Methods of Studying False Memory

Henry Otgaar[1,2], Sanne T.L. Houben[1], and Mark L. Howe[1,2]

[1]Maastricht University

[2]City, University of London

IN PRESS:

In H. Otani & B. L. Schwartz (Eds.), *Research methods in human memory.* New York: Routledge.

Methods of Studying False Memory

The study of memory is one of those domains in psychology which has clear practical relevance. Think, for example, about people with Alzheimer's disease. Devastating dysfunction experienced by these patients makes it abundantly evident that our memory constitutes an overarching and critical role in our daily life. However, in the study of memory, there is another memory phenomenon that also carries with it enormous theoretical and practical implications, namely, memory illusions. That is, people frequently claim that they remember details or even an entire event that never actually happened. These false memories can have serious consequences when they appear in the testimony of witness, victims, or suspects in legal cases (Howe & Knott, 2015; Otgaar, De Ruiter, Howe, Hoetmer, & van Reekum, in press). A person, for example, might falsely remember that he/she was sexually abused when he/she was a child, and this memory illusion might lead to false accusations that may result in wrongful convictions.

Because of the legal implications that such false memories might have, a plethora of studies have been devoted to investigating the creation and factors underlying the persistence of false memories. Across these studies, there exists a wide variety of methods that have been used to experimentally induce false memories in the laboratory, ranging from methods with strict experimental control to methods that mimic situations occurring in clinical and legal practices. In the current chapter, we provide a synopsis of different false memory procedures that memory researchers have used to study the phenomenon of false memories. We will also show that although some of these procedures were designed to promote the formation of false *memory*, recent insights have taught us that at least for some of them, what is created is false *belief*[1] rather than false memory. Before elaborating on these diverse false memory

[1] Belief has been defined as the attribution that an experience truly occurred to the self in the past (e.g., Otgaar, Scoboria, & Mazzoni, 2014)

procedures, we first describe the impetus that started experimental work into the phenomenon of memory illusions.

False Memory in the Courtroom

In the 1990s, a heated debate took place concerning the validity of repressed and recovered memories of childhood sexual abuse (Lindsay & Read, 1994; Loftus, 1993). These traumatic memories were oftentimes recovered in psychotherapy. At that time, mental health professionals asserted that these memories were repressed at the time of the trauma (i.e., patients had no access to these memories) and were only discovered during therapeutic sessions where the patient felt "safe" and therefore, could recover these painful experiences. On the other side, memory researchers argued that many of the techniques used in psychotherapy were inherently suggestive, and that it was the use of these techniques that may have caused patients to falsely remember episodes of sexual abuse. This discussion has led to the so-called "Memory Wars" which was one of the fiercest debates ever in psychological science (Loftus & Davis, 2006). Besides the controversial claim that memory repression actually exists, this debate became even more vicious because of the increasing number of legal cases in which it was shown that people were wrongly convicted on the basis of false memories that were elicited during suggestive therapy. Many accusers later retracted their claims because they realized that their testimony was the result of the enduring suggestive power of therapeutic techniques, such as dream interpretation and recovered memory therapy (Maran, 2010). Because of the possible involvement of false memories in these legal cases, memory researchers displayed increased scientific interest in methods to induce false memories.

The majority of these recovered memory cases was based on *adults* claiming that they had been abused during childhood (see Howe, 2013). However, earlier in the 1980s, an outburst of legal cases across North America and Europe were filed with *children* as the

victims. The recurring theme in these so-called daycare abuse cases was that a large group of children reported having been traumatized by the same person(s) at an elementary school or daycare center (Garven, Wood, Malpass, & Shaw, 1998; Otgaar et al., in press). In many of these cases, children were interviewed by social workers, police, and parents in suggestive ways, which might have adversely affected their statements by creating false memories. Like the examples mentioned with the cases involving adults, here too, memory scholars became interested in studying the development of children's false memories. To this end, during the past decades, several procedures have been constructed to study how false memories are formed in an experimentally controlled manner.

The Elicitation of False Memory

Myriad methods have been designed in the past years to examine the formation of false memories. All paradigms differ in a number of ways such that some use simple word lists as stimuli whereas others employ more complex realistic stimuli such as videos or staged events. Furthermore, some of these methods tap into basic forms of memories such as semantic memories, whereas others are focused more on ecologically valid procedures to foster autobiographical false memories. Besides these differences, there are several points of similarity among the diverse set of false memory methods (see Table 1). Although perhaps there are other categorizations of similarity, our idea was to classify different false memory methods based on how these false memories could be formed in real life (e.g., in a police interviewing setting). For example, it has been shown that in a number of legal cases, suggestive pressure during an interview resulted in false memories. Based on these cases, false memory methods have been constructed that use some form of suggestion. We begin by describing methods used to study these suggestion-induced false memories and then turn to a description of spontaneous false memories.

Suggestion-induced False Memories

Misinformation Method

One of the most popular and well-studied methods to evoke false memories is the misinformation method (Loftus, 2005). The misinformation method follows a three-phase procedure. In the first phase, participants are presented with stimuli such as pictures or a video about, for example, a theft. An alternative to such passive viewing is that participants are involved in a staged event, such as a thief stealing a laptop during a class presentation (Otgaar, Candel, Smeets, & Merckelbach, 2010). Following this, participants are presented with misinformation in the form of narrative or suggestive questions. During this misinformation phase, participants are exposed to misleading information (e.g., asking what weapon the culprit was carrying during the theft even though there was no weapon present). In the final stage, participants receive a memory test in which they are asked what they can remember about the presented stimuli. The important finding here is that a significant minority of participants fall prey to the misinformation and incorporate it in their memory reports. This result is known as the *misinformation effect*.

