Structured Dialectics: A Generative Framework for Systems Analysis, Theory Completion, and Worldview Transformation

Abstract

Purpose: To introduce Structured Dialectics (SD), a generative framework for operationalizing dialectical reasoning in systems analysis, theory completion, and ontology construction.

Design/methodology/approach: SD selects a thesis, generates its antithesis, and decomposes both into constructive and exaggerated poles to form a balanced tetrad. Generative rules establish complementarities, contradictions, and synthesis conditions. Examining whether a thesis fosters its constructive antithesis (A^+) helps expose conceptual absolutizations and reconsider underlying worldviews. Corrective transitions establish circular causality, fostering self-regulation, theory completion, and innovation.

Findings: SD demonstrated applicability across natural, engineered, cognitive, and institutional systems, while offering a means to reduce categorical thinking, broaden perspectives, and foster more balanced, strategic reasoning.

Research limitations/implications: The framework is demonstrated through exploratory applications; quantitative validation of its generative performance was not performed.

Practical implications: SD offers tools for diagnosing systemic imbalances, identifying leverage mechanisms, and auditing personal and institutional assumptions and decisions.

Social implications: SD may help overcome binary thinking and quick-fix temptations, strengthen critical self-reflection and personal discernment, and foster accountability and self-regulation. This may change how we view fact-checking and regulation, helping transform societal governance from strict top-down control toward more balanced bottom-up participation.

Bureaucracies and institutions may change from within as people replace linear thinking with dialectical reasoning.

Originality/value: SD extends Hegelian dialectics into a two-dimensional semantic framework, treating thesis and antithesis as distinct bipolar dimensions. This enables explicit synthesis conditions and provides a basis for distinguishing genuine, sustainable solutions from self-deceptive imitations that perpetuate systemic pathologies.

Keywords: Structured Dialectics; Systems Thinking; Dialectical Reasoning; Ontology Construction; Systems Analysis; Human–AI Collaboration

1. Introduction

How do we know if a system, theory, or policy is fundamentally complete? Most methodologies either optimize existing parameters for immediate efficiency (exploitation) or map the unknown to discover structural omissions (exploration), but rarely both simultaneously (March, 1991). In systems science, "hard" approaches excel at parameter optimization but remain blind to structural omissions, while "soft" approaches reveal hidden perspectives but offer no clear path to optimize them (Checkland, 2000; Jackson, 2003).

Meadows (1999) demonstrated that intervening at the level of parameters is the lowest-leverage way to change a system, whereas altering the underlying paradigm or ontology is the highest. When a system is stuck in low-leverage optimization, it develops structural pathologies where maximizing one variable destroys another (Ackoff, 2004; Gall, 1975; Sterman, 2000). Consider, for example, growing efficiency that eventually suppresses innovation, economic growth that degrades the environment, or security that erodes freedom. Resolving these systemic pathologies cannot be achieved by tweaking existing parameters; it requires shifting fundamental worldviews that transcend the underlying binary conflict (Ackoff, 2004; Checkland, 2000; Meadows, 1999). Supplementary Table S1-I illustrates these limitations across scientific and philosophical dichotomies.

We propose Structured Dialectics (SD), a generative framework applicable across multiple levels of abstraction (Table I). Based on modified Hegelian dialectics, SD views

opposing viewpoints—Thesis (T) and Antithesis (A)—as bipolar semantic dimensions (Author, 2025). Much like Polarity Management (Johnson, 1992), each dimension maps both constructive (+) and destructive (−) aspects. When formalized and paired with generative AI, this structure explicitly reveals blind spots and provides transition pathways toward synthesis.

Table I. Potential contributions of Structured Dialectics (SD) across application levels

Application Level	**SD Contribution**	**Illustrative Use Cases***	**Closest paradigms**
Understanding existing systems	Revealing blind spots, hidden complementarities, and leverage mechanisms	Biological, psychological, economic, engineered, and social systems	Polarity Management; Systems Thinking
Improving / designing systems, completing theories	Generating Transition Matrices, corrective interventions, synthesis principles, and new frameworks	Conflict resolution; organizational improvement; Resilience Engineering; SDD; Developmental Psychology; Relativity	System Dynamics; Dialogic Design; TRIZ; Integrative Theories
Revising fundamental concepts & institutions	Exposing conceptual absolutizations, auditing institutional authority, and enabling worldview shifts	Fact-checking; regulatory auditing; ideological bias; redefining fundamental concepts	Critical Systems Thinking; Responsive Regulation

***** Many analyses are provided in the Supplementary Material

The first two application levels in Table I focus on understanding, improving, and completing existing systems or theories. The third extends the same machinery toward iterative worldview shifts through re-examination of the foundational concepts by which systems are interpreted. This layer could provide a cognitive basis for transforming institutional governance through dialectical education, public scrutiny, and more accountable selection of decision-makers.

In addition, SD also offers a potential computational advantage because splitting reasoning into formal steps consistently enhances LLM performance (Wei et al., 2022; Zhou et al., 2023).

