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Semantic versus phonological false recognition in aging and Alzheimer's disease☆

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Abstract

Patients with Alzheimer's disease (AD) have been found to exhibit lower levels of false recognition of semantic associates compared with healthy older adults. Because these patients may show impaired performance of episodic and semantic memory tasks, this finding could be explained by deficits in episodic memory, semantic memory, or both. The authors adapted a paradigm for comparison of semantic versus phonological false recognition. They found that: (a) patients with AD exhibited lower levels of corrected false recognition of semantic, phonological, and hybrid (mixed semantic and phonological) lists than older adults, and (b) patients with AD showed very similar levels of false recognition for all list types. These results suggest that only episodic memory deficits are necessary to explain the lower level of false recognition of semantic associates observed in patients with AD when compared to older adults. Additionally, (c) older adults showed greater levels of semantic, phonological, and hybrid false recognition than younger adults, extending previous false recognition research of semantically related words and categorized colored photographs to phonologically related words.

Keywords: Memory; False memory; False recognition; Memory distortions; Alzheimer's disease; Aging; Older adults; Phonological; Semantic memory; Hybrid

1. Introduction

Patients with probable Alzheimer's disease (AD) not only fail to retrieve desired information but also suffer from distortions of memory (Förstl et al., 1994) that may impair their ability to live independently (Borson & Raskind, 1997). For example, patients may believe that they turned off the stove or took their medication when they only thought about performing these activities.

Memory distortions in AD have been explored experimentally using a false memory paradigm originally developed by Deese (1959) and revived and modified by Roediger and McDermott (1995). This Deese/Roediger–McDermott (DRM) paradigm has demonstrated robust levels of false recall and recognition in healthy adults. After studying lists of semantic associates (e.g., *candy*, *sour*, *sugar*, *bitter*, *good*, *taste*, and *so forth*) that all converge on a non-presented theme word or related lure (e.g., *sweet*), participants frequently intruded the related lure on free recall tests (Deese, 1959), and made very high levels of false alarms to these words on recognition tests (Roediger & McDermott, 1995).

Using the DRM paradigm, Balota et al. (1999b) found that, after controlling for false alarms to unrelated items, patients with AD falsely recognized *fewer* related lures than did healthy older adults (note that the recognition data were measured only after recall performance and therefore were contaminated by the

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earlier recall task). Budson, Daffner, Desikan, and Schacter (2000) also studied patients with AD using the DRM paradigm, and likewise found that patients with AD exhibited lower levels of false recognition compared with healthy older adults.

Similar results have been obtained in patients with amnesia using several types of material, including the DRM semantic associates (Schacter, Verfaellie, & Pradere, 1996; Schacter, Verfaellie, Anes, & Racine, 1998a), categorized pictures (Koutstaal, Verfaellie, & Schacter, 2001), perceptually similar words (Schacter, Verfaellie, & Anes, 1997), and perceptually related novel objects (Koutstaal, Schacter, Verfaellie, Brenner, & Jackson, 1999). Patients with amnesia exhibit severe difficulties remembering recent experiences as a consequence of damage to the medial temporal lobes and related structures in the diencephalon, despite normal perceptual and linguistic functions along with IQ scores in the normal range (e.g., Parkin & Leng, 1993; Squire, 1994). Thus, the results from the patients with AD could be entirely explained by their poor episodic memory, as is the case for patients with amnesia.

In addition to their impairment in episodic memory, however, patients with AD also show impairment on some tasks that draw upon semantic memory. Such tasks include generating words from semantic categories (typically animals, fruits, vegetables; Monsch et al., 1992; Salmon, Heindel, & Lange, 1999) and judging word relatedness (Bayles, Tomoeda, & Cruz, 1999). Patients with AD perform normally, however, on other tasks requiring intact semantic memory, including semantic priming (Balota & Duchek, 1991; Balota, Watson, Duchek, & Ferraro, 1999a) and instantiation of semantic categories in sentence comprehension (Nebes & Halligan, 1999). These seemingly contradictory data have led Balota and colleagues to postulate that the major problem with semantic memory in patients with AD is not in underlying semantic networks, but rather in an attentional control system that provides access to those networks (Balota et al., 1999a, 1999b; Watson, Balota, & Sergent-Marshall, 2001). This theory would explain why patients with AD show normal performance on paradigms such as priming, that use relatively automatic activation processes, whereas they show impairment in paradigms that require cognitive effort, and are heavily dependent upon attentional control systems, such as category word generation.

It may be that the lower level of false recognition of semantically associated words that is seen in patients with AD is attributable in part to a semantic memory deficit (regardless of the precise etiology of that deficit). Supporting this idea, Dalla Barba and Wong (1995) have demonstrated that patients with AD who showed relatively poor performance on semantic memory tasks also produced fewer related intrusions on free-recall tests.

Impairment in semantic memory may contribute to the reduced level of false recognition of semantic associates in patients with AD: if these patients do not recognize the semantic associations between the studied items, then they will not develop the general meaning, idea, or semantic gist conveyed by the collection of semantically related items (gist information; e.g., Reyna & Brainerd, 1995). It may be that in healthy older adults, as the study list is presented in the DRM paradigm, a gist representation is developed. This gist representation may result in an experience of recollection or familiarity when either a studied item *or* a related lure is presented on a later recognition test. In the DRM paradigm, accurate recognition of previously studied items probably depends upon both gist information and the specific details of a prior encounter (item-specific recollection), whereas false recognition of related lure words may be related to remembering gist but not item-specific information (cf. Brainerd & Reyna, 1998; Payne, Elie, Blackwell, & Neuschatz, 1996; Schacter et al., 1996). Whereas older adults recognize the semantic associations between related items, build up gist, and therefore become much more susceptible to responding "old" to the related lures relative to the unrelated lure words, patients with AD would show much less selectivity between these two different types of false positive responses (see Budson, Desikan, Daffner, & Schacter, 2001, for additional theories of how these patients' semantic memory impairment may contribute to their lower level of false recognition of semantic associates).

To begin to explore the contribution of semantic memory impairments to the lower level of false recognition of semantic associates observed in patients with AD, Budson et al. (2001) examined false recognition of perceptually related novel objects with little semantic content in patients with AD and matched older adults. They found that compared to older adults, patients with AD showed lower levels of false recognition of these perceptually related novel objects as well.

Thus it is clear that the lower level of false recognition of semantic associates observed in patients with AD compared with older adults cannot be entirely attributed to their semantic memory deficit, but may also involve a more general deficit in the acquisition, retention, or retrieval of gist information. What remains unclear is the relative contribution of episodic and semantic memory impairments to the observed results. Because of the differences between experiments using perceptual related novel objects (Budson et al., 2001) and DRM semantically related words (Budson et al., 2000), it is not possible to resolve this issue directly by comparing the results of these two studies. However, comparing false recognition for semantically and non-semantically related items within the same experiment should clarify the relative contributions of semantic and episodic memory impairments to the lower level of false recog-