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Autobiographical memory in semantic dementia: Implications for theories of limbic-neocortical interaction in remote memory

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Abstract

We examined autobiographical memory performance in two patients with semantic dementia using a novel measure, the Autobiographical Interview [Levine, Svoboda, Hay, Winocur, & Moscovitch (2002). Aging and autobiographical memory: Dissociating episodic from semantic retrieval. *Psychology and Aging, 17*, 677–689], that is capable of dissociating episodic and personal semantic recall under varying levels of retrieval support. Earlier reports indicated that patients with semantic dementia demonstrate autobiographical episodic memory loss following a "reverse gradient" by which recent memories are preserved relative to remote memories. We found limited evidence for this pattern at conditions of low retrieval support. When structured probing was provided, patients' autobiographical memory performance was similar to that of controls. Retesting of one patient after 1 year indicated that retrieval support was insufficient to bolster performance following progressive prefrontal volume loss, as documented with quantified structural neuroimaging. These findings are discussed in relation to theories of limbic-neocortical interaction in autobiographical memory.

Keywords: Episodic; Semantic; Temporal neocortex; Frontal lobes

The roles of limbic (hippocampal) and neocortical interactions in remote memory have been hotly debated in recent years. According to the "standard" model of memory consolidation, episodic memories become consolidated in temporal neocortex following a temporary period of storage in the hippocampus, after which the hippocampus is no longer required for storage or for retrieval of these memories (Lechner, Squire, & Byrne, 1999; Squire, Cohen, & Nadel, 1984). Support for this conclusion is drawn from experimental work confirming Ribot's (1882) observation that some amnesic patients show temporally-graded memory loss whereby consolidated memory for early life events is preserved relative to impaired memory for recent (unconsolidated) events (Bayley, Hopkins, & Squire, 2003; Scoville & Milner, 1957). In contrast to the standard model, Multiple Trace Theory (MTT; Moscovitch et al., 2005; Nadel & Moscovitch, 1997) holds that the hippocampus is involved in episodic memory recall in perpetuity. According to MTT, the hippocampus stores indices or pointers to neocortical memory representations. New traces are created each time a memory is reactivated. Older memories are less vulnerable to disruption than are recent memories because of their frequent re-instatement and multiply distributed traces.

Semantic dementia (SD) is a form of pre-senile dementia classified under the broader category of frontotemporal lobar degeneration (FTLD; Hodges & Miller, 2001; Neary et al., 1998). The behavioral presentation of SD includes marked semantic memory impairment (e.g., impaired confrontation naming), with evidence for relative preservation of episodic memory (Snowden, Griffiths, & Neary, 1994). This behavioral pattern has been linked to lateral temporal neocortical pathology, with the hippocampus and medial temporal regions relatively pre-

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served, although it is now accepted that significant hippocampal atrophy occurs in SD (Galton et al., 2001).

Research addressing temporal gradients in SD has yielded mixed results. Some studies have revealed disproportionate sparing of recall of episodic memories from the most recent 18-month to 2-year period (Graham & Hodges, 1997; Graham, Kropelnicki, Goldman, & Hodges, 2003; Nestor, Graham, Bozeat, Simons, & Hodges, 2002; Piolino, Belliard, Desgranges, Perron, & Eustace, 2003) with relative impairments emerging across the remaining time periods tested in these studies (some of which were as recent as 5 years past) in patients with SD. Notably, this reversal of the memory loss function reported in amnesic people (Graham & Hodges, 1997), namely relative sparing of recent memories, resembles the typical pattern observed in controls when performance is not at ceiling (Moscovitch & Nadel, 1999; Rubin and Wenzel, 1996), though the controls' loss may be more gradual than the step function often observed in SD. Other studies, however, have found sparing of episodic memory across the lifetime in SD, a pattern most obvious when structured or non-verbal cues (e.g., family photographs) are available to assist in retrieval, compensating for prefrontal cortical (PFC) dysfunction or for linguistic deficits, and revealing preserved episodic memory across the lifetime relative to controls (Moss, Kopelman, Cappelletti, De Mornay Davies, & Jaldow, 2003; Westmacott, Leach, Freedman, & Moscovitch, 2001, but see Graham et al., 2003).

