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State of the Science Editorial

Recent advances in false memory research

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Abstract
In the last few years, substantial gains have been made in our understanding of human memory errors and the phenomenon of false memory, wherein individuals remember entire events that did not happen at all. Research had established that false memories can be consequential and emotional, that they can last for long periods of time, and that they are not merely the product of demand characteristics or the recovery of extant but hidden memories. These recent advances are discussed as extensions of earlier foundational research.

Keywords
false memory, methodology, trauma

The memory wars and the birth of false memory research

In the 1990s, false memory research was fueled by a great divide in psychology. In the early 1990s, a newly emerging field of trauma studies, created in response to a greater understanding of the prevalence of victimization of women and children, crashed headlong into an only slightly older field of eyewitness memory and in particular misinformation research, which had already established that human memory is prone to substantial errors than can wreak havoc on the justice system (Belli, 2012; Clancy, 2009; Davis & Loftus, 2007). Both groups saw themselves as defending victims and potential victims—for trauma studies practitioners and researchers (mostly psychotherapists and psychiatrists, but also a few experimentalists), the victims were the abused children and the adults they became; for eyewitness memory researchers (mostly academic psychologists, but also some skeptical clinicians), the victims were the falsely accused and the (mostly) women who came to believe falsely that they had suffered horribly as children.

The lines were clearly drawn between these two groups by the mid-1990s, and the split is still apparent, even after nearly two decades of prolific research in this area (Belli, 2012; McNally & Geraerts, 2009; Takarangi, Polaschek, Garry, & Loftus, 2008; Wright, Ost, & French, 2006).

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Briefly, the trauma studies group argues that the experience of trauma fundamentally changes memory. Traumatic events, and perhaps especially repeated traumatic events, become detached from other memories and buried in the subconscious where they are incorruptible and inaccessible, even to their owners (Brown, Scheflin, & Hammond, 1998; DePrince et al., 2012; Freyd, 1996; Herman & Schatzow, 1987; Terr, 1991). That is, these traumatic events are "repressed" because they are too painful to live with. Later, the memories can be "recovered" as whole and uncorrupted entities, precisely because they had been stored out of reach of normal memory processes.

Normally, this recovery process happens with the assistance of a caring practitioner, using specifically designed techniques, which may include asking patients to imagine that they had been abused and talk about what it would have been like, interpreting dreams, providing social pressure in the form of group therapy sessions, and even hypnosis and the use of drugs such as sodium amytal. International surveys of practitioners have demonstrated that these techniques and the beliefs that underlie them were common in the 1990s, and are still common now (Poole, Lindsay, Memon, & Bull, 1995; Tantam, 2006; Thayer & Lynn, 2006).

The false memory research group, by contrast, argues that decades of research has demonstrated that human memory can be extremely malleable (Davis & Loftus, 2007; Loftus, 2005), and that there is a very real risk that the techniques that practitioners use to uncover supposedly repressed memories of trauma could actually be creating false memories in patients' minds (Loftus, 1993). These techniques and others (e.g., journaling, cueing memories with family pictures) have sometimes produced memories that were extremely bizarre and improbable, including memories of satanic ritual abuse and alien abduction (Clancy, 2005; Ofshe & Watters, 1994). The false memory researchers point to other research showing that traumatic events are normally remembered all too well (Kihlstrom, 2006; McNally, 2003). They argue that there is no good evidence that the particular trauma of sexual abuse should have its own separate memory system (Clancy & McNally, 2005; Holmes, 1994; Kihlstrom, 2004; McNally, 2012).

Studies conducted in laboratories around the world have demonstrated that human memory is susceptible to errors as a result of exposure to post-event information such as leading questions and reports of others (Foster, Huthwaite, Yesberg, Garry, & Loftus, 2012; Loftus & Palmer, 1974), contact with other people (Gabbert, Memon, Allan, & Wright, 2004; Wright, Self, & Justice, 2000), expectations of the self or others (Brewer, 1977; Foster & Garry, 2012; Schacter, 2001), intentional suggestions (Davis & Loftus, 2007; Takarangi, Parker, & Garry, 2006), and even tiny differences in language (Loftus, 1975). In typical "misinformation effect" studies, research participants are asked to view an event, often a mock crime or accident (e.g., Loftus, Miller, & Burns, 1978; Zhu et al., 2012). Some participants are then exposed to misleading information about what happened during the event. This misinformation leads to errors in these participants' memories, such that they end up less accurate in subsequent memory tests than are control participants who did not receive the misinformation. These studies provide further evidence that human memory does not function like a video recorder that can be rewound and replayed (Clifasefi, Garry, & Loftus, 2007); rather, our memories are malleable.