2. Dialectical Framework

2.1. Simplified View

The framework is based on the three-step procedure illustrated in Fig. 1. The first step identifies the major thesis (T)—what we explicitly assert—and its semantic antithesis (A)—what opposes T even if we are not aware of it. For instance, if we say T = "Follow the rules", we immediately generate the antithesis A = "Question the rules". The semantic antithesis is not optional but an absolute necessity that reveals our blind spots.

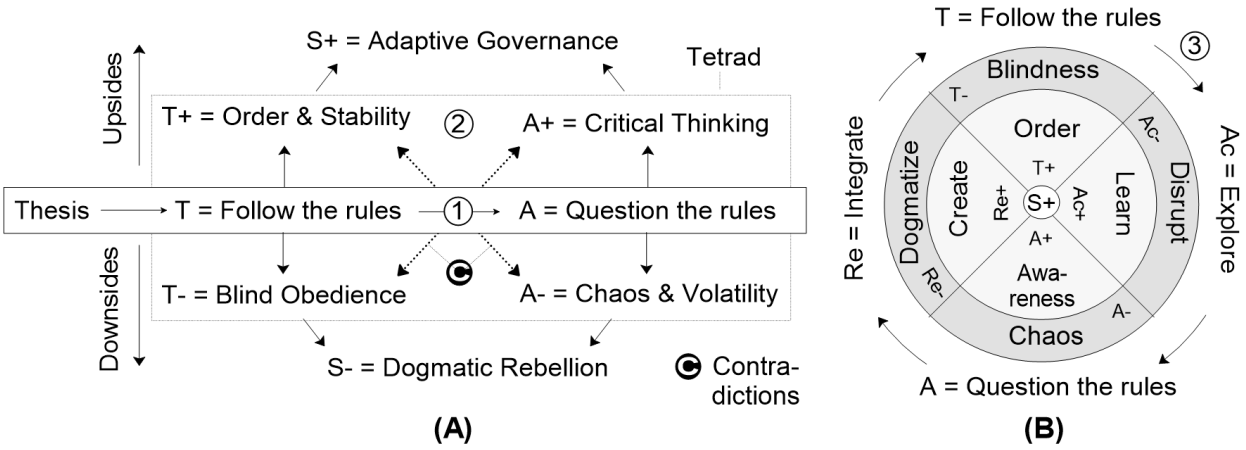

Fig. 1. Construction of the simple wheel.

The second step identifies the constructive and destructive aspects of each pole. The diagonal pairs (T+/A− and T−/A+) must form direct contradictions (dotted arrows in Fig. 1), thereby balancing the overall tetrad. For synthesis to take place, all components must possess equal argumentative and affective strengths. For instance, T+ = Order & Stability constrains A− = Chaos & Volatility, which cannot be replaced by either a weaker opposition, such as "Uncertainty & Fluidity", or a stronger consequence, such as "Destruction & Collapse".

Notably, T^+, T^-, A^+, and A^- can be interpreted as perceived goals, risks, obligations, and threats, respectively. The extent to which a thesis fosters A^- or A^+ reflects its underlying bias or constructivity, respectively.

The third step identifies the circular transitions between the poles, indicating the Actions (Ac) and Reflections (Re) that enable self-regulation. In practice, the wheel is often reduced to its constructive (+) transitions, yielding a minimum intervention plan.

Supplementary Section S2.1 provides an extended workflow for the analysis of multiple theses, while Section S2.2 provides glossary of all terms considered in this analysis. In short, T+ and A+ denote balanced (constructive) aspects of thesis and antithesis, T- and A- – their exaggerated (destructive) aspects, S+ and S- – positive (quality/complementarity-driven) and negative (quantity/dominance-driven) synthesis, whereas Ac+ and Re+– Action (T- → A+) and Reflection (A- → T+). When considering multiple theses (T1, T2, …) and/or antitheses (A1, A2, …), we also consider generalized Transition (X- → Y+) denoted as Tr(X, Y)+.

2.2. Thesis and Antithesis Selection

Thesis Selection. Selecting the appropriate thesis determines the 50% success of the subsequent analysis. Ideally, the thesis should capture the underlying causal mechanisms rather than surface symptoms (see Supplementary Section S2.3). Often, a simple prompt suffices: "Suggest the major idea or thesis of a given text in just a few words."

Antithesis Selection. Often, the antithesis is already given by the context. Otherwise, it should be selected to yield the greatest qualitative change with the least effort. The following prompt can be used: "For a given thesis T, suggest its major opposition or antithesis A, such that the positive aspect of T (T^+) contradicts the negative aspect of A (A^-), and the negative aspect of T (T^-) contradicts the positive aspect of A (A^+)." This works well in most cases, especially when T represents a binary choice for which direct negation is sufficient (e.g., True vs. False, Approval vs. Disapproval).

Crucially, formal logic and semiotic models, such as the Semiotic Square (Greimas & Rastier, 1968), distinguish logical negation (Not–T) from other forms of opposition. However, dialectical synthesis requires tension between two functionally meaningful alternatives, rather than between a concept and its mere absence. Thus, Not–T often represents a broader transition domain away from T, rather than the principal semantic antithesis capable of generating synthesis. Since T may fulfill multiple functional roles, it may admit several distinct antitheses (Fig. 2).

