



Creating false memories for visual scenes

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(Received 3 June 1997; accepted 17 September 1997)

Abstract—Creating false memories has become an important tool to investigate the processes underlying true memories. In the course of investigating the constructive and/or reconstructive processes underlying the formation of false memories, it has become clear that paradigms are needed that can create false memories reliably in a variety of laboratory settings. In particular, neuroimaging techniques present certain constraints in terms of subject response and timing of stimuli that a false memory paradigm needs to comply with. We have developed a picture paradigm which results in the false recognition of items of a scene which did not occur almost as often as the true recognition of items that did occur. It uses a single presentation of pictures with thematic, stereotypical scenes (e.g. a beach scene). Some of the exemplars from the scene were removed (e.g. a beach ball) and used as lures during an auditory recognition test. Subjects' performance on this paradigm was compared with their performance on the word paradigm reintroduced by Roediger and McDermott [18]. The word paradigm has been useful in creating false memories in several neuroimaging studies [13, 21] because of the high frequency of false recognition for critical lures (words not presented but closely associated with lists of words that were presented) and the strong subjective sense of remembering accompanying these false recognitions. However, it has several limitations including small numbers of lures and a particular source confusion. The picture paradigm avoids these limitations and produces identical effects on normal subjects. © 1998 Elsevier Science Ltd. All rights reserved

Key Words: false recognition; memory illusion; neuroimaging; schema.

Memory illusions and distortions have been studied since at least the time of Bartlett [2]. Recently, though, there has been renewed interest in the phenomenon of “false memory” and its implication in clinical, legal and laboratory settings. This interest has prompted several researchers to investigate the neural mechanisms underlying illusory memories [7, 13, 20, 21]. It is hoped that by elucidating the processes underlying the formation of false memories, a better understanding of the mechanisms involved in true memories can be achieved.

In two of the first studies to implicate neural mechanisms of false memory, lateralized recognition tests presented to a callosotomy patient demonstrated that the left hemisphere is more prone to false recognition of semantically related lures than the right hemisphere [12, 15]. More recent functional neuroimaging studies have revealed stronger activation in the dorsolateral prefrontal cortex for false memories than for “true” memories [13]

and activation in the left medial temporal lobe for both true and false memories [21]. Furthermore, converging evidence for the involvement of the medial temporal lobes in the formation of false memories is provided from studies of amnesic patients [22].

With the advent of investigations into the neural mechanisms of false memory using various brain imaging techniques, there is a need to develop paradigms that can reliably create false memories in a laboratory setting. The paradigms need to be able to generate numerous false memories since many neuroimaging techniques rely on data that is averaged across many trials. To date, neuroimaging studies have relied on the use of a word-list paradigm first introduced by Deese [5] and then re-introduced by Roediger and McDermott [18]. In this paradigm subjects hear 16 word lists, each of which consists of close semantic associates of a *critical lure*, which is not presented in the list. For example, a list may include words such as “bed”, “rest”, “tired”, and so forth, which are all associates of “sleep”. Subjects typically report recognizing the critical lures almost as frequently as they recognize studied words. Furthermore, when they are probed for the recollection of the studied lists, subjects often report that they can consciously remember the critical lures being presented during the study session.

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Although, further studies on the qualitative characteristics of these “remembered” responses have shown that subjects report fewer auditory details about the critical lures than about the studied items. This suggests that the subjects tend to make false inferences about the occurrence of an item based on associations formed during the study session [11, 14].

There are several limitations to the word paradigm. One is that it takes many studied words to create a relatively small number of critical lures. Often, researchers will try to circumvent this problem by removing some of the words from the study lists and use more lists [7]. However, removing words from the study list also decreases the overall associative strength of the list and decreases the false recognition rate of the critical lures [17]. Another limitation in the word paradigm is that the false memory created by the word design could be attributed to a particular source confusion [7]. When subjects are encoding a list of words such as “bed”, “rest”, “awake”, they may also be generating the associated word “sleep” as a mnemonic device, or even incidentally. When attempting to retrieve these items, they may be confused as to whether “sleep” was generated or perceived. A further limitation in the use of word lists is that they are less natural than pictures of everyday scenes and therefore may not be as generalizable to other situations. Other paradigms need to be created that effectively produce false memories and are practical to study in a variety of laboratory settings.

In this article we report a picture paradigm that overcomes these limitations. Our study uses pictures of scenes taken from illustrations of *The Saturday Evening Post*, which depict strong thematic, stereotypical scenes (e.g. a classroom, a beach scene). The pictures are manipulated so that some of the exemplars from the scene are removed (e.g. a teacher’s chair and a chalkboard for the picture of a classroom, or a beach ball and beach umbrellas for the picture of the beach scene). Subjects are asked to study the pictures with the missing exemplars. These missing exemplars will later serve as critical lures. Our hypothesis is that subjects will report seeing the critical lures almost as often as the studied items.

This paradigm is unique with respect to other picture paradigms used to study memory illusions (e.g. [9, 15]) in that it only requires a single presentation of each picture to produce a number of critical lures. It also does not

require suggestive or misleading information prior to testing [10], or repeated interrogations before an elaborate false recall occurs [4]. This picture paradigm also avoids the problems of the word paradigm mentioned earlier.

In this experiment, subjects were tested on both the picture paradigm we developed and the word paradigm used by Roediger and McDermott [18]. In testing both paradigms in one session, we can determine whether there will be any differences between the two tests across subjects. To facilitate this comparison, we switched the modalities originally used in the presentations of the word paradigm by Roediger and McDermott. Therefore, in both the picture and the word paradigms, the study session was presented visually and the test session was presented auditorily. However, we were concerned about the effects of switching the modalities on the word paradigm, so we pretested a separate group of subjects on the words using an auditory study and a visual test and found no effect of modality on false recognition rate.¹

When subjects were shown either the pictures or the words, they were instructed to remember as much as they could about them. After an interval of distracter tasks, they were given a recognition test consisting of the studied items, critical lures and non-studied items unrelated to the pictures or word lists. We were also interested in their phenomenological awareness of their recollections. We used a procedure developed by Tulving [24] which assesses the subject’s state of awareness about their recollection by using a “remember” vs “know” judgment. Subjects were instructed to respond “remember” when they were able to consciously recollect details or aspects of an event. They were instructed to respond “know” when they were confident that an event occurred but they were unable to consciously recollect details or aspects of the event. What distinguishes a false memory from a false feeling of knowing, is that a subject who experiences a false memory will consciously recollect details of an event that never happened. We predicted that subjects remember judgments for the critical lures in the picture paradigm would be similar to their remember judgments in the word paradigm.

Methods

Subjects

Forty-seven subjects were paid for their participation. Their ages ranged from 18–25 years old. Fifteen out of the 47 subjects were males. All of the participants signed consent forms and they were informed of their rights as experimental subjects.

Materials (pictures)

We used 18 color illustrations from *The Saturday Evening Post* which depict strong thematic, stereotypical scenes (e.g. a beach scene). Four exemplars from each scene which were

¹A separate group of 23 subjects were tested on the word paradigm using the same procedures described in this report, except that the study session was an auditory presentation and the test session was a visual presentation, identical to the Roediger and McDermott design. During the study session, subjects were read the word lists at the rate of 1 word every 2 s. During the test session, subjects saw a word presented on a computer screen, and they were to write their response on an answer sheet. Results from this testing was compared with the results of the experiment reported here, using linear regression. There was no significant effect for the mode of presentation

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