In this article, we will briefly review the foundational false memory research but then focus on the recent advances in this area, including new hypotheses, new methodologies and new study populations. Some of this research addresses the behavioral ramifications of developing false memories. Some research explicitly attempts to differentiate between false memories and true memories, with the intent of devising techniques that could be used in court or other settings to determine whether a particular memory is true or false (or of establishing that this is impossible). And some of the research provides concrete evidence for new theories explaining what happens when people claim to have recovered long-buried memories of trauma.

Foundations of false memory research

The first studies that explicitly aimed to plant false memories for whole autobiographical events used what has subsequently been termed the "lost in the mall" technique (Loftus, 1997). In these studies, participants were told that researchers had spoken with their parents and learned about some events from their childhoods (Hyman, Husband, & Billings, 1995; Loftus & Pickrell, 1995; Porter, Yuille, & Lehman, 1999). This was actually the case for some events, but in each study, one childhood event was actually provided by the researchers, after being specifically disconfirmed by the parents (e.g., being lost in a shopping mall, spilling punch on the brides' parents at a family wedding, having a serious accident). After a series of suggestive interviews, modeled on therapy techniques used to recover memories, substantial minorities of participants (20%–25% in these early studies) reported remembering the false event (these numbers increased over time, such that Wade and Garry [2005] found a weighted mean of 37% of participants in 10 studies developing false memories). The false memories produced in these studies were often detailed and even emotionally laden for those who acquired them (see also Loftus & Bernstein, 2005).

Other early false memory implantation techniques sought to model other techniques being used by therapists to recover memories of abuse, including hypnosis (Scoboria, Mazzoni, Kirsch, & Milling, 2002; Spanos, 1996), guided imagination (Garry, Manning, Loftus, & Sherman, 1996; Heaps & Nash, 1999), dream interpretation (Mazzoni, Lombardo, Malvagia, & Loftus, 1999) and picture cuing (Lindsay, Hagen, Read, Wade, & Garry, 2004). All of these techniques produced false memories in substantial proportions of research participants.

Two additional issues have been key to establishing the reliability of laboratory-created false memories, as well as their relevance to the precipitating issue of recovered memories of child sexual abuse. First, one early criticism from trauma theorists and others was that perhaps false memory researchers were not in fact planting false memories of, for example, being lost in a shopping mall, but rather were actually recovering repressed memories of these potentially traumatic events (e.g., Freyd, 1998). False memory researchers responded by giving laboratory participants false memories for events that could not have actually happened, and therefore could not be evidence of memory recovery. Braun, Ellis, and Loftus (2002) used a mock advertisement paradigm to give participants false memories for meeting the character Bugs Bunny on a trip to Disneyland—an impossibility because Bugs is a Warner Brothers character rather than a Disney character. Mazzoni and Memon (2003) gave participants false memories for experiencing a made-up medical procedure. Wade, Garry, Read, and Lindsay (2002) digitally manipulated childhood photos to convince their participants that they had been on hot air balloon rides as children. Although this may not seem like an impossibility, this research was conducted in New Zealand, where formal written parental permission is required for all minors wanting to travel by balloon. This is a big deal, and not one that parents are likely to have forgotten when asked a few years later by researchers. Thomas and Loftus (2002; see also Goff & Roediger, 1998) used imagination techniques to give participants bizarre false memories (including kissing a plastic frog) for events that had taken place in the laboratory at an earlier session. They thus had a record of the original event and could prove that the memories did not match it.

The second early criticism was that subjects in false memory studies were responding because of the demand characteristics present in the studies (see Bernstein & Loftus, 2009a; Laney, Kaasa, et al., 2008). According to this argument, participants were not really developing false memories at all in false memory studies. Instead, they were figuring out that the researchers were attempting to plant false memories (in spite of what they were told), and then acting as helpful participants by producing the responses that the researchers were looking for (including evidence of false

memories; cf. Orne, 1962). Laney, Kaasa, et al. (2008) addressed this possibility by creating what was called the "red herring" paradigm. In this study, participants were given subtle clues that the study was about something other than what they had been told. However, these clues led not to the fact that the researchers were actually trying to give them false memories, but rather to a different (red herring) interpretation of the study materials. Results showed that participants believed the red herring explanation but developed false memories nonetheless.