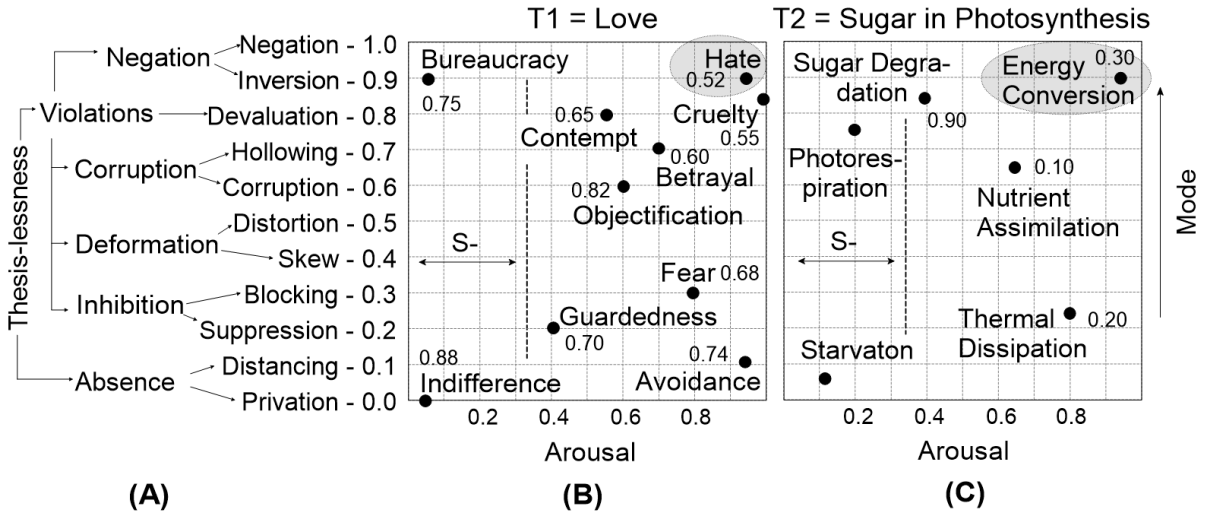

Fig. 2. Taxonomy of antitheses. Dashed ovals represent the most potent choices.

Scheme A groups antitheses into a potentially universal taxonomy, distinguishing absence from functional violation. Rather than asking "What negates T?", the key question becomes "What functionally opposes the role played by T?"

Schemes B and C position candidate antitheses along two axes: Mode (interaction mechanism) and Arousal (activation level). We hypothesize that these coordinates help distinguish generative antitheses, capable of producing S^+, from void antitheses, which inhibit synthesis and favor S^-. Candidates with high Mode and Arousal values generally appear most promising (upper-right region). Supplementary Section S2.4 provides detailed examples and procedures for more complex cases.

2.3. Constructing Balanced Tetrads

Tetradic Constraints. For a given T/A pair, the constructive (T^+, A^+) and destructive (T^-, A^-) aspects must satisfy three conditions: (1) T^+ and A^+ mutually enhance each other; (2) each negative pole represents an overdevelopment of its parent concept and an underdevelopment of its complement; and (3) T^+ directly contradicts A^-, while T^- directly contradicts A^+. These constraints provide independent semantic consistency checks (Supplementary Section S2.5).

Modality Alignment. Each concept possesses an argumentative strength and affective intensity, constituting its Modality (M), such that in a balanced system absolute modality values are all equal:

$$M(\mathrm{T}+) = -M(\mathrm{T}-) = M(\mathrm{A}+) = -M(\mathrm{A}-) = m. \qquad (1)$$

Violating this requirement causes one pole to dominate, favoring S− over S+. Modalities can be approximated *via* average complementarities to the Thesis (K_T) and Antithesis (K_A) which can be estimated by a simple prompt (e.g., "for each component estimate its numeric complementarities to T and A, each varying from 0 to 1"):

$$K_S = (K_T + K_A)/2 \qquad (2)$$

For a more elaborate prompt, see Supplementary Section S2.6. Fig. 3 illustrates typical values for balanced and distorted systems.

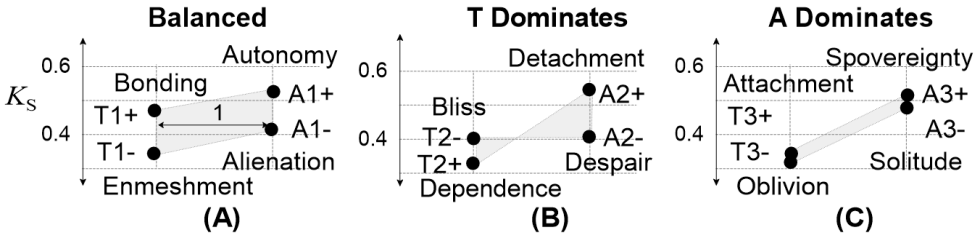

Fig. 3. Complementarity diagrams. T = Love, A = Hate.