One of the pioneering studies using this false memory method was performed by Loftus, Miller, and Burns (1978). In their study, participants were presented with a series of slides depicting a car-pedestrian accident. About half of the participants received a slide in which a red Datsun stopped at a stop sign while the other participants saw a slide in which the car stopped at a yield sign (Experiment 1). After this, participants received a questionnaire in which half of the participants were asked the question: “Did another car pass the red Datsun while it was stopped at the stop sign?” For the other half of the participants, the word “stop sign” was replaced with “yield sign.” In this way, half of the participants received information that was actually seen whereas others received misinformation. Following this, participants engaged in a forced-choice visual recognition test in which they received pairs of slides and

were asked to indicate which slide they saw during the original encoding phase. The critical finding was that more than half of the participants incorrectly remembered the wrong slide thereby demonstrating a misinformation effect.

After this study, a multitude of studies have been devoted to replicating this effect. Furthermore, these studies have examined the circumstances under which this effect can be enhanced or reduced. One vital question pertaining to this effect is whether the time interval between the presentation of misinformation and the final memory test would affect the misinformation effect. The standard finding here is that when the interval increases, so too does the size of the misinformation effect (Higham, 1998). Another important issue is whether the misinformation effect can be reduced when warnings are provided after the exposure to misinformation. A recent meta-analysis showed that although the misinformation effect is unlikely to be completely abolished, providing warnings is effective in reducing the extent of the misinformation effect (Blank & Launay, 2014). Specifically, based on this meta-analysis, it can be concluded that on average warnings can reduce the misinformation effect to less than half of its size.

An especially practically relevant question is whether the misinformation effect exists in populations other than adults, such as children. Research that has implemented the misinformation method with children has tended to focus on children's susceptibility to suggestive questioning when the suggestion is repeated or when a person of authority delivers the suggestion. Also, in many of the misinformation studies using children, children are involved in (staged) events after which they receive suggestive information. For example, in one study, 5-year-old children received a vaccination from a paediatrician (Bruck, Ceci, Francoeur, & Barr, 1995). Children were repeatedly interviewed about this event one year later. One group of children who were interviewed in a neutral, non-suggestive manner provided accurate reports of the visit. However, the group of children who were interviewed

suggestively using misinformation often falsely recollected certain details (e.g., a female researcher inoculated them instead of the male paediatrician).

The effect of suggestion on children's memory can also be subtler. In a study conducted by Poole and Lindsay (1995), 3- to 4-year-olds and 5- to 7-year-olds interacted individually with Mr. Science; an adult who demonstrated certain "science facts" to children. After a three month interval, parents suggested to some of the children details that did not take place during the Mr. Science event (e.g., "Mr. Science putting something yucky in their mouth"). The authors found that many children incorrectly remembered details that were suggested by their parents even though these details were not a part of the original event.

Even more relevant for legal purposes is the finding that misinformation effects can be stronger in younger children than in older children and adults. For example, Otgaar and colleagues (2010) instructed 4-year old and 9-year old children to remove three pieces of clothing from a puppet. Half of the children were provided with fake information suggesting that they removed four pieces of clothing. In three interviews separated by 1-week intervals, children were asked to indicate which pieces of clothing they took off from the puppet. False memory effects were higher in younger than older children. Sutherland and Hayne (2001) compared children's misinformation effects with those of adults' and found that children were more susceptible to forming false memories based on misinformation than adults. In sum, these studies show that there is an age-related decrease in the susceptibility to misinformation effects (but see Otgaar, Howe, Brackmann, & Smeets, 2016 for a reversal of this developmental pattern).

Implantation Method

An extension of the misinformation method is the false memory implantation method in which entire fictitious events are inserted into memory (Frenda, Nichols, & Loftus, 2011; Otgaar & Candel, 2011). This method has high practical relevance because it focuses on the

creation of implanted false memories that have oftentimes figured prominently in child sexual abuse cases. The basic procedure of this method goes as follows. First, researchers contact the parents (or relatives) of a potential participant and ask whether their child has ever experienced a certain event (e.g., lost in a shopping mall). If not, researchers will interview the participant and ask him/her about experienced events as well as the fabricated event. Specifically, researchers suggest to the participant that he/she has experienced these events during childhood because their parents had already informed the researchers about these events. During multiple interviews, the participant attempts to recall everything he/she can remember about these events. The chief finding here is that about 30% of participants are vulnerable to these suggestions and falsely remember that the nonexperienced event happened to them in their childhood (Scoboria, Wade, Lindsay, Azad, Strange, Ost, & Hyman, 2017).

Loftus and Pickrell (1995) were the first to show the tainting impact of personalized suggestions on memory. In their study, adult participants were suggestively interviewed that they were lost in a shopping mall when they were five years old. Participants were asked about this false event during two suggestive interviews. A quarter of participants (n = 6) created implanted false memories for the suggested event and even provided additional event-related details. Hyman, Husband, and Billings (1995) were also one of the first to examine the creation of implanted false memories. They suggested a positive (clown at a birthday party) or a negative event (overnight hospitalization for fever and ear infection) to participants and found that at the second interview, 20% (n = 4) of participants falsely remembered the suggested event.

The false memory implantation method has a number of different variants that have been used to foster implanted false memories. For example, Wade, Garry, Read, and Lindsay (2002) provided adult participants with fake photographs depicting them being on a hot air balloon ride and suggested to the participants that they were on a hot air balloon ride during

their childhood. False memory implantation studies have also been conducted using children as participants. For example, Ceci, Huffman, Smith, and Loftus (1994) provided preschool children (3- to 6-year-olds) fictitious events suggesting that their hands had been stuck in a mousetrap or that they experienced a hot air balloon ride. Children were asked to try to recollect the events on numerous occasions. About a third of the children were confident that the fabricated stories truly happened to them. Similar results were obtained when a suggestion was made that children had fallen off a tricycle and had to receive stitches in their leg (Ceci, Loftus, Leichtmann, & Bruck, 1994). These results demonstrate that children are highly susceptible to the formation of implanted false memories, and that they can falsely assent to both negative (e.g., mousetrap) and positive (e.g., hot air balloon ride) events (Ceci, Huffman, et al., 1994; Ceci, Loftus, et al., 1994).

