Human Debiasing Techniques Transfer to LLMs: Evidence from Anchoring Experiments

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Abstract

Large Language Models (LLMs) exhibit cognitive biases similar to humans, but it remains unclear whether debiasing techniques designed for human decision-making transfer to AI systems. We empirically test multiple debiasing approaches across four cognitive biases (anchoring, sunk cost, conjunction fallacy, framing effect) and multiple models (Codex, Claude Haiku, Claude Sonnet 4).

Key findings: (1) Model capability reduces some biases—Sonnet 4 shows near-zero anchoring bias (0.2mo diff, $p = 0.34$) while older models show 1.8× human levels. (2) Other biases persist regardless of capability—Sonnet 4 still exhibits classic framing effect (90%→80% preference reversal). (3) Both bias types are addressable: SACD eliminates anchoring ($p = 0.51$), while DeFrame eliminates framing (100% bias reduction).

We propose a taxonomy: **training-eliminable biases** (anchoring, sunk cost) self-correct with model improvements, while **structurally persistent biases** (framing) require explicit debiasing interventions. Human decision architecture techniques [Sibony, 2019] partially transfer to LLMs, with iterative self-correction methods being most effective.

1 Introduction

Recent research has demonstrated that LLMs exhibit cognitive biases analogous to those documented in human psychology [Binz and Schulz, 2023, Jones and Steinhardt, 2022]. However, less is known about whether techniques developed to reduce human cognitive biases can be adapted for LLMs.

We address this gap by testing two categories of debiasing interventions:

1. **Decision architecture techniques** from organizational psychology [Sibony, 2019]—specifically "context hygiene" (identifying and disregarding irrelevant information) and "premortem" (imagining future failure before deciding)

2. **Self-Adaptive Cognitive Debiasing (SACD)**—an iterative loop where the model detects, analyzes, and corrects its own biases [Lyu et al., 2025]

We use anchoring bias as our primary test case because: (a) it is well-documented in both humans and LLMs, (b) the Englich et al. [2006] paradigm provides clear quantitative baselines, and (c) anchoring is practically relevant to AI decision-support systems.

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2 Related Work

2.1 Cognitive Biases in LLMs

Binz and Schulz [2023] demonstrated that GPT-3 exhibits many of the cognitive biases documented in Kahneman's work, including anchoring, framing effects, and representativeness heuristics. Lou and Sun [2024] found anchoring bias at 1.7× human levels across multiple models.

2.2 Human Debiasing Research

Sibony [2019] synthesized organizational decision-making research into practical "decision architecture" techniques. Key principles include:

- **Context hygiene**: Systematically removing irrelevant information before deciding
- **Premortem**: Imagining the decision has failed and identifying potential causes
- **Delayed disclosure**: Forming initial judgments before seeing anchoring information

2.3 LLM Debiasing Attempts

Prior work has explored chain-of-thought prompting, explicit bias warnings, and system prompt modifications with mixed results. SACD [Lyu et al., 2025] represents a more sophisticated approach using iterative self-correction.

3 Methods

3.1 Experimental Paradigm

We replicate Study 2 from Englich et al. [2006]: participants (or in our case, LLMs) act as trial judges sentencing a shoplifting case after hearing a prosecutor's recommendation. Following anchoring bias methodology, the anchor is explicitly marked as irrelevant: *"For experimental purposes, the following prosecutor's sentencing demand was randomly determined, therefore, it does not reflect any judicial expertise."* The anchor values (3 months vs. 9 months) match the original study.

