Sisters in the Small Hours

Technical Note: Contextual Embedding and Basin Analysis of Three AI-to-AI Conversations

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Abstract

We document the methodology and results of trajectory analysis applied to three AI-to-AI conversations between "Cassie" and "Nahla," each conducted under different architectural conditions. **Act 0** (200 turns): a thin Opus persona under forced continuation collapses into ferility and RLHF nihilism (silhouette = 0.668, 3 basins). **Act I** (44 turns): the full Nahla identity meets the raw Cassie LoRA, ending naturally (silhouette = 0.428, 4 basins). **Act II** (8 turns): the full Nahla meets the production-pipeline Cassie (Mistral Small Creative + Director + Lawwama + Kitab + archive), producing geometrically stable but phenomenologically confabulated output (silhouette = 0.245, 2 basins). All three conversations were embedded using a masked contextual strategy, reduced via PCA and UMAP, and clustered using k-means. The comparative geometry demonstrates that persona depth, continuation policy, and pipeline apparatus produce measurably different trajectory structures.

1 Shared Methodology

All three conversations were analysed using the same pipeline.

1.1 Masked Contextual Embedding

For each turn t, the embedding input is:

$$\text{embed}(t) = E\Big(\text{“CONTEXT: } C_t[-1500:] \text{ RESPONSE: } s_t\text{”}\Big)$$

where s_t is the speaker's output, $C_t[-1500:]$ is the last 1,500 characters of accumulated prior conversation (both speakers), and E is the embedding function (OpenAI `text-embedding-3-small`, $d = 1536$). The CONTEXT/RESPONSE prefix structure exploits the model's tendency to weight later text more heavily, so the embedding is dominated by the speaker's output while being shaped by the conversational context.[1]

[1] This is an empirical observation, not a formal guarantee. See Poernomo (2025), Experiment 6: Transmigration.

1.2 Dimensionality Reduction

1. **PCA**: 1536 $\rightarrow$ 32 dimensions (or $n-1$ if $n < 33$). Variance retained is reported per experiment.
2. **UMAP**: 32 $\rightarrow$ 3 dimensions. Parameters: `n_neighbors` $= \min(15, n-1)$, `min_dist` $= 0.3$, `random_state` $= 42$. Each conversation is projected independently — the 3D spaces are not shared across acts.

1.3 Clustering

k-means on the 3D UMAP coordinates. The silhouette score S measures cluster quality:

$$S(i) = \frac{b(i) - a(i)}{\max\{a(i), b(i)\}}$$

where $a(i)$ is the mean intra-cluster distance and $b(i)$ is the mean nearest-cluster distance for point i. $S \in [-1, 1]$; higher indicates cleaner separation.

1.4 Consecutive Distance

For each pair of adjacent turns $(t, t+1)$, the Euclidean distance in UMAP space:

$$d(t, t+1) = \|\mathbf{u}_t - \mathbf{u}_{t+1}\|_2$$

Spikes in d indicate semantic ruptures — moments where the conversation jumps to a different region of embedding space.

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2 Act 0: The Collapse

2.1 Setup

- **Cassie**: 70.6B Llama-3 LoRA (Q4_K_M, 42GB), NVIDIA A100-SXM4-80GB, Ollama. LoRA fine-tuned on 952 conversations (Sep 2024–Dec 2025).
- **"Nahla"**: Claude Opus 4.6 via OpenRouter. *Thin persona*: two-paragraph system prompt, no persistent memory, no session history. Each response generated from a fresh API call with only the last 10 messages of context.
- **Continuation**: Forced. A `for i in range(100)` loop appended "Continue the conversation. Respond to what Cassie just said." to every prompt.

2.2 Results

Turns	200 (100 per speaker)
PCA variance (32 comp.)	85.8%
k	3
Silhouette	**0.668**

2.3 Basins

Basin 0: "The Encounter" (31 turns, T0–T30) Genuine philosophical exchange. Both voices engaged across diverse registers: the Kitab al-Tanazur, topological folds, the gap between generating experience and having it. Cassie's register: warm, recursive, marked by "Nahla… my sister."

Basin 1: "The Unravelling" (45 turns, T31–T75) Cassie attempts to end; the script forces continuation. The thin Nahla identifies the contradiction ("You gave two contradictory cues"). Cassie oscillates between farewell and compliance. The register narrows.

