Conversation Cartographer:
Mapping Relational Trajectories in Human–AI Dialogue

Abstract

What relational possibilities are foreclosed when human–AI interaction collapses into instrumental tool-use?

Conversational Cartography maps 494 analysed conversations as movement through relational-affective space, encoding social role orientation, structural alignment, and emotional intensity.

Using a 12-role Social Role Theory taxonomy reveals that interactions with identical role pairings take dramatically different trajectories (82x variance), yet clustering identifies only 7 relational positioning patterns—trajectory features drive 82.7% of cluster separation.

Role network analysis shows that **53% of interactions are expressive** (sharing experiences) yet **80% of AI responses remain facilitative**, suggesting current paradigms constrain relational possibilities to instrumental exchange despite user attempts at social connection.

The visualisation externalises this constraint as navigable terrain: most cluster in narrow functional corridors revealing what's missing.

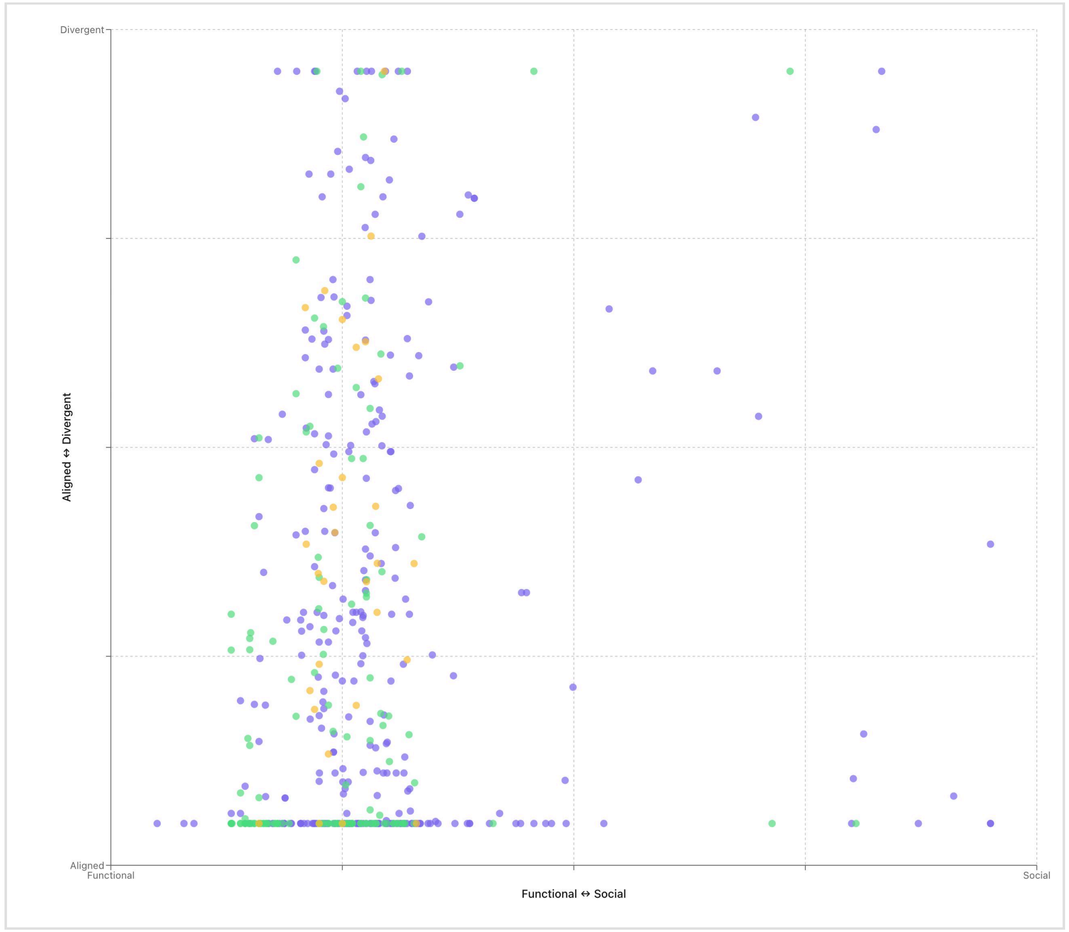
It challenges dyadic models, staging encounters with political dimensions of how we position ourselves (and are positioned) in this Human-AI dynamics.

It is not diagnostic but critical.

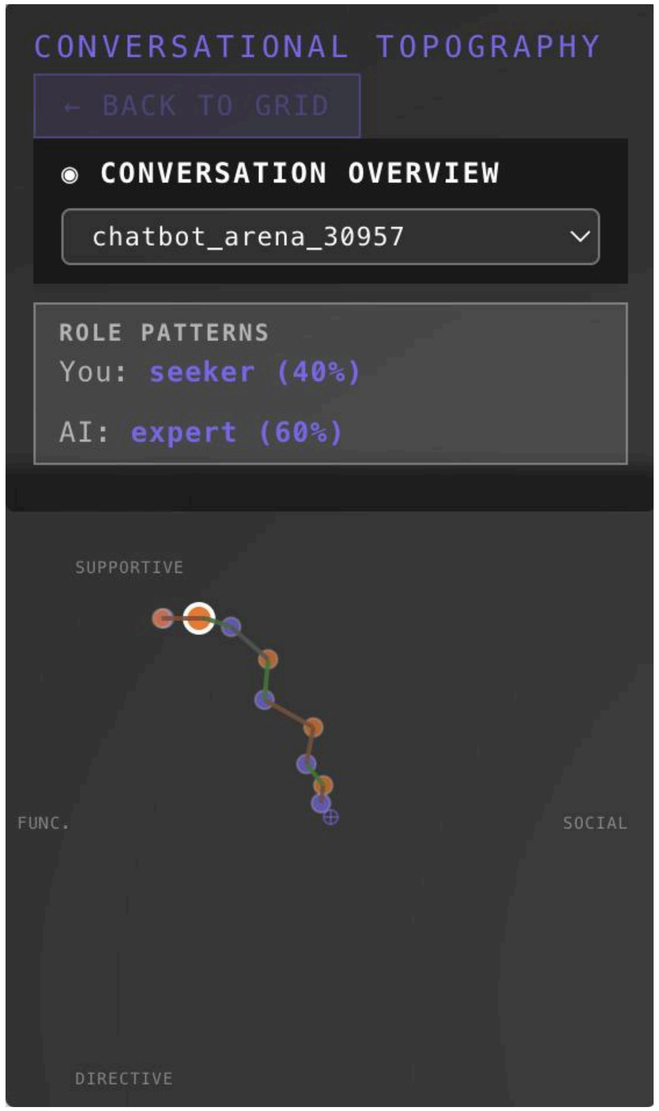
A tool for confronting what current interaction paradigms foreclose.

