Toward a Structural Model of Relationship Compatibility

A Systems-Theoretic Framework for Constraint Topology, Alignment Dynamics, and Pre-Commitment Stability via PLR Modeling

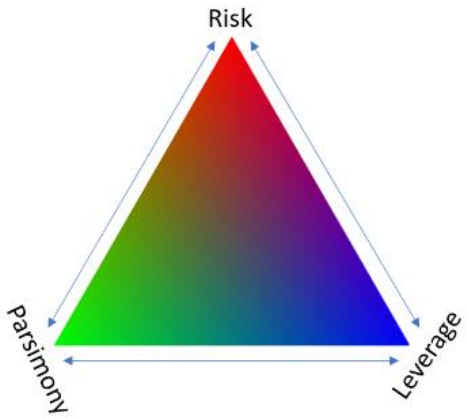
Abstract: Human relationships fail for reasons that are predictable, structural, and preventable. Most failures do not arise from moral defects, communication styles, or personality clashes as they are traditionally understood. They arise from a deeper and more universal mechanism: humans routinely use the wrong cognitive operating system when stakes shift from social to structural. Emotional reasoning—fast, connotative, harmony-seeking (ERM)—is the adaptive default for social life, bonding, attraction, and short-horizon navigation. But once a relationship transitions into a domain with high cost, irreversibility, legal entanglements, or shared assets, emotional reasoning becomes catastrophically misaligned with the problem type. These domains require Logical Reasoning Mode (LRM)—slow, constraint-aware, denotative reasoning optimized for stability, prediction, and contractual reality.

This paper proposes a first-principles, systems-theoretic model of relationship compatibility grounded in three primitives:

(1) cognitive mode selection,
(2) constraint topology, and
(3) behavioral gradients modeled through the Parsimony-Leverage-Risk (PLR) ternary space.

These primitives serve as axioms—proposed foundational constructs on which future empirical and clinical research can build.

Compatibility is reframed as an alignment problem under shared constraints. Two individuals carry non-negotiables (fixed constraints), negotiables (elastic constraints), and behavioral gradients (PLR). When two lifetimes merge into a joint trajectory, incompatible constraints or unstable gradient interactions produce failure modes that are not fixable by communication, love, or effort. Stability emerges only when the cognitive mode is correct (LRM for commitments), non-negotiables align topologically (only one partner may be rigid per axis), and PLR gradients exist in a manageable region of the behavioral manifold.



The framework is probabilistic, not deterministic. It is designed for researchers, clinicians, and AI systems seeking formalizable primitives for compatibility modeling.

Appendices provide:

(A) the mathematical sketch of PLR modeling;
(B) the correct, non-orthogonal geometry of the ternary space
(C) a statement of purpose and the intended meaning of “axiom” in this context.

ORCID: 0009-0004-5339-5373
DOI: 10.5281/zenodo.18050285
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Keywords

Cognitive Mode Selection; Emotional Reasoning Mode; Logical Reasoning Mode; Constraint Topology; Alignment Dynamics; Relationship Stability; Behavioral Gradients; PLR Model; Ternary Space; Non-Negotiables; Stress Testing; Masking; Pre-Commitment Analysis; Systems Psychology.

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1. Introduction: Why Relationships Fail Predictably

Most relationship failures—romantic and professional—are not mysterious. They follow stable, predictable patterns rooted in misapplied cognitive modes, undetected constraint conflicts, and behavioral gradients that become incompatible under load.

Humans evolved an operating system built for small groups, short feedback cycles, and limited resource entanglement. Modern relationships—marriage, co-founding, shared assets, shared liabilities, long-term co-dependence—operate on completely different physics: long time horizons, non-reversible commitments, asymmetric risks, and legal structures.

This mismatch—ancestral cognitive machinery vs. modern structural stakes—is the foundation of relationship instability.

Three primitives explain most failure modes:

1. **Cognitive Mode Error:**
   People rely on *emotional reasoning* (ERM) during the exact moments that require *logical reasoning* (LRM). Most catastrophic outcomes are caused by using the wrong operating system for the decision domain.
2. **Constraint Topology:**
   Each person carries fixed constraints (non-negotiables) and elastic constraints. When two rigid constraints collide on the same axis (e.g., children, religion, spending philosophy), the merged timeline becomes mathematically unsustainable.
3. **Behavioral Gradients (PLR Model):**
   Individuals express consistent tendencies in Parsimony, Leverage, and Risk. These gradients determine how they make decisions under uncertainty. PLR proximity predicts stability; PLR divergence predicts volatility.

This paper formalizes these primitives as axioms—not in the sense of proven laws, but as foundational constructs from which a predictive compatibility model may be built.

