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Games and phone numbers: Do short-term memory bounds affect strategic behavior?

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Abstract

Research in experimental and behavioral game theory has revealed a substantial and persistent degree of heterogeneity in the strategic behavior of real individuals. While the prevailing theoretical explanations of the observed heterogeneity typically invoke underlying differences in beliefs in the population of players, we argue that a further source of heterogeneity may consist in the individuals' different ability to process information, of which short-term memory capacity provides a measurable proxy. Research in cognitive psychology has shown that individuals typically differ in their short-term memory capacity; furthermore, short-term memory capacity provides a fundamental cognitive bottleneck to our ability to process information efficiently and hence seems correlated with performance in a variety of problem-solving and reasoning tasks. In this paper we conduct experiments on a set of well-known games whose solution concepts require the application of some paradigmatic forms of strategic reasoning, such as iterated dominance and backward induction. We separately conduct standard short-term memory tests on our subjects to detect the presence of a correlation between individuals' behavior in the games – here defined in terms of degrees of conformity to the standard game-theoretic prescriptions – and their short-term memory score.

Our results show the presence of a significant and positive correlation between subjects' short-term memory score and conformity to standard game-theoretic prescriptions in the games, thus confirming our hypothesis. While the robustness of our conjecture awaits to be confirmed by further data gathering in more interactive experimental settings, our preliminary results suggest a promising line of inquiry on the interconnections between information processing capacity and strategic behavior.

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1. Introduction

Bounded rationality is about the limits of human information processing; it is not a generic deviation from the "olympic" rationality of neoclassical economics, but the result of intrinsic limitations in our cognitive architecture. It is resource-limited, not data-limited (Norman & Bobrow, 1975). In opposition to the widespread emphasis on the scarcity of information, Herbert Simon repeatedly argued that the most important problem is quite often abundance of information, given our limited processing capacities (Simon, 1978a,b).

Within such view, a key research task is to single out the processing bottlenecks responsible for bounded rationality, to find parameters characterizing them, and to assess how such parameters affect cognitive performance. Simon criticized psychologists for directing too much effort to hypothesis testing and too little attention to parameter evaluation (Simon, 1996). And he had little doubt that the most important constraint affecting human information processing is short-term memory capacity.

> The bottleneck (. . .) must lie in in the small amount of rapid-access storage (so-called short-term memory) available and the time required to move items from the limited short-term memory store to the large-scale long-term store" (Simon, 1996, p. 61).

Short-term memory (STM) plays a central role in Simon's view of the human information processing architecture. In his joint work with Allen Newell (Newell & Simon, 1972), he attributes to STM the key role of holding the input and output symbol structures of elementary information processes, thus being directly involved in all kinds of processing activities.

While Simon himself dedicated some experimental research to STM (Simon, 1978a,b, 1989), his prototypical examples were from the domain of "toy" problem-solving puzzles and learning tasks. There seems to be a surprising lack of research dedicated to the impact of STM capacity on economic interactive behavior. The recent resurgence of interest in bounded rationality among economists does not fill this gap. Attempts at modeling "limited recall" and memory on decision-making (Rubinstein, 1998) only address forgetting processes related to long-term memory. Models trying to incorporate tradeoffs between computational complexity and rationality come closer by introducing explicitly the cost of information processing by finite automata (Abreu & Rubinstein, 1988). Complexity arises because automata have very limited working memory capacity. However, while in these models working memory capacity affects the execution of a strategy, it does not affect the thinking process by which a strategy is designed. Even more, such models typically assume that