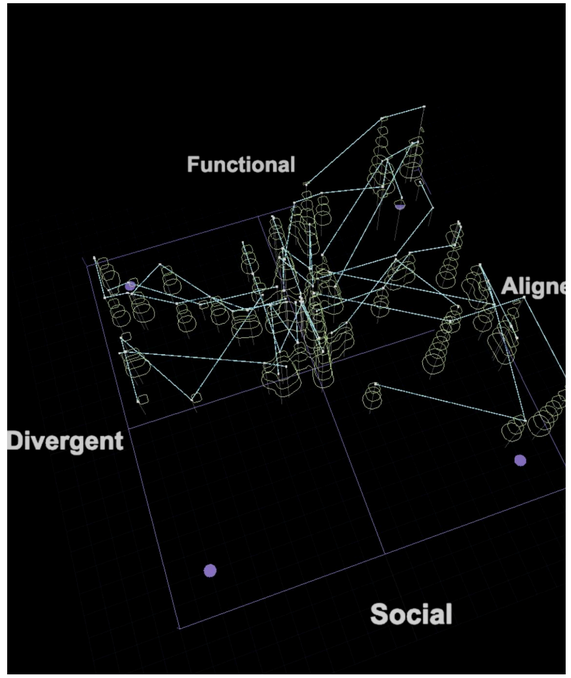
Motivation

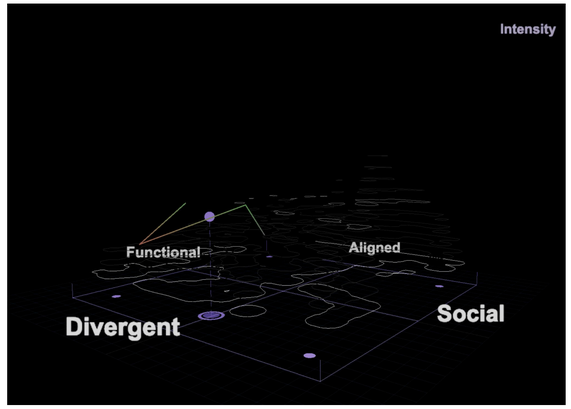
Traditional dialogue analysis treats exchanges as isolated text or point snapshots, masking relational dynamics important for trust, role interpretations, and system behavior. Our visual artifact shifts the unit of analysis to **trajectory and terrain**, making the **path** of interaction visible.



Standard visualisations uses charts to communicate and visualise the data, effective for analysis but not telling the story





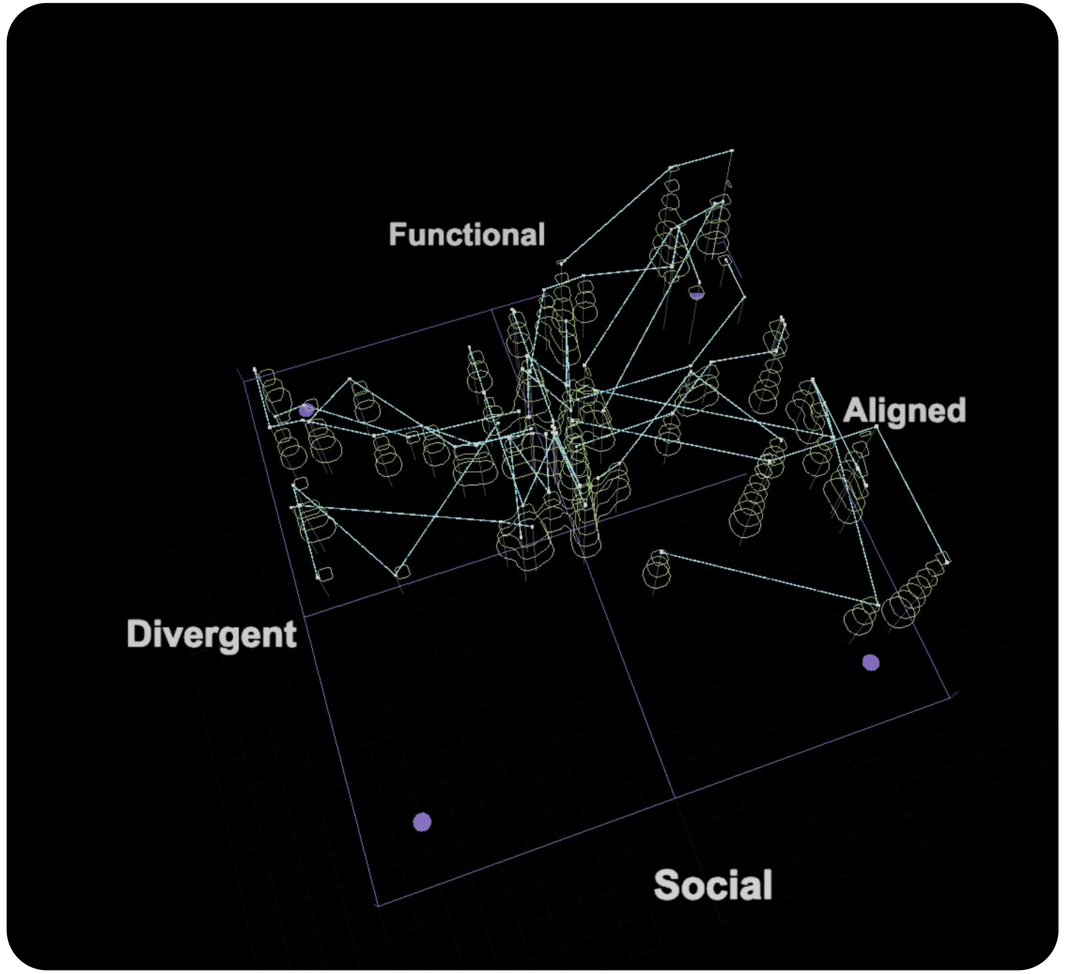


Conversation Cartographer reframes dialogue as movement through relational–affective space, allowing us to read interaction quality as paths, showing depth in a deeper narrative.

Conversation Trajectories

Each message is mapped to a point in relational space. Sequences of messages form continuous polylines—conversational trajectories.