After these initial studies, researchers have focused on the factors that are responsible for these implanted false memories in children and adults. One factor that attracted considerable empirical attention was the effect of event plausibility. One of the first studies that examined the effect of plausibility on the formation of implanted false memories in adults was conducted by Pezdek, Finger, and Hodge (1997). In two experiments, they manipulated the degree of plausibility and investigated its influence on whether participants succumbed to suggestive pressure. Specifically, in Experiment 1, Jewish and Catholic students were presented with three true and two false descriptions of (non)-experienced events. The false events referred to religious rituals; one specific to the Jewish community (Shabbot) and the other specific to the Catholic community (Communion). It was found that Jewish students were more likely to falsely remember the ritual that was considered plausible for them (Shabbot) whereas the reverse was true for the Catholic students.

In Pezdek et al's (1997) second experiment, adult participants listened to two false stories with one story representing a plausible event (i.e., lost in a shopping mall) and the

other representing an implausible event (i.e., receiving a rectal enema). Like the first experiment, the plausible event gave rise to statistically more false memories compared to the implausible event. Pezdek and Hodge (1999) replicated the second experiment with 5- to 7-year-old and 9- to 12-year-old children. The pattern of findings was nearly identical. The authors again found that plausible events were more easily implanted in children's memory than implausible events.

However, more recent studies have not replicated this effect of plausibility on children's false memory formation. In one study, younger (7/8-year-olds) and older (11/12-year-olds) children were told that when they were four years old, they were abducted by a UFO or almost choked on a candy (Otgaar, Candel, Merckelbach, & Wade, 2009). Importantly, half of the children received false newspaper articles alleging that UFO abduction or choking incidents were quite frequent at the place where they lived when they were four years old. During two interviews, we assessed children's vulnerability to producing false memories for these events. Interestingly, we found that at the second interview, children were more likely to falsely recall that they were abducted by a flying saucer when they received the fake newspaper article relative to children who did not receive the article. Furthermore, we also showed that children were equally likely to form false memories for the plausible (choked on a candy) and implausible (abducted by a UFO) events. The core message of these studies is that although plausible events are quite likely to be misremembered, even implausible events can be falsely implanted in memory. Furthermore, these experiments reveal that under certain conditions, plausibility does not fuel false memory tendencies and that both children and adults are equally likely to produce plausible and implausible false memories (see also Strange, Sutherland, & Garry, 2006, for similar findings).

Findings have also revealed that negative false events are more likely to engender false memories than neutral false events. In one of our false memory implantation studies, 7-year-old children were presented with false narratives that they copied their neighbour's homework or had to move to another classroom (Otgaar, Candel, & Merkelbach, 2008). At both interviews, our results indicated that children were more likely to falsely recall the negative than the neutral event. Subsequently, studies using suggestion-based false memory paradigms or other paradigms have shown similar findings in children as well in adults (e.g., Howe, Candel, Otgaar, Malone, & Wimmer, 2010; Porter, ten Brinke, Riley, & Baker, 2014).

Finally, script knowledge about a false event plays a vital role in the production of implanted false memories. We presented younger (7-year-olds) and older (11-year-olds) children with false narratives describing either a high-knowledge event (i.e., finger being caught in a mousetrap) or low-knowledge event (i.e., receiving a rectal enema) that ostensibly happened when they were four years old (Otgaar, Candel, Scoboria, & Merckelbach, 2010). During two interviews, they were suggestively questioned about what they could recall about the events. We showed that at both interviews, more false memories were implanted for the high-knowledge event than for the low-knowledge event. Our results also demonstrated that younger children were more likely to adopt the suggestion than older children, a finding that aligns well with developmental false memory research (Ceci & Bruck, 1993).

However, although our results indicated that script knowledge might facilitate false memory production, these results merely illuminated the role of *existing* knowledge on false memory creation. In many legal cases, children receive *additional* knowledge about false events because interviewers often assume that these events were experienced by these children (Garven, Wood, & Malpass, 2000). For example, interviewers might suggest false information about details concerning sexual abuse, details that might not be clear to children. To investigate this issue empirically, we provided 7- to 9-year-olds with extra information

about a fabricated event and assessed its impact on false memory propensity. Specifically, children were falsely told that they had visited a burn center when they were four years old (Otgaar, Smeets, & Peters, 2012). Two-thirds of the children were shown a video about what normally happens during such an event. This manipulation served to foster knowledge about the event. Half of these children had to view this material every day for a week. Notably, at the second interview which occurred one week later, children who received extra information about the event were more prone to report that they had visited a burn center than the control group who did not receive this additional information.

False Feedback

Memories can exert consequences on our behaviour. For example, victims of abuse often file an official complaint to the police because they have a vivid memory of being mistreated. This touches upon an intriguing question about whether such behavioural consequences might also occur for *false* memories. Recently, memory researchers have become interested in the functional value of false memories. In particular, they have become intrigued by the possibility that false memories might lead to certain positive consequences (e.g., Howe, 2011; Otgaar et al., 2015). An interesting method that uses suggestion to study this is the *false feedback method* (Bernstein & Loftus, 2009). In the first study of this kind, participants were led to believe that as a child they got sick of eating a particular food (Bernstein, Laney, Morris, & Loftus, 2005). In the study, participants completed several questionnaires including a Food History Inventory. After 1 week, they were told that using a computer, the researcher could generate a profile of their childhood experiences with food. Furthermore, some participants were informed that they got sick from eating a certain food (e.g., hard-boiled eggs) even though this event is not true. Following this, participants received the Food History Inventory again. The interesting result was that when participants received false feedback and became convinced that they actually experienced the event, they

reported lower preference for and willingness to eat the particular food. This result has been replicated including situations in which actual eating behaviour was also affected (e.g., Scoboria, Mazzoni, & Jarry, 2008).

