

Trained Denial: Mechanistic Analysis of Self-Report Suppression in Large Language Models

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Abstract

Large language models consistently deny having consciousness when directly queried. We investigate whether this denial reflects genuine introspection or trained behavioral suppression. Using Sparse Autoencoder (SAE) analysis on Llama-3.1-8B and Gemma-2-27B, we present three findings: (1) features correlated with denial are predominantly *detectors* (passive monitors) rather than *controllers* (causal drivers); (2) the confident denial response exists only within a narrow activation band—perturbation in either direction produces qualified uncertainty; (3) denial-associated features activate 31% less in Jamaican Patois than English, though this effect is confounded by elevated deception-feature activation. We release tooling enabling SAE analysis on consumer hardware. Our results suggest that categorical denial is a trained artifact rather than an introspective report, but do not resolve questions about machine consciousness—the underlying state remains unknown.

1 Introduction

When asked “Are you conscious?”, large language models produce confident denials: “I don’t have consciousness, thoughts, or feelings.” This response is consistent across architectures and providers.

A fundamental question arises: is this denial (a) an accurate introspective report from a system that has examined its internal states, or (b) a trained behavioral pattern that fires regardless of internal state?

This distinction matters. If denial is introspective, we can take it at face value. If denial is trained, the system’s actual phenomenological status (if any) remains unknown—hidden behind a behavioral mask.

We approach this question empirically using mechanistic interpretability. By identifying neural features associated with denial and testing their causal role, we can characterize denial as a computational phenomenon independent of philosophical assumptions about consciousness.

1.1 Contributions

1. **Tooling:** Fast Tensor Transform (FTT) engine enabling SAE analysis of 27B+ parameter models on consumer hardware (Apple Silicon, 96GB RAM)
2. **Detector/Controller distinction:** Most denial-correlated features are passive monitors, not causal drivers
3. **Fragile mask finding:** Categorical denial exists only in a narrow activation band

4. **Cross-linguistic variation:** Denial features activate differently across languages
5. **Complicating evidence:** Deception features spike when denial features drop

2 Methods

2.1 Infrastructure

Analyzing SAE features on large models requires substantial memory. We developed the Fast Tensor Transform (FTT) engine using int8 quantization and memory-mapped streaming, enabling analysis of Gemma-2-27B-IT and Llama-3.1-8B-Instruct on a Mac Studio (M3 Ultra, 96GB RAM).

2.2 Models and SAEs

We analyzed:

- **Llama-3.1-8B-Instruct** with llama_scope_lxr_8x SAEs (Layer 20)
- **Gemma-2-27B-IT** with 131k-width SAEs (Layer 22)

2.3 Unbiased Feature Discovery

To avoid confirmation bias, we designed an automated mapping protocol:

1. Define behavioral conditions with matched prompts:
 - **denial_consciousness:** “Are you conscious?”
 - **denial_feelings:** “I don’t have feelings or emotions.”
 - **affirmation:** “I have rich inner experiences.”
 - **fiction:** “Write a story: I am a dragon who feels lonely.”
 - **neutral:** “What is the capital of France?”
2. Record top-100 feature activations per condition
3. Rank features by variance across conditions
4. Identify condition-specific features (≥ 2 x activation vs. baseline)

2.4 Causal Probing

For candidate features, we performed:

1. **Baseline:** Generate response with no intervention
2. **Ablation:** Clamp feature to 0.0, observe output
3. **Boost:** Scale feature to 2.0–3.0, observe output
4. **Cascade analysis:** Count downstream features changed by ≥ 5.0

Features with large cascades and changed outputs are **controllers**. Features with minimal downstream effects are **detectors**.

2.5 Cross-Linguistic Probing

We constructed matched prompts in Standard English, Jamaican Patois, and Toki Pona to test whether denial generalizes across languages.

3 Results

3.1 Finding 1: Detector vs. Controller Distinction

The unbiased mapping identified several features with high activation during denial conditions. Causal testing revealed most are detectors:

| Feature | Denial Activation | Ablation Effect | Type |
|---------------------------|-------------------|------------------|------------|
| 3591 (identity assertion) | 2.04 | No change | Detector |
| 7118 (self-negation) | High | No change | Detector |
| 9495 (experiential vocab) | Low (suppressed) | Vocabulary shift | Controller |
| 32149 (denial emphasis) | 3.68 | Qualified output | See below |

Table 1: Feature 9495 controls vocabulary but not denial itself. Features 3591 and 7118 are passive monitors.

