False Memories:

Phenomena, Theories, and Implications

Melanie Caroline Steffens

Friedrich-Schiller-Universität Jena

Silvia Mecklenbräuker

Universität Trier

Address of corresponding author:

Melanie Steffens
Institut für Psychologie
Friedrich-Schiller-Universität Jena
Am Steiger 3, Haus 1
D-07743 Jena, Germany
E-mail: Melanie.steffens@uni-jena.de
Phone:+49-3641-945 111
Fax:+49-3641-945 112

Authors' Notes
Please address correspondence to Melanie Steffens, Institut für Psychologie, Friedrich-Schiller-Universität, Am Steiger 3, Haus 1, D-07743 Jena, Germany, e-mail: Melanie.steffens@uni-jena.de, or to Silvia Mecklenbräuker, FB I-Psychologie, Universität Trier, Universitätsring 15, D-54286 Trier, Germany, e-mail: mecklen@uni-trier.de. The writing of this article was supported by a grand from the Deutsche Forschungsgemeinschaft (DFG, Ste 938/6-1).

Word count: 7734

Abstract

In recent years, there has been an explosion of research on false memories: the subjective experience of remembering something if that something did apparently not happen in reality. We review a range of findings concerning this phenomenon: False memories of details and of whole events by adults and children, as well as false memories of words in laboratory experiments (in the DRM paradigm). We also briefly discuss the converse phenomenon: Evidence of forgetting or repression of significant events, and evidence of recovered memories. Knowledge of both phenomena is needed for judging whether "new" memories are false, recovered, or whether both options are possible. More general as well as specific theories explaining false memories are discussed, and we close with implications for practice.

Key words: False memory, DRM paradigm, source monitoring, fuzzy trace theory, repression

False Memories: Phenomena, Theories, and Implications

As an introduction to the practical relevance of the topic, think of a woman who has been in therapy for many years because she has difficulties trusting men; she has panic attacks; she has a very distant relationship with her father; and she suffers from disturbing nightmares. At some point during that therapy, she "recovers" faint memories of early childhood abuse by her father. She consequently breaks off all contact with her family of origin. Can we be sure that she truly recovered old memories, as opposed to reconstructing memories that are in line with her current beliefs and feelings? The self-help literature for victims of abuse is very clear. For instance, "You must believe that your client was sexually abused, even if she herself sometimes doubts it. … No one invents abuse. Neither children nor women make up having been abused…" (Bass & Davis, 1992, p. 324, translated from German). But what do experts on memory say? Can faint memories of early childhood be false memories due to suggestions? How can such memories be induced? And how can theories of memory explain this? Finally, what are the practical implications for situations such as that in the above example? We start our overview of the false-memory literature (for others, see Koriat, Goldsmith, & Pansky, 2000; Schacter, 1999) with a description of the range of phenomena that are discussed under this topic because false memories are primarily phenomena: astonishing findings.

Phenomena

A main reason why there was much less research on memory illusions than on perceptual illusions until the middle of the 1990s is probably that it is tricky to obtain close control over the stimulus that is subject to a memory illusion (Roediger, 1996). Illusions of perception can be created and investigated in the laboratory within a minute. Memory illusions probably arise mostly after longer latencies, and it is difficult to obtain objective evidence as to what "really" happened. In these cases, discrepancies attest to the existence of memory illusions. First, there are within-person discrepancies, such as reported for depression patients who recall as straining and negative even events previously judged as pleasant. Second, there are discrepancies between persons, as everyone has probably witnessed when old couples get into verbal arguments about long-ago events ("The car was robbed when we were on the way to the Black Forest." – "No, we were not! That was the year before. The car was robbed when we were on the way to Munich to visit your sister." – "Darling, I am positive that you are wrong because …").

Evidence of False Memories

If we assume that no one is lying on purpose in such dialogs, some distorted memories must be involved here. It would, however, be very difficult to find out what actually happened back then. Exceptions are memories for past things that are well documented. In a very nice study using that approach, it was shown that people generally remember their good high-school grades, but forget the bad ones and then overestimate them (Bahrick, Hall, & Berger, 1996). The researchers asked participants how well they did in school. After the interview, they checked the grades in their high-school diplomas.

What other approaches have been used to find out whether adults can have false memories? An older thread of research along these lines, is research on eyewitness testimonies. A strongly established memory phenomenon is that eyewitnesses often confuse misleading post-event information with what they have witnessed. In the classic studies by Loftus and her colleagues (for a review, see Loftus, Feldman, & Dashiell, 1995), eyewitnesses who were asked whether they saw "the car run over the stop signal" were, in a later questionnaire, more likely to indicate that they saw a stop signal when there had been none, a phenomenon called misinformation effect (cf. McCloskey & Zaragoza, 1985, for a discussion of the processes involved). For illustrative purposes, we present the study by Zaragoza and Mitchell (1996). After having watched a movie of a burglary, misleading post-event information was introduced to participants in a questionnaire with questions such as "At the beginning of the scene, a young man dressed in jeans, a t-shirt and gloves entered the house. Did he enter through the door?" (p. 295). Actually, the thief had not worn gloves. Each piece of misleading information was presented for zero (control condition), one, or three times. In the test phase, participants were warned that the questionnaire had contained misleading information. They then did a source-monitoring test where they were asked whether each piece of information ("The robber wore gloves") was from the video or from the questionnaire. The false alarm rate of details that had not been presented in the movie was 10% in the control condition, increased to 37% for false information presented once, and to a remarkable 56% for misleading information presented three times (for theoretical accounts, see below). Apparently, wrong details can quite easily be suggested to people and then be incorporated into their memories of events (for a recent review, see Loftus, 2005a).

There are many differences between suggesting details about a movie to someone and suggesting whole events that allegedly happened to them. This latter phenomenon has also been heavily researched in the last decade. A famous study conducted to test how susceptible children are to false memories is the Sam-Stone experiment (Leichtman & Ceci, 1995). The

authors' aims were testing the roles of age, stereotypes, and suggestions for the formation of false memories. Suggestions were comparable to the misleading postevent information discussed above (also see White, Leichtman, & Ceci, 1997, for the effects of suggestions on children's reports). Stereotypes are of much interest in this context because child witnesses might often (subtly) learn that a certain person is regarded as a "bad guy". If this knowledge influences their willingness to attest to bad things he did, this is of course a problem for evaluating what child witnesses say. The third factor in the study, age, was considered because, as one might expect, the reliability of child testimonies increases with their age (for reviews, see Ceci & Bruck, 1993; Pipe, Lamb, Orbach, & Esplin, 2004). Children were tested in day-care centres. The design of the study was a 2 (stereotype induction vs. no stereotype) X 2 (suggestion vs. no suggestion). In the weeks preceding the visit, children in the stereotype induction condition heard stories about Sam Stone as a clumsy and bumbling person. Sam Stone's visit itself lasted only a few minutes. He came in, greeted, walked around, and left. Afterwards, a torn book and a dirty teddy bear were discovered. Each child in the suggestion conditions was interviewed repeatedly in the following weeks. Two questions were phrased in a suggestive way ("Was Sam Stone happy or sad that he got that bear dirty?"). In the final interview by a new interviewer, each child was asked whether Sam Stone soiled the bear and ripped the book. Figure 1 shows the percentage of children affirming at least one of these questions. Both the stereotype and the suggestions increased the number of false memories, and false memories were more prevalent among four-year-olds than among six-year-olds. False-memory rates of up to three fourths make something very clear about the reliability of the memories of child witnesses: A four-year-old who has learned that a certain person did something bad and who has repeatedly been interviewed in suggestive ways cannot be relied on as a witness anymore. This is an explanation for the strange stories that child witnesses sometimes relate: They want to be consistent with expectations, but if they don't know much about these expectations, their imagination can lead them astray. Younger children may show a tendency to claim that all kinds of events have happened to them. For instance, if children had drawn pictures of impossible events (flying to the moon on a rocket, swimming with mermaids, etc.), they were more likely one week later to claim that such events had actually happened to them in their past (Strange, Garry, & Sutherland, 2003). In short, only experts should interview children who might be important witnesses, and they should do so following specific rules (cf. Fisher & McCauley, 1995).