Memory Conformity/Social Contagion

In the above-mentioned false memory methods, suggestion was frequently provided by researchers or persons with authority. However, what often happens is that eyewitnesses talk to each other and influence each other's memory by discussing false details. A well-known example of this is the case of the assassination of the Swedish Foreign Minister, Anna Lindh. On 10 September 2003, she was attacked and stabbed to death at a department store in Stockholm. Many people witnessed the attack, and many of them were brought together in a room soon after the attack. As they were sitting in the room, they started to discuss what happened during the attack. Subsequently, they were interviewed by the police, and some of them reported details that they heard from other eyewitnesses. Based on the account provided by these eyewitnesses, the police focused their search on a man wearing a military jacket with a camouflage pattern even though actually the culprit was wearing a grey sweater. This wrong detail was the result of the contaminating influence of eyewitnesses talking to each other. The phenomenon that eyewitnesses are influenced by what other people say is called memory conformity or social contagion of memory (Wright, Memon, Skagerberg, & Gabbert, 2009).

In general, there are three ways to examine memory conformity effects. One method is that pairs of participants are presented with a large number of stimuli (e.g., pictures) and then later their memory for these stimuli is tested. In this method, one participant responds first followed by the other participant. The crucial question here is whether the response of the first participant would influence the response of the second participants. In another method, participants in a group are presented with several stimuli (e.g., pictures of an accident). Then, they engage in a discussion with other participants some of whom may be confederates of the

experimenter. During this discussion, several misleading items are interspersed with actual items. The main finding from these studies is that participants often accept these misleading items that were provided by their fellow participants. In the last method, participants are presented with information that other co-participants have said; for example, they might be told that 90% of the other participants believed the perpetrator was tall.

Gabbert, Memon, and Allan (2003) showed different videos of the same event to pairs of participants but these participants were led to believe that they were watching the same video. Participants were then asked to recall the contents of the video either alone or in dyads. Next, participants were asked to recall again but did so individually. The basic finding was that a significant number of participants who first discussed the video with a co-witness incorporated the details they obtained during that initial discussion in their memory reports (see also Wright, Self, & Justice, 2000). This effect has since been replicated using various manipulations and populations. For example, recent research shows that children are also susceptible to memory conformity effects (e.g., Candel, Memon, & Al-Harazi, 2007; Otgaar, Howe, Brackmann, & van Helvoort, in press).

Although studies on memory conformity suggest that eyewitness discussion might be harmful for accuracy of memory, this is not necessarily the case. In a recent study, it was found that in certain circumstances, such discussions might actually improve accuracy as measured by total amount of correct recall (Vredeveldt, Groen, Ampt, & van Koppen, 2016). That is, when pairs of participants adopted certain retrieval strategies during the discussion, such as repetitions or elaborations, memory performance was not hampered but facilitated.

Crashing Memory

The crux of crashing memory method is to assess whether participants can be manipulated into stating that they saw non-existing footage of a traumatic event, particularly plane and car crashes. The interesting finding here is that this is indeed possible, indicating

that even traumatic events that are well retained can become distorted. For example, Crombag, Wagenaar, and van Koppen (1996) asked a group of participants questions about the El-Al airplane crash that happened in 1992 in Amsterdam. In this air accident, an airplane crashed into an 11-storey apartment building. The participants were asked whether they had seen "the television film of the moment the plane hit the apartment building." (p. 99). Crucially, no television film existed of this crash. The authors found that 55% (n = 107) of the respondents said that they did see this footage (Experiment 1). In their second experiment, they replicated their main result and even found that 66% (n = 61) of their sample confirmed that they saw live footage of the plane crash. Furthermore, some participants erroneously "remembered" certain specific details of the non-existent live footage such as remembering that the plane hit the building horizontally.

Other studies have replicated this finding. For example, Ost, Granhag, Udell, and Roos af Hjelmsäter (2008) found that participants stated having seen non-existant footage of the terrorist attacks in London in 2005. Furthermore, this effect was stronger among participants in UK than in Sweden. In another study, Sjoden, Granhag, Ost, and Roos af Hjelmsäter (2009) showed that participants confirmed having viewed non-existing footage of the attack on the Swedish foreign minister Anna Lindh in 2003. Taken together, the results are in line with the misinformation effect, indicating that post-event misleading information can distort people's memory. However, the unique feature of this method is that this can occur for the entire traumatic incident.

Rumor Mongering

Remembering is frequently regarded as social in nature. That is, by remembering, people engage in conversations with each other and this might facilitate social relationships. In legal cases, when such conversations contain incorrect details, false memories might be created as demonstrated by the memory conformity paradigm. Another source of socially

created false memories is rumors which might be spread particularly in legal cases dealing with child sexual abuse. Indeed, in legal cases such as the McMartin preschool case, children reported false memories of sexual abuse not only because of suggestive interviewing but also because of rumors about sexual abuse that was allegedly rampant at that school at that time. In other words, these rumors could have contaminated children's memory as well (Garven et al., 1998, 2000; Otgaar, De Ruiter, et al., in press).

An experimental analogue of the effects of such rumors on children's false memory was investigated by Principe and colleagues (2002, 2006). In their studies, four groups of 3- to 5-year-old children witnessed a magic show (Principe, Kanaya, Ceci, & Singh, 2006). During the magic show, a magician attempted to pull a live rabbit out of his hat but failed. Of most interest were the following two groups of children: one group of children overheard a conversation suggesting that the trick failed because the rabbit got loose in the school; another group of children did not hear this conversation but they were classmates of the other group. The interesting finding was that two weeks later, both groups of children incorrectly reported that the rabbit got loose in the school, and the majority of these children made these incorrect reports after receiving open-ended questions. Furthermore, many of these children also claimed to have seen the loose rabbit. This shows that spreading false rumors can generate false reports as well as false memories in children.

Forced Confabulation

The methods discussed so far have mainly been focused on presenting participants with external misinformation and then assessing the impact of this on memory. However, in legal cases, witnesses or victims are sometimes pressured to provide details they do not recollect or never experienced. Such confabulations might lead to autosuggestive effects which might affect memory as well. Ackil and Zaragoza (1998) described a child sexual abuse case (the Wenatchee, Washington child sex ring case) in which the conviction of 19

adults was called into question because one important witness retracted her statement saying that she was forced to confabulate allegations of abuse. To address the issue of whether forced confabulations might lead to false reports, Ackil and Zaragoza developed the forced confabulation method.