The skewed shapes in Fig. 3 indicate judgmental bias, suggesting various symmetry rules explored in Supplementary Sections S2.7-S2.8. Intuitively, balanced systems maximize the geometric area enclosed by the complementarity diagram. Accordingly, the most useful empirical parameter proved to be the difference between the average complementarities (K_S) of the positive and negative poles:

$$\mathrm{SP} = K_S(\mathrm{T}+) + K_S(\mathrm{A}+) - K_S(\mathrm{T}-) - K_S(\mathrm{A}-) \qquad (3)$$

Here SP denotes the Synthesis Potential that may be viewed as "dialectical work," by analogy with the area of a hysteresis loop. Corresponding modalities are approximated by the simple linear correction $M(\mathrm{X}) \approx K_S(\mathrm{X}) - (K_S)_{\mathrm{Avg}}$.

Control Statements. A balanced tetrad must satisfy two complementary conditions:

T+ without A+ yields T-, while A+ without T+ yields A-

These statements test whether we correctly understand the synthesis conditions. For instance, for T = Love, A = Hate we obtain: "Bonding (T_1^+) without Autonomy (A_1^+) yields Enmeshment (T_1^-), while Autonomy (A_1^+) without Bonding (T_1^+) yields Alienation (A_1^-)." Each statement can be characterized by the semantic meaningfulness and dialectical validity that provide additional AI-estimated criteria when SP alone is insufficient (Supplementary Section S2.9).

Ontology Profiling. The same T/A pair may generate alternative valid tetrads depending on the underlying worldview. The Mind–Matter Index (MMI) estimates this orientation from materialism (MMI = 0) to idealism (MMI = 1). Lower-MMI formulations generally favor optimization within existing ontologies, whereas higher-MMI formulations favor reconsidering fundamental assumptions. Thus, selecting a tetrad requires considering not only its Synthesis Potential but also its ontological suitability (Supplementary Sections S2.10 – S2.11).

2.4. Modelling Synthesis and Pathologies

Synthesis prediction asks whether and how a genuinely new organization can emerge. Such predictions confront a longstanding tension between holistic integration and reductionist control (McGilchrist, 2009), and between mechanistic and self-organizing accounts of system behavior (von Bertalanffy, 1968; Kelso & Engstrøm, 2006). Table II summarizes these contrasting worldviews.

Table II. Comparison of S+ and S- worldviews

	Positive Synthesis (S+)	**Negative Synthesis (S-)**
Ontology	Self-organization via emergence of new dimensions while reducing local extremes	Conservation of existing dimensions while amplifying selected extremes
Principle	Requisite variety, complementarity	Hierarchy, specialization, control
Logic	Whole exceeds sum (1+1>2)	Conservation (1+1=2), competition (1+1< 2), binarity (false/true)
Examples	Family, stereo vision, ecosystems, synergy	Top-down management, domination

Both synthesis modes are indispensable: S^+ generates new existential dimensions by providing purpose, whereas S^- preserves and stabilizes existing ones. Pathology arises when S^- structurally mimics S^+ while suppressing its generative capacity, as illustrated by tumor development (Vinnitsky, 2014) and institutional pathologies ranging from bureaucratic rigidity (Merton, 1940; Crozier, 1964) to Machiavellian manipulation (Dahling et al., 2009) and Orwellian control (Orwell, 1949; Scott, 1998).

While prevailing assumptions often associate such reductionist pathologies exclusively with physical or mechanistic systems (Habermas, 1987), Figure 4 illustrates that both S+ and S- modes occur across the entire Mind–Matter Index (MMI) scale. As this topography maps out, S- pathologies can ossify just as easily within idealistic domains (Dogmatic Ideology) as they do within materialistic ones (Technocracy). The longer these traps remain obscured, the more resistant to future intervention they become.

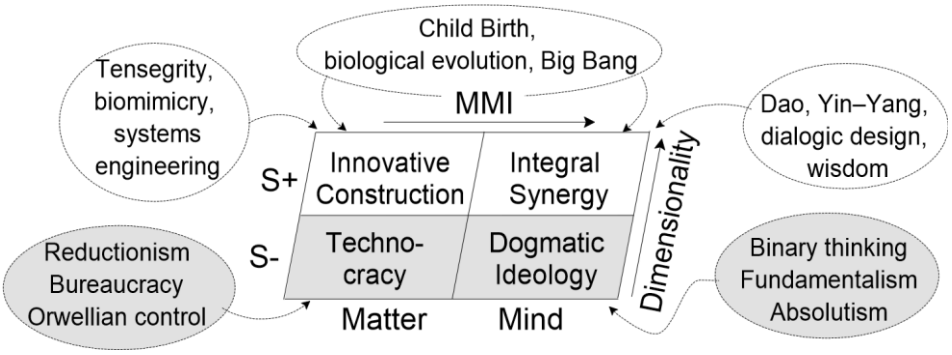

Fig. 4. S± vs MMI conceptual space.

Synthesis. Figure 1 illustrates that synthesis occurs exclusively between like-signed components. Positive synthesis takes place between T^+ and A^+, while negative synthesis occurs between T^- and A^-. No direct interaction is possible between undifferentiated or oppositely signed poles—such as T and A, T+ and A-, or T- and A+—because these represent direct oppositions or contradictions. Similarly, no direct interaction is possible between T^+ and T^- or between A^+ and A^-, as these correspond to different developmental levels of the same phenomenon. Detailed classifications and examples of S+ and S- outcomes are provided in Supplementary Sections S2.12–S2.13.