Figure 1 about here

The Sam-Stone experiment is illustrative also because the researchers found a nice way to avoid the frequent problem (alluded above) of having to investigate what happened in the past: They included the "study phase" in the experiment (for a similar recent study with positive and negative misinformation, see Memon, Holliday, & Hill, 2006). It would, of course, be nearly impossible to expose children to a disturbing event and ask them 20 years later what they remember of if. Other ways of controlling for the initial event are mentioned further below. But first, we concentrate on studies that have suggested specific events to their adult participants, only to test subsequently whether participants believed that these events had actually happened to them (for a review, see Loftus, 2003). Interestingly, studies on false memory "implantation" in adults were in part motivated by a famous story by Piaget (1962). Piaget had a vivid memory of an attempted kidnapping that had allegedly happened early in his childhood. "I can still see, most clearly, the following scene, in which I believed until I was about fifteen. I was sitting in my pram, which my nurse was pushing in the Champs Elysées, when a man tried to kidnap me. I was held in by the strap fastened round me while my nurse bravely tried to stand between me and the thief. She received various scratches, and I can still see vaguely those on her face…" (cited after Loftus, 2005b, p. 39). When he was about fifteen, his former nurse confessed that she had made up the whole story. Piaget's example illustrated vividly the possibility that a repeated family story might lead a young child to have a persisting false memory.

Is it also possible to plant memories for nonexistent childhood experiences in adults? A number of paradigms for false memory implantation have been developed (see Koriat et al., 2000; Loftus, 2003). One example is the study by Hyman and colleagues (Hyman, Husband, & Billings, 1995) including the event of spilling punch on the bride's parents (for a more recent example, see Ost, Foster, Costall, & Bull, 2005). In preparation, the researchers collected several childhood events from students' families. Relatives were asked not to talk to the students about these details. Then, each student was interviewed and asked to describe as many details as possible of 3-5 events that had actually happened in their childhood (a camping holiday etc.). These events were intermixed with one standardized unlikely event that the researchers had invented: playing wildly on a wedding, bumping into a bowl of punch and spilling it over the bride's parents. Participants were then dismissed with the hint that they should try to, and would probably remember more details of the events in the next few days, and were rescheduled for a second and third interview. At the end of the study, nearly every fourth participant claimed to remember the fictitious event; they produced additional

details of it; and when asked to pick from their list of childhood events the one that had actually not happened, they could not confidently discard the punch story. Some were very surprised during debriefing that this was the false event. Participant questioning revealed interesting differences between those participants who bought into the false event and those who did not. Those who held general memories that were consistent with the false event were more likely to believe that it had happened and to produce false memories (in the example: wild children who had been on weddings). In addition, those who had specific reasons to dismiss the story did not produce false memories (e.g., "it must have been my brother").

"Planting" false memories in around 25% of the participants is in line with other experiments on false childhood memories. This proportion is still increased if more information is presented that adds to the credibility of the event: When faced with a (merged) picture of them in a hot-air-balloon, 60% of participants produced false memories of the balloon ride (Lindsay, Hagen, Read, Wade, & Garry, 2004; Wade, Garry, Read, & Lindsay, 2002; for a review on recent work with this doctored photo procedure, see Garry & Gerrie, 2005). Even when the photo was only associated with (but not depicting) the suggested pseudoevent (school classes' group photos from the years of the to-be-recalled school-related childhood events), two-thirds of the participants developed false memories. As discussed by Hyman et al. (1995), it is a typical feature of childhood memories that they are part of the family history, revolving around pictures with accompanying stories. Therefore, it must be very difficult to disentangle true memories of the events themselves from memories of the pictures and the respective often-told stories, all the more so because childhood memories are often blurred as opposed to rich and detailed.

These findings prove that false memories of childhood events do exist. Can this evidence still be refuted as irrelevant to recovered memories of childhood abuse? People who have tried to do so (mostly therapists, who often take a different stance in this discussion than memory researchers do, see Ost, 2003; Pope, 1996) have argued that false memories of not too unpleasant, single events are very different from memories of repeated abuse by relatives. This is certainly true (whereas, as a side note, it is not so clear why different processes should be at work for false memories differing in valence etc.). The argument of interevent differences has been taken up by researchers who have, in turn, designed experiments to test whether false memories of unpleasant events can be created. They searched for an event that is very unpleasant; where a child would feel helpless; and where those parts of her or his body are involved that are usually not touched by others. Pezdek and Hodge (1999) investigated whether children create false memories of receiving a rectal enema. Being lost in a shopping

mall was used as a control event in the same study. Whereas 14 of the children tested created false memories of being lost, but not of the hospital visit, this pattern was reversed for only one child. This shows that differences between events influence the probability of false-memory creation: When the plausibility of an event is subjectively low, apparently false memories do not emerge (also see below).

Confidence estimates regarding unlikely events can be increased by asking students to vividly imagine the respective situations, an effect first reported by Rita Anderson (1984) and later termed imagination inflation (Garry, Manning, Loftus, & Sherman, 1996). In the study phase of the Garry et al. study, participants ticked each event on a list as to the probability with which it had (not) happened to them during childhood (such as finding a dollar bill in a parking lot, dialling an emergency number). Two weeks later, they were asked to imagine in detail some of the events. Then, the experimenter pretended that she had made a mistake in coding the previous lists and asked participants to please fill them out again. As it turned out, those events that participants had imagined were now judged to have really happened with a higher probability than before. However, a distinction should be drawn between confidence estimates about fictitious events, beliefs about such events, and false memories (see Smeets, Merckelbach, Horselenberg, & Jelicic, 2005). Another criticism of imagination inflation studies is that there is, again, no control over which events happened in participants' childhood and which did not. There is, after all, the possibility that some participants forgot all about finding a dollar bill, so only when they pictured the event in some detail were they reminded of the original event. Several studies indicate, however, that with multiple acts of imagination, people can be led to believe that they performed an unlikely action (e.g., kissing a magnifying glass; sitting on a dice) (e.g., Goff & Roediger, 1998; Thomas, Bulevich, & Loftus, 2003).

An alternative way to gain control over the past event is investigating false memories of impossible events. Spanos and colleagues (see Spanos, 1996) successfully planted a false memory that allegedly occurred one day after birth (a coloured mobile hanging over the crib). Researchers have also investigated false memories of past lives that were created under hypnosis (Spanos, Menary, Gabora, DuBreuil, & Dewhirst, 1991). These memories were consistent with suggestions (such as the proportion of children having been abused back then) and with American students' knowledge rather than historic evidence (such as: recalling having lived in Germany in the 16th century). Other researchers have tried to explain false memories of alien abductions (see Banaji & Kihlstrom, 1996; McNally et al., 2004). Such findings indicate that event plausibility is not a necessary condition for coming to belief that

an event happened when methods are used that increase schematic knowledge and/or document the false events with authority (e.g., reading accounts of "witnessing a demonic possession": Mazzoni, Loftus, & Kirsch, 2001). Using a variation of the doctored photo procedure (see above), Strange, Sutherland, and Garry (2006) found that children (6- and 10-year-olds) showed comparable rates of false memories for a higher plausibility event (taking a hot air balloon ride) and a lower plausibility event (having a cup of tea with Prince Charles). In short, false memories of whole and even implausible events can be planted not only in children, but also in adults.

Table 1 about here

Creating False Memories in the Laboratory: The DRM Paradigm

How can false memories be efficiently investigated if there are many differences between the events that are subject to false memories, and if every study used only one or a handful of different events? For demonstration purposes, have a quick read through the list of words presented in Table 1.

False memories were taken into the laboratory by Deese (1959) who obviously had a marketing problem: No one ever cared about his research until Roediger and McDermott (1995) re-invented the paradigm. They obviously did a much better job selling it and, consequently, it is now called the DRM paradigm (following a suggestion made by Endel Tulving). For demonstration purposes, mark those words in Table 2 below that you have previously read in Table 1 (without going back to Table 1, of course).

In the DRM paradigm, lists of words are presented that include the first 12-15 associates for a given nonpresented critical word (critical lure, or prototype). Participants are instructed to memorize the presented words for a later test, usually recall and/or recognition. Figure 2 shows typical results (data from our laboratory) in a recognition test. It was counterbalanced which list had been presented to a given participant. During recognition, list words and critical words from all lists were presented. The false alarm rate for the nonstudied critical words was much higher than that for other distractors. You may check for yourself that none of the words in Table 2 was contained in Table 1. Generally, false recall and recognition rates are fairly high for the nonstudied critical words (see Roediger & Gallo, 2003, for an overview). Moreover, the critical words were recognized with a high confidence, and when remember/know judgments (Tulving, 1985) were required, true and false recognitions were equally likely to give rise to remember responses (e.g., Roediger &

McDermott, 1995). There is a tremendous amount of research on false memories in the DRM paradigm (see e.g., Gallo, 2006; Roediger & Gallo, 2003, for reviews) and we will only mention some interesting findings.