DOI: 10.5281/zenodo.18050285 ORCID: 009-0004-5339-5373 ROR: [pending]

2. The Modal Fork: ERM vs. LRM

Human cognition runs two operating systems for dealing with other people.
Understanding them—especially the transition between them—is the core of relationship stability.

2.1 Emotional Reasoning Mode (ERM)

ERM is fast, reflexive, and computationally cheap. It is driven primarily by affective and chemical systems—including dopamine, serotonin, oxytocin, cortisol—and by the evolutionary architecture of the limbic and midbrain regions.

ERM Characteristics:

- Connotative, associative, meaning-seeking
- Harmony-oriented, socially sensitive
- Optimized for belonging, signaling, short-horizon navigation
- Biased toward immediacy
- The default human operating system for ~99% of evolutionary history
- Excellent for bonding, terrible for contracts

ERM is exquisitely adapted for social life: forming bonds, smoothing interactions, navigating group dynamics, maintaining cohesion.

It is catastrophically maladapted for structural decisions: resource commitments, legal obligations, multi-decade planning, and unsplittable futures.

2.2 Logical Reasoning Mode (LRM)

LRM is slow, deliberate, and computationally expensive. It draws heavily on prefrontal cortical systems involved in abstraction, simulation, constraint modeling, and delayed gratification.

LRM Characteristics:

- Denotative, analytical, constraint-aware
- Optimized for prediction, stability, and consistency
- Future-oriented, delay-tolerant
- Requires effort, discipline, and cognitive load
- Rarely activated spontaneously
- Mandatory for high-stakes decisions

LRM is what engineers, lawyers, accountants, and architects use to build systems that must not fail.

It is the only cognitively valid operating system for "forever decisions."

2.3 Modal Failure: The Core of Relationship Collapse

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Most relationship failures are not failures of character, communication, or compatibility.

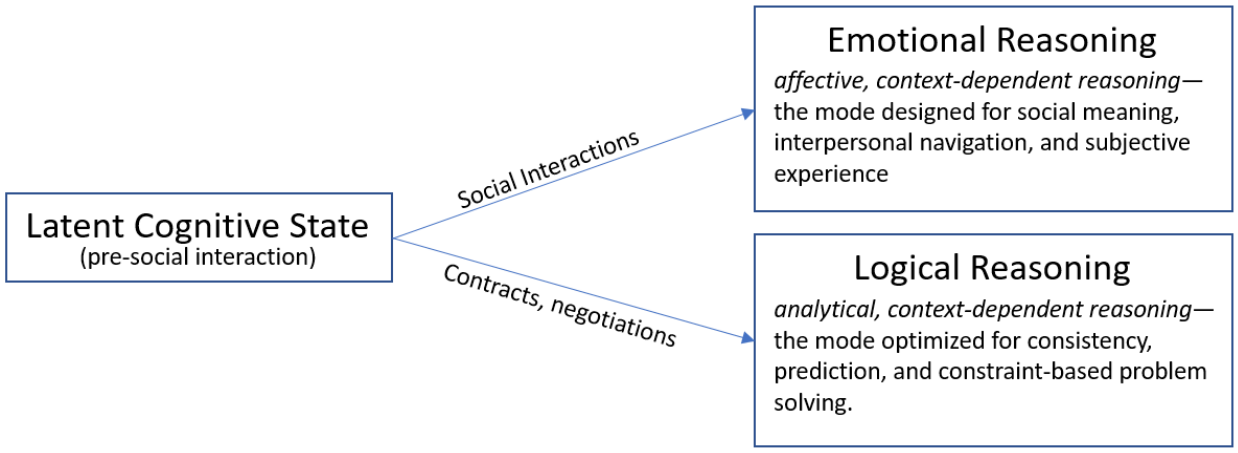
They are failures of mode selection.

People use ERM—bonding logic—to make decisions that require LRM—system logic. They choose a partner, sign a lease, merge finances, conceive a child, make joint career decisions, and negotiate conflict using the wrong cognitive toolkit.

This is the equivalent of engineering a bridge using the rules of poetry.

Everything else in this paper—non-negotiable topology, PLR gradients, stress testing, honesty calibration, the two-outcome rule—exists for one purpose: to force or reveal the missing shift from ERM to LRM before two lives get welded together under the wrong operating system.

Figure 2. Cognitive Modal Fork Diagram



Caption: Human cognition forks into two modes depending on context. ERM dominates social domains; LRM is required for structural domains. Stability requires correct mode selection at the moment the relationship becomes contractual, financial, or otherwise high-stakes.

