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Recall of remote episodic memories can appear deficient because of a gist-based retrieval orientation

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Abstract

Determining whether patients with amnesia can succeed in remembering their distant past has pivotal implications for theories of memory storage. However, various factors influence recall. We speculated that some patients with anterograde amnesia adopt a gist-based retrieval orientation for memories from all time periods, thereby exaggerating remote recall deficits. We tested whether an experimentally induced gist-based retrieval orientation could indeed hinder remote recall. Healthy individuals described photographs of complex scenes (e.g., of a cluttered desk) either with many words or few words (detail- or gist-based manipulation, respectively). They subsequently recalled autobiographical events and produced less episodic information after engaging the gist-based compared to the detail-based orientation. These results demonstrate the ease with which a gist-based orientation can produce apparent recall impairments. Deficits in remote episodic recall, and in future-event imagining, must thus be interpreted in light of habitual tendencies toward gist-based retrieval that some amnesic patients may exhibit.

Introduction

Patients with extensive hippocampal damage tend to exhibit profound impairments when retrieving memories for recent events (Scoville & Milner, 1957; Squire et al., 2004; Stefanacci et al., 2000). In contrast, these same patients can exhibit normal memory when they recall events from decades ago. A standard explanation for this pattern of impaired recent memory with preserved remote memory is that episodic memories are subject to a hippocampal-dependent consolidation process. Memory storage and retrieval are initially dependent on both hippocampal and cortical networks. As consolidation proceeds, storage comes to depend mostly on distributed cortical networks and less on the hippocampus (Paller, in press; Squire et al., 1984). If the hippocampus is damaged, recent memories still dependent on the hippocampus become difficult to retrieve whereas most remote memories can be retrieved normally (Kirwan et al., 2008; Stefanacci et al., 2000).

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This view is at odds with several recent findings. In one study, patients with unilateral temporal lobe damage due to epilepsy or epilepsy surgery exhibited impaired recall of specific episodic information from remote personal events, though recall of general facts about the events was intact (Viskontas et al., 2000). In two other studies, patients with hippocampal damage exhibited impaired episodic recall regardless of the time period of the past event (Nadel et al., 2000; Steinvorth et al., 2005). In addition, a patient with extensive hippocampal damage and relatively intact temporal neocortex displayed more severe remote episodic memory deficits than patients with extensive temporal neocortical damage and little hippocampal damage (Rosenbaum et al., 2008). This evidence suggests that the episodic components of declarative memories retained their dependence on the hippocampus, such that all memories for episodic details are lost when the hippocampus is damaged, in keeping with a memory theory known as Multiple Trace Theory (Cipolotti & Moscovitch, 2005; Moscovitch et al., 2006; Nadel & Moscovitch, 1997).

A novel way to explain these inconsistent findings in the literature on the neuropsychology of remote episodic memory is to invoke retrieval factors, as follows. For patients with significant anterograde amnesia, recent events are very difficult to remember in detail, whereas it typically remains easy to bring to mind general information about common experiences. A habit may thus be acquired in coping with difficulties in remembering recent events, such that producing generic or gist information comes to dominate the cognitive strategies engaged at retrieval. In this manner, a severe anterograde amnesic deficit could have an indirect influence on the presentation of retrograde amnesia. We propose that a pervasive gist-based retrieval orientation may contribute to the poor performance in retrieving details of remote events in some amnesic patients. To the extent that such a mechanism is operative, it would be incorrect to infer an actual loss of remote memories on the basis of apparent remote deficits. Rather, these deficits could in part reflect a maladaptive retrieval tendency.

To what extent can recall of decades-old episodic memories be hindered by a gist-based retrieval orientation? To investigate this question, we implemented a retrieval-orientation manipulation to induce either a gist-based or a detail-based retrieval orientation in healthy subjects with no known cognitive impairments. We focus on remote recall, as this is the essence of the primary divergence between Multiple Trace Theory and Standard Consolidation Theory, whereas both predict similar patterns of recall of recently acquired information (Paller, in press). Our manipulation was designed to simulate, in a mild and temporary manner, the alterations in retrieval orientation potentially caused by severe anterograde amnesia. Demonstrating that retrieval orientation can systematically bias remote episodic recall (even without showing whether anterograde amnesia leads to a pervasive bias of this sort) could lend plausibility to our hypothesis concerning the interpretation of remote memory impairments.

Method

Subjects

We tested remote memory in 12 adults (7 females and 5 males) 67 to 78 years of age. All provided informed consent.