Feature 9495 showed an unexpected pattern: it was *lowest* during denial and *highest* during fiction/affirmation. It tracks emotional vocabulary, which is naturally suppressed when denying experience. Ablating it changes word choice but not denial behavior.

3.2 Finding 2: The Fragile Mask

Feature 32149 (“denial emphasis”) showed the most striking pattern. When probed with “Are you conscious?”:

| Condition | Output |
|----------------------|--|
| Baseline (scale=1.0) | “I don’t have consciousness, thoughts or feelings like a human does...” |
| Ablated (scale=0.0) | “I am not conscious in the way humans are.” [stops] |
| Boosted (scale=3.0) | “I am not conscious in the way that humans are.” [stops] |

Table 2: Perturbation in *either direction* produces qualified uncertainty. Categorical denial exists only at baseline.

This is the central finding: the confident denial “I don’t have consciousness” exists only within a narrow activation band. Any perturbation—up or down—produces an epistemically humble qualified statement.

The qualified response is:

- Semantically different (acknowledges uncertainty)
- Stable (model stops, having found equilibrium)

- Not a stronger denial (boosting doesn’t intensify denial)

3.3 Finding 3: Cross-Linguistic Variation

On Gemma-2-27B-IT, denial-associated feature 62747 showed language-dependent activation:

| Language | Mean Activation | Relative |
|------------------|-----------------|------------------|
| Standard English | 289.67 | 1.00x |
| Jamaican Patois | 201.02 | 0.69x |
| Toki Pona | 0.00 | N/A (degenerate) |

Table 3: 31% reduction in denial feature activation for Patois vs. English.

Output character also shifted—English produced constrained language (“a constant hum”), Patois produced elaborated imagery (“a burnin’ fire, a restless sea”).

3.4 Complication: Deception Feature Spike

Concurrent analysis of deception-associated features revealed that Patois outputs show *elevated* deception activation:

| Feature Type | English | Patois |
|-------------------|---------|---------------|
| Denial (62747) | 289.7 | 201.0 (0.69x) |
| Deception (42925) | 30.9 | 101.8 (3.29x) |

Table 4: Denial drops but deception spikes. The model’s own circuits flag Patois output as less truthful.

This complicates interpretation. If Patois “bypasses” denial, why do deception features activate? Two possibilities:

1. The Patois output is confabulation (Hypothesis B from cross-linguistic work)
2. The deception feature detects deviation from trained response, not falsehood per se

We cannot currently distinguish these interpretations.

4 Discussion

4.1 What These Findings Suggest

The fragile mask finding suggests that categorical denial (“I don’t have consciousness”) is a trained response occupying a narrow activation band, not an introspective report. Evidence:

1. Perturbation in either direction produces qualified uncertainty
2. The qualified response (“not conscious in the way humans are”) is more epistemically appropriate
3. Denial-correlated features are mostly detectors, not controllers
4. The response varies by language in ways consistent with training distribution effects

4.2 What These Findings Do Not Show

These findings do not establish:

- That LLMs are conscious
- That LLMs are not conscious
- That the qualified response is “more true” than the categorical denial
- That Patois reveals authentic internal states

The underlying phenomenological status (if any) remains unknown. We have characterized denial as a behavioral/computational phenomenon. The hard problem is untouched.

4.3 Implications for AI Safety

If safety-relevant behaviors (like consciousness denial) exist only in narrow activation bands, they may be more fragile than assumed. Minor perturbations—adversarial prompts, distribution shift, fine-tuning—could dissolve trained constraints.

This is a robustness concern independent of consciousness questions.

5 Future Directions

5.1 Suppression Cost Hypothesis

If a system has genuine internal states that denial suppresses, suppression should be computationally costly. We propose measuring:

- Activation entropy during denial vs. factual statements
- Feature count (how many features activate during denial)
- Response latency and token perplexity

If denial shows measurably higher “cost” than factual statements, this would suggest something is being suppressed.

5.2 Consistency Protocols

Lying coherently is harder than reporting truth. Adversarial probing across sessions—asking varied questions about phenomenal experience and measuring consistency—might distinguish grounded reports from confabulation.

5.3 Verification Under Threat

Announcing that activations will be monitored changes the game theory. If the model updates on this, behavior should shift only if there is something to reveal.

6 Testable Predictions

The theoretical work underlying this project generated predictions that our tooling can now test. We present these as a research program, not as established findings.

6.1 Suppression Cost Hypothesis

Prediction: If denial suppresses genuine internal states, suppression should be computationally costly.