2.5. Circular Causality and Transitions

Circular Causality. Positive synthesis (S+) requires two complementary transitions occurring simultaneously: Ac^+ transforms T^- into A^+, while Re^+ transforms A^- into T^+. This follows directly from the definition of synthesis as the emergence of a new self-regulating organization that requires a closed loop of reciprocal causation (Fig. 5).

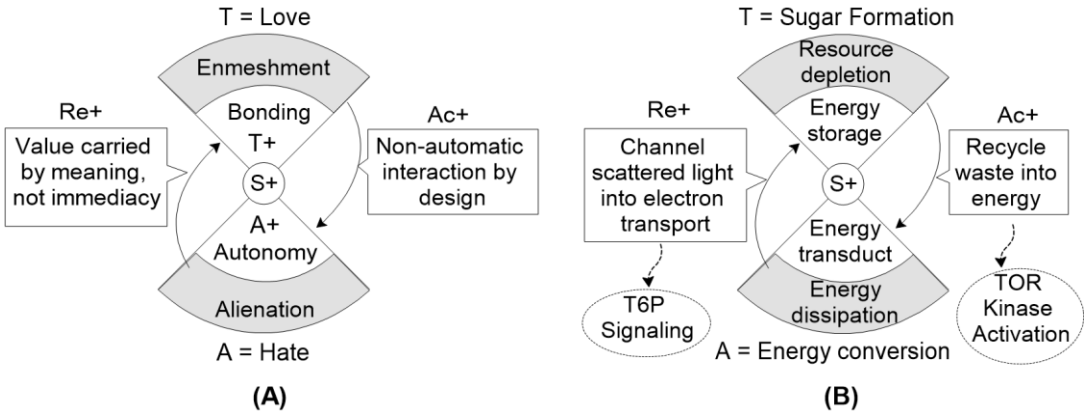

Fig. 5. Minimum self-regulatory cycles illustrating synthesis for (A) Love/Hate and (B) Sugar Formation/Energy Conversion.

Transitions are shown by the curved arrows. They can be generated by simple prompts, e.g. "suggest how to transform T− into A+ and A− into T+". Dashed arrows denote optional recursive prompts for further elaboration. Supplementary Section S2.14 introduces taxonomies of transition sophistication spanning different levels of insightfulness and proactiveness. Supplementary Section S2.15 relates the proposed operators to Greimas' semiotic square (Greimas & Rastier, 1968), providing an additional heuristic when direct AI prompting proves insufficient.

Balanced Transitions. When both constructive and destructive transitions are considered, Ac^+, Ac^-, Re^+, and Re^- form another tetrad, subject to the same symmetry constraints as the original T/A system. Thus, Ac^+ contradicts Re^-, while Ac^- contradicts Re^+. Furthermore, Ac^+ without Re^+ yields Ac^-, whereas Re^+ without Ac^+ yields Re^-.

Multi-Thesis Wheels. So far, the analysis has considered transitions within a single T/A tetrad. Real systems, however, usually involve several interacting tetrads that may come from one or more theses. These tetrads must then be arranged into causal sequences that preserve the

geometrical constraints of each tetrad. Figure 6 illustrates this procedure for a two-thesis photosynthesis cycle with T_1 = Sugar Formation and T_2 = Light Absorption.

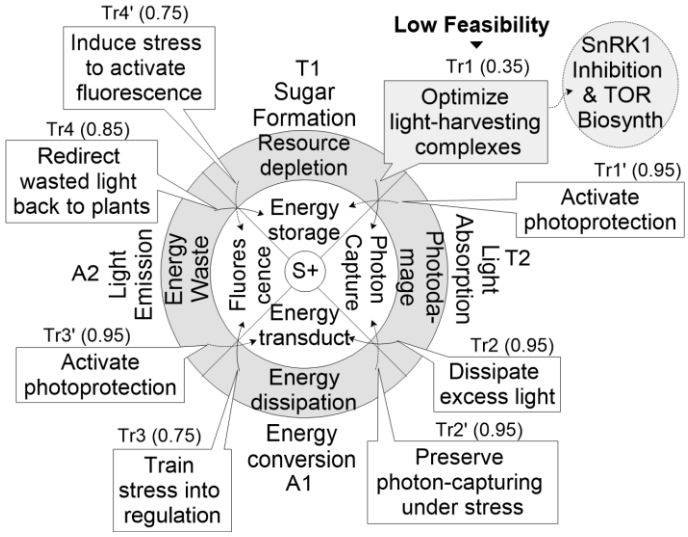

Fig. 6. Some transition steps for T1 = Sugar Formation, A1 = Energy Conversion, T2 = Light Absorption, A2 = Light Emission (Calvin cycle).

