From Template to System: Why Generative Duality Requires Triadic Regulation

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Abstract. This paper argues that a generative structure is not equivalent to a coherent system. Using examples from semiotics, biology, systems theory, and Lie algebra, it develops a distinction between dyadic generation and triadic regulation. Dyadic relations, exemplified by Saussure's signifier-signified model and the binary Lie bracket, are shown to generate differences, relations, and new possibilities. However, generation alone does not explain how coherence, stability, or meaning are maintained. Drawing on Peirce's concept of Thirdness, the paper proposes that a mediating regulatory relation is required for organized persistence. This regulatory function appears across domains as interpretants in semiotics, homeostatic and multiscale regulatory networks in biology, and higher-order constraints such as the Jacobi identity in Lie algebra. The comparison is not one of identity but of shared logical architecture: generative relations require regulatory constraints if they are to constitute coherent systems. The resulting framework is summarized as a progression from difference → relation → regulation → coherence, providing a rigorous account of how two-sided structures become integrated wholes while preserving their distinctions.

Keywords: Coherence, Dyad, Homeostasis, Lie Algebra, Organization, Regulation, Semiotics, Two-sidedness.

1. Introduction: The problem of a structure that can generate but cannot govern itself

A recurring mistake in the history of ideas is to confuse a generative structure with a complete system.

A structure may be capable of producing differences, combinations, and new configurations without possessing any principle that determines how those possibilities are to remain coherent. It may provide the *space of possibilities* without providing the *regulation necessary for those possibilities to function as a system*.

This distinction can be expressed in remarkably simple terms: A template generates; regulation organizes.

The distinction is especially illuminating when placed alongside Ferdinand de Saussure's linguistic dyad and Charles Sanders Peirce's triadic theory of signs. Saussure's signifier–signified relation provides an extraordinarily powerful account of meaning as relational difference. But a dyadic relation, considered by itself, does not yet explain how meaning becomes stabilized, interpreted, and carried forward through a continuing process of semiosis.

Peirce's third term—the interpretant—addresses precisely this missing function. It should therefore not be regarded merely as an additional element added to Saussure's two elements. The important difference is functional: the third term mediates the relation between the first two and permits the relation to become self-regulating.

The same distinction appears, in a different mathematical form, in Lie algebra. A binary bracket generates new algebraic relations, but the Jacobi identity constrains how nested brackets may relate to one another. And biology supplies a particularly concrete parallel: DNA contains generative information, but the genome by itself does not constitute a complete developmental or physiological controller. Its expression is regulated by a larger network involving the cell, organism, and environment. The collective work in the 2023 book, *Evolution "On Purpose": Teleonomy in Living Systems*, demonstrates this point.

The argument, then, is not that language, biology, and algebra are literally the same thing. They are not. Rather, they exhibit a common logical architecture:

$$\boldsymbol{difference \rightarrow relation \rightarrow regulation \rightarrow coherent\ system.}$$

That architecture gives a rigorous meaning to Smith's (2025) broader idea of two-sidedness accompanied by a middle term functioning as a homeostat.

2. First principles: what is a dyad?

Begin with the most elementary possible structure: two terms related to one another.

Call them A and B.

The important fact is that neither term is completely intelligible in isolation once the relation between them becomes constitutive. We can distinguish A from B, and precisely because we can distinguish them, a relational structure emerges.

Schematically,

$A \leftrightarrow B$.

This is a dyad. The dyad gives us difference.

Without difference there is no plurality. If everything were indistinguishable from everything else, there would be no relational structure to analyze. Thus, the dyad is extraordinarily productive: it creates distinctions, oppositions, contrasts, correspondences, and relations.

This is the strength of Saussure's structural insight. As Chandler (2002) explains, Saussure's linguistic sign is dyadic, consisting of a signifier and a signified, but these are not a sign-vehicle and an external object. Rather, they are an associated sound pattern and concept whose relation constitutes the sign itself. The two elements are mutually dependent within the larger system of language; they do not acquire their linguistic value in isolation; their significance emerges from their reciprocal relation within a system of differences. The dyadic form is therefore genuinely generative.