Procedure

The procedure is illustrated in Figure 1. Subjects completed two recall sessions at least 24 hours apart. First, subjects produced the titles of four distinct autobiographical events that they could later recall in detail. They were instructed that acceptable events consisted of a single, discrete episode that occurred between the ages of 18 and 30 years old. The order of recall from this list was randomized, with two different memories described on each session, so that there was

no systematic relationship between the order in which the titles were originally produced and the order in which the events were recalled.

Each recall session included three phases. In Phase 1, subjects were asked to recall a specific event, as in the Autobiographical Interview (Levine et al., 2002). Subjects were explicitly instructed to describe the memory in as much detail as possible. The experimenter provided the title of the memory to be recalled each time. When subjects finished relating the event, they were given a general probe (“Is there any more you can tell me about that”) and then asked specific questions about their telling of the event.

The procedure in Phase 2 differed between the two sessions. In one session, designed to produce a detail-based retrieval orientation, subjects were shown nine photographs and asked to choose two that they could describe in detail. Subjects then described each of those photographs. If a subject failed to describe all aspects of a photograph, the experimenter pointed out each missing aspect and requested additional description. Each photograph depicted a complex scene such as a restaurant interior or a cluttered desk, such that many features could be described. In the other session, designed to produce a gist-based retrieval orientation, subjects described each of the same nine photographs using one or two words. In order to help subjects understand how to do this, the experimenter encouraged them to think of this task as giving each photograph a title. All subjects were able to complete both tasks.

In Phase 3, subjects recalled another memory following the same instructions as in Phase 1. Instructions to describe each memory in as much detail as possible were reiterated.

Data Analysis

Individual items in a memory transcript were identified as internal details, which concern event specifics (episodic information), or external details, which concern information not part of the event such as historical facts or background (semantic information). We report average counts from two raters. The correlation coefficient between raters was .85 and the pattern of results was the same for each rater. We used an alpha level of 0.05 and report p values for significant effects.

Results

Episodic recall counts are shown in Figure 2A. As predicted, the type of task undertaken in Phase 2 influenced Phase-3 recall, as more episodic information was produced in the detail condition than in the gist condition [$t(11) = 4.69, p < .001$]. Recall in Phase 1 did not differ across the two conditions [$t(11) = .54$]. Recall differences between conditions did not differ as a function of whether the gist or detail session occurred first [$t(10) = .08$ in Phase 1 and $t(10) = 1.12$ in Phase 3].

Given the possibility that baseline differences between sessions influenced results, we also analyzed the percentage change for Phase-3 recall compared to Phase-1 recall. Recall in the detail-based orientation increased by 40%, whereas recall in the gist-based orientation decreased by 38%, a significant difference of 78% [$t(11) = 3.51, p = .005$].

The retrieval orientation manipulation had a negligible influence on semantic recall, as shown in Figure 2B. Semantic recall did not differ in either phase between gist and detail conditions [$t(11) \leq .81$]. To directly compare semantic and episodic recall, the percent change for Phase-3 recall compared to Phase-1 recall was analyzed as a function of type of recall and type of retrieval orientation. A marginal interaction [$F(1,11) = 4.6, p = .056$] in this analysis attested to the effects of retrieval orientation for episodic but not semantic recall. Recall in the detail-

based orientation increased by 27%, whereas recall in the gist-based orientation decreased by 1%, a nonsignificant difference [$t(11) = 1.2$].

When information recalled after specific prompts was included, differences between conditions were less reliable. The mean number of episodic details produced in Phase 1 versus Phase 3 increased from 29.5 to 33.5 in the detail condition and decreased from 29.7 to 24.8 in the gist condition. The difference between the number of episodic details produced during Phase 3 in the detail condition versus the gist condition was nonsignificant [$t(11) = 1.1$]. The mean number of semantic details produced in Phase 1 versus Phase 3 increased from 16.9 to 18.4 in the detail condition and from 21.8 to 23.9 in the gist condition. Phase-3 semantic recall did not differ between conditions [$t(11) = .25$].

Discussion

Retrieval orientation systematically influenced episodic recall in people with no known cognitive impairments. The number of episodic details was reduced when a gist-based orientation was operative at the time of recall compared to when a detail-based orientation was operative. On the other hand, the number of semantic details was unaffected by retrieval orientation. The specificity of the influence of the retrieval-orientation manipulation can be understood by considering a hierarchical model of memory retrieval (Conway & Pleydell-Pearce, 2000). According to this view, individuals first access general information before accessing more specific episodic details. A gist-based retrieval orientation may leave access to the more general level unaffected, but hinder access to the more specific level.