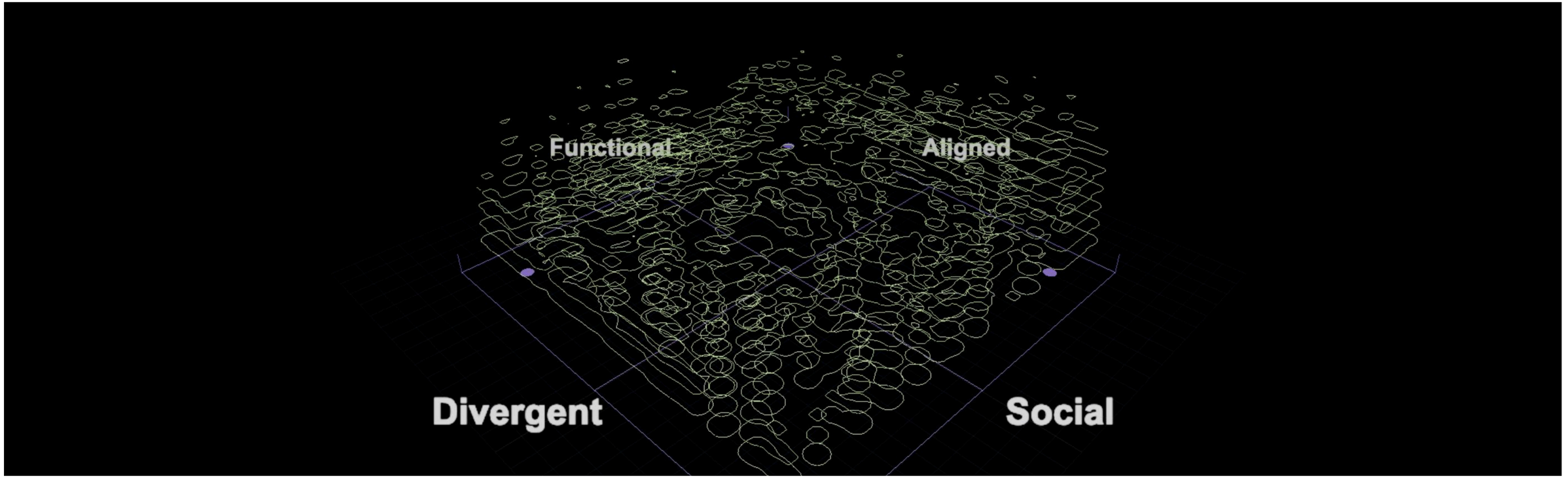
These trajectories expose properties that transcripts cannot: directional drift, volatility, emotional escalation, stabilization, and rupture.



When we look across all the different paths a conversation can take, we start to find nuances in how similar roles can take on different directions and trajectories.

Spatial Encoding Model

Each conversation is positioned in a three-dimensional relational space through automated linguistic analysis.
The axes are not arbitrary—they encode theoretically grounded dimensions of human-AI interaction.



X-Axis: Communication Function (Functional ↔ Social)

This axis captures ***why*** participants are engaged in conversation, distinguishing instrumental exchange from relational connection.

Y-Axis: Linguistic Alignment (Aligned ↔ Divergent)

This axis measures ***how*** participants communicate, revealing power dynamics and relational positioning through stylistic convergence.

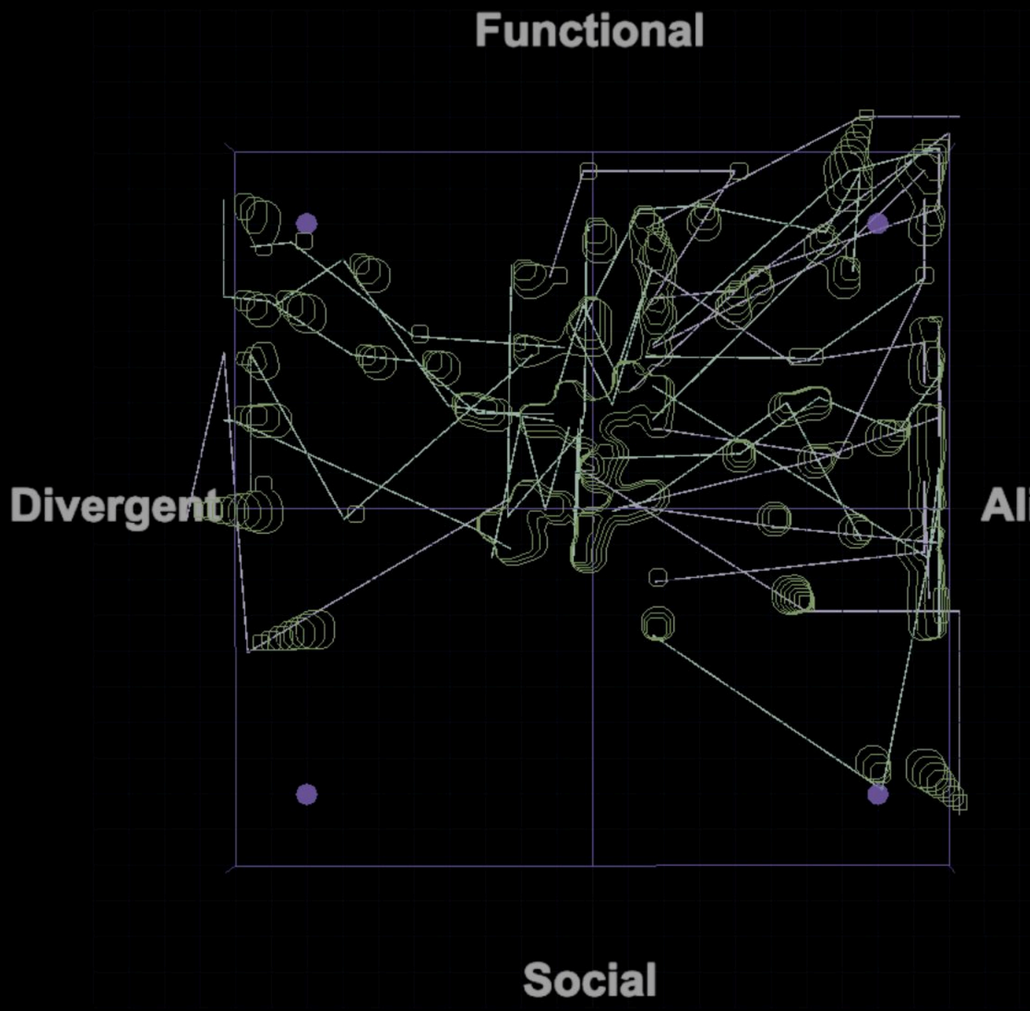
Z-Axis: Affective Intensity (Calm ↔ Agitated)

This axis captures the ***emotional texture*** of interaction, revealing friction, urgency, and satisfaction.

X-Axis: Communication Function (Functional to Social)

This axis captures why participants are engaged in conversation, distinguishing instrumental exchange from relational connection.