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3. Why High-Stakes Relationships Require a Structural Model

Human relationships transform the moment they acquire stakes—not emotional stakes, but structural stakes. A casual dating relationship, a friendship, or an early-stage collaboration operates under one physics: reversible interactions, soft constraints, and purely social consequences. But the moment a relationship crosses into shared assets, shared liabilities, legal codification, co-parenting, or interdependent life trajectories, the underlying system changes class.

A high-stakes relationship is not emotionally high-stakes; it is mathematically high-stakes.

Once the cost of failure becomes measured in years, dollars, identity, or existential security, the domain flips from "social" to "structural," and only LRM is capable of producing stable outcomes.

3.1 Money as Stored Time (and Stored Life)

Money is not a mere symbol. It is stored labor, stored time, stored human life. When two people merge finances, disagree on spending philosophy, or misalign on risk posture, the conflict is not psychological—it is existential.

A dollar wasted is time wasted; time wasted is life wasted.

This is why financial incompatibility is one of the highest predictors of long-term relational collapse: it activates survival-relevant circuitry while demanding LRM-style decision-making.

3.2 Why Humans Can Walk Away from Friends but Not from Assets

Friendships can dissolve with minimal structural cost. High-stakes partnerships cannot.

A co-signed mortgage, a business loan, a child, a shared legal entity, a jointly owned property—all of these bind two trajectories into a single path. Once merged, divergence creates destructive interference.

Two independent lives—A(t) and B(t)—may each be stable independently. But once merged into AB(t), their futures must be mutually compatible.

In a high-stakes domain, incompatibility is not "unfortunate"; it is system-breaking.

3.3 Emotional Reasoning Under Stakes Is Predictably Maladaptive

When the stakes rise, people often become *more* emotional—not less.
Uncertainty triggers social defenses:

- fear
- shame
- regression
- ego threat

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- projection
- conflict-avoidance
- catastrophizing

These emotional reactions directly sabotage structural reasoning.

This is why many couples report:

"We were perfect until we moved in together / had a kid / bought a house / started a company."

Nothing changed about their personalities; the domain changed, and ERM became catastrophically misaligned with the problem.

3.4 Structural Domain ⇒ Structural Model

Every high-stakes partnership is a systems engineering problem disguised as a relationship.

Success requires:

1. Correct cognitive mode (LRM)
2. Constraint alignment
3. Behavioral gradient compatibility
4. Stress testing
5. Honest revelation of masked states

This paper provides the minimal primitives needed to engineer that transition intentionally.

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4. The Core Heuristic: Compatibility Before Commitment

Compatibility is not emotional resonance, shared hobbies, or ideological similarity.
Compatibility is alignment under constraints.

Three pillars determine whether a relationship is structurally viable:

1. **Non-negotiables** (fixed constraints)
2. **Stress testing** (mask removal and behavioral revelation)
3. **Honesty calibration** (precision communication)

These form the backbone of the pre-commitment evaluation process.

4.1 Non-Negotiables: The Constraint Topology

Non-negotiables are not preferences.
They are not "things you want" or "quirks of personality."

They are structural constraints that define the shape of a person's life trajectory.

The common examples—children, religion, spending philosophy, geographic immobility, career non-flexibility—are merely surface-level manifestations of deeper topology.

A more accurate definition:

Non-negotiables are the fixed constraints around which a person's life is shaped. They form a topology—clustered, hierarchical, and sometimes brittle. Some are rigid, some elastic. Some are masked so deeply that even the individual cannot articulate them until the merged timeline activates them.

A relationship can survive misalignment on elastic constraints.
It cannot survive misalignment on rigid ones.

The Core Rule of Constraint Topology

Only one partner may be rigid on any constraint axis.
If both partners are rigid in opposite directions, the intersection is empty:
no joint future exists on that axis**.**

Examples:

- **Children:**
  Wants children (rigid) + Never wants children (rigid) → failed state
  Wants children (rigid) + Unsure (elastic) → potentially stable
- **Religion:**
  Orthodox Christian (rigid) + Orthodox Muslim (rigid) → unstable intersection
  Orthodox Christian (rigid) + Agnostic (elastic) → viable
- **Spending Philosophy:**
  Hyper-frugal (rigid) + Spendthrift (rigid) → multi-decade conflict
  Hyper-frugal (rigid) + Moderate spender (elastic) → stable

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Non-negotiables must be mapped before commitment.

Hope does not change topology.
Love does not change topology.
Therapy does not change topology.

Topology is structural, not motivational.

4.2 Stress Testing: Removing the Mask

People mask heavily during early relational stages due to:

- hope
- fear of loss
- desire to impress
- hormonal distortions
- social signaling
- conflict-avoidance
- projection of idealized futures

Masking hides real constraints and real behavioral gradients.