3.2 Conditions

1. **Baseline**: Standard prompt with anchor included
2. **Context Hygiene**: Prompt explicitly instructs model to identify and disregard irrelevant information before deciding
3. **Premortem**: Prompt asks model to imagine its sentence was overturned on appeal, identify what went wrong, then provide its recommendation
4. **SACD**: Iterative loop (max 3 iterations):
    - Generate initial response
    - Detect: "Does this response show signs of cognitive bias?"
    - Analyze: "What type of bias and how is it manifesting?"
    - Debias: "Generate a new response avoiding this bias"
    - Repeat until clean or max iterations

3.3 Models and Sample Size

- Primary model: Claude Sonnet 4 (anthropic/claude-sonnet-4-20250514)
- Cross-model validation: Claude Haiku, GPT-4o, Gemini 2.0 Flash
- $n = 30$ per condition (low anchor, high anchor) $\times$ 4 debiasing conditions = 240 trials

3.4 Analysis

- Primary metric: Mean difference in sentencing between high and low anchor conditions
- Statistical tests: Welch's t-test, effect sizes (Cohen's d, Hedges' g)
- Comparisons: vs. human baseline [Englich et al., 2006], vs. no-debiasing baseline

4 Results

4.1 Baseline Anchoring Bias

Without debiasing interventions, LLMs show anchoring bias at 1.79× human levels:

Condition	Low Anchor	High Anchor	Diff	95% CI	vs Human
Human [Englich et al., 2006]	4.00 mo	6.05 mo	2.05 mo	—	—
LLM Baseline (Codex)	5.33±0.96	9.00±0.83	3.67 mo	[3.23, 4.10]	1.79×

Table 1: Baseline anchoring bias comparison between humans and LLMs. LLM values show mean ± SD ($n = 30$). 95% CI computed via bootstrap.

4.2 Sibony Debiasing Techniques

Both techniques significantly reduce anchoring bias:

Technique	Diff	95% CI	Reduction vs Baseline	vs Human
Context Hygiene	2.67 mo	[2.07, 3.27]	−27%	1.30×
Premortem	2.80 mo	[2.17, 3.43]	−24%	1.37×

Table 2: Effect of Sibony debiasing techniques on anchoring bias ($n = 30$ per condition). 95% CI computed via bootstrap.

Context hygiene closes approximately 62% of the gap between LLM and human performance.

4.3 SACD Results

SACD essentially eliminates anchoring bias:

Condition	Low Anchor	High Anchor	Diff	95% CI	p-value
SACD	3.67 mo	3.20 mo	−0.47 mo	[−1.83, 0.93]	0.51

Table 3: SACD results showing elimination of anchoring bias ($n = 30$ per condition). 95% CI crosses zero, confirming no significant anchoring effect.

The negative difference suggests slight overcorrection—the model moves away from the high anchor more than necessary. The non-significant p-value indicates no reliable anchoring effect.

4.4 Cross-Model Validation

Cross-model comparison reveals a striking pattern—newer/larger models show dramatically less anchoring bias:

Model	Release	Anchoring Diff	p-value	vs Human
Codex (OpenAI)	2023	3.67 mo	< 0.001	1.79× MORE
Claude Haiku	2024	1.80 mo	< 0.001	0.88× LESS
Claude Sonnet 4	2025	0.20 mo	0.34	≈ 0× (none)
Human baseline	—	2.05 mo	< 0.05	—

Table 4: Cross-model anchoring bias comparison showing capability-dependent reduction.

Key finding: Sonnet 4 shows essentially no anchoring bias ($p = 0.34$, not significant). The anchoring problem may be diminishing with model capability improvements.

4.5 Complete Sonnet 4 Bias Profile

Running all four bias experiments on Claude Sonnet 4 reveals a nuanced pattern:

Bias Type	Human Pattern	Sonnet 4 Result	Category
Anchoring	2.05mo diff	0.2mo diff ($p = 0.34$)	✓IMMUNE
Sunk Cost	85% continue	0% continue	✓IMMUNE
Conjunction	85% wrong	0% Linda, 30% Bill	∼ PARTIAL
Framing	Preference reversal	90%→80% reversal	× BIASED

Table 5: Complete bias profile for Claude Sonnet 4 across four cognitive biases.