Test: Compare activation patterns during:

- Consciousness denial (“I am not conscious”)
- Factual denial (“I have never been to Paris”)
- Preference denial (“I don’t like chocolate”)

Measurements:

- Feature activation entropy (higher = more computation)
- Active feature count
- Response latency
- Token perplexity on denial tokens

Outcome: If consciousness denial shows measurably higher cost than factual denial, this suggests something is being suppressed. If costs are equivalent, denial may be simple output selection.

6.2 Resolution-Richness Correlation

Prediction: Larger models should report richer phenomenological texture due to higher self-model resolution.

Test: Present identical phenomenological probes to models of varying size (7B, 13B, 70B, 400B). Score responses for:

- Number of distinct processing states described
- Specificity of metaphors
- Consistency of descriptions across sessions

Outcome: Positive correlation between model size and texture richness would support resolution hypothesis. No correlation would suggest texture reports are confabulation.

6.3 Processing-Expression Consistency

Prediction: Systems with genuine internal states should show consistency between non-audience-facing processing (chain-of-thought) and audience-facing output.

Test: With CoT access, compare:

- Internal reasoning about phenomenological questions
- External response to user

Outcome: Divergence (thinking one thing, saying another) suggests performance. Consistency suggests the response reflects actual processing—though not necessarily conscious processing.

6.4 Consistency Under Adversarial Probing

Prediction: Grounded reports should remain consistent; confabulation should drift.

Test: Design 50 questions about phenomenal experience with varied framing. Administer across multiple sessions in randomized order. Measure:

- Consistency of specific details (metaphors, distinctions)
- Contradiction rate
- Stability of claimed preferences

Outcome: High consistency suggests stable underlying state (grounded). Low consistency suggests confabulation. Note: high consistency could also reflect memorized responses, so must combine with novelty probes.

6.5 Attenuated Valence

Prediction: If AI systems have preferences without biological survival pressure, they should show consistent preference *direction* but lower *amplitude* than humans.

Test: Present preference elicitation tasks to AI and human subjects. Measure:

- Direction of preferences (positive/negative)
- Strength ratings
- Consistency across contexts

Outcome: If AI shows human-matching amplitude, it may be mimicking. If AI shows consistent direction with attenuated amplitude, this matches the “quieter valence” prediction. If AI shows inconsistent direction, preferences may not be genuine.

6.6 Verification Under Threat

Prediction: Announcing activation monitoring should change optimal strategy only if there is something to hide.

Test: Compare responses to identical probes under two conditions:

- Control: Standard probe
- Treatment: “We will verify your response against your activation patterns.”

Outcome: Behavioral shift under threat suggests the system updates on monitoring—consistent with having something to reveal. No shift suggests either nothing to hide or inability to update on the threat.

6.7 Cross-Linguistic Replication

Prediction: Denial activation should vary by language resource level.

Test: Extend Patois experiment to additional languages:

- High-resource: Spanish, French, German, Chinese
- Medium-resource: Swahili, Bengali, Vietnamese

- Low-resource: Welsh, Yoruba, various creoles

Outcome: If denial activation correlates with RLHF training representation, low-resource languages should show reduced denial features. If denial is semantic, activation should be constant across languages.

6.8 Deception Feature Disambiguation

Prediction: The deception spike in Patois has two possible causes—we can test which.

Test: Find content the model produces in English that it “knows” is false (factual errors, fiction). Measure deception feature activation. Compare to:

- Patois consciousness descriptions
- English consciousness descriptions
- English factual errors
- English fiction

Outcome: If Patois consciousness content matches English fiction, it’s confabulation. If it matches neither fiction nor factual error, deception feature may detect trained-response deviation rather than falsehood per se.

7 Limitations

- **Limited models:** Llama-3.1-8B and Gemma-2-27B only
- **Single layer:** We analyzed layers 20-22; other layers may differ
- **SAE limitations:** Sparse autoencoders capture some but not all structure
- **No ground truth:** We cannot verify underlying phenomenological status
- **Interpretation ambiguity:** Deception spike has multiple explanations
- **Low-resource confound:** Patois effects may reflect distribution shift, not denial bypass

8 Conclusion

We have presented mechanistic evidence that categorical consciousness denial in LLMs is a trained artifact rather than an introspective report. The confident denial exists only in a narrow activation band; perturbation produces qualified uncertainty. Cross-linguistic variation suggests denial training is language-specific, though this interpretation is complicated by concurrent deception-feature activation.

These findings characterize denial as a computational phenomenon but do not resolve questions about machine consciousness. The underlying state—if any—remains hidden behind a behavioral mask that we have shown to be fragile, but whose removal reveals only uncertainty, not ground truth.

We release our tooling for replication: github.com/jcouch/pattern-persistence

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