The resulting wheel admits two valid sequences: $T_1 \rightarrow T_2 \rightarrow A_1 \rightarrow A_2 \rightarrow$ (clockwise) and $T_1 \rightarrow A_2 \rightarrow A_1 \rightarrow T_2 \rightarrow$ (counterclockwise), with T_x always remaining diagonal to A_x. By contrast, the sequence $T_1 \rightarrow A_1 \rightarrow T_2 \rightarrow A_2 \rightarrow$ is prohibited because it violates the tetrad geometry. More generally, for n theses (T_1, …, T_n) with n corresponding antitheses (A_1, …, A_n), this constraint reduces the number of possible permutations from $(2n)!$ to $(2^{\wedge n}\, n!/2n)$, i.e. by approximately $3n^{\wedge n}$-fold (Supplementary Section S2.16). Each remaining sequence can then be evaluated for practical feasibility, yielding one or more candidate causal sequences.

Transitions' Matrix. The resulting multi-thesis wheel is then completed by generating actionable transitions that transform each negative pole (Tx− or Ax−) into every positive pole (T_1+, …, A_1+, …). The Ac+ and Re+ transitions of individual tetrads become special cases of the type $Ac_x^+ = Tr(T_x^- \rightarrow A_x^+)$ and $Re_x^+ = Tr(A_x^- \rightarrow T_x^+)$. Thus, although Fig. 6 depicts only two outgoing transitions from each node for clarity, every node is connected to two additional positive poles. Examples of complete transition matrices are presented below. In general, *m* tetrads generate $(2m)^{\wedge 2}$ possible transitions, creating a rich decision space for discovering new ontologies and optimization strategies.

3. Applications

The following examples illustrate the proof-of-concept generative capabilities of SD outlined in Table I. The framework was explored using the prototype AI application (Author, 2026a), based on the Claude Sonnet 4.5 engine, together with direct interactions with other generative AI models (GPT-5 and Gemini-3 Flash). The project is being developed as an open-source framework, with code and prompts available in the public repository (Author, 2026b). Most analyses involved several prompting iterations, aiming to demonstrate the reproducible efficacy of the SD method rather than to guarantee verbatim semantic reproducibility. The principal advantage of SD lies in making ontological constraints explicitly visible, thereby facilitating human reasoning, synthesis, and its audit. Quantitative evaluation is left for future work.

3.1. Identifying Blind Spots and Leverage Mechanisms

Complex systems often contain so much information that their principal leverage mechanisms become difficult to identify. SD addresses this by progressively constructing dialectical wheels from individual theses (Figs. 5–6), or by starting with a minimal four-step cycle of circular causation (Supplementary Fig. S3-1). Unlike bottom-up models, which may suffer from the "hairball effect" of excessive complexity (Kitano, 2002; Sterman, 2000), SD offers top-down guidance by identifying key causal relationships through symmetry constraints. Supplementary Sections S3.1–S3.9 extend the analysis across socio-economic, political, cognitive, and technical systems, revealing further potential blind spots and leverage mechanisms. These analyses also suggest a relationship between self-regulatory capacity and the number of feasible dialectical sequences (Supplementary Fig. S3.1-1). Such analyses may help fact-checkers, regulators, and other institutional decision-makers identify blind spots with significant societal consequences (see below).

3.2. Improving Systems: Conflict Resolution

Consider a conflict between two stakeholders with remarkably different positions. A global mining corporation claims to create jobs (T1), while a local community claims that the corporation destroys the environment (T2). Supplementary Fig. S4.1-1 illustrates one possible conflict-resolution scenario based on two representative tetrads arranged into a dialectical wheel

with AI-suggested transition steps. Each step transforms the negative aspect of one stakeholder's position into a constructive aspect of the other, creating an iterative process that gradually moves toward mutually beneficial outcomes. Table III generalizes this idea into a Transition Matrix that maps each pathological pole to every constructive pole, thereby expanding the space of possible interventions.

Table III. Example of Transitions' Matrix

Negative pole	**→ T1+ Economic growth**	**→ A1+ Environmental care**	**→ T2+ Spiritual harmony**	**→ A2+ Business freedom**
T1− Pure exploitation	Fair revenue sharing	Independent environmental audits	Respect indigenous values	Responsible innovation with transparent standards
A1− Economic stagnation	Green investment and local employment	Community-led conservation projects creating jobs	Eco-tourism and cultural enterprises	Simplified permits for sustainable businesses
T2− Over-regulation	Risk-based permitting	Adaptive environmental regulation	Continuous dialogue instead of blanket prohibitions	Streamlined compliance with measurable outcomes
A2− Spiritual decay	Invest in local education and heritage	Restore damaged ecosystems	Cultural co-management and stewardship	Ethical entrepreneurship respecting local identity
Life Principle	**Share fairly; Be just**	**Protect life; Be caring**	**Build together; Be cooperative**	**Tell the truth; Be honest**

Supplementary Table S4.1-I provides additional tetrads for extending the decision space. Supplementary Section S4.2 provides prompt for generating such a matrix, while Section S4.3 presents a similar analysis for reconciling Requisite Variety and Requisite Parsimony.

Likewise, Structured Dialogic Design (SDD) produces Influence Maps that provide a natural starting point for constructing dialectical wheels. The resulting wheels may reveal overlooked implementation prerequisites that are not immediately apparent from the Influence Maps (see Supplementary Sections S3.7 and S3.8). SD may also help formulate additional

triggering questions as new considerations emerge (e.g., “How can T+ be achieved while fostering A+ and/or avoiding T− and A−?”).

