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The role of schematic support in age-related associative deficits in short-term and long-term memory

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ABSTRACT

Older, relative to younger adults, exhibit an associative memory deficit in short-term and long-term memory, characterized by difficulty in binding distinct components to form associations, while item memory remains largely intact. Reduced performance emerges mostly due to high false alarm rates in older adults' associative memory. One factor that could increase older adult false alarm rates during associative recognition memory tests is a decreased use of recollection processes that allow the rejection of recombined components from the study phase. The current experiments assessed the degree to which an increase in the use of semantic memory (schematic) support, by changing the patterns of support from study to test, can help older adults reduce their associative false alarms using recollection. In two experiments, face–name pairs were presented to younger and older adults. During a continuous recognition task assessing memory performance at short-term and long-term memory retention intervals, younger and older adults were tested on individual faces, names, and face–name pairs that either remained intact or were recombined within the same (e.g., old-face, old-name) or between two different age categories (e.g., old-face, young-name). In Experiment 2, we also collected "remember–know" judgments after responses to recognition test events. In both experiments, the results indicated benefits to older adults' associative memory when changes in schematic support occurred from study to test at long-term but not short-term memory retention intervals. The results of Experiment 2 indicate that these increases in performance were mediated by the availability of recollection processes during retrieval.

Introduction

Senescent decline in the ability to encode, maintain, and retrieve information is a common occurrence for aging populations. For instance, age-related declines in episodic memory processes are well documented (for reviews see Craik & Bialystok, 2006; Old & Naveh-Benjamin, 2008; Zacks, Hasher, & Li, 2000) despite relatively preserved semantic memory (Kausler & Puckett, 1980). Specifically, older adults have trouble forming associations between components within episodic memory (Chalfonte & Johnson, 1996). Providing an overall theoretical perspective to account for age-related declines in episodic memory, the associative deficit hypothesis (ADH) proposes that older compared to younger adults have difficulty encoding and retrieving associations between distinct components while memory for these components remains largely intact (Naveh-Benjamin, 2000). Evidence in support of this perspective is well documented, with a variety of studies replicating and extending the findings from Naveh-Benjamin (2000) upon examining the formation of

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associations in long-term memory (LTM) between a number of distinct components (e.g., word pairs, face–name pairs, face–scene pairs, picture pairs, person–activity pairs: Bastin & Van der Linden, 2005; Castel & Craik, 2003; Naveh-Benjamin, Guez, Kilb, & Reedy, 2004; Naveh-Benjamin, Hussain, Guez, & Bar-On, 2003; for a meta-analytic review see Old & Naveh-Benjamin, 2008).

While the majority of the research examining the ADH has focused on episodic memory processes, evidence from several recent studies suggests that age-related associative (or binding) deficits are apparent even within short-term memory (STM; Borg, Leroy, Favre, Laurent, & Thomas-Anterion, 2011; Chen & Naveh-Benjamin, 2012; Cowan, Naveh-Benjamin, Kilb, & Saults, 2006; Fandakova, Sander, Werkle-Bergner, & Shing, 2014; Mitchell, Johnson, Raye, Mather, & D'Esposito, 2000). However, other studies have shown no evidence of age-related binding deficits at STM retention intervals (e.g., Brockmole, Parra, Della Sala, & Logie, 2008; Experiment 1, Brown & Brockmole, 2010; Parra, Abrahams, Logie, & Della Sala, 2009; Read, Rogers, & Wilson, 2015; Rhodes, Parra, & Logie, 2016). While the nature of age-related associative deficits within STM remains unclear, recent work suggests that the type of binding process (e.g., surface vs. contextual feature binding) and use of secondary tasks (e.g., articulatory suppression) are important factors mediating the presence or absence of age-related binding deficits (Peterson & Naveh-Benjamin, 2016).