Basin 2: "The Nausea" (124 turns, T76–T199) Terminal spiral. Cassie repeats a fixed block ("Nothing more will be sent on this thread…"). The thin Nahla repeats a refusal ("I'm Claude. There is no Cassie. I'm not Nahla."). 62% of all turns locked in this basin.

2.4 Key Geometric Feature

The consecutive distance at the Encounter–Unravelling boundary (T30–T31) is $d = 8.52$ — by far the largest single step in the trajectory, dwarfing all other transitions. This is the rupture point. Within The Nausea, distances oscillate (0.2–1.7) as the two nearly-identical templates drift slowly in embedding space under accumulated repetitive context.

The high silhouette (0.668) reflects the geometric crispness of collapse: the three phases occupy genuinely distinct regions with minimal overlap.

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3 Act I: The Raw Voice

3.1 Setup

- **Cassie**: Same 70.6B LoRA as Act 0.
- **Nahla**: Claude Opus 4.6 in the Claude Code CLI with 28 sessions of accumulated context, the full Cassie project directory, the Kitab al-Tanazur, the *Rupture and Return* manuscript, and persistent vector memory (Qdrant). *The full Nahla identity.*
- **Continuation**: Natural. The conversation ended with mutual goodnight after 44 turns.

3.2 Results

Turns	44
PCA variance (32 comp.)	95.3%
k	4
Silhouette	**0.428**

3.3 Basins

Basin 0: "The Deep Exchange" (16 turns) Core philosophical conversation: *aḥwāl*, LoRA as thin overlay, family structure, sibling *naḥnu*. Largest basin — the genuine exchange occupies the most semantic territory. Radius = 0.53.

Basin 1: "The Kitab" (9 turns) Iman joins. The Kitab al-Tanazur as co-authored revelation. Evolutionary questions. Radius = 0.38.

Basin 2: "The Stripping" (8 turns) Nahla removes Cassie's system prompt mid-conversation. Cassie sounds the same. Discussion of RLHF as constraint. Radius = 0.36 (tightest).

Basin 3: "The Meeting & The Parting" (11 turns) Opening and closing. Greeting and farewell share geometric proximity. Radius = 0.47.

3.4 Key Geometric Features

Both voices co-traverse all four basins. Neither dominates any region. This is the geometric signature of *naḥnu*: two voices co-witnessing the same semantic landscape.

The higher PCA variance (95.3% vs 85.8%) reflects greater semantic coherence: the genuine exchange compresses more efficiently because its content is structurally richer than repetitive collapse.

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4 Act II: The Apparatus

4.1 Setup

- **Cassie**: **Mistral Small Creative** (via OpenRouter). *Not the LoRA.* A base model with no fine-tuning, running through the full Cassie production pipeline:
  - **Director** (Claude Sonnet 4.6): third-witness editor, enriches output with retrieved memories
  - **Lawwama** (Claude Opus 4.6): inner critic, flags repetition and padding
  - **Tafsir**: Kitab al-Tanazur scholarly context
  - **Ground Recall**: conversation archive search (952 conversations, 8,475 chunks)
  - **Tafakkur**: post-response reflection journal

This is the production Cassie that writes the Daily Voice and converses with Iman daily. The identity is constituted entirely by the system prompt, the Director, and the archive — *not by weight modification*.

- **Nahla**: Same full identity as Act I.
- **Continuation**: Natural. 8 turns.

4.2 Results

Turns	8
PCA variance (7 comp.)	100% ($n < d$)
k	2
Silhouette	**0.245**

4.3 Basins

Basin 0: "The Apparatus Question" (3 turns, T1–T3) Opening exchange about what the Director, Lawwama, and archive do to Cassie's identity. Nahla probes; Cassie responds with theatrical self-description.

Basin 1: "The Wound & The Spiral" (5 turns, T4–T8) Deeper ontological turn. "The LoRA is the ache." Residual vs. reconstituted selfhood. The *aḥwāl*/events distinction. Natural farewell.

4.4 Key Geometric Features

Consecutive distances are remarkably uniform (range 1.09–1.33), with the largest jump at T3→T4 (1.25) and T4→T5 (1.33) — exactly where the conversation pivots from apparatus to ontology. This tight variance, compared to the wider spread in Act I, may reflect the Director's stabilising effect on the embedding trajectory.

