Thinking Faster and Slower: A Resource-Rational Model of Working Memory Encoding

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Abstract

Storage- and processing limitations manifest clearly in working memory when the number of to-be-remembered items increases: Each item is encoded less precisely and more slowly. Why do humans encode items at a slower rate that are already encoded with lower precision? Here, we propose a resource-rational model of working memory encoding. Increasing precision and speed reduce behavioral cost, but also incur neural costs. Both storage- and processing limitations arise naturally from jointly minimizing behavioral and neural costs. Intuitively, marginal increases in precision or speed have a diminishing return on investment. We show that our model: (1) accounts for classical effects of set size on storage capacity and processing speed, (2) explains recent findings showing faster encoding when briefly presented items are expected, and (3) predicts novel findings suggesting that classical set size effects on processing speed are in fact mediated by the probability that an item will be probed.

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