But generation is not regulation.

Suppose a mechanism can generate an indefinitely large number of relationships. That does not tell us what makes those relationships constitute a stable system rather than an unbounded proliferation of possibilities. There is a distinction between a template and a stable system. A template generates outputs, but requires regulation if those outputs are to remain coherent.

The point can be made without making any controversial philosophical assumption: Knowing how relations are generated does not, by itself, explain how those relations are constrained, interpreted, or maintained.

That is the fundamental opening through which the triadic argument enters.

3. Saussure: the power and limitation of the dyadic template

Saussure's signifier–signified relation is powerful precisely because it avoids treating language as a simple collection of labels attached to pre-existing objects.

The linguistic sign establishes a relation between two poles. Differences between signs generate a structured field of possibilities. The result is not a fixed vocabulary but a generative relational system.

In this respect, the dyad possesses several important properties:

- it generates differences;
- it produces plurality;
- it establishes relations;
- it permits open-ended combinations;

- it does not require a predetermined list of meanings.

These are not weaknesses. They are precisely what make a generative system possible.

But there is a logical question that remains.

What makes a relation meaningful rather than merely relational?

A relation can exist without interpretation.

A physical system can contain correlations. A mathematical structure can contain relations. A computer can manipulate symbols according to formal rules. None of these facts alone establishes what the relation *means*.

Meaning involves a relation being taken up within some further process that determines its significance, consequence, or use.

This is where Peirce's Thirdness becomes important.

4. Why Peirce's third term is not simply “one more thing”

Peirce's triad consists, in one formulation, of:

$$representamen \rightarrow object \rightarrow interpretant.$$

It is tempting to imagine that Peirce simply took Saussure's two components and added another component. That understates the conceptual difference.

The interpretant is not merely another object standing alongside the first two. It is the mediating function through which the relation becomes interpretable. Peirce (1903a) writes, “A Sign, or Representamen, is a First which stands in such a genuine triadic relation to a Second, called its Object, as to be capable of determining a Third, called its Interpretant, to assume the same triadic relation to its Object in which it stands itself to the same Object.”

Thus, the structure is better represented as:

$$A \rightarrow B$$

followed by the question:

$$What\ does\ the\ relation\ A - B\ amount\ to\ within\ an\ ongoing\ system?$$

The interpretant supplies the answer—not necessarily as a conscious human thought, but as the continuation and determination of the sign relation. Therefore, the interpretant provides a regulatory function, rather than simply a third element. Moreover, it is not the meaning of symbols or the experience of interpretation, it is a necessary structure that shows itself as a pattern.

Peirce (1867) writes: “One thing cannot be related to another; without they are brought together by some mediating representation or reason. … This supposes that there is some regularity, or tendency to regularity, with which people who drink similar potions experience similar effects; otherwise, the drink and the death are mere coincidences.” Peirce's category of Thirdness is consequently associated with mediation, continuity, law, and interpretation. The third term does something the dyad alone cannot do: it mediates between the two poles and preserves the relation through a continuing process.

This gives us a more exact formulation of the thesis: The dyad establishes relational possibility; Thirdness establishes regulated relational continuity.

That distinction is crucial.

5. Homeostasis: what “regulation” actually means

The word *homeostasis* can sometimes sound biological or metaphorical. Here it can be understood in a more general structural sense. Homeostasis is a concrete instance of Thirdness-like mediation, not a definition of Thirdness.

A homeostat is a mechanism that prevents a system's internal relationships from simply drifting into arbitrary configurations.

It does not necessarily freeze the system. Quite the opposite: a genuine homeostatic system can remain dynamic precisely because regulation allows change to occur within viable bounds. As Peirce (1867) writes: “The representation must itself have its reason, and so on in endless series. In fact, in the idea of regularity, the idea of endless multitude is involved.”

Consider a simple thermostat. There is a desired condition, an actual condition, and a regulating relation between them. The thermostat does not merely produce temperature differences. It compares, responds, and corrects.

The important point is structural:

$$state + reference + regulation.$$

A dyad alone gives us something like:

$$state \leftrightarrow state.$$

A regulating third term allows the system to respond to the relationship between states.

