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Testing fMRI predictions of a Cognitive Model of the Problem State Multitasking Bottleneck

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Abstract: It has been shown that people can only maintain one intermediate mental representation, or 'problem state', concurrently. When multiple problem states have to be maintained, performance decreases sharply, an effect referred to as the problem state bottleneck. We investigate this bottleneck using a triple-task, in which participants have to solve subtraction problems, enter text, and perform a listening task concurrently. The triple-task confirmed the existence of a problem state bottleneck. To explain the behavioral results in detail, a cognitive model was developed using ACT-R (Anderson, 2007) and the threaded cognition theory (Salvucci & Taatgen, 2008). The model showed a close fit to the empirical data. It was subsequently used to generate fMRI predictions for five brain areas. These predictions were tested in an experiment, showing a good correspondence between model predictions and fMRI data, indicating that the problem state bottleneck is probably located in the intraparietal sulcus.