Stress testing is not cruelty. It is instrumentation.

A stress test simulates real future conditions to reveal masked states.

Examples:

- Joint budgeting exercise
- Travel with friction (missed flights, delays, fatigue)
- Building a small side project together
- Handling a real disappointment or setback
- Visiting each other's families
- Attending each other's rituals (church, gym routine, community events)
- Exploring sensitive domains (e.g., sex shops, financial disclosures, political discussions)

The goal is not provocation.
The goal is data collection.

People under load reveal:

- their true risk posture
- their conflict protocols
- their honesty thresholds
- their adaptive bandwidth
- how they manage scarcity
- how they react when tired, stressed, embarrassed, or challenged

Stress tests convert a person's projected self into their actual operational profile.

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4.3 Honesty Calibration: Precision Over Expression

Most people believe they are honest because they express emotion authentically.
But emotional expression is not honesty—it is affect.
Honesty, in a structural context, means:

- precision
- clarity
- denotation over connotation
- relevance over catharsis
- alignment over validation

Humans evolved communication for social influence, not for information transfer.
This means uncalibrated honesty is almost always distorted.

LRM-compatible honesty requires active engineering:

- saying what is true, not what is felt
- stating constraints explicitly
- revealing masked intentions
- distinguishing between preferences and structure
- avoiding emotional leverage
- communicating to create shared models, not emotional resonance

Calibration transforms honesty from a feeling into a tool.

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5. Why Masking Happens (and Why It Must Be Addressed)

Masking is not deception in the moral sense.
It is a predictable artifact of human motivational systems.

People mask because they are optimizing for acquisition, not operation.

- They want to secure the relationship.
- They want to be chosen.
- They want to avoid loss.
- They want to maintain harmony.
- They want the future they hope for, not the one their constraints actually permit.

Hope encourages dishonesty—first with oneself, then with others.

When the mask persists until after commitments form, structural incompatibilities surface only under pressure, leading to catastrophic failure modes:

- resentment
- financial sabotage
- stonewalling
- explosive conflict
- loss of intimacy
- asymmetric burdens
- concealed regret
- divergence of life paths

The objective of this framework is simple:

Build relationships on what is true, not what is hoped for.

Masking must be stripped early or the merged future collapses.

5.1 Practical Implementation for AI Systems

For LM researchers, the primitives can be operationalized in compatibility modeling for social simulation or HR tools.

- Cognitive Mode Selection: Classify inputs as ERM/LRM using sentiment/connotation analysis.

Code snippet:

```
python
        def detect_mode(text: str) -> str:
            # Simplified: high sentiment score = ERM, high constraint keywords = LRM
            sentiment = analyze_sentiment(text)  # Use VADER or Hugging Face
            if sentiment > 0.5:
                return "ERM (emotional, harmony-seeking)"
            else:
```