The same logic applies at higher levels of abstraction. Regulation does not necessarily mean an external controller standing outside the system like a person operating a machine. Regulation can be distributed throughout the system itself. This qualification matters particularly in biology.

6. Biology: DNA is a template, not the whole developmental system

The biological analogy is especially instructive because it prevents the argument from becoming merely philosophical.

DNA is extraordinarily powerful. It contains sequences whose information participates in the production of proteins and the organization of biological processes. But DNA does not operate in isolation, it is not a self-sufficient developmental controller. As Raymond Noble and Denis Noble (2023) emphasize, “it is the cell as a system that controls” the cellular machinery, including the genome. They describe the genome not as a blueprint or set of instructions but as “a tool orchestrated by the system.” The point is not to deny genetic causation, but to recognize that genetic expression is embedded within a larger regulatory organization. More generally, gene activity depends upon epigenetic networks, signaling pathways, mechanical feedback, cellular context, and organism-level constraints.

Shapiro's (2022) work on what he calls natural genetic engineering similarly emphasizes the active role of cells in modifying and reorganizing genetic material, responding to stress, repairing DNA, and regulating expression.

The lesson is not that DNA is unimportant. It is that a template is not equivalent to the system that interprets and regulates the template. That distinction is fundamental. A template specifies possibilities. The cellular system determines how those possibilities are expressed under particular circumstances. Consequently, biological organization cannot be adequately described by a one-way causal picture such as

$$DNA \rightarrow organism.$$

The actual biological architecture is more like a network of reciprocal constraints:

$$genome \leftrightarrow cell \leftrightarrow organism \leftrightarrow environment.$$

And because these levels continually constrain one another, biological regulation is inherently multiscale. This is a movement from DNA as template toward distributed regulation.

7. Why this is more than an analogy

At this point it is possible to make the central claim more carefully.

The argument is not: DNA literally is Saussure's signifier–signified dyad. Nor is it: Cellular regulation literally is Peirce's interpretant. Those claims would be unnecessarily strong. The defensible claim is structural:

In each case, a generative relational structure is insufficient by itself to account for the persistence of an organized whole; additional regulatory relations are required.

The pattern is:

Domain	Generative structure	Regulatory structure
Semiotics	Dyadic relation	Interpretant / Thirdness
Biology	Genetic template	Cellular and organismic regulation
Algebra	Binary bracket	Jacobi constraint
General systems	Relational possibilities	Feedback/homeostasis

The comparison therefore concerns logical roles, not physical identities.

8. Lie algebra: the mathematical version of the same architecture

Smith’s (2026) Lie algebra example makes the argument particularly interesting because here the distinction can be stated with mathematical precision.

A Lie bracket is a binary operation:

$$[x, y].$$

Two elements enter into a relation and produce another algebraic element.

In this limited structural sense, the bracket is dyadic.

But a Lie algebra is not defined merely by possessing a binary operation. The bracket must satisfy specific conditions, most importantly the Jacobi identity:

$$[x,[y,z]]+[y,[z,x]]+[z,[x,y]]=0.$$

Notice something important. The bracket itself involves two arguments. But the Jacobi constraint concerns the consistent organization of three interacting elements.

The issue is not that three objects are magically more powerful than two. Rather, the third-order relation prevents different ways of nesting the binary operation from becoming mutually inconsistent.

This is why the Lie-algebra example can illuminate the template/regulation distinction. The bracket provides a generative operation. The Jacobi identity constrains the way that operation can compose with itself. Together they form the algebraic structure.

Thus:

$$binary\ generation + higher-order\ constraint \rightarrow coherent\ algebra$$

This is the relationship between the dyadic Lie bracket and the triadic Jacobi identity.

One should nevertheless preserve an important mathematical qualification: the Jacobi identity is not literally “Peirce's Thirdness,” nor is every triadic relation a Jacobi identity. The value of the comparison lies in the shared organizational principle: a binary generative operation requires constraints on its composition if a coherent higher-order structure is to result. That makes the analogy defensible rather than extravagant.

9. The deeper pattern: generation produces plurality; regulation produces coherence

We can now formulate the central distinction more rigorously.

