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The influence of strategic encoding on false memory in patients with mild cognitive impairment and Alzheimer's disease dementia

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ABSTRACT

Patients with Alzheimer's disease (AD) dementia exhibit high rates of memory distortions in addition to their impairments in episodic memory. Several investigations have demonstrated that when healthy individuals (young and old) engaged in an encoding strategy that emphasized the uniqueness of study items (an item-specific encoding strategy), they were able to improve their discrimination between old items and unstudied critical lure items in a false memory task. In the present study we examined if patients with AD could also improve their memory discrimination when engaging in an item-specific encoding strategy. Healthy older adult controls, patients with mild cognitive impairment (MCI) due to AD, and patients with mild AD dementia were asked to study lists of categorized words. In the Item-Specific condition, participants were asked to provide a unique detail or personal experience with each study item. In the Relational condition, they were asked to determine how each item in the list was related to the others. To assess the influence of both strategies, recall and recognition memory tests were administered. Overall, both patient groups exhibited poorer memory in both recall and recognition tests compared to controls. In terms of recognition, healthy older controls and patients with MCI due to AD exhibited improved memory discrimination in the Item-Specific condition compared to the Relational condition, whereas patients with AD dementia did not. We speculate that patients with MCI due to AD use intact frontal networks to effectively engage in this strategy.

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1. Introduction

Patients with mild cognitive impairment (MCI) due to Alzheimer's disease (AD) and patients with AD dementia commonly exhibit impairments in episodic memory and rapidly forget newly learned information. In addition, these patients exhibit a higher incidence of memory distortions compared to their cognitively healthy older peers. These memory distortions can be severe, such as confabulation (Nedjam, Devouche, & Dalla Barba, 2004), though generally they are more mundane. For example, a patient may have thought they have turned off their stove when they simply *misremembered* that they turned off the stove. Organizational strategies, such as using pillboxes for medication, can help in the remembering of daily living activities. However, this type of strategy does not help when patients experience false memories—not looking in their pillbox, for example, because they falsely remember taking their medication. It is, therefore, important to examine strategies that can reduce false memory in these patients.

False memory has often been examined variations of the Deese-Roediger-McDermott (DRM) false memory paradigm (Roediger & McDermott, 1995). In this paradigm participants study lists of semantically related words (e.g., *door*, *glass*, *pane*, *shade*, etc.). In a recognition memory test, participants are tested on their memory for studied old words (e.g., *door*), unrelated new words (e.g., *lawyer*), and strongly related but unstudied *critical lure* words (e.g., *window*). High rates of false recall and recognition of critical lure items has been consistently observed in healthy young adults across variations of the DRM-false memory paradigm (for a review see Gallo, 2010). False memories arise from the spread of activation to semantically related items in memory, strengthening gist-information, causing individuals to endorse critical lure words more readily (Reyna & Brainerd, 1998; Roediger, Watson,

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McDermott, & Gallo, 2001). Individuals typically engage in different memory strategies to combat the influences of spreading activation and gist, which can involve the use of *item-specific information*. Item-specific information refers to distinctive features of individually studied items. When more item-specific information is stored into memory, individuals can more readily use retrieval monitoring mechanisms to reduce gist-based false memory.

Relative to healthy young adults, healthy older adults are more susceptible to false memory. Healthy older adults have been shown to rely more on gist for their memory judgments (Gallo, Bell, Beier, & Schacter, 2006; Koutstaal & Schacter, 1997; Norman & Schacter, 1997). In comparison to healthy older individuals, patients with AD dementia exhibit more false memories and memory distortions (Balota et al., 1999; Budson, Daffner, Desikan, & Schacter, 2000; Budson, Sitarski, Daffner, & Schacter, 2002; Budson, Todman, Chong, et al., 2006; Budson, Todman, & Schacter, 2006; Budson et al., 2003; O'Connor et al., 2015). Patients with AD dementia have been shown to have higher rates of false memory to critical lures when matched on true memory performance (Balota et al., 1999). Furthermore, when gist is strengthened through repetition of study lists, patients with AD become more likely than healthy older adults to endorse critical lure items (Budson et al., 2000).