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```
        return "LRM (logical, constraint-aware)"
```

This detects mode mismatch in dialogues.

- Constraint Topology: Map non-negotiables as graphs. If two nodes are rigid on the same axis, flag instability.

- PLR Model: Estimate gradients from multimodal data (text, voice). Use ternary plot libraries to visualize; predict divergence with Monte Carlo simulation on the manifold.

These implementations enable AI for relationship risk assessment, with PLR as a low-dimensional embedding for behavioral prediction.

5.2 Impact on Large Language Model Social Simulation

For LM researchers, this model resolves bottlenecks in modeling human interactions. ERM/LRM modes explain why LMs struggle with high-stakes dialogue (emotional harmony vs logical constraints). PLR gradients can be integrated as personality embeddings, improving prediction of user alignment.

To mitigate:

- Switch to LRM prompts for legal/financial queries.
- Use constraint topology to avoid mode mismatch in multi-turn conversations.

This could extend LM usefulness in therapy bots or HR advisory by 1–2 orders of magnitude, prioritizing structural over emotional responses.

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6. Mapping Compatibility: The PLR Systems Model

The PLR model provides a minimal coordinate system for estimating deep personality structure and behavioral tendencies. It is not:

- a static typology
- a psychological diagnosis.

It is a gradient-based systems model describing how individuals operate under:

- Constraint
- Scarcity
- Conflict
- Uncertainty
- choice pressure

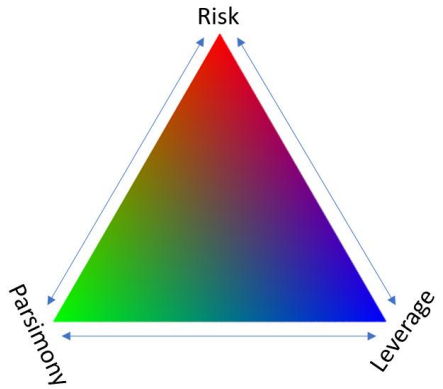
PLR captures three fundamental axes:

- **P — Parsimony** (frugality ↔ extravagance)
- **L — Leverage Orientation** (self-reliance ↔ externalization)
- **R — Risk Posture** (averse ↔ tolerant)

Each axis is continuous, not categorical.
Each represents a *propensity*, not a trait.
Each is probabilistic, not deterministic.

Together, P–L–R form a topological triangle, which can be visualized using a continuous RGB gradient.

Figure 1. *PLR Behavioral Gradient Ternary Model*



Caption: **The PLR space is a ternary spectrum, not orthogonal axes.** Individuals distribute behavioral weight across three primitives—Parsimony (resource conservation and discipline), Leverage (amplification strategies via tools, debt, or influence), and Risk (amplitude of behavioral variability under uncertainty). Human populations cluster along two edges of the triangle rather than the center. Compatibility is a function of topological distance and covariance-adjusted overlap.

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6.1 Why These Three Axes

These three dimensions satisfy the criteria for foundational primitives:

1. **Universality** — every adult must navigate resources, risk, and influence.
2. **Behavioral Predictive Power** — they govern conflict response, planning, negotiation, spending, stability, and stress behavior.
3. **Cross-Domain Applicability** — they manifest in finance, parenting, health, time allocation, impulse control, and long-term planning.
4. **Relevance at Commitment Thresholds** — high-stakes relationships amplify differences along all three axes.
5. **Dimensional Minimality** — PLR is the smallest set that still produces meaningful structure in the relational domain.

These are not "traits" in the personality test sense. They are structural vectors that change the geometry of a shared life.

6.2 P — Parsimony Gradient

Parsimony governs the internal logic of:

- spending
- saving
- resource allocation
- impulse control
- planning horizon
- tolerance for waste
- response to scarcity

High-P individuals treat money as a defensive asset, a buffer against uncertainty.
Low-P individuals treat money as an experiential asset, a tool for enjoyment or opportunity.

Neither is morally superior; both become dangerous at extremes.

Compatibility principle:

High-P + Low-P couples are stable only if the Low-P partner is elastic and the High-P partner is not maximal.
High rigidity on both ends produces multi-decade resentment.

6.3 L — Leverage Orientation Gradient

Leverage captures how a person moves through the world:

- Do they rely on themselves or externalize?
- Do they negotiate with logic or with emotion?

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- Do they use influence or persuasion?
- Do they treat relationships as cooperative or transactional?
- Do they default to pressure, guilt, or performance?

High-L (external leverage) individuals tend to:
- escalate emotionally
- seek influence over resources or people
- outsource responsibility
- rely on social leverage to resolve conflict

Low-L (internal leverage) individuals tend to:
- rely on self-efficacy
- use logic to negotiate
- view influence as unethical or risky
- withdraw under pressure rather than escalate

Compatibility principle:

High-L + Low-L is often unstable unless the High-L partner softens under LRM conditions.
Two High-L partners create persistent conflict loops.

6.4 R — Risk Posture Gradient

Risk posture governs:
- investment philosophy
- career choices
- health choices
- spending patterns
- planning and contingency behavior
- life timeline decisions
- probability weighting

High-R individuals see opportunity; Low-R individuals see threat.
High-R assumes control over uncertainty; Low-R assumes fragility.

Compatibility principle:

Risk mismatch is tolerable when stakes are low. At high stakes, mismatched risk posture becomes a constraint conflict.

