SCIENCE BRIEFS

Remembering Between the Lines: Creating False Memories Via Associative Inferences

by Henry L. Roediger III, and Kathleen B. McDermott, Washington University in St. Louis

In watching a news program on TV, or reading a book, or listening to a friend's comments, we do not register the events literally as they happen, but interpret them through our own organizational schemes. We carry our own perceptions, thoughts, and reactions into the mix. Therefore, the version of the event that is encoded and later remembered involves our personal reaction as part and parcel of the transaction. We have no literal tape- or video-recording of the events of our past, but rather we retain a recoding of the events as filtered through the lens of our own perspectives and biases.

We make inferences during any interaction with the world. These inference processes seem relatively automatic and make us intelligent beings—we go beyond the information that is given in an event or message to infer underlying meanings. Although inference is a natural part of comprehending and understanding the world around us, inferential processes also can create problems. In particular, we can later remember something as having been said or read when it was only inferred. The remembered "fact" may have been implied, but not actually spoken or presented. This basic point has been made in the study of remembering, but the usual assumption has been that powerful suggestive techniques, or long delays since exposure to information, and only certain types of materials can be used to achieve these effects.

We will outline here a relatively new paradigm (based on work by James Deese in 1959) that produces a striking example of false memories. The paradigm involves a standard list learning technique (often thought to encourage accurate, even rote, responding) with conditions of immediate testing and with strong warnings to the subjects to be very careful to not make errors. Nonetheless, the results reveal some of the most robust demonstrations of false memory in the literature.

Henry L. Roediger III, is James S. McDonnell Distinguished University Professor and Chair of the Psychology Department at Washington University in St. Louis. He received his PhD from Yale University in 1973 and has taught at Purdue University, the University of Toronto, and Rice University. Kathleen B. McDermott is Research Assistant Professor of Psychology at Washington University, and is cross-appointed in the Department of Radiology. She received her PhD from Rice University in 1996. Their first paper on the research described in this article was "Creating false memories: Remembering words not presented in lists" and appeared in the Journal of Experimental Psychology: Learning, Memory, and Cognition in 1995 (Volume 21, 803-814). Further information can be obtained from www.artsci.wustl.edu/~roediger/memory and in a special issue of the Journal of Memory and Language in 1996 (Volume 35, Number 2).

The Basic Paradigm

The standard paradigm we developed to elicit false memories involves single-trial free recall. Subjects (typically college students) hear a list of related words and then recall the words in any order immediately after presentation, with instructions to be sure to recall only the words just heard. For example, *door, glass, pane, shade, ledge, sill, house, open, curtain, frame, view, breeze, sash, screen,* and *shutter* are presented at the rate of one word per 1.5 seconds. The words in the list are the first 15 associates to the word *window*, but *window* itself is not presented. However, on the immediate free recall test, subjects often recall *window*. For example, in one of our first experiments, subjects recalled 47% of the items from the middle positions of the list, yet recalled the critical missing item for 55% of the lists. Recall of a word that was not presented was greater than recall of the words that were (at least for those words in the interior of the list). After subjects studied and recalled many lists in our experiment, they received a final recognition test in which list items (*glass, house*) were interspersed with various types of distracters or lures, both the critical items (*window*) and completely unrelated words (such as *computer*). Subjects were asked to judge whether or not each test item had been studied. If the answer was yes, they were also to indicate whether they could remember the specific moment of the word's occurrence in the list, or if, instead, they just knew it had been presented. Subjects recognized the list items actually studied 79% of the time and judged the unrelated lures to have been studied only 16% of the time. However, the critical items such as *window*, which were implied by the list but not actually studied, were falsely recognized 81% of the time. Further, when subjects judged if they remembered the moment of occurrence of the recognized items, they reported *remembering* studied items and critical lures at the identical level (.72 of the possible occasions). (The level of "remembering" unrelated lures was only 16%.) Therefore, this procedure creates a powerful

memory illusion: subjects recall, recognize, and remember events that never actually happened, even under laboratory conditions that stress accurate responding much more than in natural memory situations outside the laboratory. This basic procedure has been dubbed the DRM paradigm, for Deese-Roediger-McDermott.