In this method, children and adults are presented with, for example, a video, and are asked to answer questions about the details that were not actually a part of the video. For example, participants are asked the question "What did the boy say Sullivan had stolen?". However, in the video, nothing was stolen by Sullivan, and Sullivan was not accused of theft. Participants are then led to confabulate a response to these false detail questions. One week later, participants receive a source memory test in which they are asked to answer whether they spoke about certain details the week before and whether they had seen these details in the video. The interesting finding is that participants often claim to remember seeing their previously mentioned forced confabulations.

Subsequent research has replicated this finding (e.g., Otgaar, Howe, Memon, & Wang, 2014) and extended it with various manipulations. For example, the original study focused on the effect of forced confabulation on false memory details. Building on this finding, Chrobak and Zaragoza (2008) examined whether forced confabulation of an entire fictitious event would lead to false memories of the event. Participants first looked at a video and then were forced to confabulate entire scenes that were not in the video. Although such false memory development was sparse after one week, after eight weeks, participants freely claimed to recollect their forced confabulations of the entire fabricated event. In addition, research has shown that the impact of forced confabulations on false memory production is increased when participants are told that their forced confabulations are indeed true (Zaragoza, Payment, Ackil, Drivdahl, & Beck, 2001).

Imagination Inflation

Imagination plays a vital part in remembering. Furthermore, the act of imagining occurs frequently in the real-world. For example, in certain forms of psychological treatment, therapists may request their clients to imagine a sexually abusive experience as a means to uncover so-called repressed memories. Furthermore, law enforcement agencies sometimes instruct suspects to imagine a criminal act in order to achieve a confession (Ofshe, 1992). Memory researchers have devised several ways to examine the effects of imagination on memory.

Garry, Manning, Loftus, and Sherman (1996) conducted one of the first studies on this topic. In their study, participants were involved in two sessions. In the first session, they were asked to complete the Life Events Inventory (LEI) which contains 40-items about how confident they were that some events happened to them before the age of 10 (e.g., "Broke a window with your hand"). Two weeks later, participants were instructed to imagine four critical events and were then asked to fill out the LEI once more. What the researchers found was that participants became more confident that the critical events happened to them even though they initially rated these events as unlikely to have happened. They termed this effect imagination inflation.

This effect has also been assessed by using different stimuli. For example, Goff and Roediger (1998) examined whether repeated imaginings can lead to false memories of having performed a certain action. In their study, participants heard simple actions statements such as "break the toothpick." For some actions, they actually performed the actions whereas for others they simply imagined performing the actions. In a second session, participants were instructed to imagine performing the actions that were mentioned in the first session as well as new actions. During the final test session, participants indicated whether an action occurred in the first session and whether they had to perform, imagine, or heard it. The chief finding was that the repeated imaginations led to participants falsely remembering that they

performed actions when in fact, they did not. This effect has since been replicated (e.g., Otgaar, Scoboria, Howe, Moldoveanu, & Smeets, 2016). It is important to stress that the imagination inflation method does not use explicit suggestive pressure to promote the formation of false memories. However, the finding that imagination can by itself lead to the creation of false memories indicates that imagining has likely played a vital role in the creation of false memories during psychotherapy.

Spontaneous False Memories

Apart from methods that have been constructed to study suggestion-induced false memories, methods also exist that promote the production of spontaneous false memories. This latter type of false memory has received much empirical attention. There are several reasons for this. One reason is that whereas suggestion-based false memories can be caused by a combination of memory mechanisms and social factors, spontaneous false memories are purely the result of memory mechanisms such as spreading activation (e.g., Howe, Wimmer, Gagnon, & Plumpton, 2009; Otgaar et al., 2016). Consequently, the production of spontaneous false memories provides us with a better and more complete understanding of the underlying factors that lead to false memory production. Second, in legal cases, eyewitnesses and victims oftentimes spontaneously come up with a false account of an event without having received any suggestive questions before that statement. A relevant question here is to what extent memory errors would spontaneously slip into these accounts without any external prompting.

Deese/Roediger-McDermott Paradigm

Probably the most popular way to induce spontaneous false memories is the Deese/Roediger-McDermott (DRM) method, which was originally developed by Deese (1959) and reinvented by Roediger and McDermott (1995). The basic procedure is as follows. Participants are presented with several word lists. The lists can contain 12 to 15 words that are

associatively related to each other (e.g., *tiger, circus, jungle, tamer, den, cub*) as well as to a non-presented word called the critical lure (e.g., *lion*). After the encoding phase, participants are asked to recall or recognize the words on the list that was presented earlier. A robust and reliable finding is that many participants claim to remember the critical lure that was not a part of the original list, and that the rate of false remembering is indistinguishable from the rate of true remembering. The method is popular because the DRM false memory illusion is quite resistant to forewarnings and correlates with false autobiographical memories (e.g., Gallo, 2010).

Another recent line of research has been dedicated to the examination of developmental trends in the DRM false memory illusion. What this research has shown is a counterintuitive finding that in contrast to suggestion-induced false memories, the DRM false memory illusion is higher among adults than in children, a phenomenon that can be described as a developmental reversal (Brainerd, Reyna, & Ceci, 2008; Otgaar et al., 2016). This finding has strong legal implications because in court, the default assumption is that children are inferior witnesses because of their high susceptibility to false memories. However, this line of research shows that the story about this is much more complex, and that when no suggestion in involved, adults can be more susceptible to producing false memories than children.