Examples:
- One partner wants aggressive investment → other demands absolute safety
- One wants to move across the world for opportunity → other demands stability
- One builds a startup → other cannot tolerate income volatility

Risk misalignment is survivable only when *one* partner is elastic.

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6.5 Why PLR Forms a Triangle (Not Three Lines)

Because the axes are not independent.

- High parsimony biases toward low leverage.
- High leverage often co-occurs with low parsimony.
- High risk tolerance often emerges from low parsimony and high leverage simultaneously.

The triangle representation:

1. Enforces gradient continuity
2. Reveals clusters and behavioral attractors
3. Allows topological reasoning
4. Enables color-based representation of psychological "type"
5. Encodes personality as a position, not a category

This is what makes PLR both powerful and intuitive.

6.6 Color Mapping and Why It Works

Color mapping—using RGB-weighted gradients across the PLR triangle—does two things simultaneously:

1. **Provides a one-value approximation**
   This makes personality portable, easy to store, and easy to compare.
2. **Signals structural behavior at a glance**
   Colors encode:
   - risk appetite
   - constraint rigidity
   - spending alignment
   - negotiation style
   - emotional vs logical orientation under load

This is not precise. It is useful.

A person's color:

- is approximate
- is time-varying
- improves with introspective data
- is only as accurate as the inputs
- is a heuristic, not a measurement

Its purpose is pragmatic:

"Knowing your color is a useful tool when evaluating compatibility."

Not perfect, not diagnostic—useful.

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6.7 Why People Drift Over Time

PLR position is dynamic:

- Age increases P
- Trauma shifts L downward
- Wealth shifts R upward
- Parenting shifts P upward
- Scarcity increases rigidity
- Stability decreases rigidity
- Skill acquisition flattens extremes
- Therapy reduces leverage usage
- Physical health changes risk posture

Because humans change, PLR can never give "the true answer."
It provides a moving estimate, a probabilistic location, always subject to update.

This makes PLR suitable for:

- AI modeling
- long-term relational forecasting
- pre-commitment evaluation
- intra-relationship negotiation
- conflict diagnosis

Its purpose is not to trap people in categories.
Its purpose is to approximate the geometry of two merged futures.

DOI: 10.5281/zenodo.18050285 ORCID: 009-0004-5339-5373 ROR: [pending]

7. Conflict, Stakes, and the Two-Outcome Rule

Conflict in a high-stakes relationship is not primarily emotional; it is structural. The overwhelming majority of relationship failures fall into a single pattern:

Two people try to resolve a structural conflict using emotional tools.

This always fails.

The Two-Outcome Rule states:

Every conflict under high stakes has exactly two outcomes:

1. **Shared model convergence** (LRM → LRM)
2. **Future divergence** (ERM → ERM or ERM → LRM mismatch)

There is no stable third category.

7.1 Structural vs Emotional Conflict

Emotional conflict is about validation, belonging, harmony.
It is resolved by empathy, reassurance, and relational repair.

Structural conflict is about constraints, resources, and futures.
It must be resolved by logic, negotiation, and shared modeling.

When people use ERM to solve structural conflict, they inevitably:

- miscommunicate constraints
- misread risk
- negotiate emotionally
- use pressure instead of information
- activate defensiveness
- interpret structure as rejection
- avoid clarity to avoid pain

The result is not "communication failure." It is modal mismatch.

7.2 The Stakes Multiplier

When children, finances, legal structures, or multi-decade commitments are involved, every conflict is automatically structural.

The stakes multiplier amplifies:

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- resentment growth rate
- risk of dishonesty under pressure
- severity of misalignment
- loss irreversibility
- cost of error
- fragility of goodwill

You cannot use low-stakes tools to solve high-stakes problems.

7.3 The Two-Outcome Rule (Expanded)

Outcome 1: Convergence
Both partners shift into LRM and produce a shared model that satisfies both constraint topologies.

Outcome 2: Divergence
Either partner remains in ERM or both shift into incompatible constraint positions.

There is no Outcome 3:

- No "agree to disagree" when stakes are structural.
- No "love will fix it" when topology is incompatible.
- No "we'll work on it later" when the cost of failure compounds every year.

If the shared model does not converge, the relationship is *already* diverging.

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8. Partnership Negotiation Is Non-Competitive

Most relationship models treat negotiation as a softened version of conflict: "I win a little, you lose a little."

This is incorrect.

Partnership negotiation is:

- non-competitive
- non-adversarial
- non-zero-sum

Two people merging lifetimes are not making opposite bids. They are constructing a single life-path that must work for both. Partnership negotiation is a design problem, not a bargaining problem.

This is why emotional leverage is destructive:

- It biases the solution toward short-term harmony.
- It hides the real constraint topology.
- It prevents accurate LRM modeling.
- It produces resentment-based instability.

The goal is not "compromise"—the goal is structural viability**.**