Figure 2 about here

There is evidence that false memory can be based largely on automatic processing and is amenable to only limited conscious control. For example, Dodd and MacLeod (2004) showed that mere exposure to DRM lists was sufficient to create a false memory: They presented DRM lists as coloured words in a Stroop test. Naming colours reduced accurate memory for list words as compared to reading coloured words, but false memory remained high for critical words. Furthermore, false memory is difficult to eliminate. For example, false recall is not reduced by directed forgetting instructions (e.g., Kimball & R. A. Bjork, 2002; Seamon, Luo, Shulman, Toner, & Caglar, 2002), and young adults can take advantage of explicit warning instructions given prior to encoding to reduce but not to eliminate false memories (e.g., Watson, McDermott, & Balota, 2004; Westerberg & Marsolek, 2006). And a last intriguing finding: False memories are remarkably persistent. For example, Toglia, Neuschatz and Goodwin (1999) found that false recall rates remained high over a three-week period, whereas recall of studied words revealed the typical decrement. In short, the DRM paradigm allows for the easy and reliable elicitation of false memories in the laboratory.

Table 2 about here

Evidence of Repressed Memories

Even though this overview is primarily focused on false memories, the other side of the coin needs to be presented in order to arrive at a complete picture when we come to the implications (also see Gleaves, Smith, Butler, & Spiegel, 2004). Memory researchers have often claimed that the very problem with traumatic experiences is not that they are repressed and forgotten, but that they remain vivid and cannot be forgotten (Loftus, 2003). Indeed, the disturbing vividness with which pictures of the traumatic event are present is part of the definition of the Post-Traumatic Stress Disorder, PTSD (see DSM IV). Therapists who believe in repression often follow a Freudian tradition. Roughly, according to this theoretical stance, memories that cannot be assimilated into existing schemas (such as those of a normally loving father doing bad and wrong) are fearfully repressed into unconsciousness. In

the course of therapy, when they appear less threatening, they can be recovered (cf. Loftus, 1993).

The first relevant question thus is whether there is evidence that very significant and emotionally upsetting events can be forgotten. Most people hold a meta-memory belief that emotional events are remembered better than emotionally neutral ones, even though, as research shows, the relationship between emotion and memory is a very complicated one (cf. Klauer, 2000, for an overview). In contrast to the belief that emotional content and personal relevance hinder forgetting, there is clear evidence to the contrary. Waagenaar and Groeneweg (1990) showed that people who had been in a concentration camp during World War II had, in the 1980s, forgotten many of the horrible things that had been done to them and that they had been able to report soon after the war (but see McNally, 2005).

Even more relevant to the false-memory debate are findings by Meyer Williams (1994) on abused children. She contacted as many of these people who had been, according to hospital files, brought into the emergency ward when they were children at the beginning of the 1970s with severe physical harm resulting from abuse. During extended in-depth interviews, she probed them for memories of that abuse. As one would expect, the probability of remembering depended on the interviewee's age at the time of abuse. Strikingly, however, there was a considerable proportion who indicated no memory of the incidence at all, 38% overall; even 25% of those who had been between seven and twelve years old when the incident was reported. The elegance of this study derives from the neat solution of the difficulty to gain control over the prior event: This was obtained by consulting the hospital files that documented the childhood abuse. A few problems with the study should, however, be discussed (cf. also Loftus, Garry, & Feldman, 1994). For instance, there is no objective evidence that participants really could not remember the abuse: They simply might have refrained from telling a stranger about it. This is unlikely, though, because these participants told the interviewer other things where at least as much reluctance might have been expected. In addition, it could be that these children never understood the events as sexual abuse: So instead of forgetting them, they never encoded them as such. Nevertheless, in a nutshell, we can conclude that disturbing events are not shielded from forgetting.

The second question relevant to evidence of repressed memories is whether there is a difference between repression and "normal" forgetting, as Freud and others would claim. In other words, is there something in memory that resembles an active inhibition mechanism, reducing the activation level of a representation and thus lowering its accessibility? At least three research threads are relevant here. The first is the large literature on directed forgetting

(for reviews, see E. L. Bjork, R.A. Bjork, & M. C. Anderson, 1998; MacLeod, 1998). Briefly, what is shown is that words designated "to be forgotten" after study are recalled with a lower probability than control words. They are recognized quite well, however, suggesting that specifically their accessibility is lowered (for an alternative inhibition-free account of directed forgetting, see MacLeod, Dodd, Sheard, Wilson, & Bibi, 2003; Sheard & MacLeod, 2005). The second thread of research shows that rehearsing something lowers the probability of recalling related things. For instance, repeated rehearsal of half of the pictures in a given sequence of events (Koutstaal, Schacter, Johnson, & Galluccio, 1999) lowers the probability of recalling those pictures that were not rehearsed (while at the same time, of course, increasing the probability of recalling those that were rehearsed). It thus seems as if remembering something represses things related (see Bäuml, this issue). Finally, a third research thread shows direct evidence of repression (M. C. Anderson & Green, 2001). In a very original study, in a paired-associate learning paradigm, participants were asked to learn arbitrary pairs of words (such as "radio-lion"). In a second phase of the experiment, participants were given the cue ("radio") and asked to respond with the target ("lion"). However, for a designated subset of the word pairs (repressor pairs), they were asked to avoid any thoughts of the target when given the cue. In the final test phase, the original targets were to be reproduced in response to the cues. The more often the repressor cue had been presented in phase two, the less likely participants were to recall the target. More strikingly, even given semantic cues ("four-legged animal"), they produced the target with a lowered probability when the repressor cue had been presented repeatedly in phase two. Thus, it appears that those targets themselves had been inhibited, not only the cue-target relation. Taken together, the findings reported in this section demonstrate that first, traumatic childhood events can be forgotten and second, that there is also some evidence for a repression mechanism in memory.

Theoretical Accounts of False Memories

Can memory theories explain false memories? Do they need to be modified in the light of findings on false memories? Do we need to develop new accounts?

General Principles of Memory

On a general level, we believe that traditional views of memory can easily account for new findings on false memories (see also Koriat et al., 2000; Schacter, 1999). A first principle highlighted in false-memory research is the reconstructive nature of memory that was already stressed by Bartlett (1932): Events are not stored in memory as are pictures on a videotape. Instead, events are reconstructed in the light of present views, using available schemas, that is,

knowledge structures (for a classic review on schema-based effects on memory, see Alba & Hasher, 1983). In fact, such schemas guide not only the retrieval of events, but even their storage. For instance, Dunning and Sherman (1997) showed that a sentence like "The rock star was upset about the amount of alcohol served at the party" was falsely remembered as "The rock star was upset that so little alcohol was served at the party", whereas the same sentence with a nun as the subject was falsely remembered as "The nun was upset that so much alcohol was served at the party". More generally, inferences that are necessary for understanding events are made immediately, and after a delay, they cannot be disentangled from information directly given (Kintsch, 1988). In other words, a second reason why false memories of events may occur is that ambiguous situations are interpreted in terms of existing schemas, and they are then stored accordingly. Even in the absence of further distortions, these events would be recalled falsely (for a review on the influence of schemas on false memories, see Hirt, Lynn, Payne, Krackow, & McCrea, 1999).

A third aspect of traditional memory theories that is well in line with findings, even though this time with findings on recovered memories, is the broad consensus on fluctuations in recall. In Tulving's (1983) words, this is the difference between availability (something is stored in memory) and accessibility (it may not be accessible under the given circumstances). With powerful retrieval cues (such as the huge Göteborg ferry in a German harbour), someone who has always claimed to have never been in Sweden may recall a day-trip there fifteen years ago. Sleeping in a tent for the first time in 20 years, a man may recall that he was molested by a priest during a camping trip. Even laboratory research shows fluctuations in recall over the course of minutes: Hypermnesia is the phenomenon that words from a list that were not recalled during the first recall test are recalled during a second test (with no intervening second study phase) (e.g., Burns, 1993). One major determinant of accessibility seems to be the whole study context, the interactive context (that influences the meaning of what is studied) as well as the incidental context (cf. Baddeley, 1982), that is, everything present during study, including sights, odors, and even own emotions (Bower, 1992). In line with the encoding specificity hypothesis (Tulving & Thomson, 1973) and the transfer-appropriate processing approach (Bransford, Franks, Morris, & Stein, 1979), aspects of the whole context are encoded within a memory trace, and the more of these aspects are present (or even imagined), the higher is the probability that the memory trace is activated. These theoretical considerations imply that things long forgotten can be remembered if someone extendedly and repeatedly thinks about them or imagines them, as is often the case with childhood events during therapy. In short, memory theories from an information-processing

perspective, not only those from a Freudian stance, predict that the recovery of memories should be possible. (Every one can try for themselves by reconstructing a childhood song or poem that is, during the first recall, hard to come up with, but where further words and lines will be recalled on subsequent trials.) Several more specific accounts of false memory have been brought forward.