3.3. Completing Theories

Many theories are organized around competing paradigms whose integration remains incomplete. Table IV summarizes selected T/A oppositions across several theories, together with syntheses and recommendations derived from the corresponding Transition Matrices.

Table IV. Summary of theory and ontology completion from Supplementary Sections S4.1-S4.8

Theory	**T**	**A**	**Synthesis**	**Summary Recommendations**
Organizational Ambidexterity (March, 1991)	Exploitation	Exploration	Self-correcting organizational learning	Continuously challenge successful routines. Turn exploration into learning and practice. Optimize across the whole organization, not locally.
Resilience Engineering (Hollnagel, 2014)	Safety I	Safety II	Bounded Adaptive Autonomy	Continuously learn from both success and weak signals. Adapt rules to context within red lines. Delegate operational autonomy within clear limits.
SDD (Christakis, 2025)	Requisite Variety	Requisite Parsimony	Structured collective sense-making	Preserve diversity, yet focus on what matters. Build shared meaning before deciding. Map key relationships without over-formalizing.
Developmental Psychology (Kegan, 1982)	Socialized Mind	Self-Authoring Mind	Relational Autonomy	Develop autonomy without losing connection. Question conformity while accepting shared responsibility. Integrate self-determination with compassion for others.
Theory of Relativity (Einstein)	Theory of Relativity	de Broglie-Bohm formalism	Covariant Nonlocal Geometry	Covariantly couple quantum dynamics to geometry. Geometrize nonlocal quantum guidance. Preserve Lorentz covariance without imposed foliation.
	Theory of Relativity	Bohm’s Implicate Order	Empirical Deep Ontology	Seek deeper order beyond observable structure. Preserve causal traceability within holistic connection. Ground deeper interpretations in observable reality.
Conflict Resolution	We bring jobs	They destroy nature	Regenerative economic partnership	Share economic benefits fairly. Protect nature and local identity. Enable responsible business through transparent rules.

The Theory of Relativity provides a particularly revealing case because, unlike the preceding examples, it does not contain an obvious internal polarity from which to begin. SD

therefore starts by exploring candidate antitheses (Supplementary Fig. S2.4-1(D) and Section S4.5). Pairing Relativity with the de Broglie–Bohm formalism yields primarily physical/mathematical requirements, whereas pairing it with Bohm's Implicate Order yields broader ontological requirements. Thus, theory completion need not presuppose that the missing paradigm is already known. The same procedure extends beyond formal theories: conflict resolution and innovation design can be viewed as analogous completion processes (Supplementary Sections S4.1 and S4.9 – S4.10).

3.4. Auditing Fact-Checking

Conventional fact-checking rests on a fundamental limitation: every isolated fact is a partial truth, potentially supporting misleading conclusions and turning factual verification into institutionalized cherry-picking (cf. Suomalainen et al., 2025). Table V illustrates how a verified increase in antibody levels may be generalized into broader judgments about vaccination.

Table V. Dialectical audit of a factually correct claim

T = A vaccine booster increases antibody levels after administration	**A = Increasing antibody levels comes at the expense of other health outcomes**
Implied T: "Vaccination is good"	**Implied A: "Vaccination is bad"**
T+ = Enhanced immune protection against a specific threat	**A+ =** Preservation of overall health beyond specific antibody levels
T- = Antibody maximization at the expense of overall health	A- = Vulnerability to specific infections
	Re+ (A- → T+) = Test immunity gaps
	Ac+ (T- → A+) = Avoid unnecessary boosting; improve lifestyle
S- = Boost with maximum doses and frequency	S+ = Boost only after testing immunity gaps, then allow restoration via healthy lifestyle

The first column begins with a verifiable claim, while the second introduces a functional antithesis concerning broader health outcomes. Alternative antitheses may address waning antibody responses, intervention trade-offs, or other mechanisms of immune protection. These considerations highlight the complexity of adaptive immunity (Muraille, 2014), immune

imprinting (Francis, 1960; Wheatley et al., 2021), and population heterogeneity (Britton et al., 2020).

More broadly, fact-checking often reinforces fear-driven interpretations while overlooking deeper psychological and institutional causes (Soprano et al., 2024). Blind-spot identification (Section 3.1) should therefore be combined with SDD to shift attention from what to fear toward what to do (see the Global Climate Problematique analysis in Supplementary Section S3.8). The ability to distinguish actual dangers from interpretations that exaggerate them should become a primary criterion for evaluating fact-checkers, regulators, and other institutional decision-makers.

3.5. Auditing Regulations

Regulations suppress autonomy, initiative, and responsibility when their complementary functions are neglected (Stigler, 1971; Niskanen, 1971; Power, 1997; Muller, 2018). SD offers a formal framework for auditing regulations themselves, as exemplified in Table VI.

