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Visual integration enhances associative memory equally for young and older adults without reducing hippocampal encoding activation

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Abstract

The ability to remember associations between previously unrelated pieces of information is often impaired in older adults (Naveh-Benjamin, 2000). Unitization, the process of creating a perceptually or semantically integrated representation that includes both items in an associative pair, attenuates age-related associative deficits (Bastin et al., 2013; Ahmad et al., 2015; Zheng, et al., 2015). Compared to non-unitized pairs, unitized pairs may rely less on hippocampally-mediated binding associated with recollection, and more on familiarity-based processes mediated by perirhinal cortex (PRC) and parahippocampal cortex (PHC). While unitization of verbal materials improves associative memory in older adults, less is known about the impact of visual integration. The present study determined whether visual integration improves associative memory in older adults by minimizing the need for hippocampal (HC) recruitment and shifting encoding to non-hippocampal medial temporal structures, such as the PRC and PHC. Young and older adults were presented with a series of objects paired with naturalistic scenes while undergoing fMRI scanning, and were later given an associative memory test. Visual integration was varied by presenting the object either next to the scene (Separated condition) or visually integrated within the scene (Combined condition). Visual integration improved associative memory among young and older adults to a similar degree by increasing the hit rate for intact pairs, but without increasing false alarms for recombined pairs, suggesting enhanced recollection rather than increased reliance on familiarity. Also contrary to expectations, visual integration resulted in increased hippocampal activation in both age groups, along with increases in PRC and PHC activation. Activation in all three MTL regions predicted discrimination performance during the Separated condition in young adults, while only a marginal relationship between PRC activation and performance was observed during the Combined condition. Older adults showed less overall activation in MTL regions compared to young adults, and associative memory performance was most strongly predicted by prefrontal, rather than MTL, activation. We suggest that visual integration benefits both young and older adults similarly, and provides a special case of unitization that may be mediated by recollective, rather than familiarity-based encoding processes.

Key words: cognitive aging, visual unitization, MRI

1. Introduction

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