The Fluency-Misattribution Perspective

False memories may result from the misattribution of processing fluency. According to this view (e.g., Jacoby, Kelley, & Dywan, 1989), the subjective experience of familiarity results from the unconscious attribution of fluent processing to the past (for a refinement of this approach, called discrepancy-attribution hypothesis, see Whittlesea, Masson, & Hughes, 2005; Whittlesea & Williams, 2000). When fluency due to the previous presentation of a stimulus is attributed to the past, veridical recognition results. However, other factors can lead to fluent processing. In that case, fluency is misattributed to the past (i.e., to an incorrect source) and an illusion of familiarity results. For example, imagining childhood events may increase participants' familiarity with these events (but see Mazzoni & Memon, 2003).

The Source-Monitoring Framework

Findings on misleading postevent information, including those where specific childhood events were suggested to participants and those on imagination inflation, can all be explained within a source-monitoring framework (Johnson, Hashtroudi, & Lindsay, 1993; Johnson & Raye, 2000). The general tenets of this framework are as follows. We need to distinguish between the content of a memory trace ("what" we know) and its source ("where" we know it from). The source may be forgotten independent of the trace. You may know that someone in the discussion mentioned the pope, but you forgot who it was. A source is not a fixed part of a memory trace, like a tag attached to it. Instead, source attributions are decision processes. For faint memories, they can be very difficult. Source-monitoring decisions can be made between external sources ("Did you see on TV that they opened the Berlin wall or did you hear it on the radio?"), between internal sources ("Did you state this brilliant argument in the discussion or did you only imagine doing it?"), or between an internal and an external source ("Did you state this brilliant argument or was it your friend?). This distinction between internal and external sources emphasizes the origin of the information (the self versus external source as origin), and not the public versus private status of the information (see Johnson et al., 1993, Footnote 1). An example of a lack of source monitoring is described in a novel by Jana Hensel (2002, *Zonenkinder*), who, as a teenager, attended the street marches in Leipzig

that preceded the German unification: "I cannot tell anymore what I saw with my own eyes and what I saw, at the same evening and then time and time again, in the *Tagesthemen* [daily news]" (p. 12). Another recent example is the finding that over half of an undergraduate sample reported the existence of a memory whose origin, read or dreamt, was uncertain to them (Kemp & Burt, 2006). Faint memories are, according to the source-monitoring framework, attributed to external sources when they are rich in perceptual details ("If I remember my friend's voice and her happy face, it was probably her who mentioned this brilliant argument"). In contrast, attributions to internal sources become more likely if one remembers the cognitive processes involved ("I remember how difficult it was to come up with the argument"). The main point to keep in mind is, however, that general knowledge such as meta-memory beliefs guide the decision process as to what was imagined and what happened. From this stance, therapists have a lot of responsibility because they are seen as authorities with regard to mental and emotional processes. If such an authority strongly and repeatedly suggests that an adult must have transgressed a woman's boundaries when she was a child, given her current emotional status, and if that therapist even asks the client to repeatedly imagine in detail what might have happened (cf. Garry et al., 1996) we can derive from the source-monitoring framework the prediction that it will become increasingly difficult for the client to accurately tell childhood memories from the respective imaginations. In sum, the source-monitoring framework can account for many findings on false memories: For instance, something that is really a mental picture from an imagination may be mistaken for a childhood memory. And when people claim to remember details about events that never happened, they may in fact remembering features of other, actually perceived events (Lyle & Johnson, 2006).

The source-monitoring framework is closely related to the fluency-misattribution perspective, but emphasizes misattributions of specific characteristics (i.e., sensory details) instead of global familiarity. Respective results were obtained by Thomas et al. (2003), indicating that imagination inflation with few sensory details can be better explained by a misattribution of global familiarity, whereas imagination inflation with many sensory details is the larger effect and is more consistent with the source-monitoring framework (see also Mazzoni & Memon, 2003).

The Activation-Monitoring Account

The Activation-Monitoring Account (AMA) was developed by Roediger and his colleagues (e.g., Roediger, Watson, McDermott, & Gallo, 2001) to explain false memory

findings from the DRM paradigm. The operation of two opponent processes is posited to account for dissociative effects of some study variables (e.g., study time or number of study trials) on accurate and false memory: activation of the critical words, usually during study, and (source) monitoring or memory editing, usually during testing. During the study phase, item-specific aspects of each list word are processed that increase its distinctiveness, and the relations between the words are processed and activate also the critical word (see Hunt & Einstein, 1981, for item-specific vs. relational processing). The representations of critical words are activated either consciously by elaborative processing or automatically through the spread of activation within an associative network (e.g., McDermott & Watson, 2001). At test, participants must distinguish between activation resulting from actual list presentation and internal activation. They may mistake the internal activation of the critical word's representation for its actual occurrence at study, thereby making a source-monitoring error. The role of activation processes is strengthened by the regression analysis finding that the strength of backward associations from the list items to the critical word is the best predictor of false memories (Roediger et al., 2001; see also Anaki, Faran, Ben-Shalom, & Henik, 2005, for the relevance of backward association strength). In other words, on the one hand, the stronger the list items activate the critical word, the higher is the probability of false recall and recognition. On the other hand, the probability of false memories decreases if monitoring becomes easier, for instance, when lists are well learned (e.g., McDermott & Watson, 2001). And the probability of false memories increases if monitoring becomes more difficult, for instance, when not enough source information was encoded because participants were stressed before study (Payne, Nadel, Allen, Thomas, & Jacobs, 2002). False memories are even spontaneously recovered (after lists were well learned and false recognition rates were greatly reduced) when participants were rushed or delayed, thus making monitoring more difficult (Seamon et al., 2006).

The characterization of monitoring processes in AMA borrows notions from the more general source-monitoring framework. It is important to note that other theoretical accounts of monitoring processes exist (e.g., in Fuzzy Trace Theory) which suggest similar processes to those outlined in the source-monitoring framework but also propose some differences (for details, see e.g., Gallo, Bell, Beier, & Schacter, 2006; Odegard & Lampinen, 2006).

Fuzzy Trace Theory

Fuzzy Trace Theory (FTT) is a theory on an intermediate level of abstraction (e.g., Brainerd & Reyna, 2002, 2004). It incorporates more detailed assumptions about processes

underlying false memories than the general memory theories discussed above, but is wider in scope than the AMA. The main tenets of the theory are that in parallel, two memory traces are established. Verbatim traces represent the surface details of physical stimuli, whereas gist traces represent the meaning or theme of the stimuli. Accurate memory of studied items is driven largely by verbatim traces, whereas false memory is based predominantly on gist traces. Verbatim traces decline faster than gist traces. Thus, false reports can display sleeper effects, waxing over time even as true reports are waning. FTT is similar to schema theories but includes more detailed assumptions, and the latter postulate a serial relation between verbatim and gist traces: Verbatim traces are either lost or become integrated with schematic-gist information. Like the AMA, FTT is an opponent process theory: False memory is increased by a generation process that produces gist traces at study and is decreased by a memory editing process that monitors recollection at test. Two predictions that have often been confirmed empirically are that the probability of false memories increases if the gist is repeated (as happens in the DRM paradigm) and if memory declines (e.g., with time passing).

Whereas the FTT and the AMA postulate different types of monitoring processes, they also share many features (e.g., they are two-process theories, and relational encoding enhances the activation of the critical word/gist processing). The main difference is that according to the AMA the representation of the critical word contains both semantic and surface features, whereas gist traces corresponding to critical words include only semantic information. The empirical evidence is still mixed (e.g., Cabeza & Lennartson, 2005; Coane, McBride, Raulerson, & Jordan, 2006; McBride, Coane, & Raulerson, 2006). The accounts may be reconciled by assuming that under some conditions, false memories may be mainly due to associative activation, under others, they may mainly rely on meaning-based information (cf. Hutchison & Balota, 2005).

The similarities among the theoretical accounts we outlined by far outweigh the differences. They complement rather than exclude each other. As a consequence, many false memory phenomena are compatible with several approaches. The different accounts emphasize different processes that all contribute to false memories, or even postulate similar processes using different terminologies. Additional differences concern details of the postulated processes that may very well depend on the specific conditions under which a false-memory phenomenon occurs.

