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Review

Age differences in the neural correlates of novelty processing: The effects of item-relatedness

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ABSTRACT

Past research finds that age-related increases in false recognitions are a key contributor to age-related memory decline, suggesting that older adults have difficulty in correctly distinguishing between new and old information, particularly when new items at retrieval are semantically or perceptually related to items from encoding. However, little work has examined the neural mechanisms older adults engage to avoid false recognitions and successfully identify information as novel. In the present study, young and older adults were scanned during a retrieval task in which new items were exemplars from studied categories (related lures) or unstudied categories (unrelated lures) in order to detect age-related differences in the neural correlates of related and unrelated novelty processing. Results showed that, unlike young adults, older adults did not differentially recruit regions such as the anterior cingulate and bilateral middle/inferior temporal gyrus to capitalize on the salient categorical differences in unrelated items. Likewise, older adults did not differentially recruit regions of early visual cortex or anterior hippocampus, suggesting that older adults have difficulty using item-specific details to make successful related novelty decisions. Instead, older adults recruited bilateral ventrolateral prefrontal cortex differentially for successful novelty processing and particularly for related novelty processing. Overall, results suggest that age deficits in novelty processing may arise because older adults process related and unrelated lures similarly and do not capitalize on categorical or item-specific properties of novel items. Similar to aging patterns in memory retrieval, results also showed that older adults have the strongest novelty success activity in lateral PFC regions associated with control and monitoring processes.

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1. Introduction

It is well documented that older adults have more difficulty remembering information than young adults (for reviews see Craik (1994), Light (1991) and Spencer and Raz (1995)) and that this memory deficit is often reflected in age differences in neural functioning during both encoding and retrieval (for reviews see Dennis and Cabeza (2008) and Rajah and D'Esposito (2005)). With regard to retrieval, aging research has typically focused on age-related differences in the neural basis of true memories. However, recent research in the domain of false memory has suggested that older adults also have difficulty in correctly rejecting lures at retrieval (e.g., Koutstaal and Schacter (1997) and McCabe et al. (2009)) and that these behavioral differences are associated with significant age differences in neural recruitment associated with false recognitions (Dennis et al., 2008, 2014; Duarte et al., 2010; Giovanello et al., 2009). Despite the contribution of false recognition to age-related memory decline, relatively little research has examined this issue from the perspective of novelty processing and the successful rejection of retrieval lures. Thus, little is known about the cognitive and neural processes that young and older adults engage to avoid false memories and instead successfully identify information as novel. The present study sought to elucidate the neural basis of novelty processing in young and older adults and assess how factors that increase false recognitions (i.e., item relatedness) moderate neural activity associated with rejecting lures at retrieval.

Research has shown that aging is associated with both declines in true memory and increases in false memories (see McCabe et al. (2009) for a meta-analysis). As such, age deficits in detecting novelty represent a significant contributing factor to age-related memory impairment. Further, behavioral evidence indicates that increasing the similarity or relatedness between retrieval lures and studied items leads to increased false memories (and thus deficits in novelty processing) in both young and older adults (Koutstaal and Schacter, 1997; Norman and Schacter, 1997; Tun et al., 1998). For example, studies using false memory paradigms such as the Deese–Roediger–McDermott (DRM) paradigm and perceptual relatedness paradigms have shown that it is relatively easy to correctly reject lures when they share few perceptual or semantic features with previously encountered items (i.e., unrelated lures; Gallo et al., 2001; Meade et al., 2007). However, both young and older adults have difficulty in correctly rejecting lures that share perceptual or semantic features with previously encountered items (i.e., related lures; Koutstaal and Schacter, 1997; Norman and Schacter, 1997; Tun et al., 1998). While both young and older adults falsely recognize related lures more often than unrelated lures, research has also shown that age-related increases in false memories are significantly greater for related lures (Balota et al., 1999; Butler et al., 2004; Koutstaal and Schacter, 1997; Rankin and Kausler, 1979; Tun et al., 1998). Thus, behavioral research has demonstrated that the degree of relatedness between old and new items is a key factor driving age-related increases in false memories and thus age deficits in novelty processing.

However, as noted previously, neuroimaging studies that have investigated age-related deficits in novelty processing during memory retrieval have typically focused on elucidating the neural correlates of novelty errors (i.e., false memories; Dennis et al., 2008, 2014; Duarte et al., 2010; Giovanello et al., 2009) and have not focused on novelty success (i.e., correct rejections). These studies find that older adults' increase in false memories results from an overreliance on gist or familiarity processing in lateral temporal and parahippocampal (PHG) regions for related items presented at retrieval (Dennis et al., 2008, 2014; Giovanello et al., 2009) as well as a reduced reliance on item-specific processing within sensory regions for unrelated items (Duarte et al., 2010). This shift in processing makes new items more likely to be confused with old items, particularly when they share semantic and/or perceptual properties. While these previous studies shed light on the processes underlying novelty errors, it is also critical to identify the neural resources older adults utilize when they make *successful* novelty decisions (i.e., by