One possible explanation for the conflicting findings is variance in methods used to assess autobiographical memory. Autobiographical memory consists of episodic elements that are recollections of experiences specific in time and place as well as semantic elements that are facts about the world and oneself. The most common method for dissociating episodic and semantic autobiographical memory, the Autobiographical Memory Interview (AMI; Kopelman, Wilson, & Baddeley, 1990), relies on separate interviews that are not matched for difficulty or content. Yet episodic and semantic autobiographical information are not separated in natural discourse; they occur in varying degrees within a single narrative (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002). Furthermore, the AMI and other instruments (Graham & Hodges, 1997; Piolino et al., 2003b) derive scores for episodic autobiographical memory using an ordinal scale that encompasses both generic and specific autobiographical events and is therefore subject to contamination by semantic autobiographical memory.

As stated above, the standard model predicts relative sparing of recent compared to remote episodic memory in SD (a reverse gradient in comparison to amnesic people), whereas MTT predicts equivalent sparing of episodic memory across time periods relative to controls, if the hippocampus is preserved. In the case of semantic memory, a reverse gradient, namely relative sparing of more recent semantic memories, is consistent with both theories, as both predict that temporal neocortical damage can affect remote semantic memories (albeit by different mechanisms; Nadel, Samsonovich, Ryan, & Moscovitch, 2000; Westmacott et al., 2001). To the extent that a putative measure of recent episodic autobiographical memory in SD is contaminated by semantic processes, a reverse gradient may occur due to the semantic contribution.

Yet another source of variance relates to patterns of parenchymal volume loss in SD. Patients with SD often have prefrontal cortical damage (Rosen et al., 2002a, 2002b) leading to speculation that autobiographical memory impairment in this disorder may be related to strategic retrieval deficits (Moscovitch & Nadel, 1999). Previous studies of autobiographical memory in SD have relied upon free (unstructured) recall, providing little or no compensation for PFC-mediated deficits in this population (Graham & Hodges, 1997; Graham et al., 2003; Nestor et al., 2002; Piolino et al., 2003a, 2003b). This may disproportionately affect remote memories, which may require more strategic effort to retrieve than recent memories (see Moss et al., 2003).

Methods that allow for separation of the episodic and semantic components of recall, and that include compensation for PFC-mediated retrieval deficits, should allow for more precise specification of medial temporal lobe (MTL) and temporal neocortical contributions to episodic recall in SD. The purpose of the present study was to examine patterns of autobiographical memory loss in SD using the Autobiographical Interview (AI; Levine et al., 2002; Rosenbaum, McKinnon, Levine, & Moscovitch, 2004; Steinvorth, Levine, & Corkin, 2005). This measure has several advantages over tests of autobiographical memory used previously with SD. The AI dissociates episodic from semantic elements of autobiographical memory within a single, transcribed autobiographical protocol at the time of scoring (rather than at the time of test administration, as in the AMI (Kopelman et al., 1990) using a reliable, text-based scoring system. The AI also examines autobiographical memory across the lifespan at different levels of retrieval support, allowing for the testing of hypotheses concerning strategic contributions to autobiographical memory.

We hypothesized that separation of episodic and semantic components of autobiographical recall and compensation for frontally-mediated retrieval deficits would eliminate the reverse gradient seen under free recall in other studies (Graham & Hodges, 1997; Graham et al., 2003; Nestor et al., 2002; Piolino et al., 2003a), and show unimpaired episodic autobiographical memory performance in our patients.

We administered the AI to two patients with SD, A.A. and B.B. The AI data are interpreted in the context of quantified regional neocortical and limbic volume loss derived from high resolution three-dimensional MRI. One of the patients, A.A., was tested at two intervals, allowing us to examine the effects of disease progression on AI performance.

1. Methods

1.1. Participants

We tested two semantic dementia patients: patient A.A., assessed in two testing sessions held 1 year apart, and patient B.B., assessed on one occasion.

Patient A.A., a right-handed female with 14 years of education, was 62 years old at the time of testing in 2001. Patient B.B., a right-handed female with 13 years education, was 67 years old at the time of testing. Both A.A.'s and B.B.'s most prominent impairments were in the domain of linguistic and semantic functioning, although they also showed evidence of executive dys-