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Preserved conceptual implicit memory for pictures in patients with Alzheimer's disease

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ABSTRACT

The current study examined different aspects of conceptual implicit memory in patients with mild Alzheimer's disease (AD). Specifically, we were interested in whether priming of distinctive conceptual features versus general semantic information related to pictures and words would differ for the mild AD patients and healthy older adults. In this study, 14 healthy older adults and 15 patients with mild AD studied both pictures and words followed by an implicit test section, where they were asked about distinctive conceptual or general semantic information related to the items they had previously studied (or novel items). Healthy older adults and patients with mild AD showed both conceptual priming and the picture superiority effect, but the AD patients only showed these effects for the questions focused on the distinctive conceptual information. We found that patients with mild AD showed intact conceptual picture priming in a task that required generating a response (answer) from a cue (question) for cues that focused on distinctive conceptual information. This experiment has helped improve our understanding of both the picture superiority effect and conceptual implicit memory in patients with mild AD in that these findings support the notion that conceptual implicit memory might potentially help to drive familiarity-based recognition in the face of impaired recollection in patients with mild AD.

1. Introduction

Recent work has been directed at understanding which aspects of memory remain intact in patients with Alzheimer's disease (AD), with the intention of developing interventions that focus on using these intact processes to help improve the daily lives of these patients. While perceptual implicit memory seems to be relatively intact in patients with AD (Fleischman et al., 2005; Park et al., 1998), prior studies of conceptual implicit memory in patients with AD have been largely mixed (Fleischman, 2007; Fleischman et al., 2005; Gong et al., 2010). In general, tasks that require patients to utilize a cue to generate or produce a response often find impaired conceptual implicit memory, while tasks that require patients to identify previously presented stimuli often report intact conceptual implicit memory (Martins & Lloyd-Jones, 2006). However, there has been little investigation into memory for different types of conceptual information to see whether further breaking down the type of stimuli could determine more precisely what type of processing is preserved and impaired.

Several studies have suggested that there might be an important task-dependent aspect to conceptual processing tasks (Grondin, Lupker, & McRae, 2009; Taylor, Devereux, Acres, Randall, & Tyler, 2012). Taylor and colleagues have investigated the contribution of two different types of features to conceptual processing. They found that shared features facilitate identification of an item at a category level (e.g., "has four legs" facilitates a living/nonliving decision) whereas distinctive features facilitate identification of an item at a basic level (e.g., "long neck" facilitates giraffe). This distinction might be important to understanding the processes preserved and impaired in conceptual implicit memory in patients with mild AD.

Hamilton and Geraci (2006) proposed that the type of conceptual processing tested might be critical for examining conceptual implicit memory. Many studies have suggested that pictures are better remembered than words as a result of deeper and more

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elaborate conceptual processing than words (Nelson, 1979; Nelson, Reed, & Walling, 1976; Paivio, 1971; Weldon & Roediger, 1987; Weldon, Roediger, & Challis, 1989; but see Mintzer & Snodgrass, 1999). This picture superiority effect is also found in patients with amnestic mild cognitive impairment (aMCI) and AD in explicit recognition tasks (Ally, 2012; Ally, Gold, & Budson, 2009; Ally, McKeever, Waring, & Budson, 2009; Beth, Waring, Budson, & Ally, 2009; Deason, Hussey, Budson, & Ally, 2012; Embree, Budson, & Ally, 2012; O'Connor & Ally, 2010). Pictures may allow for greater activation of related concepts or may allow for deeper, more elaborate processing of conceptual features. For example, if a person is presented with the word "giraffe", they might activate the feature of long neck. But if they are presented with a picture of giraffe, the picture might spur activation of additional concepts such as "has spots", "vegetarian", "jungle", and "my daughter had a stuffed giraffe she carried around when she was young." The deeper conceptual activation that results from pictures leads to better memory performance. However these accounts would generally predict that a picture superiority effect should be found in both explicit and implicit memory tests in healthy young adults. While the benefit of pictures has been widely shown in explicit tasks, the findings using implicit memory tasks are more mixed (Hamilton & Geraci, 2006; Stenberg, 2006; Vaidya & Gabrieli, 2000; Weldon & Coyote, 1996).

