because they are internalized through the natural process of Bildung, I argue that biological norms need not be externally imposed to be genuinely normative, because they are constituted through the natural processes of evolution and organizational closure. The living system, through its evolutionary and organizational history, internalizes the conditions of its own persistence as normative standards. It does so not through conscious learning, but through the structural dependence of its continued existence on the coordinated operation of its components. Biological normativity is, in this extended sense, life's second nature: normative standards rooted in the constitutive conditions of the living system's own mode of being.

This adaptation continues the Aristotelian tradition of natural teleology while avoiding its supernatural commitments. Each natural thing has its inherent purpose (telos), and realizing that purpose constitutes its good. The heart's good is pumping blood, and this is not a metaphor but a description of what the heart must do for the organism to persist. The adaptation of McDowell shows, I suggest, that this teleological structure needs no appeal to design or to pre-existing normative facts; it can be grounded in the constitutive conditions of living systems themselves, conditions established by evolution and realized through organizational closure.

6. Addressing Criticisms

6.1. Systematic Response to Corti's Three Interpretations

Corti argues that organizational theory cannot bridge the gap from causal structure to normative force through any of three candidate interpretations: causal dependency, teleology, or counterfactual reasoning. Each interpretation, he argues, either presupposes the normativity it aims to explain or relies on a premise that organizational theory has not independently established. His challenge is serious for pure organizational theory. I argue that the relational framework, by introducing the fragility condition and the analysis of functional attributions as already normatively structured when applied within self-maintaining systems, answers Corti’s challenge without circularity.

Causal dependency. In a general physical system, a component may be causally necessary for the system's operation without that necessity carrying normative force. Removing a catalyst slows a reaction without threatening the reaction system's existence. Corti's point is that causal necessity alone cannot generate normative claims. The fragility condition supplies the needed distinction. In a living system, the causal contribution of a component is not merely facilitative but constitutive: its failure does not merely alter system behavior but undermines the conditions of the system's continued existence. When insulin production fails, blood glucose regulation collapses, and the organism dies. The causal dependency is therefore not of the same kind as that between a catalyst and a reaction rate; it is a dependency that is, as the fragility condition specifies, potentially irreversible and system-threatening. The normative force attaches to this specific kind of dependency, not to causal dependency in general.

Teleology. Corti charges that organizational theory smuggles in teleology by presupposing self-maintenance as a goal. The relational framework responds that this teleology is not presupposed but explained. The system’s ‘directedness’ toward self-maintenance is not a goal we impute to it; it is a structural feature of a closed constraint network. When a network of constraints is organized such that each constraint is a product of the system’s own activity and each constraint regulates other constraints within the same network, the network as a whole exhibits a directionality: any deviation from the operating regime threatens the network’s continued instantiation. This directionality is a consequence of closure, not an external purpose imposed on it. Corti is right that if one begins with bare causal relations and then adds ‘and self-maintenance is the goal,’ one has introduced normativity by fiat. But organizational closure plus fragility explains why the system exhibits its teleological structure without presupposing normative content. The teleology is in the structure, not in the eye of the beholder.

Counterfactual dependency. Corti's third interpretation concerns the move from 'if C were removed, the system could not self-maintain' to 'the system ought to maintain C.' As Corti notes, counterfactual conditionals are not themselves normative: they are descriptions of dependency relations. The relational framework accepts this point but insists that the fragility condition changes the argument. When the counterfactual scenario involves irreversible systemic collapse (F2) that is biophysically possible (F3), the counterfactual is no longer a merely logical exercise. It identifies a real vulnerability of the system. It identifies a way the system could genuinely fail. Once we recognize that the system's continued existence depends on avoiding that failure, the conclusion that the system ought to maintain C is not a non sequitur but an acknowledgment of what is at stake. The fragility condition makes explicit what Corti's analysis shows organizational theory leaves implicit: that the relevant counterfactuals concern real, system-threatening possibilities, and that it is this real threat that grounds normative force.

6.2. The Circularity Problem of Functional Concept's Normative Loading

The most fundamental objection to the relational framework is this: if the concept of ‘function’ is itself already normatively loaded, then using function to explain normativity is circular. The objection has force, and I address it at two levels.

At the conceptual level: the normative content of the functional concept in biology is not an additional ingredient we add to a descriptive notion. When we say 'the function of X in system S is F,' we are not first describing X's causal contribution and then separately evaluating it. The concept of function, as applied within a self-maintaining system, is thick: its descriptive and evaluative dimensions are inseparable aspects of a single act of conceptual judgment. The charge of circularity would apply if the argument's premises presupposed the normative concept and then derived it as a conclusion. But in the relational framework, the thickness of the functional concept means that normative content is inherent in the structure of functional attribution from the start. The argument does not introduce normativity; it makes explicit what was already there.