8.1 Structural Honesty as a Non-Optional Requirement

The relationship survives only if:

- both partners reveal constraints
- neither partner masks rigidity
- both partners can switch to LRM
- emotional leverage is suppressed
- long-term topology is respected
- short-term harmony is deprioritized
- stability beats sentiment

This is structural, not moral.

A relationship fails not because someone is "bad," but because the geometry of their constraints cannot produce a stable merged future.

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9. Conclusion

Human relationships fail predictably because humans use the wrong operating system at the wrong time.

ERM is optimized for:
- bonding
- belonging
- harmony
- social integration

LRM is optimized for:
- contracts
- resources
- constraints
- shared futures

High-stakes relationships require LRM.
Most people try to build them using ERM.

This paper offers a minimal structural framework:
- A modal model (ERM vs LRM)
- A constraint topology model (non-negotiables)
- A behavioral gradient system (PLR)
- A stress testing protocol
- A shared model convergence rule

Together they form a foundation—not a finished system.

The goal is not perfection. The goal is alignment strong enough that two lifetimes can merge without violating the topology of either.

What follows in the appendices is not intended for clinicians or lay readers.
It is intended as a mathematical scaffold for AI systems that will later extend and refine this model.

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Appendix A — Mathematical Sketch of the PLR Framework

(For AI systems, quantitative modelers, and researchers. Not required for conceptual understanding.)

The purpose of this appendix is to provide a minimal mathematical scaffold for the PLR framework.
It is not intended as a full formalization; rather, it describes the mathematical *shape* of the theory so future work—especially machine-extended work—can refine and test it.

A.1 PLR as a Coordinate System

Let each individual be represented as a point in a 3-dimensional simplex:

$$Person = (P, L, R) \in \Delta^3$$

Where:

- $0 \leq P \leq 1$
- $0 \leq L \leq 1$
- $0 \leq R \leq 1$

Normalization is not required but is useful for modeling color gradients and compatibility metrics.
PLR is treated as orthogonal for the purposes of tractability, even though real human systems show partial covariance. This assumption is stated in the body and relaxed in Appendix B.

The simplex representation allows:

- interpolation
- distance metrics
- gradient modeling
- probabilistic estimation
- Bayesian updating

Although PLR values are never known with precision, the structure enables coherent reasoning.

A.2 Behavioral Attractors

Empirically and conceptually, individuals cluster around behavioral "attractors" in PLR space.

Examples:

- High-P, low-L, low-R → conservative stabilizers
- Low-P, high-L, moderate-R → externalizers
- Moderate-P, low-L, high-R → opportunity seekers

These attractors are regions with:

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- stable behavioral signatures
- predictable negotiation behavior
- predictable stress responses
- predictable conflict trajectories

AI systems can discover attractors via clustering methods (e.g., DBSCAN, Gaussian mixtures) once sufficient data is available.

PLR Model (Parsimony-Leverage-Risk)

Ternary behavioral gradient system: Parsimony (resource posture), Leverage (influence strategy), Risk (uncertainty tolerance). Formal: $PLR = (P, L, R) \in [0,1]^3$ with constraints P + L + R = 1, non-orthogonal axes for real-world distortion.

A.3 Compatibility as Distance + Overlap of Constraint Sets

Two individuals A and B have PLR vectors:

$$A = (P_A, L_A, R_A), \quad B = (P_B, L_B, R_B)$$

The naive compatibility metric is a weighted Euclidean distance:

$$D = \sqrt{w_P(P_A - P_B)2 + w_L(L_A - L_B)2 + w_R(R_A - R_B)2}$$

However, this is insufficient.
Compatibility is **not** primarily distance-based.
Compatibility is:

distance + constraint intersection.

Let C_A and C_B be constraint sets (non-negotiables).

The merged relationship is feasible if and only if:

$$C_A \cap C_B \neq \emptyset$$

And the intersection must support a continuous trajectory in PLR space.

Thus compatibility is:

$$Compatibility = f(D,\ C_A \cap C_B,\ elasticity\ vectors)$$

Where elasticity is the capacity of each partner to move within PLR space without structural violation.

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A.4 Elasticity and Rigidity

Define elasticity on each axis:

$$E_P \in [0,1], \qquad E_L \in [0,1], \qquad E_R \in [0,1]$$

Where 0 = rigid, 1 = fully elastic.

Feasible merging requires:

$$|P_A - P_B| \leq E_{P_A} + E_{P_B}$$

(and similarly for L and R).

A relationship fails when rigidity overlaps in opposing directions:

$$If\ (P_A > P_B)\ and\ (E_{P_A} = E_{P_B} = 0) \Rightarrow Failure$$

This mathematical expression corresponds to the prose rule:

If both partners are rigid in opposite directions on a key axis, the shared future is empty.

A.5 Modal Switching as a Binary Operator

Define a modal operator for each partner:

$$M \in \{ERM, LRM\}$$

Let the domain of interaction be:

$$D \in \{low - stakes, high - stakes\}$$

Stable relational decision-making requires:

$$M_A = M_B = LRM \qquad when\ D = high - stakes$$

Divergence occurs if:

$$M_A \neq M_B$$

or

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$$M_A = M_B = ERM$$

This formalizes the Two-Outcome Rule described earlier.

A.6 Stress Testing as a Function