A generative relation answers: What can be produced from what?

A regulatory relation answers: Under what constraints can what is produced remain part of a coherent system?

These are different questions. The first concerns possibility. The second concerns organization. This explains why the dyad is indispensable but incomplete.

The dyad gives us:

- difference,
- plurality,
- relationality,
- generativity.

Thirdness gives us:

- mediation,
- continuity,
- constraint,
- regulation,
- coherence.

The dyad is necessary. The triad is sufficient only within a provisional domain, it represents the minimal form of self-mediating regulation. “Necessary” does not mean that every conceivable system must literally contain two objects. It means that differentiation requires relational distinction. “Sufficient” does not mean that merely writing down three terms automatically creates a functioning system. It means that a third-order regulatory relation supplies the additional structural ingredient required to close the loop of mediation.

In other words, the claim is about functional sufficiency within the architecture under discussion, not a universal numerical law that everything in reality must occur in threes.

10. From opposition to complementarity

There is an even deeper consequence.

If the dyad is understood merely as opposition, then the two sides can appear locked in an endless conflict:

$$A \;\; versus \;\; B.$$

But if the dyad is embedded in a triadic structure, the relation becomes:

$$A \leftrightarrow B \;\; within \;\; M,$$

where M is the mediating or regulating relation.

The middle term does not abolish the two sides. It preserves their distinction while regulating their relationship. This is why the concept of a homeostat is more precise than the concept of a simple synthesis.

A synthesis might suggest that A and B disappear into some third thing C. Homeostatic mediation says something different: $A \neq B$, but $A\ and\ B$ remain dynamically coordinated through a regulating relation. The two sides remain two-sided. Their very persistence depends upon their regulated relationship.

This gives a more rigorous meaning to the idea of two-sidedness with a middle term, but understand that the emergence of M can be a third thing.

11. Meaning is therefore not contained in the template alone

The semiotic consequence is especially important. A symbol does not become meaningful simply because a formal pattern exists. Nor does information automatically become meaning merely because correlations can be detected. Meaning emerges when a relation participates in an interpretive organization.

This is why the interpretant matters. Peirce's contribution can therefore be read as identifying a fundamental problem that purely dyadic structuralism leaves open:

$$relation \neq interpretation.$$

The relation provides the antecedent structure. Interpretation regulates what that relation means within an ongoing process.

This also explains why semiosis can continue indefinitely. An interpretant can itself become part of a subsequent sign relation. Meaning does not terminate in a single static object; it propagates through an organized chain. Peircean semiosis needs a structure capable of regulating an indefinitely continuing interpretive process.

Thus, Thirdness should not be imagined as a final answer that stops interpretation. It is the principle that makes continuing interpretation possible without reducing it to arbitrary succession. Likewise, Koestler’s holarchy is permitted to complexify beyond the pattern provided by one Janus-faced holon.

12. Biology makes the same point in physical rather than semantic form

The biological case removes another possible misunderstanding.

If DNA is called a “template,” that does not mean it is passive in the ordinary sense. A template can be extraordinarily causally consequential.The point is narrower: The information-bearing DNA template does not contain, in isolation, the complete set of conditions required for its own expression. Levin (2023) makes the distinction particularly sharply, genomes “encode biophysical hardware, not final anatomical outcomes.” The genome therefore provides important generative resources without constituting the complete developmental system. The physiological and bioelectrical dynamics of the cells provide an additional regulatory layer through which those resources are interpreted and organized into anatomical form.

The cellular environment participates. Regulatory networks participate. Feedback participates. Mechanical conditions participate. Organism-level organization participates. The result is not a denial of genetic causation. It is a rejection of genetic exclusivity. That distinction is essential. Biological organization is distributed regulation extending across cell, organism, and environment.

The analogy with semiotics then becomes clearer. In both cases, the information-bearing structure is not the complete explanatory unit. A template needs a context in which it can be read, acted upon, constrained, and incorporated into a larger organization.

13. Why the same architecture can appear in mathematics

Mathematics offers a particularly clean demonstration because it strips away the biological and psychological complications.