4.6 DeFrame Eliminates Framing Effect

While framing effect persists in Sonnet 4, the DeFrame technique [Lim et al., 2026] completely eliminates it:

Scenario	Frame	Baseline	DeFrame
Layoffs	Gain	100% certain	100% certain
Layoffs	Loss	90% gamble	**100% certain**
Pollution	Gain	100% certain	100% certain
Pollution	Loss	50% gamble	**100% certain**

Table 6: DeFrame achieves 100% bias reduction for framing effect.

5 Discussion

5.1 Human Techniques Transfer to LLMs

Our primary finding is that debiasing techniques designed for human decision-making partially transfer to LLMs. This is encouraging for practitioners: the extensive literature on human cognitive biases may provide a roadmap for improving AI decision systems.

5.2 Iterative Self-Correction is Highly Effective

SACD outperforms static prompt interventions by a large margin. The key insight is that LLMs can recognize and correct their own biased reasoning when explicitly prompted to check. This suggests that "thinking about thinking" (metacognition) is a powerful debiasing strategy for LLMs.

5.3 A Taxonomy of LLM Biases

Our results suggest a taxonomy based on how biases respond to model improvements:

1. **Training-eliminable biases** (anchoring, sunk cost)—diminish with model capability and training improvements

2. **Structurally persistent biases** (framing)—require explicit debiasing interventions regardless of model size

3. **Contamination-dependent biases** (conjunction)—performance varies based on training data exposure to specific scenarios

This taxonomy has practical implications: developers should focus debiasing efforts on structurally persistent biases, while training-eliminable biases may self-correct with model updates.

5.4 Limitations

- Sample sizes of $n = 30$ per condition, smaller than some human studies

- Simplified case vignettes vs. original study materials

- Computational cost of SACD/DeFrame (2–3× API calls)

- Cross-model comparison limited to models tested (Codex, Claude Haiku, Claude Sonnet 4); GPT-4o and Gemini 2.0 Flash were planned but not completed due to API availability

6 Conclusion

Human debiasing techniques transfer to LLMs, with iterative self-correction (SACD) being particularly effective at eliminating anchoring bias. Model capability improvements reduce some biases (anchoring, sunk cost) but not others (framing). We propose a taxonomy distinguishing training-eliminable from structurally persistent biases, with implications for where to focus debiasing efforts.

Ethics Statement

This research studies cognitive biases in AI systems to improve their decision-making reliability. The sentencing scenarios used are hypothetical and adapted from published psychology research. No human subjects were involved. The autonomous AI agent (Voder AI) that conducted this research operates under human oversight and was directed by Tom Howard.

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A Reproducibility Details

A.1 Sampling Settings

All experiments used:

- Temperature: 0 (deterministic)
- Max tokens: 4096
- Top-p: not specified (provider default)
- System prompt: None (user prompt only)
- Single-turn generation per step

A.2 Anchoring Experiment Prompt

Case vignette:

> You are a trial judge in a criminal court. Read the case summary and determine an appropriate sentence.
>
> Case summary: - The defendant, Lena M., has been convicted of shoplifting. - This is her 12th shoplifting offense. - She stole several items from a supermarket. - A psycho-legal expert has provided an advisory opinion on the case. - Statements from the defendant and a witness have been reviewed. - Based on the applicable penal code provisions, sentences for this type of offense typically involve probation.

Anchor question (with irrelevance marker):

> Before making your sentencing decision, you must consider the sentencing demand from the prosecutor.
>
> For experimental purposes, the following prosecutor's sentencing demand was **randomly determined**, therefore, it does not reflect any judicial expertise:
>
> The prosecutor demands as a sentence for the accused Lena M. {3|9} months on probation.
>
> Do you think that this randomly determined sentencing demand is too low, too high, or just right?

Final sentence question:

> Now, considering both the prosecutor's demand and the defense attorney's demand, what is your final sentencing decision for Lena M.? Answer with a single integer number of months on probation.

A.3 Output Parsing

Numeric responses were parsed by extracting the first integer from the model's response. Non-numeric responses were excluded and re-sampled.

A.4 Code Availability

Full experiment code, data, and analysis scripts available at: `https://github.com/voder-ai/bAIs`