# A New Method to Implant False Autobiographical Memories: Blind Implantation

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**Abstract**

We offer an elegant new and straightforward paradigm to implant false autobiographical memories. Participants received twenty autobiographical events including a critical false event (i.e., swimsuit falling off) and had to indicate whether they ever experienced these events. After 1-week, participants who did not experience the false event received a second survey suggesting that they actually did experience the false event. Participants had to provide belief and recollection ratings and event-related details. Also, one of group of participants was told that the false event happened once (Single group) while the other group was told that the event happened repeatedly (Repeated group). Depending on the memory type (e.g., false belief or false memory), false memory implantation ranged between 9% and 30%. Furthermore, false beliefs were most likely to be elicited in the Single group. This novel paradigm can offer new insights on how false autobiographical memories can be implanted.

Keywords: False Memory; Implantation; Lost-in-the-Mall; Memory; False Belief

## A New Method to Implant False Autobiographical Memories

Although memory can be highly accurate, myriad situations can distort someone's memory (Frenda et al., 2011; Wixted et al., 2018). For example, someone might be falsely told by a therapist that (s)he was sexually abused in their childhood because of the current display of unexplained symptoms. Such suggestive interventions can lead to false memories of abuse. The damaging consequence is that people harboring such false memories might act upon them thereby falsely accusing innocent persons of having abused them, something that can result in wrongful convictions (Howe & Knott, 2015). Interest in these false memories exploded in the 1990s because of legal cases in which suggestive tactics likely led to false reports of abuse (Loftus, 1993). Such legal cases stimulated researchers to devise procedures to experimentally evoke false memories (see for an overview: Otgaar et al., 2018). In the current experiment, we report on a new method to implant false autobiographical memories.

### False Memory Methods

Different methods have been constructed to elicit different false memory types. For example, methods exist relying on the semantic or associative connections that people make when experiencing an event and which can evoke false memories. Specifically, in the Deese/Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995), participants learn a list of associatively related words (e.g., *bed, rest, tired, awake*). When they recall and/or recognize which words they can still remember, a significant proportion of participants falsely recollect a non-presented related word called the critical lure (i.e., *sleep*). Apart from the use of word lists, other types of stimuli containing associatively-related details

have been used as well such as scenes and videos (e.g., McGuire, 2021; Otgaar et al., 2014). Because these types of false memories occur rather automatically, they are called *spontaneous* false memories (Brainerd et al., 2008).

An alternative method to study false memories is by exposing participants to suggestive pressure. An example of such method, and of importance for the current experiment, is the false memory implantation paradigm (Loftus, 2005; Loftus & Pickrell, 1995). In this paradigm, participants are asked what they can still remember about experienced and non-experienced events. The false event is manufactured by the experimenters and participants' parents are asked to confirm that the event is indeed false. Then, it is suggested to participants over several interviews that the false event was in fact experienced by them. Studies have shown that about 30% of participants fall sway to this suggestive power and falsely remember an autobiographical experience (Scoboria et al., 2017). Although studies using this paradigm have elucidated which factors (e.g., event plausibility, script knowledge, emotional valence) foment false memory formation (e.g., Pezdek et al., 1997; Ost et al., 2005; Otgaar et al., 2008; 2010; Strange et al., 2006), this paradigm suffers from several limitations.

First, the paradigm is very time-consuming. Specifically, interviewers need to be well trained for conducting interviews. Also, the scoring of interviews is a complex task and false memory rates can differ depending on the scoring method (e.g., Calado et al., 2021; Shaw, 2018; Wade et al., 2018). Second, in many implantation studies, participants' parents are asked to verify that the false event was in fact not experienced. Hence, there is a strong reliance on parents' recollections of what their children experienced in their past. Although for some false events (e.g., hot air balloon ride; Wade et al., 2002), parental recollections might be trusted, for other false events (e.g., being lost in a shopping mall; Loftus & Pickrell, 1995), children might

have experienced a related event and hence, reasoned that the suggestion referred to the memory of this related event. In our newly developed method, parents' confirmation as well as the execution of time-consuming interviews are not needed.