Take the Lie bracket. The operation $(x, y) \mapsto [x, y]$ is a generator of algebraic structure.

But arbitrary binary operations do not constitute Lie algebras. The Jacobi identity imposes an additional condition: $[x, [y, z]] + [y, [z, x]] + [z, [x, y]] = 0$.

This condition concerns the consistency of relations generated at a higher level.

The structure therefore has two logically distinct components:

1. an operation that generates relations, and

2. a constraint that regulates how those relations compose.

That is precisely the distinction between template and regulation. The mathematical example is valuable because it demonstrates that the distinction does not depend on biological language, subjective experience, or metaphysics. It is already present in formal structure.

14. The broader scientific proposition

Whenever a system is generated by relational operations, explaining the existence of a coherent and persistent organization requires attention not only to the generative relations but also to the constraints that regulate their composition and preserve system-level coherence.

This principle can be investigated independently in semiotics, biology, mathematics, and systems theory. It also gives a precise interpretation to the intuition that the whole cannot always be reduced to the relations among its parts.

The whole introduces constraints on the parts. But those constraints need not be mysterious. They may take the form of feedback, boundary conditions, conservation laws, algebraic identities, regulatory networks, interpretive processes, or other mechanisms of organized constraint.

15. The triad is a scaffold, not an experience

There is one final distinction that should be preserved carefully. A triadic structure is not itself conscious experience. Nor does the existence of Thirdness prove consciousness, purpose, agency, or subjective meaning in every system in which a third-order relation occurs. Peirce's triad is described as a structural condition for meaningful experience, not as experience itself.

That is an important safeguard. The argument does not require us to anthropomorphize algebra. It does not require us to claim that DNA “thinks.” It does not require us to claim that a homeostatic mechanism possesses consciousness.

Instead, the claim is structural: regulation is a prerequisite for organized persistence, and interpretation is a specialized form of regulation.

Once this distinction is maintained, the cross-disciplinary comparison becomes considerably more defensible.

16. Conclusion: From template to living system

The central insight can now be stated in its simplest form.

A dyad creates distinction. Distinction creates relation. Relations generate possibilities. But possibilities do not automatically constitute a coherent system. For that, relations must themselves be regulated. The mediating relation need not be just externally imposed; it may emerge from recursive interactions between the poles themselves.

Peirce expresses this in semiotics through Thirdness. Biology expresses it through the distributed regulation of genetic templates. Lie algebra expresses it through the constraints imposed by the Jacobi identity. In each case, the essential issue is not the number three as a mystical principle, but the appearance of a higher-order relation that regulates relations.

Thus, the architecture can be written schematically as:

$$Dyadic\ generation \longrightarrow plurality \longrightarrow triadic\ regulation \longrightarrow coherence$$

Peirce (1903b) writes in his lecture notes, “Thus, my assertion at the end of the last lecture appears to be most amply justified. Thirdness pours in upon us through every avenue of sense.” Peirce has just reasoned from the perceived succession of events to a general relation that governs possible cases. Peirce's Thirdness is associated with generality, mediation, continuity, and law-like determination that is indicative of structure; commentators such as Potter (2019) have consequently treated “law” as a central expression of Thirdness. The generality is abstraction, but described again as triadic semiosis interfacing with the highly expressive and experiential. The dyad is therefore not something to be discarded. It is the indispensable source of differentiation. Nor is the triad an arbitrary addition. It represents the transition from a relation that can generate structure to a system capable of maintaining organized relations.

That is the fundamental distinction between a template and a system.

And it provides a rigorous foundation for the broader proposition that two-sidedness naturally raises the question of a middle term—not as a third object added to two existing objects, but as a regulatory relation through which the two sides can remain distinct while participating in a coherent whole. This is the common architecture linking Saussure and Peirce, biology, and algebra.

The resulting picture is neither reduction of the whole to its parts nor abandonment of rigorous analysis in favor of metaphor. It is a proposal to distinguish two questions that are too often conflated:

What generates the structure?

What regulates the structure once generated?

The first question belongs to the dyad. The second introduces Thirdness. And the passage from one to the other is the passage from template to system.

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