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Metacognition and false recognition in patients with frontal lobe lesions: the distinctiveness heuristic

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Abstract

The distinctiveness heuristic is a response mode in which participants expect to remember vivid details of an experience and make recognition decisions based on this metacognitive expectation. Whereas much is known about the cognitive processes that are involved in using the distinctiveness heuristic, little is known about the corresponding brain processes. Because such metacognitive processes that involve the evaluation and control of one's memory are believed to be dependent upon the frontal lobes, the authors examined whether the distinctiveness heuristic could be engaged to reduce false recognition in a repetition lag paradigm in patients with lesions of their frontal lobes. Half of the participants studied pictures and corresponding auditory words; the other half studied visual and auditory words. Studied and novel items were presented at test as words only, with all novel items repeating after varying lags. Controls who studied pictures were able to reduce their false recognition of repeated lag items relative to those controls who studied words, demonstrating their use of the distinctiveness heuristic. Patients with frontal lobe lesions showed similar levels of false recognition regardless of whether they studied pictures and words or words only, suggesting that they were unable to use the distinctiveness heuristic. The authors suggest that the distinctiveness heuristic is a metacognitive strategy, dependent upon the frontal lobes, that may be engaged by healthy individuals to reduce their false recognition.

Keywords: Memory; Frontal lobes; False memory; Metacognition; Patients

1. Introduction

Although memory is often accurate, memory distortions and false memories frequently occur (Schacter, 1996). False recognition is one type of memory distortion that has been recently studied in the laboratory. False recognition occurs when people incorrectly claim to have previously encountered a novel word or event. During the past several years, there has been growing interest in procedures that reduce the occurrence of false memories (see Dodson, Koutstaal, & Schacter, 2000; Schacter & Wiseman, 2003, for review). For example, a number of experiments have observed reduced false recognition of novel items that are semantically related to previously studied items when the study and test trials are repeated multiple times (Budson, Daffner, Desikan, & Schacter, 2000; Kensinger & Schacter, 1999; McDermott, 1996; Schacter, Verfaellie, Anes, & Racine, 1998a). These studies have contributed to our understanding of the neuropsychology of memory failure in specific brain diseases and the occurrence of clinically relevant memory distortions in certain patient populations, as well as having aided our understanding of normal memory function.

Israel and Schacter (1997) investigated another method to reduce false recognition. They tested the idea that if false recognition of semantically-related words depends upon par-

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ticipants' reliance upon the common semantic features or gist of the study list, then it should be possible to reduce false recognition by use of study conditions that promote encoding of distinctive information about particular items. Israel and Schacter presented one group of young adults with lists of semantic associates in which each word was presented auditorily and was also accompanied by a corresponding picture. A second group heard the same words auditorily, but instead of an accompanying picture, they saw the visual presentation of the word. Israel and Schacter found that pictorial encoding yielded lower levels of false recognition of both semantically related and unrelated lures than did word encoding alone.

In a follow-up study, Schacter, Israel, and Racine (1999) found that participants showed a more conservative response bias after picture encoding than after word encoding. They suggested that this more conservative response bias observed after picture encoding may depend on a general shift in responding based on participants' metamemorial assessments of the kinds of information they feel they should remember (Strack & Bless, 1994). Because they had encountered pictures with each of the presented words, participants in the picture encoding condition used a general rule of thumb whereby they demanded access to detailed pictorial information in order to support a positive recognition decision; failure to gain access to such distinctive information when tested with related lures would tend to result in a negative recognition decision. Importantly, Schacter et al. (1999) argued that suppression based on metamemorial assessments can function without access to specific information regarding the particular items studied. They hypothesized that the suppression of false recognition observed in the picture encoding group thus relied on a general expectation that a test item should elicit a vivid perceptual recollection if, indeed, it had been presented previously. Participants in the word encoding group, by contrast, would not expect to retrieve distinctive representations of previously studied items and are thus much less likely to demand access to detailed recollections. Schacter et al. (1999) referred to the hypothesized rule of thumb used by the picture encoding group as a distinctiveness heuristic (cf. Chaiken, Lieberman, & Eagly, 1989; Johnson, Hashtroudi, & Lindsay, 1993; Kahneman, Slovic, & Tversky, 1982).

We agree with Dodson and Schacter (2002a,b) who argue that the idea of the distinctiveness heuristic is consistent with Johnson and colleagues' source monitoring framework in which participants can recruit a variety of different decision strategies when making memory judgments (Johnson et al., 1993). Previous studies have found that strategies similar to the distinctiveness heuristic are used when test items are attributed to a particular source (e.g. Anderson, 1984; Foley, Johnson, & Raye, 1983; Hashtroudi, Johnson, & Chrosniak, 1989; Hicks & Marsh, 1999; Johnson, Raye, Foley, & Foley, 1981; Kelley, Jacoby, & Hollinghead, 1989). One example is the "it had to be you" effect which refers to a test bias in which individuals who heard some words and generated others are more likely to claim that falsely recognized words were heard rather than generated (Johnson et al., 1981). Presumably, this bias reflects the metamemorial belief that self-generated information is more memorable than heard information (Johnson & Raye, 1981), leading participants to judge a familiar item to be heard rather than generated because of the absence of recollection of having generated the item. This view of the distinctiveness heuristic is also consistent with the monitoring processes discussed by Schacter, Norman, and Koutstaal (1998) in their constructive memory framework, and with the activation/monitoring account of Roediger, McDermott, and colleagues (e.g. McDermott & Watson, 2001; Roediger, Watson, McDermott, & Gallo, 2001). For example, Hicks and Marsh (1999) demonstrated that a decision strategy based upon the absence of memory for expected source information allows participants to reduce their false recall of semantic associates. (See Dodson & Schacter, 2002a,b,c, for further discussion of the distinctiveness heuristic in relation to retrieval strategies.) In summary, we believe the distinctiveness heuristic is a particular instance of the general class of metacognitive strategies in which the absence of memory for expected information is diagnostic that the item was not studied.

Whereas much is known about the cognitive processes that are involved in using the distinctiveness heuristic, Schacter and Wiseman (2003) note that nothing is known about the corresponding brain processes. However, such metacognitive processes that involve the evaluation and control of one's memory are believed to be dependent upon the frontal lobes (Fernandez-Duque, Baird, & Posner, 2000; Shimamura, 2000; Thaiss & Petrides, 2003). In their reviews, Fletcher and Henson (2001) and Simons and Spiers (2003) note that dorsolateral frontal cortex in particular is important for verification, monitoring, and evaluation of representations that have been retrieved from memory and are maintained by ventrolateral frontal cortex. We therefore thought it likely that the dorsolateral frontal cortex would be important for metacognitive processes such as the distinctiveness heuristic. To test this hypothesis, we studied patients with lesions in dorsolateral frontal cortex (roughly Brodmann areas 9 and 46) from strokes or tumor resections that were at least 1-year-old. We predicted that such patients would be unable to use the metacognitive strategy of the distinctiveness heuristic to reduce their false recognition.

We used a repetition-lag paradigm introduced by Underwood and Freund (1970) and modified by Jennings and Jacoby (1997) and Dodson and Schacter (2002b). In the modified version of this paradigm, participants either study a list of unrelated words or pictures and then make old-new recognition judgments about previously studied items and new words. Each new word occurs twice on the test, with a variable lag (i.e. a variable number of intervening words) between the first and second occurrence. Participants are instructed to say "old" to studied words only, and to say "new" to non-studied words, even when they repeat. Although participants are explicitly told that if a word occurs twice on the test they can safely conclude that it is a new word, participants