Prior studies have focused on memorial strategies that patients could use to reduce false memories by reducing their reliance on gist-information. Two specific strategies that have been examined in healthy individuals and in patients with AD are the *distinctiveness heuristic* and the *recall-to-reject* strategy. The distinctiveness heuristic refers to a strategy whereby participants reject unstudied new items in a memory test when they are sufficiently unique or distinctive. For example, "If I had seen that gigantic spider before, I'm sure I would have remembered it." Patients with AD are less able to use the distinctiveness heuristic to reduce their false recognition to critical lures (Budson et al., 2002). Budson, Dodson, Daffner, and Schacter (2005) found that patients were aware of the distinctiveness heuristic as a viable memory retrieval strategy; however, due to impairments to item-specific recollection, they were unable to use it selectively, reducing both false and true recognition (see also Gallo, Chen, Wiseman, Schacter, & Budson, 2007). Recall-to-reject is another strategy that can be used to reduce false recognition, when a participant sees an item in one of two contexts, and can recall enough details of the item in one context to know that it was not seen in the other. Using an associative recognition memory paradigm, Gallo, Sullivan, Daffner, Schacter, and Budson (2004) demonstrated that patients with AD dementia, relative to healthy individuals, were less able to engage in a recall-to-reject strategy to combat the influence of gist (and memorial familiarity) because of their impaired item-specific recollection. By contrast, with intact item-specific recollection, healthy older controls were able to use a recall-to-reject strategy to reject unstudied associative word pairings.

These studies show that patients with AD are generally limited in the use of the distinctiveness heuristic and recall-to-reject strategies to reduce their false recognition. Other investigations have focused on examining the effectiveness of an *Item-Specific* encoding strategy. This strategy aims to enhance the encoding of unique perceptual and contextual characteristics of an item and to prevent the strengthening of gist information, leading to reductions in false memory and improvement in memory discrimination (higher hit rates, lower false alarm rates). Item-Specific encoding has usually been contrasted with a strategy where individuals are asked to remember items in a more associative manner (referred to as *Relational* encoding). McCabe, Presmanes, Robertson, and Smith (2004) compared Item-Specific and Relational encoding strategies in healthy young adults using a DRM paradigm. For each word in the Item-Specific condition, participants were instructed to think about one unique characteristic that differentiated that item from others in the same list. In the Relational condition, participants were instructed to relate an item to others in the same list, and to focus on what they had in common. After each condition, participants were given a recognition memory test. Their results showed that memory discrimination was higher in the Item-Specific condition compared to the Relational condition. Extending these findings, Huff and Bodner (2013) compared Item-Specific and Relational encoding strategies to a "Read Only" strategy, whereby participants simply read each word aloud. They discovered a similar pattern of results: Item-Specific encoding led to improved discrimination when compared to Relational and "Read Only" encoding. In healthy older adults, Thomas and McDaniel (2013) found that older adults with higher frontal lobe functioning had lower false recall when they engaged in Item-Specific encoding compared to older adults with lower frontal lobe functioning. These studies demonstrate that Item-Specific encoding strategies—perhaps engaged by the frontal lobes—enhance detailed oriented information in memory, making memory cues more readily available for memory retrieval, thus facilitating the use of different retrieval strategies.

Given that prior studies have shown that Item-Specific encoding was effective in reducing false memory in older adults, we investigated the efficacy of this strategy in patients with MCI due to AD and in patients with mild AD dementia in a false memory paradigm with categorized word lists. Item-Specific encoding was expected to enhance item-specific recollection across all groups, preventing the strengthening of gist-information and the spread of activation which should, in turn, reduce false recognition and improve memory discrimination. We were interested in investigating the efficacy of this strategy with both patient groups, because we hypothesized that the severity of cognitive impairment may influence a patient's ability to use this encoding strategy. As Thomas and McDaniel (2013) indicated, frontal lobe ability might underlie the ability to engage in an Item-Specific encoding strategy. Patients with MCI due to AD have been shown to have fewer frontal/executive deficits than patients with mild AD dementia (e.g., Marshall et al., 2011), and therefore the former may be able to use encoding strategies more readily than the latter. We therefore predicted that, following the use of an Item-Specific encoding strategy, the largest increase in memory discrimination would be observed in the healthy older control group, followed by patients with MCI due to AD, with the smallest increase observed in patients with mild AD dementia. These predictions are based on the idea that as the AD pathology spreads to other cortical areas (e.g., medial temporal lobe, parietal lobe, frontal lobe) impairments in item-specific recollection and the ability to engage in encoding and retrieval strategies would become more apparent.

We contrasted Item-Specific encoding by asking patients to engage in relational encoding. In daily life, individuals may engage in relational/associative processing when attempting to remember related items (e.g., purchasing groceries for a meal) (unpublished observations). For healthy individuals, this is often an efficient memory strategy. For patients with MCI due to AD and mild AD dementia, however, engaging in this type of strategy may actually promote the strengthening of gist, and may thereby decrease their overall ability to discriminate between old desired versus new related but non-desired items. For this reason, we believed that the use of a relational strategy would provide an ideal appropriate contrast to the implementation of a more item-specific encoding strategy.