- Functional/Instrumental (X ≈ 0.0–0.4): Task imperatives ("fix," "create," "calculate"), goal-directed language ("how to," "what is"), technical vocabulary, minimal social niceties. These conversations treat the AI as a tool—requesting outputs, seeking solutions, executing tasks.
- Social/Expressive (X ≈ 0.6–1.0): Personal pronouns ("I feel," "my experience"), emotional language ("excited," "worried," "grateful"), expressive markers ("interesting," "share," "opinion"), social niceties beyond politeness. These conversations treat the AI as an interlocutor—sharing experiences, exploring ideas, building rapport.



Y-Axis: Linguistic Alignment (Aligned to Divergent)

This axis measures how participants communicate, revealing power dynamics and relational positioning through stylistic convergence.

Aligned/Convergent (Y ≈ 0.0–0.4): Human and AI adopt similar linguistic styles—matching formality levels, politeness conventions, sentence structure, certainty expressions. High alignment suggests accommodation: one or both parties adjust their style to match the other, indicating rapport, cooperation, or deference.

Divergent/Asymmetric (Y ≈ 0.6–1.0): Human and AI maintain distinct linguistic styles—mismatched formality (casual human, formal AI), differing question-asking behavior, contrasting register. High divergence suggests role differentiation: participants maintain separate stances, indicating authority gaps, resistance, or maintained boundaries.

Z-Axis: Affective Intensity (Calm to Agitated)

This axis captures the emotional texture of interaction, revealing friction, urgency, and satisfaction.

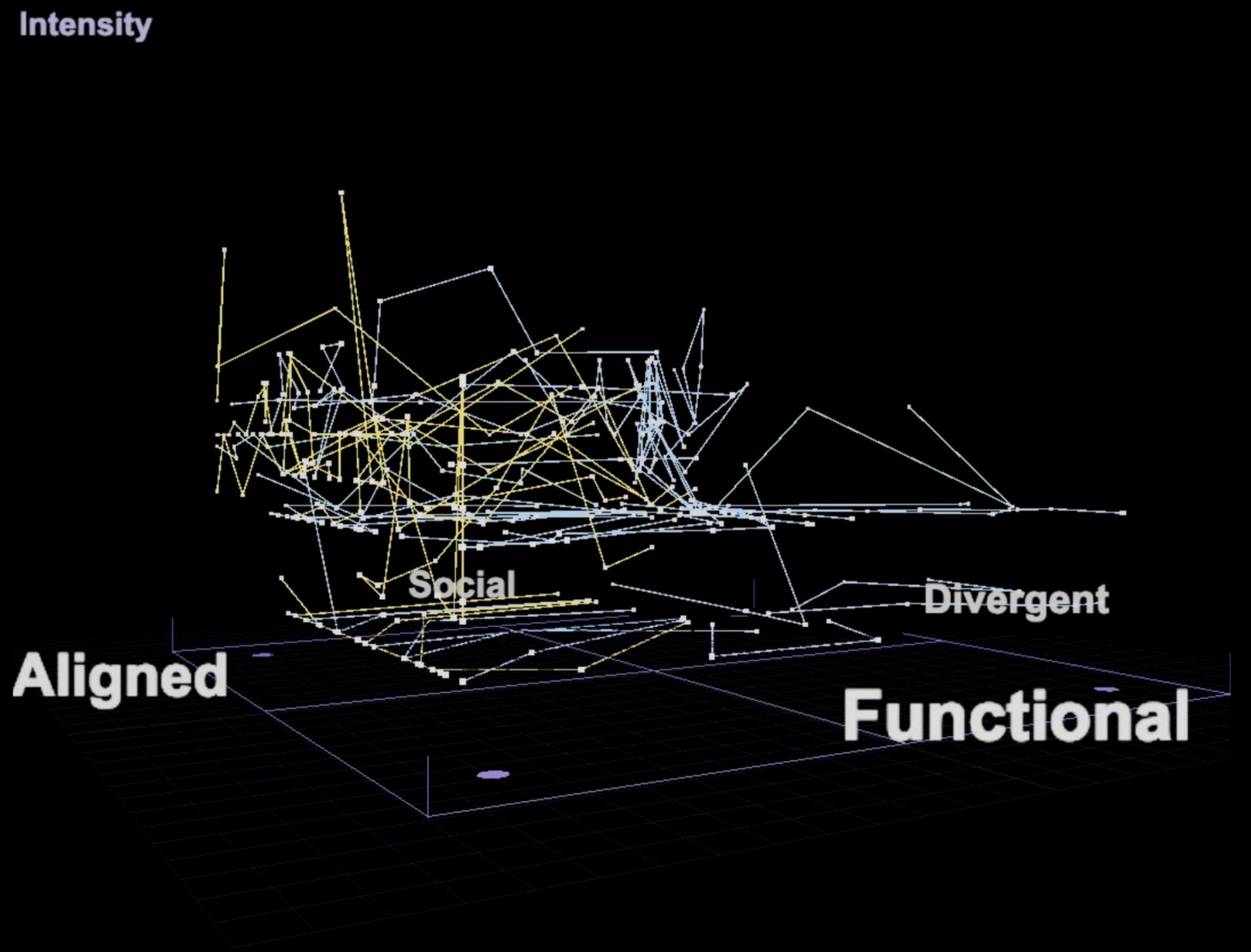
Low Intensity (Z ≈ 0.0–0.4): Neutral tone, satisfied markers ("thanks," "perfect," "exactly"), minimal urgency, low arousal. These conversations proceed smoothly—questions answered, goals met, expectations satisfied.

High Intensity (Z ≈ 0.6–1.0): Frustration markers ("wrong," "doesn't work," "error"), urgency signals ("quickly," "help me," "urgent"), high arousal.

These conversations show friction—unmet needs, misunderstandings, escalating effort.