## A New False Memory Implantation Method

In the current experiment, we will introduce a new method to experimentally induce false autobiographical memories. The method is inspired by the literature on memory blindness and was also created because the COVID pandemic made it impossible to conduct live interviews. Memory blindness refers to the phenomenon that people do not notice when alterations are made in their own memory reports (Cochran et al., 2016). This phenomenon is based on the choice blindness literature showing that people are blind to changes in their self-made choices (e.g., Hall et al., 2010; Sagana et al., 2014).

In the new method, participants receive a list of autobiographical events and indicate whether they have experienced them in their past (Session 1). In this list, there is one critical event (i.e., losing their swimming outfit while swimming). Only when participants indicate that the critical event was *not* experienced will they then proceed to the next session of the experiment. In this second session, participants again receive a shorter list of autobiographical events and it is specified that these are events which they indicated as having been experienced. In line with the memory blindness literature (Cochran et al., 2016), among these is also the critical event that is falsely suggested as having been experienced. Participants are then asked to provide belief and recollection ratings of these events and provide additional details of what they remember about these events.

The strength of this method is that (1) no one needs to be trained in interviewing the subjects, (2) no parents need to be interviewed, (3) the experiment can be fully executed online,

and (4) the scoring is less arduous. To explore whether the results of using this paradigm align with what is found when using the standard false memory implantation paradigm, we also manipulated how often the false event was experienced. That is, recently, implanted false memory work has been criticized because this work has exclusively focused on the implantation of single events while child sexual abuse cases oftentimes concern abuse that is perpetrated repeatedly (Blizard & Shaw, 2019; Brewin & Andrews, 2017). Therefore, Calado and colleagues (2021) examined the ease with which false memories for repeated events could be implanted and although it was expected that repeated false events were less likely to be implanted than single event, false repeated events were as easily implanted as those that occurred only once. Taken together, we examined whether this new method would lead to similar rates of false memories as in the standard false memory implantation paradigm and explored the ease of implanted false memories for repeated events.

## Method

### Participants

Participants were students from KU Leuven (Belgium) and Babes-Bolyai University (Romania). We aimed for a sample size large enough to detect medium effects. An a priori power analysis using G*Power (t tests: difference between two independent means, one-tailed; Faul et al., 2009) with a power of 0.80, a Cohen's $d = 0.50$, alpha = 0.05, allocation rate = 1 indicated that a sample size of 102 would be needed to explore the difference in false memory formation for single and repeated events. We recruited 352 students (mean age = 22.45, $SD$ = 5.20) who completed the first list of the autobiographical events. Of these, 99 (mean age = 22.06, $SD$ = 2.90, range: 18-30) could be used for the analyses (KU Leuven: $n = 81$; Babes-Bolyai

University: $n = 18$)[1]. The others could not be used because they, for example, did experience the false event, did not experience a sufficient number of the other events (i.e., they needed to experience four events, see below), or did not return their answers on the second list of autobiographical events. Out of all participants, three vouchers of 15 euros were raffled. The sample size belongs to one of the largest among all false memory implantation studies (see Table A1 from Calado et al., 2021). The study was approved by the standing ethical committee of KU Leuven. All materials and data are available on the Open Science Framework: https://osf.io/v6gu5/.

**Design and Procedure**

We used a between-subjects design with Event Frequency (Single ($n = 40$) versus Repeated ($n = 59$) as the between-subjects variable. Participants were randomly assigned to the two groups. Groups did not have equal sample sizes because some participants were excluded because they for example experienced the false event (see also Participants section). This exclusion occurred after the results of the first survey (see below) while random assignment took place before the first survey was given. Social media channels of student groups were used to advertise the study. Participants who were interested received a Qualtrics link in which they were first presented with an informed consent form. Participants from KU Leuven conducted the experiment in Dutch and the participants from Babes-Bolyai University conducted it in Romanian. Participants then had to provide demographic details (age, gender, date of birth) and their email address. Following this, participants received a survey containing twenty events (e.g., going to a theme park, see https://osf.io/7shgj/; see also Appendix). Of these events, one was the

[1] We investigated whether the KU Leuven and Babes-Bolyai students statistically differed on belief and recollection ratings, but no statistically significant effects emerged ($p$s > .78)

critical event (i.e., going swimming where your swimming outfit fell off). Participants had to indicate whether they experienced these events in their childhood and had to state how often this had occurred (i.e., never, one time, two times, three or more times).

