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Output position and word relatedness effects in a DRM paradigm: Support for a dual-retrieval process theory of free recall and false memories ☆

Terrence M. Barnhardt *, Hyun Choi, David R. Gerkens, Steven M. Smith

Department of Psychology, Texas A&M University, College Station, TX 77843, USA

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Abstract

Five experiments investigated predictions—derived from a dual-retrieval process approach to free recall (Brainerd, C. J., Wright, R., Reyna, V. F., & Payne, D. G. (2002). Dual-retrieval processes in free and associative recall. *Journal of Memory and Language*, *46*, 120–152.)—about false memories in a DRM-like paradigm. In all the experiments, the presence of the critical words in the study lists was manipulated within subjects. In all the experiments, the output position of presented critical words was earlier than the output position of nonpresented critical words and the output positions of both types of words was closer to the center than to the ends of the recall protocols. In Experiments 2–5, unrelated words were intermixed with related words in the study lists. In all of these experiments, recall of related words was greater than recall of unrelated words. However, in Experiments 4 and 5, the advantage for recall of related words was greater after the critical item was output than before it was output. These findings were consistent with the notions that: (1) there are two successive retrieval processes (direct access of verbatim traces and reconstruction from gist traces) in free recall, (2) items are recalled in ascending order of strength during direct access and descending order of strength during reconstruction from gist, and (3) false memories for words are attributable to reconstruction from gist traces.

Keywords: False memory; Free recall; Output order; Fuzzy-trace theory; Reconstruction; Cognitive triage

The history of psychology is replete with laboratory examples of memory errors—or false memories—in which subjects claim that they had earlier encountered some stimulus that had not actually been presented or had some experience that had not actually occurred (for review, see Roediger, 1996; Schacter, 1995). Many different paradigms have been used to study false memories, but studying false memories within the context of traditional list-learning experiments has sharply increased since Roediger and McDermott (1995) reintroduced an approach first used by Deese (1959). In what has come to be known as the Deese-Roediger-McDermott (DRM) paradigm, subjects study a series of lists where each list consists of words that are associatively related to a critical nonpresented word. In Roediger and McDermott (1995), subjects performed both free recall and recognition tests. As Roediger and McDermott (1995) pointed out, most experiments concerned

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* Corresponding author.
E-mail address: tbarnhardt@tamu.edu (T.M. Barnhardt).

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with memory errors had used recognition tests because such errors had been more reliably observed on this type of test than on free recall tests. For example, in Experiment 2, false recognition of critical nonpresented words that had not been falsely recalled occurred at an even higher rate (65%) than the recognition of presented words that had not been recalled (50%). However, Roediger and McDermott (1995) considered the high rate of false recall the more important finding because reliable observations of robust false recall had previously been so rare. Indeed, in Experiment 1, the false recall rate was 40% (recall rate of studied words was 65%) and in Experiment 2 the false recall rate was 55% (recall rate of studied words presented in the middle of the studied lists was 47%).

In explaining false memory effects of this kind, Roediger and his colleagues (e.g., Robinson & Roediger, 1997; Roediger, Watson, McDermott, & Gallo, 2001) have offered an activation/monitoring framework. In the theory's simplest form, the role of reality monitoring (Johnson & Raye, 1981) or source monitoring (Johnson, Hashtroudi, & Lindsay, 1993) in the incidence of false memories principally occurs during test. The job of these mechanisms is to discriminate events that actually occurred from events that were only imagined. These mechanisms have failed, for example, when a subject reports having seen a picture of an object when they had only seen the name of the object (e.g., Lane & Zaragoza, 1995).

The role of activation in the incidence of false memories predominantly occurs at study. In the DRM paradigm, when the list of words is presented, the representation of the critical nonpresented word is highly activated as a function of spreading activation mechanisms (e.g., Collins & Loftus, 1975). Such activation can lead to the occurrence of implicit associative responses, or IAR's (Underwood, 1965). That is, the activation of the nonpresented critical word may be powerful enough that the word is consciously thought of during the study episode. As such, the idea of the word may become associated with the environmental context in which the list was presented, just like the words that were actually presented (but see Seamon et al., 2002 for a counterexample).

A number of observations support the idea that false memories of nonpresented critical words are very similar to veridical memories of presented words. For example, a high degree of confidence usually accompanies false memories (e.g., Payne, Elie, Blackwell, & Neuschatz, 1996; Roediger & McDermott, 1995), false memories are often accompanied by remember judgments (e.g., Gallo, McDermott, Percer, & Roediger, 2001; Payne et al., 1996), subjects are willing to identify the voice in which a critical nonpresented word was "presented" (e.g., Gallo et al., 2001; Hicks & Marsh, 1999; Mather, Henkel, & Johnson, 1997; Payne et al., 1996), and priming for critical nonpresented items on implicit memory tests has been observed (e.g., McDermott, 1997; see also McKone & Murphy, 2000; Smith, Gerkens, Pierce, & Choi, 2002; Tse & Neely, 2005). Priming on such tests has often been attributed to perceptual mechanisms (e.g., Schacter, 1990).

However, true and false memories are not necessarily isomorphic. For example, Mather et al. (1997) used a modified memory characteristics questionnaire (Johnson, Nolde, & De Leonardis, 1996) to ascertain the qualitative characteristics of veridical and false memories. Mather et al. (1997) showed that false memories had less auditory detail and less remembered feelings and reactions than memories for presented words. In addition, whereas veridical memory of presented items tends to decline over a delay, false memory of nonpresented critical items remains relatively stable (e.g., Brainerd, Reyna, & Brandse, 1995a; McDermott, 1996; Payne et al., 1996; Thapar & McDermott, 2001; Toglia, Neuschatz, & Goodwin, 1999). Retained false memories are also more likely to be given a remember judgment after a delay (Payne et al., 1996). Finally, when carefully controlling for demand characteristics, small differences have been found between correct recognition and false recognition in participants' willingness to attribute items to a particular source and in their confidence in doing so (Lampinen, Neuschatz, & Payne, 1999). However, participants were willing to make source attributions and were confident in their false memories for nonpresented critical items quite often and significantly more often than for unrelated lures (Lampinen et al., 1999).

In contrast to activation/monitoring theory, fuzzy trace theory (e.g., Brainerd, Reyna, & Kneer, 1995b) offers a clear distinction between the nature of the memory trace of a presented word and the nature of the memory representation that supports false memories. In fuzzy trace theory, the encoding of presented words results in the creation of verbatim traces, which are item-specific traces that preserve the surface details of the stimulus. The encoding of the presented words also results in the formation of a gist memory, which is an abstraction of the property or properties that the studied words have in common, like the sense of meaning that can be derived from a list of words that are associatively related. In fuzzy trace theory, gist memories serve as the basis upon which false memories are generated at test.

With respect to free recall tests, Brainerd, Wright, Reyna, and Payne (2002) have proposed a dual-retrieval process theory of free recall in which verbatim and gist traces are differentially accessed at test by two distinct retrieval processes: direct access and reconstruction. In direct access of verbatim traces, "participants recall the targets by merely reading out surface information as it . . . flashes in the mind's eye, much as an actor would recite words . . . seen on a script" (Brainerd et al., 2002, p.