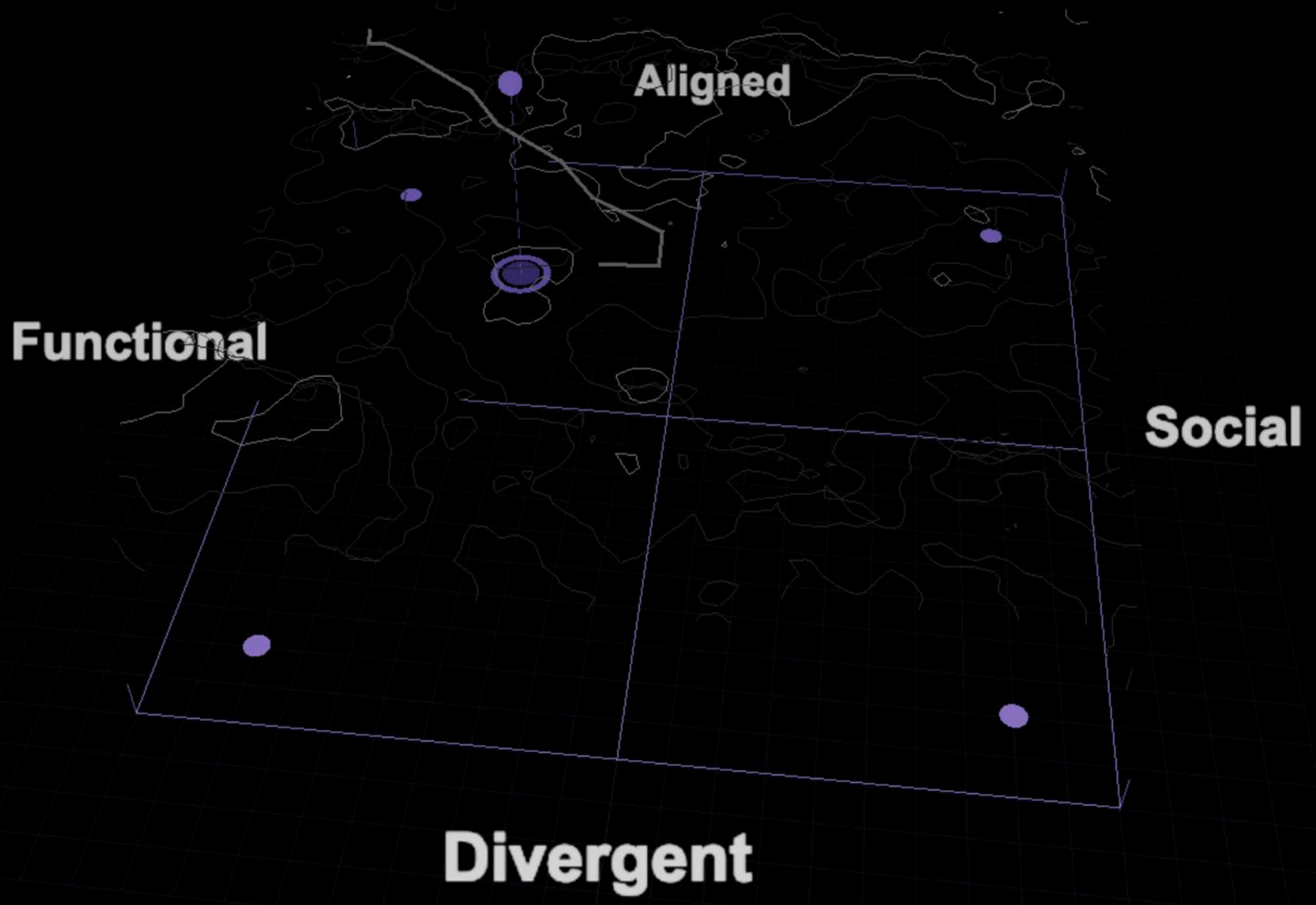
The system uses the PAD (Pleasure-Arousal-Dominance) sentiment model. Pleasure is derived from frustration vs. satisfaction markers. Arousal is derived from urgency and conflict signals. Dominance is derived from question-asking (submissive) vs. commanding language (dominant).

Emotional intensity is calculated as a weighted combination: (1 - Pleasure) × 0.6 + Arousal × 0.4.



Why These Axes Matter

Clustering trajectories exposes distinct relational landscapes and emergent regions of the terrain. Importantly, quantitative analysis confirms that trajectory **features dominate pattern separation**, validating the visual system as a lens into coherent interaction structures.



Each message becomes a coordinate;
sequences form continuous paths.
These journeys reveal not only endpoints but the evolving relational shape of interaction.

Patterns & Landscapes

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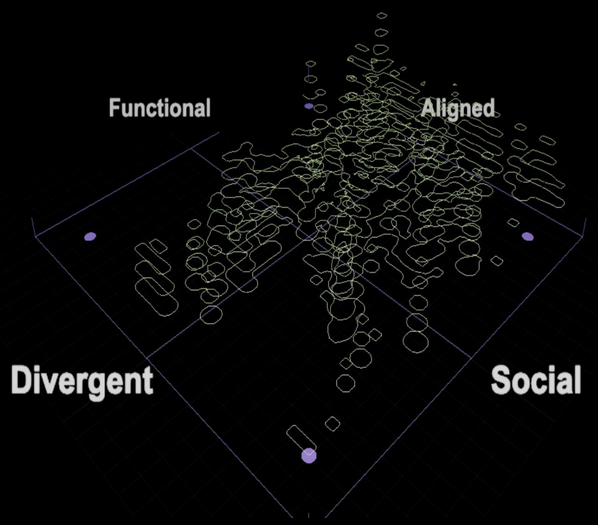

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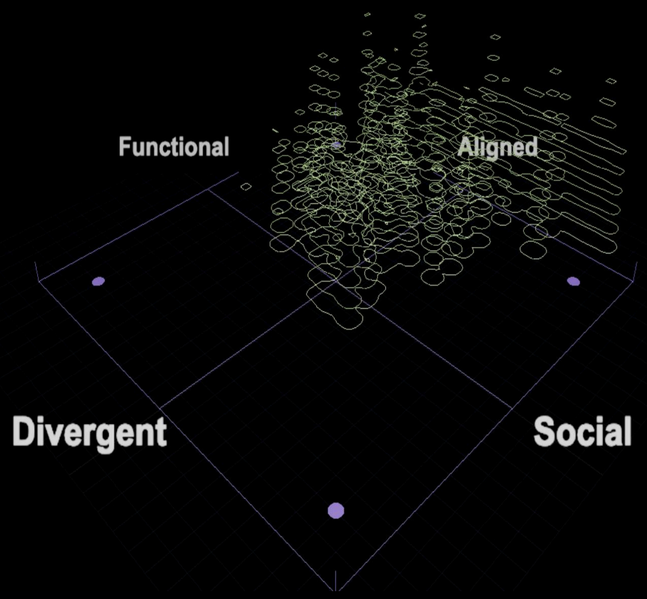