At the ontological level: the normative content of functional facts in biology does not derive from our conceptual conventions but from a difference in the mode of existence of living systems. A catalyst in a chemical reaction has a 'function' in only a descriptive sense, because the catalyst is not fragile in the defined sense. Its absence alters the reaction rate but does not threaten the existence of any entity whose persistence depends on it. In a living system, by contrast, a component's function is normatively loaded because the system's existence is directly dependent on that component's operation, and that dependence is fragile. The source of normativity is ontological: it lies in the kind of thing a living system is, not in our conceptual conventions alone.

These two levels of response are complementary. The conceptual level explains why functional attribution in biology is not a neutral descriptive act; the ontological level explains why biological systems support functional attributions of this kind in a way that general physical systems do not.

6.3. The Sufficiency of Integrating Selected-Effects and Organizational Theories

A critic might grant that selected-effects and organizational theories capture different dimensions of biological normativity but deny that integrating them under a single relational framework is legitimate. Perhaps the two theories are not merely complementary but fundamentally incompatible, rivals that cannot be reconciled by treating them as answers to different questions.

This objection underestimates the depth of the connection between evolutionary history and organizational structure. Selected-effects theory and organizational theory describe different temporal stages of the same phenomenon, not different phenomena. Evolutionary history is the process by which organizational structures are formed; organizational structure is the present material realization of that evolutionary history. They are not rival metaphysical claims about the source of normativity but complementary descriptions of how normativity is constituted over time. Historical origin and present realization are not competitors for explanatory primacy; they are both necessary for a complete account. A normativity that has only a history but no present structural embodiment is a ghost; a normativity that has only present structure but no historical determination of its content is a cipher.

The integration I propose is therefore not a forced combination of incompatible theories but a recognition of their mutual dependence. Selected-effects theory without organizational theory cannot explain why function carries normative force now; organizational theory without selected-effects theory cannot explain why a trait has this function rather than that one. Either alone yields an incomplete account of biological normativity. Together, they describe the full arc: how the normative content of biological function is established over evolutionary time and how it is realized and enforced in the present organizational structure of the living system.

This complementarity does not require that the two theories be reduced to a single unified formalism. It requires only that we recognize that biological normativity is multidimensional. It is constituted by both historical and structural factors, and a complete philosophical account must address both. The relational framework provides the conceptual space within which these two dimensions can be seen as aspects of a single phenomenon rather than as rival explanations of it. A further question is whether the two theories might generate systematically conflicting function assignments in particular cases. If they did, that would pose a difficulty for the relational framework. But such conflicts have not been demonstrated, and the framework's prediction is that apparent conflicts will dissolve once the different temporal perspectives—historical origin and present structural realization—are properly distinguished: a trait may have different functions under different temporal perspectives without those functions being contradictory, just as a city's original purpose as a trading post does not contradict its present function as a cultural capital.

7. Conclusion

I have argued that biological normativity can be naturalized without reduction and without projection. The argument has proceeded in three stages.

First, normativity in biology is fundamentally relational. ‘X ought to do Y’ is always relative to a biological system as a whole. Functional facts are not value-neutral descriptions waiting to be bridged to normative conclusions; when a function is attributed within a self-maintaining system, the attribution already carries normative structure. The move from functional fact to normative judgment is not an inference across a categorical gap but an explication of what functional attribution involves.

Second, selected-effects theory and organizational theory are complementary, not competing. Evolutionary history determines the content of normative judgments: it tells us why pumping blood rather than some other effect is the heart's function. Organizational structure supplies normative force: it tells us why the fact that the heart pumps blood carries genuine normative weight. Separating these dimensions renders normativity incomplete; integrating them under the relational framework restores the full picture.

Third, the fragility condition anchors normative force in the concrete vulnerabilities of living systems. When a system's self-maintenance is genuinely precarious, when component failure is biophysically possible and potentially irreversible, 'ought to maintain' carries substantive content. Without fragility, normative language in biology would be formally intelligible but practically empty. The connection between fragility and normativity also illuminates Canguilhem's analysis of pathology as normative failure and, in an adapted form, extends McDowell's concept of second nature to the biological domain.

Three lines of further inquiry follow from this framework. First, how do normative standards change during development and evolution? The relational framework predicts that changes in organizational structure should produce corresponding changes in normative content; empirical investigation of this link would test the framework's adequacy. Second, how precisely does the fragility condition map onto actual biological systems at multiple scales, from molecular circuits to organ systems to ecological networks? Third, Canguilhem's claim that living systems create genuinely new normative standards requires a more detailed account of how organizational reorganization generates novel norms. The relational framework provides the structure for that account but does not yet fill it in.

Author Contributions

Jianhui Li: Conceptualization, Formal Analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing

Conflicts of Interest

The author declares no conflicts of interest.

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