Current false memory research

Once it was well established that false memories could be produced in laboratory settings (and in concert with the proof that these memories were in fact false and were not likely to be merely the product of demand), additional research was possible. This new research used some of the same techniques, as well as new techniques, to address many additional questions.

Some of this research was highly creative. For example, Seamon, Philbin, and Harrison (2006) expanded on the work done by Goff and Roediger (1998) and Thomas and Loftus (2002) by taking participants on a walk around campus rather than having them perform tasks in the laboratory. As they walked, subjects were asked to perform some tasks and to imagine performing others (or to watch the experimenter perform some tasks and imagine him or her performing others). After a 2-week delay, participants had trouble differentiating between experienced (or viewed) events and imagined events, such that they falsely remembered performing some tasks that they had only imagined performing—including, rather absurdly, proposing marriage to a Pepsi machine (see also Seamon et al., 2009).

One of the key questions being addressed in current false memory research is whether it could be possible to differentiate between false memories (whether intentionally planted in the lab or created by problematic justice procedures or therapeutic techniques out in the real world) and true memories (see Bernstein & Loftus, 2009b). If there was such a technique, it would have immense value both in the justice system and in our everyday lives. For this reason, many possible distinguishing factors have been identified and tested.

One potential way to differentiate between true and false memories is by considering their consequences for other thoughts, intentions, and behaviors. True memories matter for our lives. If a person remembers that a trip on a ski lift badly scared him, he may choose to go cross-country skiing rather than downhill skiing next time. If a child remembers that she got horribly sick after eating chili last summer, she may find chili inedible in the future. However, do false memories have these same sorts of consequences for people's lives? If not, then it could be possible to test for consequences of a particular memory that is in doubt as an indicator of that memory's veracity. Researchers have used a simple false feedback procedure to determine whether false memories have consequences in the way that true memories do (Berkowitz, Laney, Morris, Garry, & Loftus, 2008; Bernstein, Laney, Morris, & Loftus, 2005a, 2005b; Laney & Loftus, 2008; Laney, Morris, Bernstein, Wakefield, & Loftus, 2008).

In one study, participants were told (falsely) that an advanced computer system had analyzed data they provided previously and concluded that they had once gotten sick after eating hard-boiled eggs (Bernstein et al., 2005a). About 30% of manipulated participants (called "Believers") adopted this suggestion and came to believe that they had indeed gotten sick from the food. Participants were then asked how much they liked various foods (including hard-boiled eggs), and how much they wanted to eat various foods (including egg salad sandwiches) at an outdoor party, among many other questions. Believers claimed to like hard-boiled eggs less (and want to eat egg salad sandwiches less) than did both participants who were manipulated but did not form false memories

("Non-believers") and control participants. That is, the false memories apparently had real consequences for those who developed them.

These early studies of false memory consequences employed paper-and-pencil tasks rather than putting hard-boiled eggs (or other manipulated foods, which included pickles, asparagus, cookies, and ice cream) in front of participants to see whether they would eat them. Later studies provided these more real-life tests. Scoboria, Mazzoni, and Jarry (2008) gave participants a less personalized suggestion that they were likely to have been exposed to spoiled peach yogurt as children. A week later, under the guise of a supposedly separate, taste-test study, participants were given peach yogurt as well as other flavors of yogurt and crackers to eat. Participants exposed to the peach yogurt manipulation ate less yogurt of all flavors, but not fewer crackers than did control participants. In a follow-up study, Scoboria, Mazzoni, Jarry, and Bernstein (2012) found that personalized (rather than general) suggestions produced false memories and more and more specific (to peach yogurt) consequences than generalized suggestions.

Geraerts et al. (2008) gave their participants personalized suggestions that they had gotten sick after eating egg salad. Manipulated participants professed lesser desire (relative to controls) to eat egg salad sandwiches. What is more, after they were given a bogus debriefing and offered various kinds of sandwiches as a thank you, they indeed ate fewer egg salad sandwiches than did controls. After a 4-month delay, 85% of the original sample was successfully recruited for what they believed was a separate study and again offered various kinds of sandwiches. This time, those who had formed false memories (but not those who had resisted the false memories) ate fewer egg salad sandwiches than controls.