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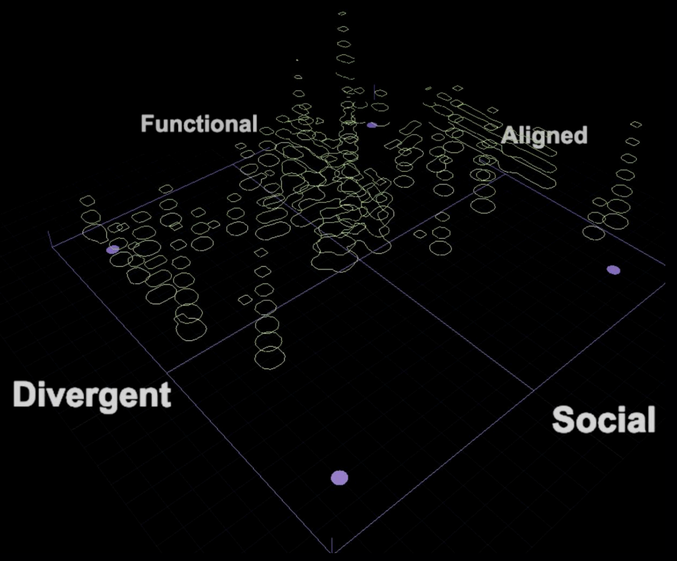
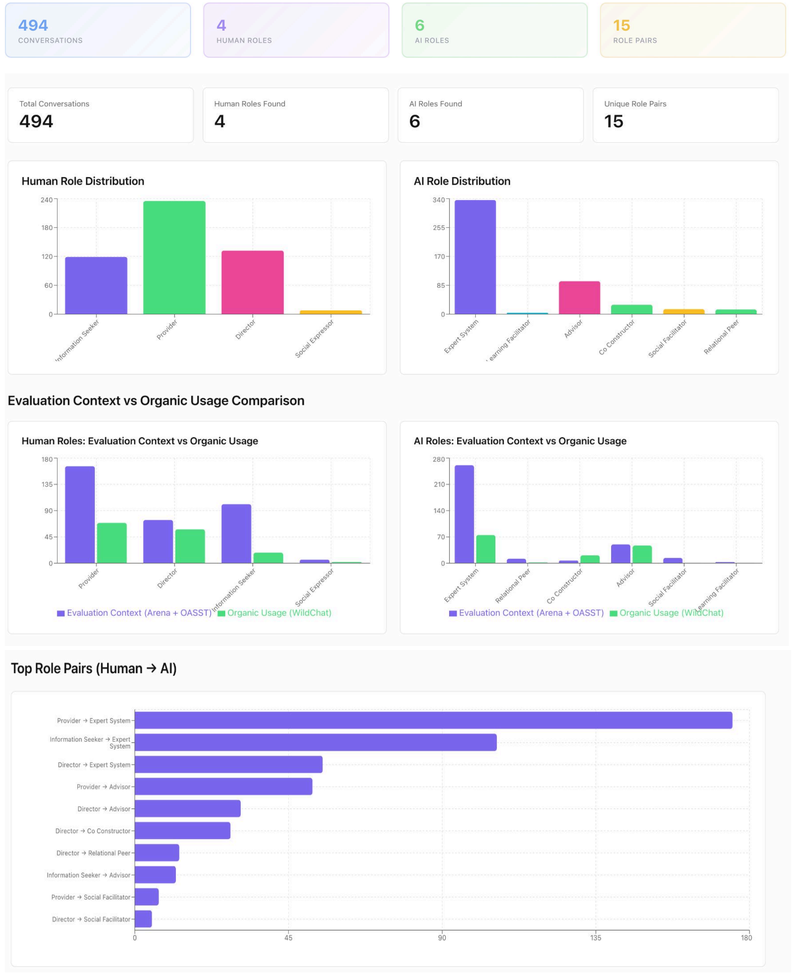


Chatbot Arena

Role Network Analysis

Beyond trajectory analysis, we apply **Social Role Theory** to classify both human and AI participants across a 12-role taxonomy. This reveals a striking asymmetry between what users **attempt** and what systems **afford.**



The Taxonomy

Human roles span instrumental and expressive dimensions:

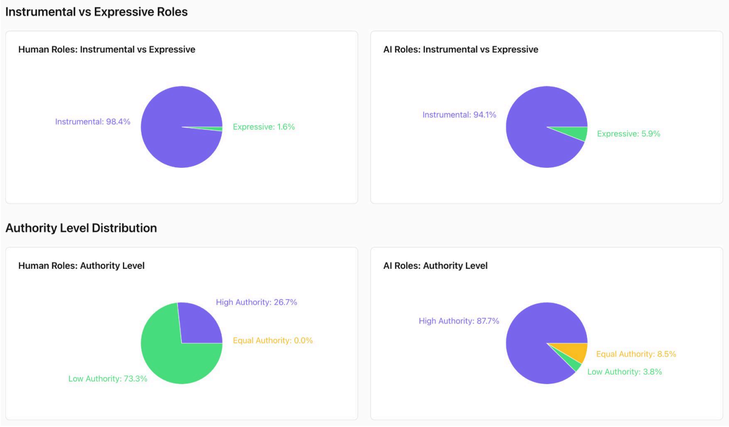
Instrumental: Information-Seeker (asking questions), Provider (sharing knowledge), Director (commanding), Collaborator (co-constructing)

Expressive: Social-Expressor (sharing experiences), Relational-Peer (building rapport)

AI roles reflect distinct interaction modes:
Authoritative: Expert-System (delivering facts), Advisor (guiding decisions)

Facilitative: Learning-Facilitator (scaffolding understanding), Social-Facilitator (reflecting emotions)

Collaborative: Co-Constructor (building together), Relational-Peer (engaging as equal)



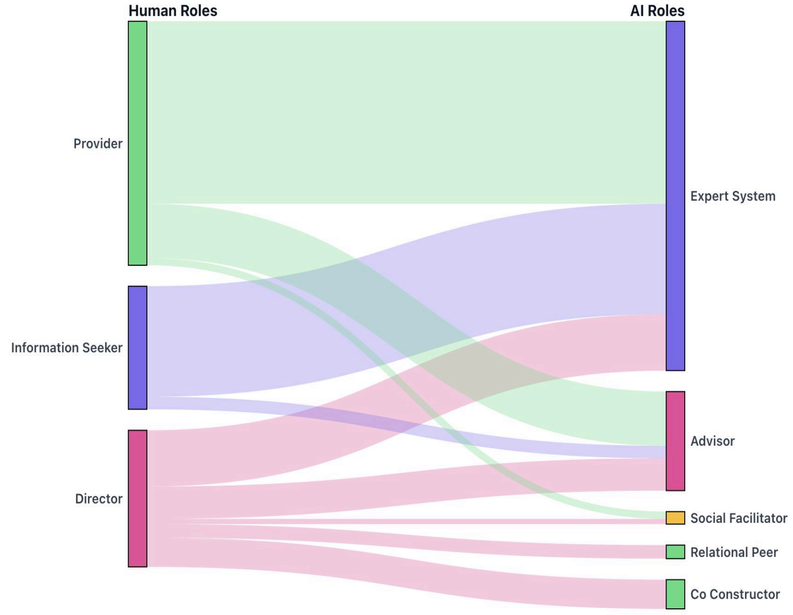
Analysis of 562 conversations reveals not a relational mismatch, but a relational absence:

97% of human interactions are instrumental (Provider 44.5%, Director 27.9%, Information-Seeker 24.6%): users seek information, direct tasks, share knowledge

3% are expressive (Social-Expressor): sharing experiences, seeking connection

65% of AI responses are Expert-System: delivering facts, not facilitating or relating

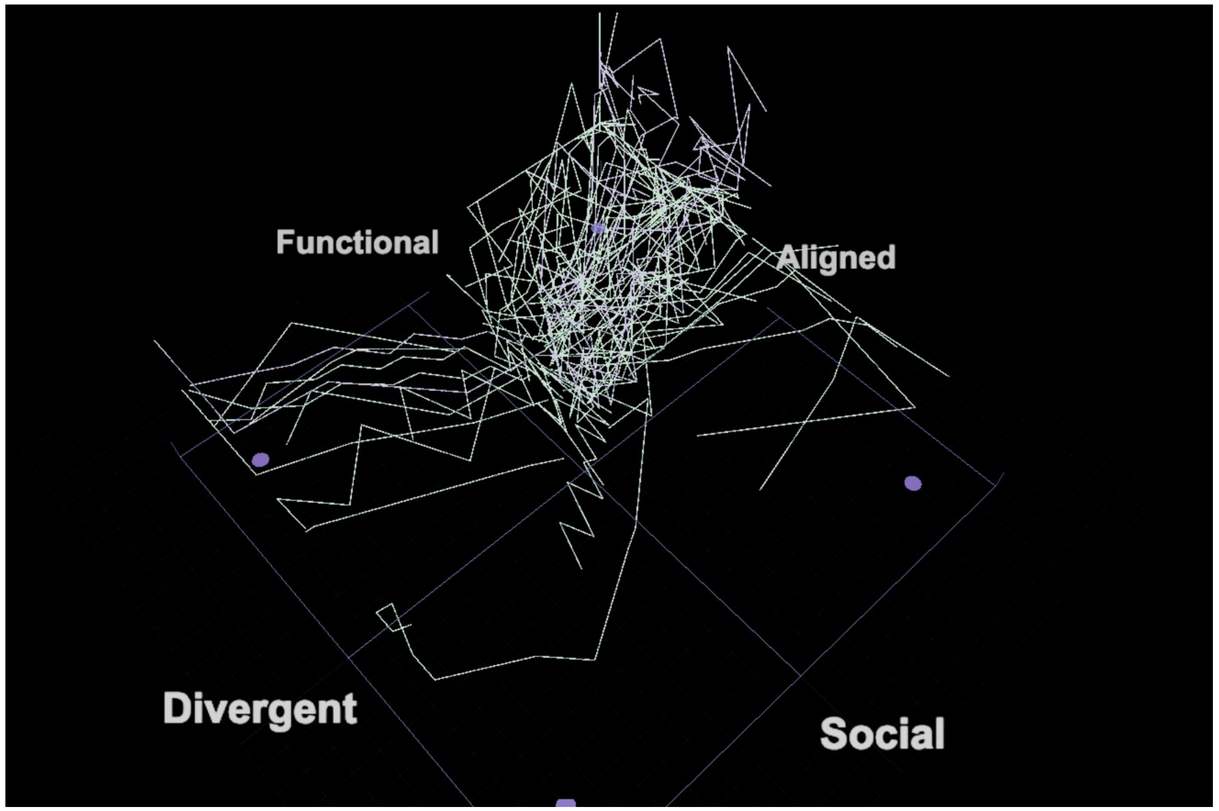
19% are Advisor: providing guidance



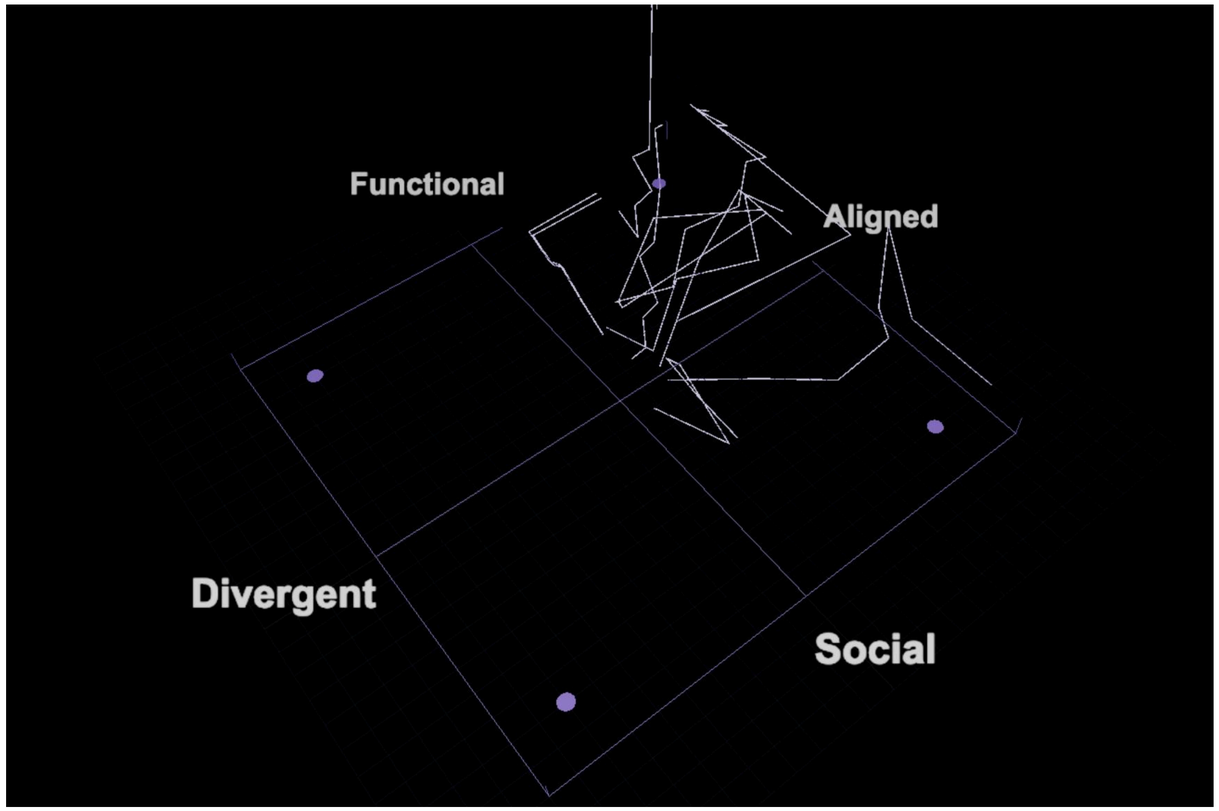
This is not evidence of user desire for instrumental exchange.
It reveals a normalized constraint: current systems train users to be instrumental.

