How do you know if you saw that? Electrophysiological correlates of searching through memory

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People are remarkably adept at recognizing thousands of previously studied pictures or objects (Brady et al., 2008). Wolfe (2012) extended this finding to the visual search domain by asking subjects to search for any instance of up to 100 memorized objects presented in a visual search display ("Hybrid search"). By varying both the number of objects held in memory and in the visual search array, he found that increasing the number of objects in visual space led to linear increase in response time (RT), whereas increasing the number of items in memory led to a logarithmic increase in RT. Although we know a great deal about the electrophysiological correlates of visual search, we know much less about memory search. In the current study, we sought to identify the electrophysiological correlates of memory search in a modified hybrid search task. During the learning phase, subjects (n=32) memorized a set of 2, 4, 16, or 64 real world objects and completed a subsequent recognition test. Next, subjects searched for the items in a lateralized search display. In order to identify the ERP components specific to searching through memory, the visual set size was constrained to a single lateralized object with a lateralized distractor. ERP waveforms were time-locked to the onset of the two-item search array. To examine recognition memory, we subtracted Absent from Present trials. We found a large modulation of N400 amplitude and latency (measured using fractional area latency) as a function of memory set: Larger memory set sizes were associated with a significantly smaller, later N400 deflection. While much prior research has shown that the N400 is sensitive to recognition of previously observed stimuli (e.g., Kutas & Federmeier, 2011), the current work suggests it may also be acutely sensitive to searching through memory spaces of different sizes.

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