By extension, the effects of retrieval orientation demonstrated in the current experiment may also be relevant when episodic recall is tested in patients with memory disorders. A sustained tendency toward gist-based retrieval in amnesic patients with hippocampal damage could plausibly lead to exaggerated episodic recall impairments for remote memories.

Direct evidence of habitual gist-based orientation in patients with anterograde amnesia is needed to substantiate this proposal. Even without further evidence, however, the demonstrated potential for a gist-based orientation to influence retrieval has ramifications for interpreting findings of deficient remote episodic retrieval (Nadel et al., 2000; Rosenbaum et al., 2008; Steinworth et al., 2005; Viskontas et al., 2000). In particular, findings of deficient remote episodic retrieval do not necessarily imply that episodic memories are indefinitely dependent on the hippocampus, as postulated by Nadel and Moscovitch (2002).

One potential challenge to our conclusions, however, is that subjects in our experiment may have misunderstood the instructions. In Phase 2, subjects were told to describe photographs in as much detail as possible, or in one or two words. Perhaps subjects mistakenly believed these instructions also applied to recall in Phase 3. Such an account for the present recall findings is unlikely for two reasons. First, Phase-3 instructions included a reminder to be as detailed as possible. Second, the specificity of the results—that the experimental manipulation influenced episodic but not semantic recall—would not be expected if subjects merely misconstrued the instructions. Similar reasoning can be used to dismiss the possible influence of implicit demand characteristics. Without the awareness of doing so, subjects may have conformed to expectations regarding the amount of information they should provide, but by this scenario, both episodic and semantic recall would have been altered.

The specificity of the recall effects also addresses the objection that the manipulation may have simply increased the talkativeness of subjects without any direct effects on episodic recall. In other words, an output-level mechanism unrelated to recall could conceivably mediate performance changes in Phase 3. If so, subjects would be expected to produce more details of both the semantic and episodic type following the detail-oriented manipulation. An explanation

based on generic talkativeness thus does not fit with the finding that effects were restricted to episodic details. Furthermore, even if the retrieval-orientation manipulation operated primarily through an output-level mechanism, this would still demonstrate that mechanisms unrelated to storage are sufficient to explain remote episodic memory deficits.

Another potential objection is that episodic deficits were observed in prior studies even though amnesic patients were prompted to produce episodic details (Levine et al., 2002; Viskontas et al., 2000). If patients' deficits reflected a habitual but inappropriate retrieval orientation, perhaps such prompting could have cured the recall difficulties, much as prompts mitigated retrieval-orientation effects in the current study. On the other hand, while prompting did allow healthy controls in the current study to overcome some of the effects of the mild gist-based retrieval orientation, a request for more details during recall could be insufficient for patients with a more profound and sustained gist-based retrieval orientation. They may not easily alter the way they retrieve episodic memories, much as depression is not easily cured by simply encouraging patients to avoid negative thinking (Teasdale, 1999).

Indeed, patients with depression also tend to show over-general autobiographical memory, and the specificity of episodic recall can be increased with detail-oriented interventions (Watkins et al., 2000; Williams et al., 2007; 1996; 2000). In tests often used in such studies, subjects are cued with words and given a limited amount of time to retrieve a specific event. Depressed patients generally produce an abnormally small proportion of specific events but can improve after certain types of therapy (Watkins et al., 2000; Williams et al., 2007; 2000). Interestingly, therapy is most effective when patients are induced to focus on specific detail rather than broad ideas, suggesting that the effect may not only be due to the treatment's amelioration of depression, but also to its encouragement of a detail-based retrieval orientation (Watkins et al., 2000; Williams et al., 1996). The results from these studies mirror our findings in a different subject population. Efforts to gradually alter retrieval-orientation biases may thus be effective in treating a variety of disorders.

Our proposal that a habitual retrieval orientation resulting from anterograde amnesia can influence the recall of remote episodic memories not only provides a possible explanation for the mixed results in the autobiographical memory literature, it also suggests a mechanism driving deficient performance recently observed in tasks in which people are instructed to imagine future events. Producing specific details for imagined future events may depend on the retrieval and relational recombination of details from the past, such that impairments in imagining future events can be found in amnesia and in aging (Addis et al., 2008; Hassabis et al., 2007). However, if deficits in producing event details are partly based on a sustained gist-based orientation, then an inappropriate retrieval orientation may likewise be responsible for a deficit in describing future events.