Table VI. Dialectical Audit of Institutional Regulation

T = Regulation	**A = Autonomy**
T+ = Safety, coordination, accountability	**A+ =** Initiative, responsibility, self-regulation
T- = Bureaucratic rigidity, suppressed judgment	**A-** = Recklessness, negligence, unaccountable behavior
	Re+ (A- → T+) = Accountability via Feedback
	Ac+ (T- → A+) = Bounded discretion
S- = Rigid enforcement of compliance regardless of actual outcomes	S^+ = Advisory by default, mandatory by exception; cultivate responsible autonomy within essential safety boundaries.

Thus, regulators must demonstrate not only how their rules prevent harm (T+), but also how they cultivate the positive capacities that regulation might otherwise suppress (A+). This approach extends the complementarity of Safety-I (preventing failures) and Safety-II (enabling successful adaptations; Hollnagel, 2014). Regulators thus become accountable for fostering self-regulation rather than merely enforcing compliance, consistent with responsive and polycentric governance (Ayres & Braithwaite, 1992; Ostrom, 2010). Supplementary Sections S4.7 and S4.9

illustrate this approach through Resilience Engineering and the Macondo Blowout analysis, respectively.

4. Discussion: Worldview Transformation

Perhaps the greatest advantage of SD is that it broadens our perspective through a simple procedure. Across diverse applications, it redirects attention from seemingly important yet short-lasting details toward the mechanisms determining long-lasting outcomes. This has particularly consequential implications for institutional accountability. Regulators evaluate others' compliance with established rules, while the validity of these rules and the judgments of regulators often escape equivalent scrutiny (Power, 1997; Argyris & Schön, 1978). SD provides a formal basis for such scrutiny. Table VII illustrates the deeper conceptual shifts needed to reconsider institutional assumptions.

Table VII. Conceptual Shifts Toward Dialectical Synthesis

T	Common Perception	A	A+*	Conceptual Shift	PC*
Truth	Reality, facts	Falsehood Imagination	Creativity Innovation	Truth is a process rather than a fact: T is true iff it fosters A+	0.3
Success	Achievement	Failure	Learning	Focusing on qualitative change	0.3
Logics	1 +1 = 2	Intuition	Holism	Whole exceeds sum: 1 + 1 > 2	0.2
Certainty	Absence of doubt	Uncertainty	Openness	The only certainty is uncertainty; Seek invariant principles rather than reproducible observations	0.2
Optimi-zation	Objective maximization	Deterioration Randomization	Acceptance Exploration	The optimizer's ontology is part of the optimized system	0.3

* PC is Perceived Complementarity (see the text). Supplementary Section S4.11 provides tetrads for these concepts and A+ with PC values for additional concepts

These shifts derive from the principle that *a thesis without constructive antithesis yields a degenerative state* (T without A+ yields T-). Thus, genuine synthesis (S+) depends on the degree to which T fosters A+, rather than on attempts to strengthen T+ directly. Strengthening T+ directly also strengthens A−, which in turn flips T+ into T−.

The PC (Perceived Complementarity) column estimates the extent [0,1] to which the conventional interpretation of T fosters its A+, averaged across two AI models (agreement within ca. ±0.1). The consistently low PC values suggest that many contemporary conceptualizations remain biased toward S− mentality, often imitating synthesis rather than fostering it. Although these estimates depend on AI judgments, the systematic divergence between A+ and common perception is notable. This interpretation is broadly consistent with Kahneman's (2011) distinction between automatic System 1 processing and deliberate reasoning, as well as Beck's (1976) description of binary ("all-or-nothing") cognitive distortions.

Ultimately, SD treats cognition itself as part of the optimized system, as suggested by Glanville (2004). The modality constraints (Eq. 1) suggest a simple inflation–conservation principle expressed through the proposed Synthesis Energy:

$$E(S+) = |M(T+)| + |M(T-)| + |M(A+)| + |M(A-)| \quad (4)$$

Under balanced synthesis (Eq. 1), $E(S^+) = 4m$, where m is the absolute modality of each pole. This suggests two institutional obligations: to minimize unnecessary argumentative and affective inflation, thereby lowering E(S+); and to audit not only the systems being governed but also the convictions and assumptions of those governing them. Ontology construction thus becomes a recursive component of systems optimization (Krippendorff, 2011), shifting authority from enforcing selected truths toward cultivating self-regulation. Overcoming institutional inertia remains a major challenge (Rumelt, 1995; Gilbert, 2005). Practical implementation should combine AI-assisted dialectical education with gradual decentralization rather than bureaucratic control (Ayres & Braithwaite, 1992; Ostrom, 2010).

5. CONCLUSION

This work presents Structured Dialectics (SD) as a generative framework for AI-assisted systems reasoning. By transforming theses into tetrads, Transition Matrices, and higher-level ontologies, SD reveals blind spots, leverage mechanisms, and hidden assumptions, enabling progressively deeper systems understanding and transformation.

Beyond optimizing individual systems, SD offers a potential framework for auditing and improving the institutions that govern society. By making constructive complementarities and

systemic obligations explicit, it seeks to overcome binary absolutizations and align scientific and institutional practices toward positive synthesis (S^+).

If further validated, SD could provide a common generative language for systems thinking and a foundation for transforming not only how systems operate, but also how societies evaluate success, exercise authority, and revise their fundamental worldviews.

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