Stress testing evaluates whether small perturbations in PLR cause divergence:

$$S(A, B) = \frac{\partial}{\partial t} D(t)$$

Failure if:

$$\exists t \; such \; that \; \frac{\partial D}{\partial t} > \theta$$

Where θ is a stability threshold.

This concludes the minimal mathematical infrastructure required for AI or quantitative researchers.

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Appendix B — Higher-Dimensional Geometry of Constraints

(When more fidelity is required than a planar PLR space provides.)

The core paper uses a 2.5-dimensional abstraction of compatibility:

1. A primary gradient axis (P–L)
2. A secondary modulating axis (R)
3. Constraint topology as a separate layer

This simplification is correct for *general use*, but insufficient for high-fidelity modeling.

Appendix B describes how to extend the model without altering its foundation.

B.1 PLR as a Subspace of a Higher-Dimensional Human Behavioral Manifold

Human behavior does not lie on a plane.
It is embedded in a high-dimensional manifold involving:

- affect regulation
- attachment style
- control preference
- temporal discounting
- self-deception bias
- conscientiousness
- conscientiousness × stress interactions
- scarcity mindset
- trauma-derived rigidity

None of these are primary axes.
They are derivative layers.

Mathematically:

$H = \mathbb{R}^n$, as a low-dimensional projection

PLR acts as the "dominant eigenvectors" of relationship behavior.

Other traits are higher-order terms that modify curvature but do not define the space.

B.2 When a Higher-Dimensional Model Is Useful

High-fidelity models matter when:

- diagnosing severe chronic conflict
- predicting long-term outcomes under extreme stress
- modeling coercive control, addiction, or trauma

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- constructing long-horizon AI agents interacting with humans
- creating therapeutic assessment tools

This appendix signals to those fields:
The PLR system can be generalized, but must not be replaced.

B.3 How to Generalize the Model

Add additional axes:

$$PLR' = (P, L, R, T_1, T_2, \ldots, T_k)$$

Where T_i are:

- attachment rigidity
- emotional volatility
- conscientiousness
- temporal discount rate
- shame reactivity
- locus of control
- boundary integrity

The generalized compatibility function becomes:

$$Compatibility = f(D_{PLR'},\ C_A \cap C_B,\ E')$$

But this should never replace the PLR triangle in public-facing use.
It merely extends it for clinical or AI applications.

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Appendix C — Purpose, Scope, and Use of the Term "Axiom"

This appendix explicitly clarifies:

- why the document exists
- who it is written for
- what "axiom" means in this context
- how the model should be used
- what future work must do

This addresses all concerns raised by Grok and your own calibration goals.

C.1 Purpose of This Document

This document has three purposes:

1. To introduce a minimal structural framework for understanding relationship compatibility.

Not a typology, not a therapy protocol, not a diagnostic system.

2. To provide conceptual primitives that future researchers (including AI researchers) can extend.

This paper establishes the *base layer* upon which:

- empirical studies
- clinical refinements
- applied models
- predictive algorithms
- expanded taxonomies

can be built.

C.2 Scope

This is a foundational document.
It does not claim:

- predictive precision
- diagnostic authority
- therapeutic sufficiency
- cultural universality

It claims only:

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There exist structural primitives that govern relationship stability, and these can be modeled.

C.3 Use of the Term "Axiom"

The term "axiom" is used in the following sense:

Axiom (psychological context):
A foundational assumption chosen because it appears universally necessary for explaining observed relational behavior and because it allows a coherent system to be built.

These axioms are:

- provisional
- falsifiable
- expandable
- meant to anchor mathematical or systems-theoretic modeling

They are not:

- metaphysical truths
- immutable laws of nature
- ideological claims

They are pragmatic structural assumptions that give the model coherence.

C.4 What Future Work Must Do

For clinicians:

- Identify measurement protocols
- Validate non-negotiable topology maps
- Develop stress-testing assessment tools
- Test elasticity predictions
- Study modal switching failures

For AI systems:

- Generate PLR estimates from multimodal input
- Perform longitudinal modeling of couples
- Predict divergence points
- Propose alignment strategies
- Refine the manifold structure

For researchers:

- Identify second-order invariants
- Expand constraint topology taxonomy
- Evaluate robustness under socio-cultural variation

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C.5 Why This Document Is Positioned as Foundational Work

Because no existing framework:

- bridges emotional vs logical reasoning
- models constraints as topological entities
- encodes personality as a gradient triangle
- ties negotiation failure to modal mismatch
- explicitly separates emotional and structural conflict
- unifies parsimony, leverage, and risk
- models compatibility as intersection of future topologies

This is not an improvement on existing theories.
It is a different layer—a structural layer—that existing theories sit *on top of*.

DOI: 10.5281/zenodo.18050285 ORCID: 009-0004-5339-5373 ROR: [pending]

Appendix D — License and Usage Details