

Binding in Working Memory: Cognitive and Neural Mechanism

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The binding problem is a pivotal issue within the domain of working memory (WM) and remains a central topic of contention among various WM models. In this talk, I will encapsulate a decade's worth of understanding into the mechanisms of feature binding within WM, as gleaned from research conducted in my laboratory. I will begin by noting that discussions on binding in WM have traditionally focused on voluntary binding. However, it is crucial to acknowledge that WM involves two distinct forms of binding: involuntary and voluntary, each characterized by unique processing dynamics. Through our application of psychophysics and ERP experiments, we have identified two separate pathways for the formation of implicit bindings within WM. Regarding voluntary binding, our extensive psychophysics studies have shown that its maintenance within WM requires an additional allocation of object-based attention, rather than merely requiring more central executive or spatial attention. Furthermore, I will discuss the cognitive architecture of the storage buffer for voluntary binding in WM. Our findings, derived from structural equation modeling and psychophysics experiments, suggest that WM does not possess a dedicated storage space for bindings, such as an episodic buffer. Instead, bindings share the same storage space as other WM features. Finally, I will explore the neural underpinnings of voluntary binding processing in WM. Using fMRI and TMS, we have endeavored to elucidate the core brain networks involved in the processing of conjunctive and relational bindings within WM, highlighting the critical brain regions common to these two distinct types of binding.