How Attentional Blink Facilitates Multitasking

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Introduction

Multitasking is a required skill for complex and dynamic activities such as driving a car and piloting an airplane. Previous research in cognitive modeling has suggested that top-down control improves multitasking ability (Taatgen, 2005). An empirical study has been conducted to investigate how a basic neuro-cognitive effect (attentional blink) makes top-down control possible and improves multitasking performance.

Method and Hypothesis

Multitasking performance has been assessed with an Abstract Decision Making (ADM) measure (Joslyn & Hunt, 1998) and a Dual Task and Timing (DTT) measure (Taatgen, 2005). The N-back test (NB) has been used to measure Working Memory (WM) performance. NB consists of maintaining a changing stream of stimuli in working memory and comparing them with incoming stimuli (McElree, 2001). A Rapid Serial Visual Presentation test has been used to measure Attentional Blink (AB). AB is missing the second out of two targets presented rapidly (10 stimuli per second) in a stream of distractors. Limited cognitive resources are allocated to full processing of the first target, causing the second target to be missed (Martens, Wolters, & van Raamsdonk, 2002).

The four tasks have been performed by 37 subjects randomly selected from the subject's database of Carnegie Mellon University.

We hypothesize that attentional blink makes top-down control possible and consequently facilitates performance in tasks requiring a fair amount of top-down control. In other words, the more one blinks (misses the second target), the better one performs at multitasking.

Results

Structural Equation Modeling (SEM) has been used to investigate the influence of AB via NB on multitasking (MT). NB has been hypothesized to mediate the influence of AB on MT since it requires top-down control to maintain a changing stream of stimuli in WM. MT was included in the structural model as a latent variable (factor) indicated by DTT and ADM (fig.1). The SEM model fits the data very well (Model Chi square = 0.39, DF = 3, p = 0.94; Adjusted Goodness-of-fit Index = 0.98) and confirms our hypothesis. By making top-down control possible, AB improves WM performance and eventually facilitates MT performance.

Cognitive models for the four tasks have been developed using the built-in functionality and parameters of the ACT-R architecture (Anderson et al., 2004). These models account for common effects, individual differences and relationships between variables allowing understanding of the underlying neuro-cognitive mechanisms involved in performing various tasks.

Conclusion and Discussion

Attentional blinking – suppressing incoming stimuli to allow completion of important routines – seems to be a basic neuro-cognitive mechanism involved in top-down control and performance at multitasking.

This combined empirical and computational approach seems promising in bridging the gap between the neuro-cognitive accounts of behavior and human performance in real-world tasks.

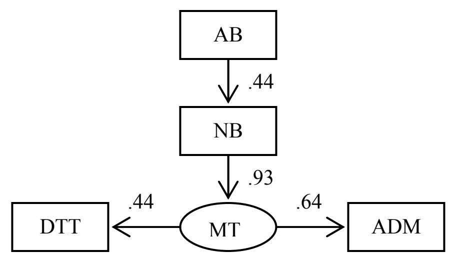

Figure 1: A SEM model showing the influence of AB on MT. Numbers are standardized structural coefficients.

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