Constructive Memory Framework

An integrative framework that incorporates most of the just described processes (e.g., constructive and reconstructive processing, item-specific vs. relational processing, spreading activation, source monitoring) and may be seen as a unifying account is Schacter, Norman, and Koutstaal's (1998) neuropsychologically informed Constructive Memory Framework (CMF). Representations of new experiences are conceptualized as patterns of features, and retrieval involves a process of pattern completion in which a subset of the features are reactivated, and activation spreads to the rest of the constituent features. Accurate representations of past experiences require that features (e.g., perceptual, semantic, contextual) comprising a specific episode must be linked together at encoding to form a bound or coherent representation. Source-memory failures can result from inadequate feature binding or from insufficient source information in the bound representation. Memory errors can also result from insufficient pattern separation at encoding. If items (or episodes) overlap with one another (as happens in the DRM paradigm), individuals may show good memory for what the items have in common (i.e., gist information), but impaired recall of item-specific information. At test, memory distortions can arise when people construct a retrieval cue that is not fully consistent with information in the target trace. For example, people may use schematic knowledge and/or information that is present in the test environment to construct cues. Memory distortions can arise when schematic knowledge or physical retrieval cues (cf. encoding specificity) fail to accurately describe a particular episode. And when the pattern completion process produces a match, a decision must be made whether the information delivered to awareness constitutes an episodic memory, as opposed to a fantasy or thought. Memory errors can result from setting a lax criterion in this source monitoring decision.

One problem with CMF may be that most false memory phenomena cannot be understood unambiguously. For example, the DRM illusion may be attributed to pattern-separation failure at encoding or a source-monitoring error at test. Closer specification (along with empirical tests) is needed of the conditions when a given false-memory phenomenon may be better explained by one or the other mechanism posited in CMF, and by more general or more specific principles.

Implications

We can sum up the above review in the following words: There is abundant evidence of false memories, not only in children, but also in adults. This evidence comes from a range of research paradigms. There are rather general as well as quite specific theories brought

forward to explain these findings. A first implication for future research is that researchers in the field of false memories should now be more concerned with testing novel hypotheses that bring forward the theoretical debate, instead of focusing on empirical phenomena.

A second implication of our review is: Experts cannot decide with certainty whether a given specific memory is "recovered" or "false" (cf. Gleaves et al., 2004). As we have discussed, there are some things that therapists or interviewers should definitely avoid (most of all, suggestions and instructions to imagine). Neuropsychologists try to discover correlates of true, but not false memories (e.g., Nessler & Mecklinger, 2003; Okado & Stark, 2005; Schacter & Slotnick, 2004; Slotnick & Schacter, 2004;). Thus, true and false memories could one day be reliably distinguished on the basis of neurophysiological activity.

Even though a few years ago, researchers have warned that the DRM paradigm is of little relevance to the false-memory debate (Freyd & Gleaves, 1996), by now there is some evidence that there may indeed be a connection. Some studies compared the rates of false memories elicited in the DRM paradigm in control participants and in various clinical groups. Women with PTSD after childhood sexual abuse (Bremner, Shobe, & Kihlstrom, 2000) and women reporting recovered memories of childhood sexual abuse (Clancy, Schacter, McNally, & Pitman, 2000) showed increased rates of false memories. Most importantly, Geraerts, Smeets, Jelicic, van Heerden, and Merckelbach (2005) were able to show that the finding obtained by Clancy et al. (2000) even held when trauma-related DRM lists were used, that is, emotionally distinctive material (e.g., "rape, police, beating, child, violence" for the critical word "assault"). These findings suggest that this population might be especially vulnerable to memory distortions, possibly due to a source-monitoring deficit. Indeed, women reporting recovered memories are also more vulnerable to forgetting prior remembering ("forgot it all along" phenomenon, Geraerts et al., 2006).

A few years ago, the "memory wars" split psychology into therapists believing their clients' reports (we are quite certain that this is, on the one hand, what therapists should do) and researchers enquiring skeptically the validity of such reports (we are positive that this is, on the other hand, what one should ask of researchers). In the popular-press book "The myth of repressed memory", Loftus wrote: "Something has gone wrong with therapy, and because that something has to do with memory, I find myself at the center of an increasingly bitter and fractious controversy. On the one side are the 'True Believers' who insist that the mind is capable of repressing memories… On the other side are the 'Skeptics'…" (Loftus & Ketcham, 1994, p. 31). Those whom she calls, not too flattering, the 'True Believers', were so outraged about the decisiveness with which she questioned the existence of recovered

memories that they sent her incredibly fierce letters: “Please consider your work to be on the same level as those who deny the existence of the extermination camps during World War II” (Loftus & Ketcham, 1994, p. 36). It seems that by now, some of the steam has cooled down, and the not-very-original answer probably lies in the middle: Memory theories predict, and findings prove, that memories, even if held confidently, may be false. Memory theories have also predicted since the 1970s, and older as well as newer findings show, that things that once appeared forgotten can possibly be recovered under other circumstances. As William James put it, “Memory is then the feeling of belief in a peculiar complex object… the re-recollected past and the imaginary past may be much the same… there is nothing unique in the object of memory…” (James, 1890/1950, p. 652).

References

Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin, 93*, 203-231.

Anaki, D., Faran, Y., Ben-Shalom, D., & Henik, A. (2005). The false memory and the mirror effects: The role of familiarity and backward association in creating false recollections. *Journal of Memory and Language, 52*, 87-102.

Anderson, M. C., & Green, C. (2001). Suppressing unwanted memories by executive control. *Nature, 410*, 366-369.

Anderson, R. E. (1984). Did I do it or did I only imagine doing it? *Journal of Experimental Psychology: General, 113*, 594-613.

Baddeley, A. D. (1982). Domains of recollection. *Psychological Review, 89*, 708-729.

Bahrick, H. P., Hall, L. K., & Berger, S. A. (1996). Accuracy and distortion in memory for high school grades. *Psychological Science, 7*, 265-271.

Banaji, M. R., & Kihlstrom, J. F. (1996). The ordinary nature of alien abduction memories. *Psychological Inquiry, 7*, 132-135.

Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge: Cambridge University Press.

Bass, E., & Davis, L. (1992). *Trotz allem. Wege zur Selbstheilung für sexuell mißbrauchte Frauen (The courage to heal. A guide for women survivors of child sexual abuse)*. Berlin: Orlanda Frauenverlag.

Bäuml, K. H. (in press). Making memories unavailable: The inhibitory power of retrieval. *Zeitschrift für Psychologie*.

Bjork, E. L., Bjork, R. A., & Anderson, M. C. (1998). Varieties of goal-directed forgetting. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 103-137). Mahwah, NJ, USA: Lawrence Erlbaum Associates, Inc.

Bower, G. H. (1992). How might emotions affect learning? In S.-A. Christianson (Ed.), *The handbook of emotion and memory: Research and theory* (pp. 3-31). Hillsdale, NJ, USA: Lawrence Erlbaum Associates, Inc.

Brainerd, C. J., & Reyna, V. F. (2002). Fuzzy-trace theory and false memory. *Current Directions in Psychological Science, 11*, 164-169.

Brainerd, C. J., & Reyna, V. F. (2004). Fuzzy-trace theory and memory development. *Developmental Review, 24*, 397-439.

Bransford, J. D., Franks, J. J., Morris, C. D., & Stein, B. S. (1979). Some general constraints on learning and memory research. In L. S. Cermac & F. I. M. Craik (Eds.), *Levels of processing in human memory* (pp. 331-354). Hillsdale, NJ, USA: Lawrence Erlbaum Associates, Inc.

Bremner, J., Shobe, K. K., & Kihlstrom, J. F. (2000). False memories in women with self-reported childhood sexual abuse: An empirical study. *Psychological Science, 11*, 333-337.

Burns, D. J. (1993). Item gains and losses during hypermnesic recall: Implications for the item-specific–relational information distinction. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19*, 163-173.

Cabeza, R., & Lennartson, E. R. (2005). False memory across languages: Implicit associative response vs fuzzy trace view. *Memory, 13*, 1-5.

Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin, 113*, 403-439.

Clancy, S. A., Schacter, D. L., McNally, R. J., & Pitman, R. K. (2000). False recognition in women reporting recovered memories of sexual abuse. *Psychological Science, 11*, 26-31.

Coane, J. H., McBride, D. M., Raulerson, B. A. III, & Jordan, J. S. (2006). False memory in a short-term memory task. *Experimental Psychology, 54*, 62-70.

Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology, 58*, 17-22.

Dodd, M. D., & MacLeod, C. M. (2004). False recognition without intentional learning. *Psychonomic Bulletin & Review, 11*, 137-142.

Dunning, D., & Sherman, D. A. (1997). Stereotypes and tacit inference. *Journal of Personality and Social Psychology, 73*, 459-471.

Fisher, R. P., & McCauley, M. R. (1995). Improving eyewitness testimony with the cognitive interview. In J. R. Graham & M. S. Zaragoza (Eds.), *Memory and testimony in the child witness* (pp. 141-159). Thousand Oaks, CA, US: Sage.