According to Hamilton and Geraci's conceptual distinctiveness account, the picture superiority effect results from conceptual processing of a picture's distinctive features rather than semantic information (also see Cree, McNorgan, & McRae, 2006; Mirman & Magnuson, 2009). That is, pictures contain individuating characteristics that make them conceptually distinctive in memory. Hamilton and Geraci tested their conceptual distinctiveness hypothesis by using two types of conceptual implicit memory tasks. One task required subjects to simply access semantic knowledge, whereas the second task required subjects to specifically access the individuating characteristics of the picture or word. As an example, subjects studied the item "lemon" as a picture or word. The implicit test cue on the general semantic task asked, "What is a used car sometimes called?" In contrast, the implicit test cue on the distinctive conceptual information task asked, "What fruit is egg shaped?" Hamilton and Geraci reported that healthy young adult subjects demonstrated the picture superiority effect only for the implicit task assessing distinct conceptual information, providing evidence that the distinctive features of pictures provide diagnostic conceptual information that leads to superior memory.

The primary objective of the present investigation was to examine whether aspects of conceptual implicit memory might be preserved in patients with mild AD, particularly if different types of conceptual implicit memory are examined separately. To accomplish this goal, we used a modified version of Hamilton and Geraci's (2006) conceptual implicit memory paradigm. Healthy older adults and patients with mild AD studied both pictures and words followed by an implicit test section where they were queried regarding distinctive conceptual or general semantic information related to the items they had previously studied (or novel items). Participants then performed a short recognition test to see whether the more typical picture superiority effect in explicit recognition could also be demonstrated. Conceptual priming was measured when participants responded with items that had been previously studied more often than with unstudied items. If participants responded with previously encoded items more often when they had been studied as pictures rather than words, this demonstrated an implicit conceptual picture superiority effect. According to the prior results of Hamilton and Geraci (2006), we predicted there would be conceptual priming and a picture superiority effect shown for the distinctive conceptual focused questions but not for the questions focused on more general semantic information for healthy older adults. While patients with mild AD have shown a preserved picture superiority effect in explicit recognition, there have been mixed results when examining conceptual implicit memory in this group. Often when patients as asked to generate a response, performance on conceptual implicit memory tasks is impaired. Potentially by examining different types of conceptual priming in the current experiment, we will learn more precisely what is preserved and impaired in mild AD.

2. Methods

2.1. Participants

Fourteen healthy older adults (8 female/6 male, 5 run in Boston) with a mean age of 74.57 (range = 62–85) and education level of 15.36 years participated in this study. Fifteen patients with a clinical diagnosis of very mild AD (7 female/8 male, 11 run in Boston) with a mean age range of 76.27 (range = 63–85) and education level of 15.20 years participated in this study. Patients were recruited from the Vanderbilt University Cognitive Disorders Clinic and the Boston University Alzheimer's Disease Center (BU ADC). Patients were each assessed by a neurologist and neuropsychologist in one of the Vanderbilt or Boston University clinics, and met criteria for mild AD described by the National Institute on Ageing and Alzheimer's Association workgroup criteria (McKhann et al., 2011). Healthy older adults were recruited through online and community postings in Boston, MA and Nashville, TN and through online postings on the Vanderbilt University ResearchMatch.org website. Participants were excluded if they had a history of psychiatric illness, alcoholism, head injury, stroke, or diagnosed with another neurodegenerative disorder (e.g. Parkinson's disease). All participants had corrected to normal vision and were native English speakers. This study was approved by the Behavioral Science Committee of the IRB at Vanderbilt University, Nashville, TN and the Human Subjects committee at the Edith Nourse Rogers Memorial Veterans Hospital, Bedford, MA, Boston University, Boston, MA, and VA Boston Healthcare System, Boston, MA. Written informed consent was obtained from all participants and their caregivers, when appropriate. Participants were paid $10/h for their time.

In order to evaluate current cognitive functioning, all participants completed a brief neuropsychological battery, which included the Mini Mental Status Exam (MMSE; Folstein, Folstein, & McHugh, 1975), the word list memory test from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD; Morris et al., 1989), Trail Making Test Part A and B (Adjunct General's Office, 1944), Verbal Fluency to letters and categories (Monsch et al., 1992), and the 15-item Boston Naming Test

Table 1
Demographic and neuropsychological data.

Test	Healthy older adults Mean (SD)	Patients Mean (SD)
Age	74.6 (7.49)	76.3 (6.86)
Years of education	15.4 (2.06)	15.2 (2.54)
MMSE	29.3 (0.73)	25.9 (3.16)*
CERAD		
Immediate	21.4 (3.56)	14.5 (4.34)*
Delayed	7.1 (1.66)	2.5 (2.20)*
Recognition	9.9 (0.27)	7.47 (2.56)*
Trails-B	74.8 (21.71)	209.8 (92.28)*
FAS	46.3 (13.67)	37.2 (12.7)
CAT	48.2 (8.16)	29.3 (11.1)*
BNT-15	14.4 (0.74)	13.0 (1.36)*

* Indicates a significant difference ($p < .05$) between the healthy older adults and the patients with mild AD.