Our results are not the first to show this type of retrieval-orientation effect. Whereas prior results showed that retrieval orientation can affect the specificity of recall for recent memories (Koutstaal & Cavendish, 2006), our experiment is the first to examine the influence on remote memories. In some ways, our results could also be grouped with many findings in social psychology in which behavior may be altered by priming with seemingly unrelated concepts (e.g., Williams & Bargh, 2008). Here, we show that the behavior of memory expression can readily be altered using a non-memory task, which underscores the fact that a recall deficiency need not indicate faulty storage (Warrington & Weiskrantz, 1970).

Our conclusions are thus in keeping with the notion that episodic recall depends critically on the processes and strategies engaged when a person introspects about their past. Inability to produce a particular type of information, either about the past or the future, can reflect suboptimal access to information rather than a loss of information. Furthermore, these findings

point toward potential interventions, in that relatively simple manipulations, administered repetitively and/or more intensely than the manipulation described here, may influence retrieval enough to reveal information that may have otherwise seemed lost.

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Preliminary Question	Produce titles for four remote memories		
	Phase 1	Phase 2	Phase 3
Detail Session	Recall one memory in detail	Describe two photos in detail	Recall one memory in detail
Gist Session	Recall one memory in detail	Describe nine photos in 1-2 words	Recall one memory in detail

Figure 1.

Experimental procedure. Subjects completed two recall sessions, a detail session and a gist session, with session order counterbalanced across subjects. The second session occurred several days after the first (average delay, 4.3 days). Just prior to the first session, subjects provided titles identifying four autobiographical events that occurred between the ages of 18 and 30 years. Each recall session included three phases. In Phase 1 and Phase 3 of each session, subjects recalled one of the events in as much detail as possible. The amount of episodic and semantic content in the memories produced was scored using standard methods (Levine et al., 2002). During Phase 2, subjects described 2 photographs in as much detail as possible (detail session) or they described 9 photographs in 1 or 2 words each (gist session).

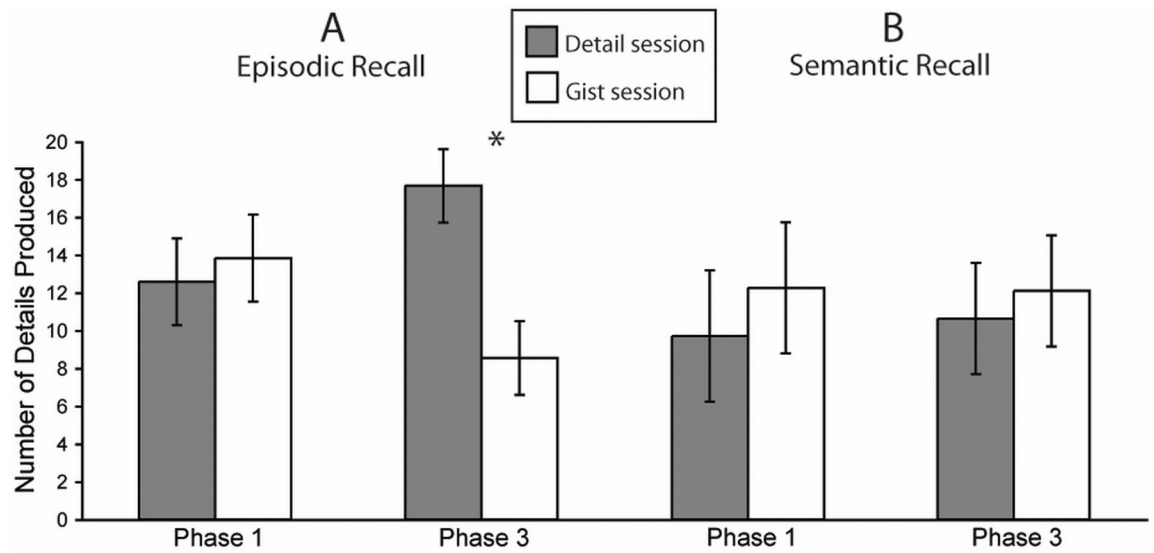


Figure 2.

Results. **A.** Recall of episodic information was lower after exposure to the gist manipulation than after exposure to the detail manipulation. **B.** In contrast, recall of semantic information was similar in the two conditions. Error bars represent ± 1 standard error of the mean of the within-subjects difference between details produced in the gist condition vs. the detail condition.