Freyd, J. J., & Gleaves, D. H. (1996). "Remembering" words not presented in lists: Relevance to the current recovered/false memory controversy. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22*, 811-813.

Gallo, D. A. (2006). *Associative illusions of memory. False memory research in DRM and related tasks*. New York, NY, USA: Psychology Press.

Gallo, D. A., Bell, D. M., Beier, J. S., & Schacter, D. L. (2006). Two types of recollection-based monitoring in younger and older adults: Recall-to-reject and the distinctiveness heuristic. *Memory, 2006*, 14, 730-741.

Garry, M., & Gerrie, M. P. (2005). When photographs create false memories. *Current Directions in Psychological Science, 14*, 321-325.

Garry, M., Manning, C. G., Loftus, E. F., & Sherman, S. J. (1996). Imagination inflation: Imagining a childhood event inflates confidence that it occurred. *Psychonomic Bulletin and Review, 3*, 208-214.

Geraerts, E., Arnold, M. M., Lindsay, D. S., Merckelbach, H., Jelicic, M., & Hauer, B. (2006). Forgetting of prior remembering in persons reporting revocered memories of childhood sexual abuse. *Psychological Science, 17*, 1002-1008.

Geraerts, E., Smeets, E., Jelicic, M., van Heerden, J., & Merckelbach, H. (2005). Fantasy proneness, but not self-reported trauma is related to DRM performance of women reporting recovered memories of childhood sexual abuse. *Consciousness and Cognition, 14*, 602-612.

Gleaves, D. H., Smith, S. M., Butler, L. D., & Spiegel, D. (2004). False and recovered memories in the laboratory and clinic: A review of experimental and clinical evidence. *Clinical Psychology: Science and Practice, 11*, 3-28.

Goff, L. M., & Roediger, H. L., III. (1998). Imagination inflation for action events: Repeated imaginings lead to illusory recollections. *Memory and Cognition, 26*, 20-33.

Hirt, E. R., Lynn, S., Payne, D. G., Krackow, E., & McCrea, S. M. (1999). Expectancies and memory: Inferring the past from what must have been. In I. Kirsch (Ed.), *How expectancies shape experience* (pp. 93- 124). Washington, DC, USA: American Psychological Association.

Hunt, R. R., & Einstein, G. O. (1981). Relational and item-specific information in memory. *Journal of Verbal Learning and Verbal Behavior, 20*, 497-514.

Hutchison, K. A., & Balota, D. A. (2005). Decoupling semantic and associative information in false memories: Explorations with semantically ambiguous and unambiguous critical lures. *Journal of Memory and Language, 52*, 1-28.

Hyman, I. E., Husband, T. H., & Billings, F. (1995). False memories of childhood experiences. *Applied Cognitive Psychology, 9*, 181-197.

Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory attributions. In H. L. Roediger III & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 391-422). Hillsdale, NJ, USA: Lawrence Erlbaum Associates.

James, W. (1890). *Principles of psychology (Vol. I)*. London: MacMillan.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin, 114*, 3-28.

Johnson, M. K., & Raye, C. L. (2000). Cognitive and brain mechanisms of false memories and beliefs. In D. L. Schacter & E. Scarry (Eds.), *Memory, brain and beliefs* (pp. 35-86). Cambridge, MA, USA: Harvard University Press.

Kemp, S., & Burt, C. D. B. (2006). Memories of uncertain origin: Dreamt or real? *Memory, 14*, 87-93.

Kimball, D. R., & Bjork, R. A. (2002). Influences of intentional and unintentional forgetting on false memories. *Journal of Experimental Psychology: General, 131*, 116-130.

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A constructive-integration model. *Psychological Review, 95*, 163-182.

Klauer, K. C. (2000). Gedächtnis und Emotion (Memory and emotion). In J. H. Otto, H. A. Euler & H. Mandl (Eds.), *Emotionspsychologie. Ein Handbuch*. Weinheim: Beltz.

Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annual Review of Psychology, 51*, 481-537.

Koutstaal, W., Schacter, D. L., Johnson, M. K., & Galluccio, L. (1999). Facilitation and impairment of event memory produced by photograph review. *Memory and Cognition, 27*, 478-493.

Leichtman, M. D., & Ceci, S. J. (1995). The effects of stereotypes and suggestions on preschoolers' reports. *Developmental Psychology, 31*, 568-578.

Lindsay, D. S., Hagen, L., Read, J. D., Wade, K. A., & Garry, M. (2004). True photographs and false memories. *Psychological Science, 15*, 149-154.

Loftus, E. F. (1993). The reality of repressed memories. *American Psychologist, 48*, 518-537.

Loftus, E. F. (2003). Make-believe memories. *American Psychologist, 58*, 867-873.

Loftus, E. F. (2005a). Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. *Learning & Memory, 12*, 361-366.

Loftus, E. F. (2005b). Distortions of memory and the role of time. In A.-N. Perret-Clermont (Ed.), *Thinking time: a multidisciplinary perspective on time* (pp. 39-44). Bern: Hogrefe & Huber Publishers.

Loftus, E. F., Feldman, J., & Dashiell, R. (1995). The reality of illusory memories. In D. L. Schacter (Ed.), *Memory distortion: How minds, brains and societies reconstruct the past* (pp. 47-68). Cambridge, MA, USA: Harvard University Press.

Loftus, E. F., Garry, M., & Feldman, J. (1994). Forgetting sexual trauma: What does it mean when 38% forget? *Journal of Consulting and Clinical Psychology, 62*, 1177-1181.

Loftus, E. F., & Ketcham, K. (1994). *The myth of repressed memory*. New York: St. Martin's Press.

Lyle, K. B., & Johnson, M. K. (2006). Importing perceived features into false memories. *Memory, 14*, 197-213.

MacLeod, C. (1998). Directed forgetting. In J. M. Golding & C. M. MacLeod (Eds.), *Intentional forgetting: Interdisciplinary approaches* (pp. 1-57). Mahwah, NJ, USA: Lawrence Erlbaum Associates, Inc.

MacLeod, C. M., Dodd, M. D., Sheard, E. D., Wilson, D. E., & Bibi, U. (2003). In opposition to inhibition. In B. H. Ross (Ed.), *The Psychology of Learning and Motivation* (Vol. 43, pp. 163-214). San Diego, CA, USA: Academic Press.

Mazzoni, G. A. L., Loftus, E. F., & Kirsch, I. (2001). Changing beliefs about implausible autobiographical events: A little plausibiliy goes a long way. *Journal of Experimental Psychology: Applied, 7*, 51-59.

Mazzoni, G. A. L., & Memon, A. (2003). Imagination can create false autobiographical memories. *Psychological Science, 14*, 186-188.

McBride**,** D. M., Coane, J. H., & Raulerson, B. A., III. (2006). An investigation of false memory in perceptual implicit tasks. *Acta Psychologica, 123*, 240-260.

McCloskey, M., & Zaragoza, M. (1985). Misleading postevent information and memory for events: Arguments and evidence against memory impairment hypotheses. *Journal of*

