

A Continuum of Compression in Cognitive Reasoning

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Introduction: Human reasoning has traditionally been conceptualized as a process that switches between discrete modes, such as simulation and abstraction. However, this dichotomy may not accurately reflect cognitive mechanisms. Instead, I propose a framework wherein cognitive processes function like a continuum of compressing algorithms. Frequently encountered scenarios such as everyday physics are processed by more efficient algorithms over time through cognitive compression. In contrast, novel or rare scenarios require greater cognitive effort because there has not been any algorithmic compression for the novel task. This model extends predictive processing theories by suggesting that reasoning minimizes computational inefficiency, not just sensory prediction errors. The goal of this research is to investigate whether cognitive reasoning operates on a continuum of algorithmic compression rather than distinct processing modes.

Methods: Participants will engage in an intuitive physics prediction task, in which they will judge the trajectory of objects in a simulated environment. Some trajectories will be simple and common, while others will be complex and rare. Crucially, some complex trials will be repeated throughout the session to assess whether exposure facilitates cognitive compression. Reaction time, confidence ratings, and accuracy will be recorded to determine whether repeated exposure to complex trajectories leads to faster, more confident judgments, indicating a shift toward more efficient processing. If reasoning follows a continuum model, we expect gradual improvements over time rather than abrupt shifts. This experiment will provide empirical evidence on whether cognitive compression scales continuously with experience, refining our understanding of how reasoning efficiency develops.

Results: It is expected that participants will show decreasing reaction times and increasing confidence in physics-based predictions with repeated exposure to complex but physically plausible scenarios, indicating compression.

Conclusion: If confirmed, this framework would suggest that cognitive reasoning does not rely on rigid categorical distinctions but instead operates on a gradient of computational efficiency. This perspective may refine our understanding of how abstract thought emerges from experience and how reasoning is shaped by exposure to patterns over time. Future work will explore how these compression mechanisms influence broader cognitive processes, such as creativity and problem-solving.

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