Implications and Extensions

Although our procedure was developed in the lab (and therefore, like all lab procedures, is artificial), we believe the phenomena captured by it do reveal inference processes that occur to all of us every day. The words in the list spark associations to other words—a type of inference process—and the items falsely remembered are those that are inferred, or created through associative processes. We have recently shown that (over a total of 55 lists) the best predictor of the power of individual lists in producing false recall is how strongly words in the list are associated to the critical missing item. Colloquially, if the words in the list tend to make a person think of the critical item (it might be consciously aroused or just strongly activated at an unconscious level), then people will tend to falsely recall the critical item after hearing the list.

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We have explored how numerous variables affect false remembering. If people are warned about the phenomenon and are given a demonstration list, they reduce somewhat their tendency towards false recall and false recognition. However, the effect is still robust even under these conditions. If the warning to be especially cautious is given after lists have been studied but before the test is given, the warning has practically no effect on false recognition. People are generally more cautious in calling test items old, but equally so for studied items and for critical items. However, one way to dramatically reduce the effect is to greatly slow the presentation rate of the list or to give multiple study and test trials on the materials. When memory for the individual list items is very good, false recall decreases. However, this is not a universal generalization; other variables that increase list recall (such as a deep, semantic level of processing relative to a more shallow level) actually increase both veridical recall and false recall. One primary challenge is to determine why some manipulations produce a positive correlation between veridical and false recall and other manipulations create a negative correlation. The activation/monitoring framework provides a good starting place.

Activation and Monitoring

The framework that we believe helps explain this associative memory illusion involves two sets of component processes, those involved in activation at encoding and in monitoring during retrieval. Considerable evidence supports the idea that activation of the critical item during encoding is a key component in arousal of false memories. As noted above, lists whose items are strongly associated to the critical item produce the effect more strongly than do lists in which associative tendencies are weaker. If the critical item is strongly activated during encoding, then the subject in our experiments is catapulted into a difficult reality monitoring situation when tested: "Did the item actually occur in the list, or did I just think of it during list presentation?" Subjects must monitor their memories closely in making such recognition decisions. Any factor that makes the list items more easily discriminated from the critical item will help in this decision. When list items are presented slowly or many times, subjects can presumably retrieve information about item characteristics that would help distinguish studied from nonstudied items, thereby driving down levels of false recall and recognition. Daniel Schacter and his colleagues at Harvard University have shown that presentation of the list items with pictures also drives down false recall and false recognition, again by making list items distinctive.

In short, many phenomena in the literature on this topic can be explained by assuming that factors increasing activation of the critical item also increase false remembering, whereas those factors that make monitoring easier (by making list items more discriminable) reduce false responding.

Individual Differences

One interesting arena of work employing the DRM associative memory illusion examines individual differences in creation of illusory memories: are some people more susceptible than others? Eugene Winograd and his colleagues at Emory University have shown that scores on a test measuring dissociative experiences show a positive correlation with illusory memories. People who score high on the Dissociative Experiences Scale also report more false memories in the DRM paradigm. Susan Clancy and her collaborators at Harvard have shown that women who report having repressed and recovered memories of childhood sexual abuse also report more false memories than do control groups of women.

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In some of our own research with David Balota at Washington University, we have examined arousal of false memories in older adults and patients with mild forms of Alzheimer's disease. These are interesting groups to study because previous research has shown that their associative processes are intact (as assessed by semantic priming paradigms), yet their monitoring processes are impaired (as measured by source monitoring paradigms). In our study with DRM lists, healthy older adults recognized list items worse than young adults, but recognition by Alzheimer's patients was worst of all. However, relative to young adults, both older adults and patients showed an increased level of false recognition. This outcome was anticipated by a previous writer from Missouri, Mark Twain, who wrote: "When I was younger, I could remember anything, whether it happened or not; but my faculties are decaying now and soon I shall be so I cannot remember any but the things that never happened. It is sad to go to pieces like this, but we all have to do it." Our research confirms that with age we cannot remember as well what did happen to us, but remember more readily events that did not occur.