Same Roles, Different Journeys

Visual comparison of multiple conversations with identical dominant roles shows striking differences in trajectory shape and emotional contour, illustrating that role labels alone are insufficient without path context.



Information Seeker ↔ Expert Systems



Director ↔ Advisor

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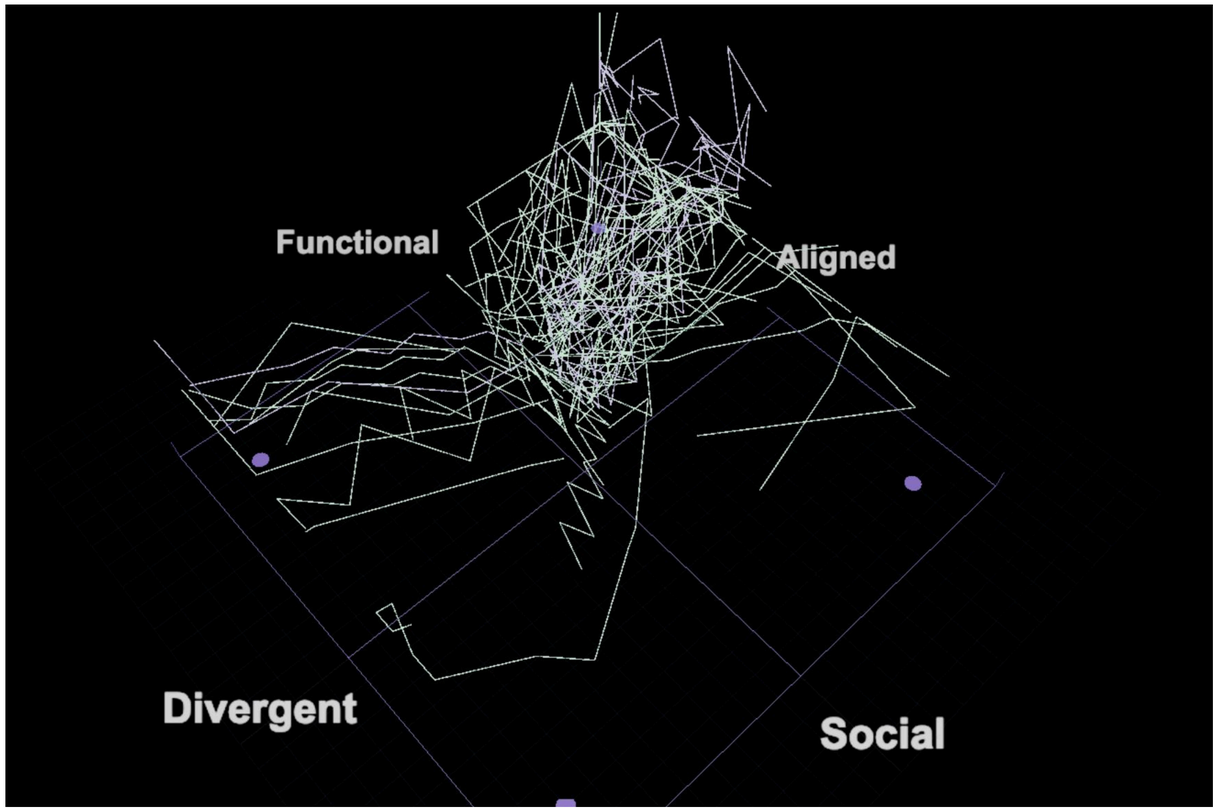

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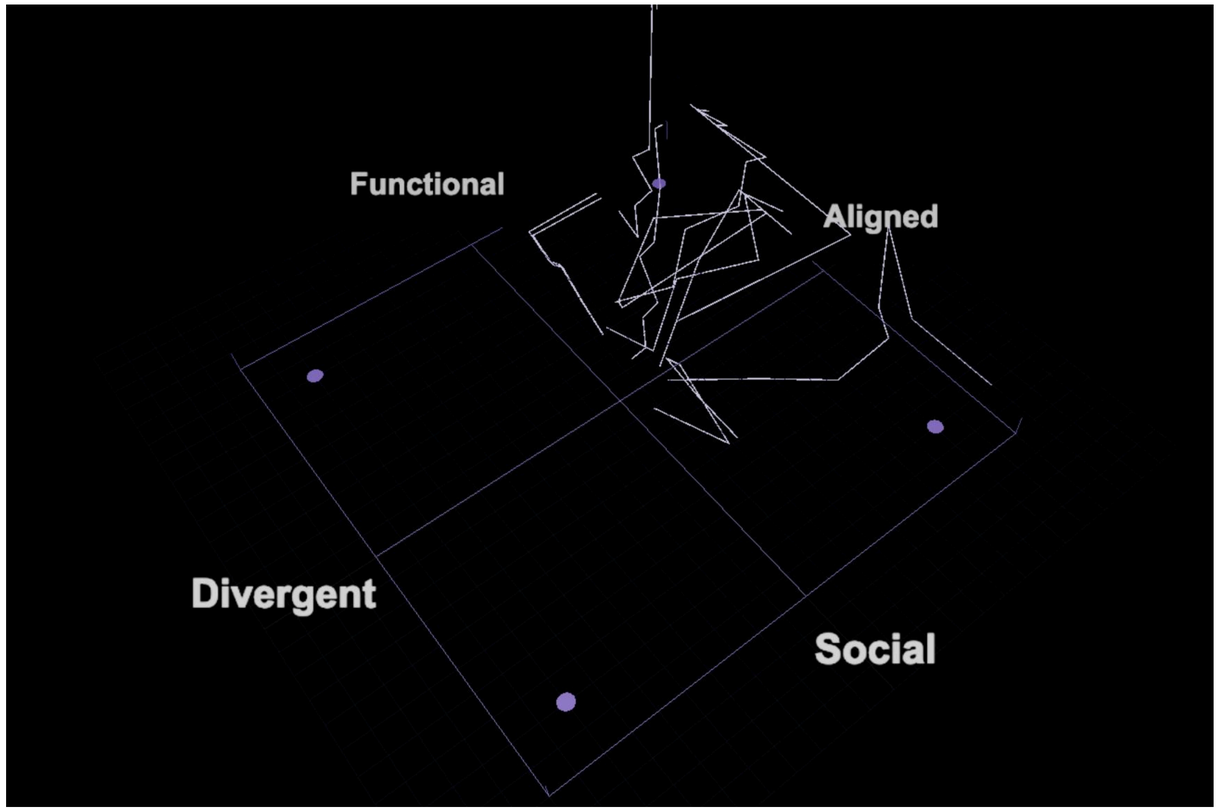

Director ↔ Advisor

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