All of this suggests that consequentiality may not be such a good way of discriminating between true and false memories once the latter have been planted. Another potential method of discriminating between true and false memories is in terms of their emotionality. That is, we know that true memories can be associated with substantial emotion—when thinking of a loved one or a particularly meaningful experience, for example. However, what about false memories? If, as many jurors seem to assume, only true memories can be endowed with genuine emotion, then we could reasonably look to emotion as an indicator of memory truth. If, instead, false memories can be highly emotional for those who possess them, then memory would not be a good yardstick of memory truth.

One important study of the emotionality of false memories did not involve planting false memories at all. McNally et al. (2004) instead sought out naturally occurring (presumably) false memories in the real world. Specifically, they recruited participants who believed they had been abducted by space aliens. McNally et al. then measured the physiological responses (heart rate, skin conductance, and facial muscle movements) of these individuals and yoked controls in response to scripts of their abduction memories and other emotional and nonemotional memories. They found that the "abductees" were every bit as emotional about their abduction memories as they were about their memories of other, presumably genuine, life traumas (like the death of a loved one). This certainly argues that emotionality, in and of itself, does not guarantee memory truth.

In another study of emotional false memories, Laney and Loftus (2008) used the false feedback paradigm to give undergraduate participants false memories for three different emotional childhood events (witnessing a violent fight between their parents, being hospitalized overnight, catching their parents having sex). We then compared these participants' emotional responses (this time via paper-and-pencil tasks) to those of other participants who had true memories for the same events. We found that true and false memories were statistically indistinguishable on most measures of emotionality, and not usefully different (i.e., different in a way that would allow one to tell whether a particular memory was true or false) on any measure. These findings suggest that, like consequentiality, emotionality is not a useful indicator of memory truth.

Another possible characteristic for discriminating between true and false memories is endurance. We know that true memories can last for months or years or even decades. What about false memories? Can they last too, or do they fade quickly to reveal what really happened? We have already hinted above that false memories (and their consequences) can last, at least for months (see Geraerts et al., 2008). However, this is not the only evidence. Laney, Bowman Fowler, Nelson, Bernstein, and Loftus (2008) also demonstrated that false memories at their consequences can last for months, and for longer than did memory for the manipulation that produced the false memories (another argument against a demand characteristics explanation of this effect). Zhu et al. (2012) used a misinformation technique to show that highly distorted memories can remain highly distorted for at least a year and a half, with distorted aspects of memory remaining in place for as long as true aspects.

A different approach to the question of telling true and false memories apart is to look at people who are more or less likely to develop false memories (or false memories for particular types of events). Early research pointed to increased false memory development in people who scored higher on measures of absorption and dissociative experiences (Hyman & Billings, 1998; Platt, Lacey, Jobs, & Finkelman, 1998; see also Wilson & French, 2006), but other proposed individual differences did not reliably distinguish between these groups. Porter, Birt, Yuille, and Lehman (2000) found that false memories were particularly likely when suggestions were given in interpersonal interactions between an extroverted interviewer and an introverted participant, thus highlighting important social factors underlying the production of some false memories. More recently, Gerrie and Garry (2007) found that individuals with higher working memory capacity were better able to resist some types of false memories.

Recent research has addressed new kinds of individual differences. For example, Laney and Takarangi (in press) found that more aggressive individuals were more likely to form false memories for perpetrating aggressive acts. This study used the false feedback technique to give participants false memories for giving someone a black eye by punching them (or receiving one by being punched) or spreading malicious gossip. These false memories were easy to plant, with approximately twice as many participants taking on false memories for perpetrating aggressive acts as for being a victim (in this or other studies). However, those who demonstrated lower levels of trait aggression were less likely to take on the false memories (see also Takarangi, Polaschek, Hignett, and Garry [2008] and Vannucci, Nocentini, Mazzoni, and Menesini [2012] for the relationship between aggression and false memories for aggression-related words).

Conclusion

Although human memory errors have been a ripe area for research for decades, and demonstrations of false memories for entire autobiographical events have been available in the literature for almost 20 years, this is still a ripe area for research. New research is planting new kinds of false memories, and exploring the details of who develops false memories and how. Although many factors have been tested in attempts to differentiate between true and false memories, no firm distinguishing characteristic has yet been established. Because of the potential advantages of discriminating between true and false memories, further research is called for.

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