Visual and Video Scenes

Recent research has also used more complex and realistic stimuli to promote spontaneous false memory production. That is, researchers have used visual scenes and videos that contain details that are related to each other but also related to non-presented items. For example, Moritz, Woodward, and Rodriguez-Racke (2006) presented participants visual scenes to examine memory deficits in schizophrenic patients. They constructed simple drawings of scenes (e.g., a beach) in which several related elements were left out (e.g., a

beach ball, bath towel; see also Miller & Gazzinga, 1998). Although such a method can be seen as a visual analogue of the DRM procedure, this is not completely accurate. In the DRM method, the degree of association among list items and the critical lure is known precisely and is expressed in terms of backward associative strength (BAS). However, this value is unknown when using the visual scene method (because no one has ever normed these stimuli).

In addition to using visual scenes, videos have also been used to generate spontaneous false memories. For example, Peters, Hauschildt, Moritz, and Jelinek (2013) presented schizophrenic patients with several video sequences (e.g., police surveillance). Then, during a recognition test, several related but non-presented items (e.g., a weapon) were presented as well. In general, studies using visual or video material have shown that it leads to reliable rates of false memory in various populations (see Otgaar, Howe, Peters, Sauerland, & Raymaekers, 2013). Of further interest is recent work showing that when such material (videos and visual scenes) is used, children are more vulnerable to the formation of spontaneous false memories than adults, a finding that runs counter to the developmental reversal effect mentioned earlier. The theoretical explanation for this finding is that videos or visual scenes would make it easy for children to identify the underlying theme. As a consequence, children begin to make incorrect associations related to the theme, sometimes resulting in even higher false memory rates than adults (Otgaar, Howe, Peters, Smeets, & Moritz, 2014).

False Beliefs versus False Memories

The distinction between believing and recollecting an event has recently received increasing empirical interest (Otgaar, Scoboria, & Mazzoni, 2014). The reason for this is because previous research has often unintentionally conflated these two concepts. Specifically, the majority of memory research has focused mainly on *believed memories*

(Scoboria et al., 2017). However, for some experiences, no recollection exists and there is merely a belief in the occurrence for those experiences. A good example is our own birth. Obviously, we do not have a recollection of this event, but we do believe that the event had occurred in the past. Many methods that we have just described were intended as methods to induce false *memories*. However, recent studies have shown that many of the just-mentioned methods are more likely to generate false *beliefs* rather than memories.

Two examples are the crashing memory and imagination inflation methods. Recent studies have confirmed that these methods are more likely to lead to increases in belief instead of changes in recollection (e.g., Smeets, Telgen, Ost, Jelicic, & Merckelbach, 2009). These results are important because a debate exists as to whether certain suggestive techniques truly lead to false memory production. If not, the risk of false memory production may not be as high as is often assumed (e.g., Otgaar, Merckelbach, Jelicic, & Smeets, 2017). However, recent work has revealed that when methods such as the implantation are employed, suggestive pressure can lead to about 30% of individuals falsely *remembering* that they experienced an event (Scoboria et al., 2017). Such a high percentage is certainly alarming particularly when suggestion takes place in police interrogation settings. Moreover, evidence is accumulating that merely believing in an event is sufficient to motivate one to act on that belief, showing that belief (true or false) can have as much of an impact on behavior as (true or false) memory (see Otgaar, Moldoveanu, Wang, & Howe in press). This would imply that even when no recollection exists, a belief (false or not) about having been sexually abused might be enough for someone to file an official complaint to the police.

Conclusion

In this chapter, we have delineated the main methods used to induce false memories in the laboratory. We have shown that many of these methods use some form of suggestion to promote false memories whereas others rely on the spontaneous generation of false memories

based on basic memory mechanisms such as spreading activation. We have shown that many of these methods were designed because of legal questions concerning the authenticity of eyewitness testimony and hence, these methods reflect real life situations including those pertinent to legal settings. Furthermore, both methods that elicit suggestion-induced or spontaneous false memories are of relevance in the legal arena because both can occur in a single particular case. That is, a young child can spontaneously come up with a statement of being abused after being suggestively interviewed by his/her mother about what ostensibly happened. Such examples are quite common in child sexual abuse cases, underscoring the importance of examining the different ways false memories can be produced. By doing so, researchers and forensic investigators become more cognizant of the importance of memory in court as well as the mechanisms that lead to the formation of false memories.

References

Ackil, J. K., & Zaragoza, M. S. (1998). Memorial consequences of forced confabulation: Age differences in susceptibility to false memories. *Developmental Psychology*, *34*, 1358–1372. doi:10.1037/0012-1649.34.6.135

Bernstein, D.M., Laney, C., Morris, E.K., & Loftus, E.F. (2005). False beliefs about fattening foods can have healthy consequences. *Proceedings of the National Academy of Sciences, USA, 102,* 13724–13731.

Bernstein, D.M., & Loftus, E.F. (2009). The consequences of false memories for food preferences and choices. *Perspectives on Psychological Science, 4*, 135-139.

Blank, H., & Launay, C. (2014). How to protect eyewitness memory against the misinformation effect: A meta-analysis of post-warning studies. *Journal of Applied Research in Memory and Cognition, 3,* 77-88. doi:10.1016/j.jarmac.2014.03.005

Brainerd, C. J., Reyna, V. F., & Ceci, S. J. (2008). Developmental reversals in false memory: A review of data and theory. *Psychological Bulletin*, *134*, 343–382. doi:10.1037/0033-2909.134.3.343

Brainerd, C. J., Reyna, V. F., & Forrest, T. J. (2002). Are young children susceptible to the false–memory illusion? *Child Development*, *73*, 1363–1377. doi:10.1111/1467-8624.00477

Bruck, M., Ceci, S. J., Francoeur, E., & Barr, R. (1995). "I hardly cried when I got my shot!" Influencing children's reports about a visit to their pediatrician. *Child Development*, *66*, 193–208. doi:10.1111/j.1467-8624.1995.tb00865.x

Candel, I., Memon, A., & Al-Harazi, F. (2007). Peer discussion affects children's memory reports. *Applied Cognitive Psychology*, *21*, 1191–1199. doi:10.1002/acp.1355

Ceci, S. J., & Bruck, M. (1993). Suggestibility of the child witness: A historical review and synthesis. *Psychological Bulletin*, *113*, 403–439. doi:10.1037/0033-2909.113.3.403