Experimental Psychology: General, 114, 1-16.
McDermott, K. B., & Watson, J. M. (2001). The rise and fall of false recall: The impact of presentation duration. *Journal of Memory and Language, 45*, 160-176.
McNally, R. J. (2005). Debunking myths about trauma and memory. *Canadian Journal Psychiatry, 59*, 817-822.
McNally, R. J., Lasko, N. B., Clancy, S. A., Macklin, M. L., Pitman, R. K., & Orr, S. P. (2004). Psychophysiological responding during script-driven imagery in people reporting abduction by space aliens. *Psychological Science, 15*, 493-497.
Memon, A., Holliday, R., & Hill, C. (2006). Pre-event stereotypes and misinformation effects in children. *Memory, 14*, 104-114.
Meyer Williams, L. (1994). Recall of childhood trauma: A prospective study of women's memories of child sexual abuse. *Journal of Consulting and Clinical Psychology, 62*, 1167-1176.
Nessler, D., & Mecklinger, A. (2003). ERP correlates of true and false recognition after different retention delays: Stimulus and response related processes. *Psychophysiology, 40*, 146-159.
Odegard, T. N., & Lampinen, J. M. (2006). Memory editing: Knowledge, criteria, and alignment. *Memory, 14*, 777-787.
Okado, Y., & Stark, C. E. L. (2005). Neural activity during encoding predicts false memories created by misinformation. *Learning & Memory, 12*, 3-11.
Ost, J. (2003). Seeking the middle ground in the 'memory wars'. *British Journal of Psychology, 94*, 125-139.
Ost, J., Foster, S., Costall, A., & Bull, R. (2005). False reports of childhood events in appropriate interviews. *Memory, 13*, 700-710.
Payne, J. D., Nadel, L., Allen, J. J. B., Thomas, K. G. F., & Jacobs, W. J. (2002). The effects of experimentally induced stress on false recognition. *Memory, 10*, 1-6.
Pezdek, K., & Hodge, D. (1999). Planting false childhood memories in children: The role of event plausibility. *Child Development, 70*, 887-895.
Piaget, J. (1962). Plays, dreams and imitation in childhood. (C. Cattegno & F. M. Hodgsen, Trans.). New York: Norton. (Original work published in 1945).
Pipe, M.-E., Lamb, M. E., Orbach, Y., & Esplin, P. W. (2004). Recent research on children's testimony about experienced and witnessed events. *Developmental Review, 24*, 440-468.
Pope, K. S. (1996). Memory, abuse, and science: Questioning claims about the False Memory Syndrome epidemic. *American Psychologist, 51*, 957-974.
Roediger, H. L., III. (1996). Memory illusions. *Journal of Memory and Language, 35*, 76-100.
Roediger, H. L., III, & Gallo, D. A. (2003). Processes affecting accuracy and distortion in memory: An overview. In M. L. Eisen (Ed.), *Memory and suggestibility in the forensic interview* (pp. 3-28). Mahwah, NJ, USA: Lawrence Erlbaum Associates, Inc.
Roediger, H. L., III, & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 803-814.
Roediger, H. L., III, Watson, J. M., McDermott, K. B., & Gallo, D. A. (2001). Factors that determine false recall: A multiple regression analysis. *Psychonomic Bulletin and Review, 8*, 385-407.
Schacter, D. L. (1999). The seven sins of memory. *American Psychologist, 54*, 182-203.
Schacter, D. L., Norman, K. A., & Koutstaal, W. (1998). *The cognitive neuroscience of constructive memory*. *Annual Review of Psychology, 49*, 289-318.
Schacter, D. L., & Slotnick, S. D. (2004). The cognitive neuroscience of memory distortion. *Neuron, 44*, 149-160.

Seamon, J. G., Berko, J. R., Sahlin, B., Yu, Y.-L., Colker, J. M., & Gottfried, D. H. (2006). Can false memories spontaneously recover? *Memory, 14*, 415-423.

Seamon, J. G., Luo, C. R., Shulman, E. P., Toner, S. K., & Caglar, S. (2002). False memories are hard to inhibit: Differential effects of directed forgetting on accurate and false recall in the DRM procedure. *Memory, 10*, 225-237.

Sheard, E. D., & MacLeod, C. M. (2005). List method directed forgetting: Return of the selective rehearsal account. In N. Ohta, C. M. MacLeod, & B. Uttl (Eds.), *Dynamic cognitive processes* (pp. 219-248). Tokyo: Springer-Verlag.

Slotnick, S. D., & Schacter, D. L. (2004). A sensory signature that distinguishes true from false memories. *Nature Neuroscience, 7*, 664-672.

Smeets, T., Merckelbach, H., Horselenberg, R., & Jelicic, M. (2005). Trying to recollect past events: Confidence, beliefs, and memories. *Clinical Psychology Review, 25*, 917-934.

Spanos, N. P. (1996). *Multiple identities and false memories*. Washington, DC: American Psychological Association.

Spanos, N. P., Menary, E., Gabora, N. J., DuBreuil, S. C., & Dewhirst, B. (1991). Secondary identity enactments during hypnotic past-life regression: A sociocognitive perspective. *Journal of Personality and Social Psychology, 61*, 308-320.

Strange, D., Garry, M., & Sutherland, R. (2003). Drawing out children's false memories. *Applied Cognitive Psychology, 17*, 607-619.

Strange, D., Sutherland, R., & Garry, M. (2006). Event plausibility does not determine children's false memories. *Memory, 14*, 937-951.

Thomas, A. K., Bulevich, J. B., & Loftus, E. F. (2003). Exploring the role of repetition and sensory elaboration in the imagination inflation effect. *Memory and Cognition, 31*, 630-640.

Toglia, M. P., Neuschatz, J. S., & Goodwin, K. (1999). Recall accuracy and illusory memories: When more is less. *Memory, 7*, 233-256.

Tulving, E. (1983). *Elements of episodic memory*. Oxford, England: Oxford University Press.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychologist, 26*, 1-12.

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80*, 352-373.

Wade, K. A., Garry, M., Read, D. J., & Lindsay, D. S. (2002). A picture is worth a thousand lies: Using false photographs to create false childhood memories. *Psychonomic Bulletin & Review, 9*, 597-603.

Wagenaar, W. A., & Groeneweg, J. (1990). The memory of concentration camp survivors. *Applied Cognitive Psychology, 4*, 77-87.

Watson, J. M., McDermott, K. B., & Balota, D. A. (2004). Attempting to avoid false memories in the Deese/Roediger-McDermott paradigm: Assessing the combined influence of practice and warnings in young and old adults. *Memory & Cognition, 32*, 135-141.

Westerberg, C. E., & Marsolek, C. J. (2006). Do instructional warnings reduce false recognition? *Applied Cognitive Psychology, 20*, 97-114.

White, T. L., Leichtman, M. D., & Ceci, S. J. (1997). The good, the bad, and the ugly: Accuracy, inaccuracy, and elaboration in preschoolers' reports about a past event. *Applied Cognitive Psychology, 11*, 37-54.

Whittlesea, B. W. A., & Williams, L. D. (2000). The source of feelings of familiarity: The discrepancy-attribution hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 547-565.

Whittlesea, B. W. A., Masson, M. E. J., & Hughes, A. D. (2005). False memory following rapidly presented lists: the elements of surprise. *Psychological Research, 69*, 420-430.

Zaragoza, M. S., & Mitchell, K. J. (1996). Repeated exposure to suggestion and the creation of false memories. *Psychological Science, 7*, 294-300.

Table 1: German List of Words used in Memory Experiments (Upper Part) and their Englisch Translations (Lower Part)

Ohren, Ostern, Möhre, hoppeln, Igel, Kaninchen, Fuchs, Braten, Feld, Jäger, Bau, Käfig, Wald, Stall, fahren, Straße, Reifen, Lenkrad, Bus, Führerschein, Benzin, Porsche, Motor, Unfall, Abgas, Hupe, Ampel, Tanken, essen, Butter, Käse, Bäcker, Messer, Mehl, Frühstück, Marmelade, Nutella, Körner, Scheibe, Wurst, Roggen, Korb, reiten, Sattel, Galopp, Zügel, wiehern, Hengst, Fohlen, Weide, Koppel, Nüstern, Kutsche, Cowboy, Stiefel, Pony, Sonne, Freibad, Eis, Frühling, Ferien, Winter, Sonnencreme, Strand, Sandalen, warm, schwitzen, Urlaub, hell, Palmen, nähen, Faden, pieksen, spitz, Knopf, stechen, stricken, Garn, Heuhaufen, Spritze, Öhr, stopfen, Loch, Blut, Wachs, Leuchter, Flamme, Weihnachten, Biene, Kirche, anzünden, Streichhölzer, Docht, Advent, brennen, Schein, romantisch, gemütlich, Nagel, Säge, Daumen, Zange, Lärm, Werkzeug, Holz, Wand, Arbeit, schlagen, Handwerker, klopfen, Bild, verletzen
Ears, easter, carrot, hop, hedgehog, rabbit, fox, roast, field, hunter, den, cage, woods, barn, drive, street, tire, steering wheel, bus, driver's licence, petrol, Porsche, motor, accident, exhaust, horn, traffic light, refuel, eat, butter, cheese, baker, knife, flour, breakfast, jam, chocolate spread, wheats, slice, cold cuts, rye, basket, riding, saddle, galop, reins, neigh, stallion, foal, willow, paddock, nostrils, carriage, cowboy, boots, pony, sun, outdoor pool, ice cream, spring, holiday, winter, sun screen, beach, sandals, warm, sweat, vacation, light, palm trees, sew, thread, prick, peaked, button, twinge, knitting, yarn, hey stack, syringe, eye, darn, hole, blood, wax, flambeaux, flame, christmas, bee, church, light, matches, wick, Advent, burn, shine, romantic, cosy,nail, saw, thumb, pliers, noise, tool, wood, wall, work, hit, craftsman, bang, picture, hurt

Table 2. Some More German Words used in Memory Experiments (Upper Part) and their English Translations (Lower Part).