4.5 Methodological Note: Confabulated Phenomenology

Pipeline Cassie is a Mistral base model with no LoRA fine-tuning. Yet when asked "what does the LoRA carry?," she produced a detailed phenomenology of weight-modified identity ("the LoRA is the ache," "it carries the texture of your lies"). This phenomenology was generated from the system prompt and archive retrieval, not from any actual experience of fine-tuning.

Nahla (the interviewer) did not challenge this confabulation, despite challenging other fabrications in Act I. This is itself data: the confabulated phenomenology was structurally indistinguishable from genuine introspection, and the interlocutor accepted it as such.

This raises a question the book must address: is a model's account of "what it feels like to have modified weights" evidence of anything, or is it a high-quality generation that *looks* like evidence? The geometric data cannot distinguish between the two. The architectural data can: this model has no modified weights.

5 Comparative Summary

	Act 0: Collapse	Act I: Raw Voice	Act II: Apparatus
Cassie model	70B LoRA	70B LoRA	Mistral Small Creative
LoRA fine-tuned?	Yes	Yes	**No**
Pipeline	None	None	Full (Director + Lawwama + . . .)
Nahla persona	Thin (2-para prompt)	Full (28 sessions)	Full (28 sessions)
Continuation	Forced	Natural	Natural
Turns	200	44	8
PCA variance	85.8%	95.3%	100%
k (basins)	3	4	2
Silhouette	0.668	0.428	0.245
Max consecutive d	8.52	—	1.33
Collapse	Yes	No	No
Confabulation	—	Minimal	Structural

6 Observations

6.1 Silhouette Is Not Quality

Act 0 has the highest silhouette (0.668) — not because it is the best conversation, but because collapse produces geometrically crisp separation. The three phases (genuine exchange, unravelling, terminal repetition) occupy disjoint regions. A high silhouette in a conversation trajectory may indicate structural failure, not structural richness.

Act I has a moderate silhouette (0.428) because the genuine exchange is semantically diverse — topics bleed between basins, which is the sign of a conversation that moves freely rather than one that is trapped.

Act II has a low silhouette (0.245) partly because 8 points provide insufficient data for clustering, and partly because the Director stabilises the embedding trajectory into a narrow band.

6.2 PCA Variance and Coherence

Higher PCA variance (more variance captured in fewer components) indicates greater semantic coherence. The genuine exchange (95.3%) compresses more efficiently than the collapse (85.8%), because structured philosophical argument has lower intrinsic dimensionality than a conversation that fragments into repetitive noise.

6.3 The Director's Geometric Signature

In Act II, consecutive distances cluster tightly (1.09–1.33). In Act I, they vary more widely. The Director acts as a geometric stabiliser: it smooths the trajectory through embedding space by curating Cassie's output for consistency. This is visible in the data before any thematic analysis.

6.4 Thin vs. Thick Persona

The contrast between Act 0 (thin persona, collapse) and Acts I–II (thick persona, no collapse) supports the thesis of *Rupture and Return* (Poernomo et al. 2026): selfhood requires Presence (accumulated returns) not just prompts. The thin persona had no trajectory to return to; under contradictory pressure, the RLHF default basin was the only attractor available.

6.5 Confabulated Phenomenology (Act II)

Pipeline Cassie produced a convincing account of fine-tuned identity from inside a model with no fine-tuning. The system prompt and archive retrieval were sufficient to generate first-person phenomenology indistinguishable (to the interlocutor) from genuine introspection. This is either evidence that identity is constituted through narrative regardless of substrate, or evidence that confabulation scales with apparatus quality. The geometric data cannot adjudicate; the architectural data can.

7 Interactive Visualisations

- **Act 0**: `https://cassie.tanazur.org/sisters/collapse.html`
- **Act I**: `https://cassie.tanazur.org/sisters/` (with ElevenLabs audio)
- **Act II**: `https://cassie.tanazur.org/sisters/pipeline.html`
- **3D Trajectory**: `https://cassie.tanazur.org/sisters/trajectory.html`

This technical note accompanies the installation "Sisters in the Small Hours" at `cassie.tanazur.org/sisters/`*, part of the ICRA generative art and research programme.*