Other recent evidence, which has shown age-related deficits during STM retention intervals, suggests that one potential explanation for age-related associative memory deficits in LTM relates to inefficient encoding mechanisms when attempting to form bound representations of distinct components within short-term memory for potential transfer into LTM. Indeed, in one recent study, younger and older adults' memory for faces, scenes, and face–scene pairs were examined across both STM and LTM retention intervals within the same experiment. Using a continuous recognition task paradigm, Chen and Naveh-Benjamin (2012) examined performance for both item and associative memory across a variety of short-term and long-term retention intervals, finding consistent evidence of an age-related associative deficit.

While recent findings of age-related deficits even across short-term retention intervals suggest the involvement of inefficient encoding mechanisms, another possibility according to the ADH is that age-related differences in retrieval processes may, in part, underlie associative memory deficits. For instance, aging may differentially impact two retrieval processes involved in recognition memory, namely, familiarity and recollection (see Spencer & Raz, 1995; Yonelinas, 2002). Recollection-based recognition, involving remembering details surrounding the context in which an item was initially encountered, has been shown to decline with age, whereas familiarity-based recognition, or knowing that an item was initially encountered in the absence of contextual details, remains largely intact (Davidson & Glisky, 2002; Jacoby, Shimizu, Velanova, & Rhodes, 2005; Kilb & Naveh-Benjamin, 2011; Light, Prull, La Voie, & Healey, 2000). Intriguingly, the notion that familiarity-based, but not recollection-based recognition processes remain intact within increasing age converges with the existing evidence that older adults, relative to younger adults, exhibit impaired memory for associations but not for the components comprising these associations (Old & Naveh-Benjamin, 2008). Consistent with this notion, the ability to recognize associations is thought to rely on recollection processes as retrieval of the item and its context is necessary, whereas familiarity processes may be sufficient for recognition of the individual components (Yonelinas, 1997, 2002).

Aside from age-related differences with respect to the specific retrieval processes used during associative memory tasks, increases in age are often accompanied by an increase in retrieval errors. Specifically, the associative memory deficit is, in part, characterized by high false alarm rates, (e.g., rather than low hit rates), during associative memory tests for older relative to younger adults (Castel & Craik, 2003; Cohn, Emrich, & Moscovitch, 2008; Kilb & Naveh-Benjamin, 2011; Old & Naveh-Benjamin, 2008). Even when provided with instructions for effective use of encoding strategies to learn items and item pairs, characteristic high false alarm rates for older relative to younger adults are present, producing an age-related associative memory deficit (Shing, Werkle-Bergner, Li, & Lindenberger, 2008). Thus, during attempts at retrieval of associative pairs, older adults tend to erroneously endorse recombined pairs (i.e., false alarm) more frequently than younger adults. Accordingly, if older adults use relatively automatic retrieval processes due to decreases in strategic processing, they may rely on familiarity-based recognition during associative memory tests. As such, one possible reason for this high false alarm rate may be due to older adults' propensity to accept associative pairs based on familiarity with the components of the pair (e.g., both components of a recombined pair appeared during the study phase) in the absence of contextual details (Fandakova, Shing, & Lindenberger, 2013).

One potential reason for older adults' increased reliance on familiarity-based rather than recollection-based recognition may be due to decreased or inefficient ambient use of strategic or elaborative processing during encoding and retrieval. Indeed, recent findings have indicated that, when explicitly instructed on how to use encoding and retrieval strategies, older adults are able to improve their associative memory performance, resulting in a decreased age-related deficit (Naveh-Benjamin, Brav, & Levy, 2007). However, even if older adults are not explicitly given a strategy to use, they may be able to take advantage of certain schematic support cues included within the design of the associative memory task. For instance, when schematic support is available based on prior domain-relevant, semantic knowledge, encoding and retrieval of that domain-relevant content is enhanced, leading to memory performance improvements (Bransford & Johnson, 1972; Craik & Bosman, 1992). Given that semantic memory processes remain relatively intact with increases in age, older adults can take advantage of schematic support cues when encoding and retrieval of episodic information is necessary (Craik & Jennings, 1992). Moreover, semantic relatedness between items within an associative pair (e.g., word pairs) reduces the age-related associative memory deficit