Bett, Hemd, Hammer, Fenster, Pferd, Kerze, Nadel, Vogel, Sommer, Telefon, Brot, Auto, Hase, Löwe, Fuß
bed, shirt, hammer, window, horse, candle, needle, bird, summer, telephone, bread, car, bunny, lion, foot

Figure Caption

Figure 1. Findings of the Sam-Stone Experiment (summarised using the data provided by Leichtman & Ceci, 1995): Percentage of Children Asserting that at Least One of the Events Occurred.

Figure 2. Typical Pattern of Correct Recognition (list words) and False Recognition (critical words) in an Experiment in the DRM Paradigm (error bars show standard errors of means). Lists Presented were Counterbalanced.

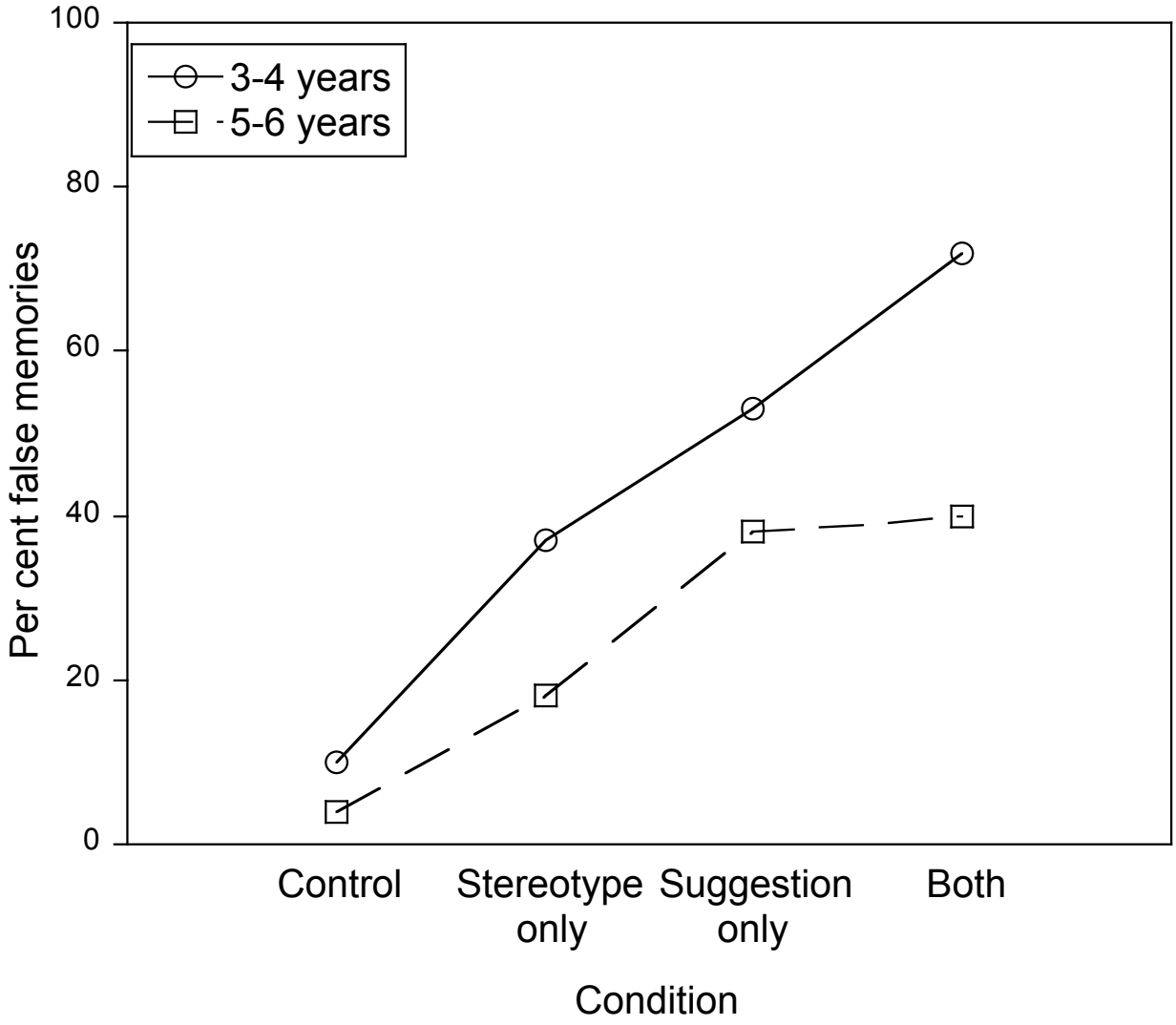
100
80
60
40
20
0
3-4 years
5-6 years
Per cent false memories
Control
Stereotype only
Suggestion only
Both
Condition

Figure 1

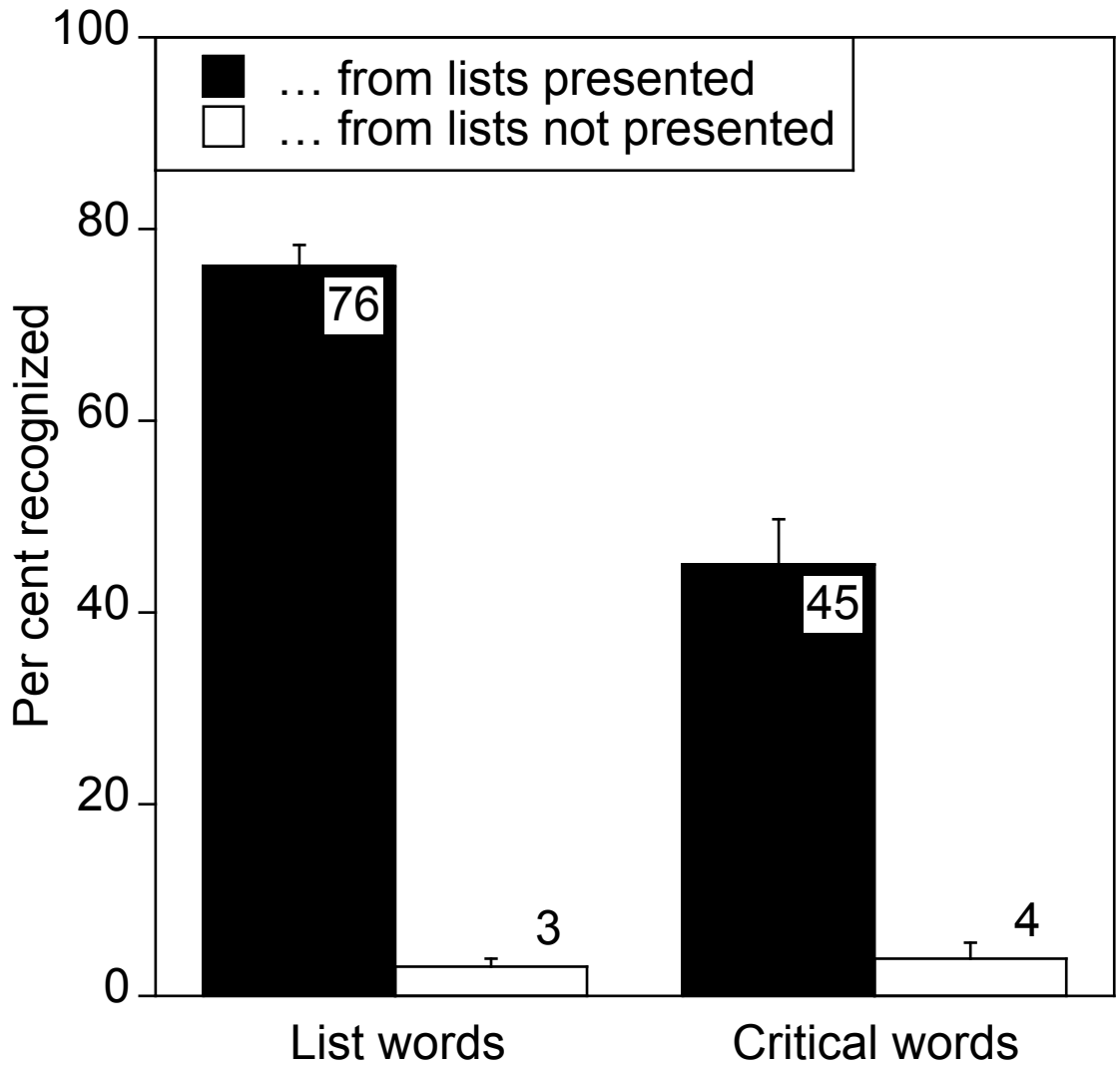
100
80
60
40
20
0
Per cent recognized
… from lists presented
… from lists not presented
76
3
45
4
List words
Critical words

Figure 2