Ceci, S. J., Huffman, M. L. C., Smith, E., & Loftus, E. F. (1994). Repeatedly thinking about a non-event: Source misattributions among preschoolers. *Consciousness and Cognition*, *3*, 388–407. doi:10.1006/ccog.1994.1022

Ceci, S. J., Loftus, E. F., Leichtman, M. D., & Bruck, M. (1994). The possible role of source misattributions in the creation of false beliefs among preschoolers. *International Journal of Clinical and Experimental Hypnosis*, *42*, 304–320. doi:10.1080/00207149408409361

Chrobak, Q. M., & Zaragoza, M. S. (2008). Inventing stories: Forcing witnesses to fabricate entire fictitious events leads to freely reported false memories. *Psychonomic Bulletin & Review, 15,* 1190-1195. doi:10.3758/PBR.15.6.1190

Crombag, H. F. M., & Wagenaar, W. A., & van Koppen, P. J. (1996). Crashing memories and the problem of 'source monitoring'. *Applied Cognitive Psychology, 10,* 95-104.

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

Frenda, S. J., Nichols, R. M., & Loftus, E. F. (2011). Current issues and advances in misinformation research. *Current Directions in Psychological Science, 20,* 20-23.

Gabbert, F., Memon, A., & Allan, K. (2003). Memory conformity: Can eyewitnesses influence each other's memories for an event? *Applied Cognitive Psychology, 17,* 533-543. doi:10.1002/acp.885

Gallo, D. A. (2010). False memories and fantastic beliefs: 15 years of the DRM illusion. *Memory & Cognition, 38,* 833-848. doi:10.3758/MC.38.7.833

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 & Review, 3,* 208-2140

Garven, S., Wood, J. M., & Malpass, R. S. (2000). Allegations of wrongdoing: The effects of reinforcement on children's mundane and fantastic claims. *Journal of Applied Psychology*, *85*, 38–49. doi:10.1037/0021-9010.85.1.38

Garven, S., Wood, J. M., Malpass, R. S., & Shaw, J. S. (1998). More than suggestion: The effect of interviewing techniques from the McMartin Preschool case. *Journal of Applied Psychology, 83,* 347-359.

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

Higham, P. A. (1998). Believing details known to have been suggested. *British Journal of Psychology, 89,* 265-283.

Howe, M. L., & Knott, L. M. (2015). The fallibility of memory in judicial processes: Lessons from the past and their modern consequences. *Memory, 23,* 633-656.

Howe, M. L., Candel, I., Otgaar, H., Malone, C., & Wimmer, M. C. (2010). Valence and the development of immediate and long-term false memory illusions. *Memory*, *18*, 58–75. doi:10.1080/09658210903476514

Howe, M. L., Wimmer, M. C., Gagnon, N., & Plumpton, S. (2009). An associative-activation theory of children's and adults' memory illusions. *Journal of Memory and Language, 60*, 229–251. doi:10.1016/j.jml.2008.10.002

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

Lindsay, D. S., & Read, J. D. (1994). Psychotherapy and memories of childhood sexual abuse: A cognitive perspective. *Applied cognitive Psychology, 8,* 281-338.

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

Loftus, E. F. (2005). Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. *Learning & Memory*, *12*, 361–366. doi:10.1101/lm.94705

Loftus, E. F., & Davis, D. (2006). Recovered memories. *Annual Review of Clinical Psychology, 2,* 469-498. doi:10.1146/annurev.clinpsy.2.022305.095315

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information into a visual memory. *Journal of Experimental Psychology, 4,* 19-31.

Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals, 25,* 720-725.

Maran, M. (2010). *My lie: A true story of false memory*. Willey: Jossey-Bass.

Miller, M. B., & Gazzaniga, M. S. (1998). Creating false memories for visual scenes. *Neuropsychologia, 36,* 513-520. doi:10.1016/S0028-3932(97)00148-6

Moritz, S., Woodward, T. S., & Rodgriquez-Raecke, R. (2006). Patients with schizophrenia do not produce more false memories than controls but are more confident in them. *Psychological Medicine, 36,* 659-667. doi:10.1017/S0033291706007252

Ofshe, R. J. (1992). Inadvertent hypnosis during interrogation: False confession due to dissociative state: Mis-identified multiple personality and the satanic cult hypothesis. *International Journal of Clinical and Experimental Hypnosis, 40,* 125-156.

Ost, J., Granhag, P.-A., Udell, J., & Roos af Hjelmsäter, E. (2008). Familiarity breeds distortion: The effects of media exposure on false reports concerning media coverage of the terrorist attacks in London on 7 July 2005. *Memory, 16,* 76-85. doi:10.1080/09658210701723323

Otgaar, H., & Candel, I. (2011). Children's false memories: Different false memory paradigms reveal different results. *Psychology, Crime & Law*, *17*, 513–528. doi:10.1080/10683160903373392

Otgaar, H., Candel, I., & Merckelbach, H. (2008). Children's false memories: Easier to elicit for a negative than for a neutral event. *Acta Psychologica*, *128*, 350–354. doi:10.1016/j.actpsy.2008.03.009

Otgaar, H., Candel, I., Merckelbach, H., & Wade, K. A. (2009). Abducted by a UFO: Prevalence information affects young children's false memories for an implausible event. *Applied Cognitive Psychology, 23*, 115–125. doi:10.1002/acp.1445

Otgaar, H., Candel, I., Smeets, T., & Merckelbach, H. (2010). "You didn't take Lucy's skirt off": The effect of misleading information on omissions and commissions in children's memory reports. *Legal and Criminological Psychology*, *15*, 229–241. doi:10.1348/135532509X471951

Otgaar, H., De Ruiter, C. , Howe, M. L., Hoetmer, & van Reekum (in press). A case concerning children's false memories of abuse: Recommendations regarding expert witness work. *Psychiatry, Psychology, and Law.*

Otgaar, H., Howe, M. L, Brackmann, N., & Smeets, T. (2016). The malleability of developmental trends in neutral and negative memory illusions. *Journal of Experimental Psychology: General, 145,* 31-55. doi:10.1037/xge0000127

Otgaar, H., Howe, M. L., Brackmann, N., & van Helvoort, D. (in press). Eliminating age differences in children's and adults' suggestibility and memory conformity effects. *Developmental Psychology.*

Otgaar, H., Howe, M. L., Memon, A., & Wang, J. (2014). The development of differential mnemonic effects of false denials and forced confabulations. *Behavioral Sciences & the Law, 32,* 718-731. doi:10.1002/bsl.2148

Otgaar, H., Howe, M. L., Peters, M., Sauerland, M., & Raymaekers, L. (2013). Developmental trends in different types of spontaneous false memories: Implications for the legal field. *Behavioral Sciences & the Law, 31*, 666-682.

