ACADEMIC PRESS

Brain and Cognition 50 (2002) 51–61

Brain and Cognition

www.academicpress.com

Dissociating perceptual and conceptual implicit memory in multiple sclerosis patients

Diana Blum,[a] Andrew P. Yonelinas,[b,*] Tracy Luks,[a] David Newitt,[a] Joonmi Oh,[a] Ying Lu,[a] Sarah Nelson,[a] Donald Goodkin,[c] and Daniel Pelletier[c]

[a] *Department of Radiology, University of California, San Francisco, CA, USA*
[b] *University of California, Davis, CA 95616, USA*
[c] *Department of Neurology, University of California, San Francisco, CA, USA*

Accepted 14 January 2002

Abstract

Previous studies indicate that Multiple Sclerosis (MS) patients exhibit deficits in tests of explicit memory such as free recall, but show normal priming on implicit tests of memory such as word stem completion. However, the memory performance of patients with different MS disease subtypes has not been fully examined. In the current study, memory was assessed in Primary Progressive (PPMS), Relapsing Remitting (RRMS), and Secondary Progressive (SPMS) MS subgroups. Explicit memory as well as perceptual and conceptual implicit memory were examined using free recall, word fragment completion, and exemplar generation tests, respectively. All three groups of MS patients exhibited free recall deficits and normal priming on the exemplar generation test. However, the PPMS group exhibited a deficit in word fragment completion priming, whereas the RRMS and SPMS groups exhibited normal levels of priming on this task. Lesion load was assessed using magnetic resonance imaging and was negatively correlated with explicit memory performance, but it did not account for the observed deficits in perceptual implicit memory. The results indicate that PPMS patients exhibit a pattern of memory impairment that is distinct from that of the RRMS and SPMS groups. Moreover, the results indicate that perceptual implicit memory can be neurologically dissociated from conceptual implicit memory. © 2002 Elsevier Science (USA). All rights reserved.

1. Introduction

Multiple sclerosis (MS) leads to a deficit on tests of explicit memory, such as free recall and recognition (e.g., Beatty, Goodkin, Monson, & Beatty, 1990; Carroll, Gates, & Roldan, 1984; Grant, 1984; Rao, Hammeke, McQuillan, Khatri, & Lloyd, 1984, 1991). In contrast, these patients perform normally on tests of implicit memory, such as word stem completion (e.g., Beatty et al., 1990; Latchford, Morley, Peace, & Boyd, 1993; Scarrabelotti & Caroll, 1998, 1999), pursuit rotor learning

* Corresponding author. Fax: +530-752-2087.
E-mail address: apyonelinas@ucdavis.edu (A.P. Yonelinas).

PII: S0278-2626(02)00009-X

(Beatty et al., 1990), and picture naming (e.g., Carroll et al., 1984). These previous studies, however, have not explored differences between subpopulations of MS patients, and it is not known whether memory performance is equally affected in these different populations.

There are at least two clinically distinct forms of MS, one which is progressive from the onset with no evidence of relapses or remissions (i.e., primary progressive, PPMS) and the other in which the disease initially begins with a relapse-remitting phase—the initial phase is referred to as relapsing-remitting MS (RRMS) and the later phase is referred to as secondary progressive (SPMS). PPMS demonstrates a more rapid progression to advanced disability (Thompson et al., 1997), despite fewer inflammatory lesions (Revesz, Kidd, Thompson, Barnar, & McDonald, 1994) and a lower MRI lesion load throughout the brain than the other form of MS (Thompson et al., 1990, Thompson, Kermode, & Wicks, 1991; Stevenson et al., 1999). There is also epidemiological (e.g., Cottrell et al., 1999; Andersson, Waubant, Gee, & Goodkin, 1999) and immunogenetic evidence (e.g., Olerup et al., 1989; Weinshenker et al., 1998) that these two forms of MS are distinct. Moreover, PPMS patients sometimes exhibit less severe deficits in explicit memory, attention, and reasoning, even when the degree of physical disability is comparable (e.g., Comi et al., 1995) with the other MS group.

The current study examined three distinct forms of memory in PPMS, RRMS, and SPMS patients in order to determine if the memory performance of these groups differs. Explicit memory was measured using a free recall test, perceptual implicit memory was measured using a word fragment completion test, and conceptual implicit memory was measured using an exemplar generation test. These three types of memory are functionally distinct in the sense that they are differentially influenced by several experimental variables, and they are neurologically distinct in the sense that they can be differentially disrupted in different patients populations (for reviews see Gabrieli, 1999; Roediger & McDermott, 1993). For example, selective hippocampal damage leads to selective explicit memory deficits, leaving implicit memory abilities preserved. In contrast, Alzheimer's disease generally disrupts conceptual implicit memory along with explicit memory but leaves perceptual implicit memory reserved.

No previous studies have examined conceptual implicit memory in MS patients, and thus it is not clear how these patients will perform on this form of memory test. Moreover, as mentioned above, perceptual implicit memory and explicit memory have been examined previously in MS patients; however, these studies have not separately examined the performance of patients with different MS subtypes, thus it is not known if the different subgroups will perform similarly on these tests.

In addition to the memory tests, each MS patient in the current study underwent an MRI scan in order to compare the lesions in the different groups and to assess the relationship between lesion load and memory performance. MS results in a progressive accumulation of juxtacortical and deep white matter lesions that disrupt connections between cortical and subcortical structures, and previous studies have indicated that MS patients with cognitive impairments, including impairments in explicit memory, exhibit higher lesion loads than patients who do not (e.g., Comi et al., 1995; Huber et al., 1992; Hohol et al., 1997; Rovaris et al., 1998; Franklin, Heaton, Nelson, Filley, & Seibert, 1988; Rao, Leio, & St. Aubin-Faubert, 1989a,b; Reischies, Baum, Brau, Hedde, & Schwindt, 1988). However, it is not known whether lesion load is related to implicit forms of memory. Consistent with previous studies, we used T1- and T2-weighted images to assess lesion load. T1 lesion load was assessed by hypointense (dark) lesions seen on a T1-weighted image, and T2 lesion load was assessed by hyperintense (bright) lesions seen on a T2-weighted image.