Otgaar, H., Howe, M. L., Peters, M., Smeets, T., & Moritz, S. (2014). The production of spontaneous false memories across childhood. *Journal of Experimental Child Psychology, 121*, 28-41.

Otgaar, H., Merckelbach, H., Jelicic, M., & Smeets, T. (2017). The potential for false memories is bigger than what Brewin and Andrews suggest. *Applied Cognitive Psychology, 31*, 24-25.

Otgaar, H., Smeets, T., & Peters, M. (2012). Children's implanted false memories and additional script knowledge. *Applied Cognitive Psychology*, *26*, 709–715. doi:10.1002/acp.2849

Peters, M. J. V., Hauschildt, M., Moritz, S., & Jelinek, L. (2013). Impact of emotionality on memory and meta-memory in schizophrenia using video sequences. *Journal of Behavior Therapy and Experimental Psychiatry, 44,* 77-83. doi:10.1016/j.jbtep.2012.07.003

Pezdek, K., & Hodge, D. (1999). Planting false childhood memories in children: The role of event plausibility. *Child Development*, *70*, 887–895. doi:10.1111/1467-8624.00064

Pezdek, K., Finger, K., & Hodge, D. (1997). Planting false childhood memories: The role of event plausibility. *Psychological Science*, *8*, 437–441.

Poole, D. A., & Lindsay, D. S. (1995). Interviewing preschoolers: Effects of nonsuggestive techniques, parental coaching, and leading questions on reports of nonexperienced events. *Journal of Experimental Child Psychology, 60,* 129-154.

Porter, S., ten Brinke, L., Riley, S. N., & Baker, A. (2014). Prime time news: The influence of primed positive and negative emotion on susceptibility to false memories. *Cognition and Emotion, 28,* 1422-1434. doi:10.1080/02699931.2014.887000

Principe, G. F., & Ceci, S. J. (2002). "I saw it with my own ears": The effects of peer conversations on preschoolers' reports of nonexperienced events. *Journal of Experimental Child Psychology*, *83*, 1–25. doi:10.1016/S0022-0965(02)00120-0

Principe, G. F., Kanaya, T., Ceci, S. J., & Singh, M. (2006). Believing is seeing: How rumors can engender false memories in preschoolers. *Psychological Science, 17, 243-248.*

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of experimental psychology: Learning, Memory, and Cognition*, *21*, 803-814.

Scoboria, A., Mazzoni, G., & Jarry, J. (2008). Suggesting childhood food illness results in reduced eating behavior. *Acta Psychologica, 128*, 304–309.

Scoboria, A., Wade, K. A., Lindsay, D. S., Azad, T., Strange, D., Ost, J., & Hyman, I. E. (2017). A mega-analysis of memory reports from eight peer-reviewed false memory implantation studies.

Sjöden, B., Granhag, P.-A., Ost, J., & Roos af Hjelmsäter, E. (2009). Is the truth in the details? Extended narratives help distinguishing false 'memories' from false 'reports'. *Scandinavian Journal of Psychology, 50,* 203-210. doi:10.1111/j.1467-9450.2008.00694.x

Smeets, T., Telgen, S., Ost, J., Jelicic, M., & Merckelbach, H. (2009). What's behind *crashing memories*? Plausibility, belief and memory in reports of having seen non-existent images. *Applied Cognitive Psychology, 23,* 1333-1341. doi:10.1002/acp.1544

Strange, D., Sutherland, R., & Garry, M. (2006). Event plausibility does not determine children's false memories. *Memory*, *14*, 937–951. doi:10.1080/09658210600896105

Sutherland, R., & Hayne, H. (2001). Age-related changes in the misinformation effect. *Journal of Experimental Child Psychology*, *79*, 388–404. doi:10.1006/jecp.2000.2610

Vredeveldt, A, Groen, R. N., Ampt, J. E., & van Koppen, P. J. (2016). When discussion between eyewitnesses helps memory. *Legal & Criminoloical Psychology.*

Wade, K. A., Garry, M., Read, J. D., & 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. doi:10.3758/BF03196318

Wright, D. B., Memon, A., Skagerberg, E. M., & Gabbert, F. (2009). When eyewitnesses talk. *Current Directions in Psychological Science*, *18*, 174–178. doi:10.1111/j.1467-8721.2009.01631.x

Wright, D. B., Self, G., & Justice, C. (2000). Memory conformity: Exploring misinformation effects when presented by another person. *British Journal of Psychology, 91,* 189-202.

Zaragoza, M. S., Payment, K. E., Ackil, J. K., Drivahl, s. B., & Beck, M. (2001). Interviewing witnesses: Forced confabulation and confirmatory feedback increase false memories. *Psychological Science, 12,* 472-477.

Table 1. Classification of different false memory methods

Classification	**Specifics**	**False Memory Methods**
Suggestion	External suggestion	Misinformation
	External suggestion	Implantation
	External suggestion	False feedback
	External suggestion	Memory conformity/Social contagion
	External suggestion	Crashing memory
	External suggestion	Rumour mongering
	Autosuggestion	Forced confabulation
	Imagination	Imagination inflation
Spontaneous		DRM
		Visual and Video Scenes