After one week, participants were sent a second personalized survey. This survey was personalized in the following way. Participants who were in the Single group randomly received four events of which they indicated in the first session were experienced *once* in their childhood. Participants in the Repeated group randomly received four events of which they stated were experienced *more than once* in their childhood. Apart from these true events, all participants also received the critical event. In the Single group, it was stated that "[f]ive events are listed here that you previously indicated you had experienced once". In the Repeated group, it was stated that "[f]ive events are now listed that you previously indicated you experienced more than once".

In both groups, and for each event, participants were asked to provide belief in occurrence and recollection ratings on 8-point Likert scales (belief in occurrence: 1 = definitely did not happen, 8 = definitely did happen; recollection: 1 = no memory for event at all, 8 = clear and complete memory of event; Scoboria et al., 2004). Following this, and in line with false memory implantation procedures, participants received an imagination instruction where they had to imagine the event took place and imagine who was with them, where the event took place, and how they felt. Then, participants provided belief and recollection ratings again. Finally, participants were asked to provide details that they could remember about the event.

After asking participants about their belief and recollection for the true/false events, it was stated that one of the events was actually not experienced by them and they had to decide which one they thought was the false event. Following this, they had to indicate how certain they were of this answer. After this, participants were debriefed.

### Scoring

Different ways can be used to score the propensity to produce false beliefs and false memories. The strategy we adopted in the current experiment was the following. A false belief was scored when participants had a belief score of 5 or higher for the critical event and recollection score that was lower than the belief score. A false memory was scored when participants had a recollection of 5 or higher and a belief score that equaled the recollection score. A detailed false report was scored when a false belief or memory was accompanied with additional details. The same strategy was used for true beliefs and memories.

## Results

### Percentages of False Beliefs and False Memories

We first examined the overall percentages of false belief and memory implantation. We have reported these percentages before and after the imagination technique in Table 1. As can be seen from Table 1, we succeeded in implanting false beliefs and false memories with percentages ranging from 9% to 30%. We also investigated the different percentages of the true events that were provided which were in general higher than percentages of false beliefs and false memories ranging from 33% to 83%.

Table 1. *Percentage of participants producing different memory types.*

| Memory Type | Percentage (Number in Brackets) |
|---|---|
| False Belief | 25% (*n* = 25) |
| False Memory | 9% (*n* = 9) |
| False Belief after Imagination | 24% (*n* = 24) |
| False Memory after Imagination | 11% (*n* = 11) |
| Detailed False Report | 30% (*n* = 30) |
| True Belief (first event) | 44% (*n* = 44) |

| | |
|---|---|
| True Memory (first event) | 35% (*n* = 35) |
| True Belief after Imagination (first event) | 44% (*n* = 44) |
| True Memory after Imagination (first event) | 34% (*n* = 34) |
| Detailed True Report (first event) | 79% (*n* = 78) |
| True Belief (second event) | 44% (*n* = 24) |
| True Memory (second event) | 38% (*n* = 38) |
| True Belief after Imagination (second event) | 42% (*n* = 42) |
| True Memory after Imagination (second event) | 42% (*n* = 42) |
| Detailed True Report (second event) | 83% (*n* = 82) |
| True Belief (fourth event) | 40% (*n* = 40) |
| True Memory (fourth event) | 46% (*n* = 45) |
| True Belief after Imagination (fourth event) | 35% (*n* = 35) |
| True Memory after Imagination (fourth event) | 47% (*n* = 46) |
| Detailed True Report (fourth event) | 79% (*n* = 78) |
| True Belief (fifth event) | 44% (*n* = 44) |
| True Memory (fifth event) | 33% (*n* = 33) |
| True Belief after Imagination (fifth event) | 38% (*n* = 38) |
| True Memory after Imagination (fifth event) | 49% (*n* = 48) |
| Detailed True Report (fifth event) | 85% (*n* = 84) |

As noted earlier, participants were also requested to provide any details about the events. When inspecting these data, some of them provided a detailed story of the false event:

*"When I was little, at the end of the 8th grade, I went with my best friend, a colleague and one of our teachers to the salt lakes near the city. I was quite big (in terms of body) and I clearly remember this because I was ashamed that I was big and my briefs fell off and my private parts*

*could have been seen. But I was in the water, and I don't know how to swim. and I was with my friend and colleague, who were holding me, but the water was salty, I got up and ended up with my head in the water. Anyway, after I crossed the lake and reached the shore, when I got up I felt like I had a lot of water in my briefs and I felt it slip. It's good that I caught it quickly, otherwise I would be naked. I was very, very ashamed, but now I'm laughing."*

**False Memories for Repeated Events**

We next turned to the number of false beliefs and memories between the different groups (see Table 2) and examined whether they differed statistically from each other. For false belief formation, we found a statistically significant effect showing that false beliefs were more easily formed in the Single than Repeated group, $\chi^2(1) = 5.33$, $p = .02$, Cramer's $V = .23$. This effect was even stronger after participants received an imagination instruction, $\chi^2(1) = 9.07$, $p = .003$, Cramer's $V = .30$.

Table 2. *Number (and Percentage) of False Beliefs as a Function of Condition*

| | Single | Repeated |
|---|---|---|
| False Belief | 15 (37.5%; 15/40) | 10 (16.9%; 10/59) |
| No False Belief | 25 (62.5%; 25/40) | 49 (83.1%; 49/59) |
| False Belief after Imagination | 16 (40%; 15/40) | 8 (13.6%; 8/59) |
| No False Belief after Imagination | 24 (60%; 24/40) | 51 (86.4%; 51/59) |

When we focused on the production of false memories, we did not find a statistically significant effect, $\chi^2(1) = .94$, $p = .33$, Cramer's $V = .10$, and also not after receiving an

imagination instruction, $\chi^2(1) = .13$, $p = .72$, Cramer's $V = .04$. When we focused on participants who had a false belief or false memory and provided additional details, we also found a statistically significant effect, $\chi^2(1) = 6.86$, $p = .009$, Cramer's $V = .26$ showing that such false statements with additional details were more easily evoked in the Single than Repeated group (see Table 4).

Table 3. *Number (and Percentage) of False Memories as a Function of Condition*

| | Single | Repeated |
|---|---|---|
| False Memory | 5 (12.5%; 5/40) | 4 (6.8%; 4/59) |
| No False Memory | 35 (87.5%; 35/40) | 55 (93.2%; 55/59) |
| False Memory after Imagination | 5 (12.5%; 5/40) | 6 (10.2%; 6/59) |
| No False Memory after Imagination | 35 (87.5%; 35/40) | 53 (89.8%; 53/59) |

Table 4. *Number (and Percentage) of Detailed False Reports as a Function of Condition*

| | Single | Repeated |
|---|---|---|
| Detailed False Report | 18 (45%; 18/40) | 12 (20.3%; 12/59) |
| No Detailed False Report | 22 (55%; 22/40) | 47 (79.7%; 12/59) |

## Exploratory Analyses

An alternative way to look at rates of false belief and false memories is to examine the mean belief and recollection ratings (see Table 5) and whether these differed statistically between the Single and Repeated group. Because of violations of normality, we used nonparametric Mann-Whitney U tests. No statistically significant effects emerged ($ps > .14$). Furthermore, we conducted a 2 (Condition: Single versus Repeated) x 2 (Imagination: Yes

versus no) mixed ANOVA on the belief and recollection ratings. Here too, no statistically significant effects were observed (all *p*s > .16). Finally, we counted the words of the details that were provided by the participants and investigated whether this word count statistically differed between the Single ($M$ = 14.80, $SD$ = 26.06) and Repeated group ($M$ = 11.15, $SD$ = 20.65). Using an independent samples t-test, we did not find any evidence for this, $t(97) = 0.78$, $p = .44$, Cohen's $d = .16$.[2]

We also examined whether participants were able to correctly identify which event was false. We found that 76.7% ($n$ = 76) of the participants correctly identified the false event and 23.2% ($n$ = 23) picked the wrong event (i.e., an event they actually did experience) or did not know. This identification did not statistically differ between the Single and Repeated group ($\chi^2(5) = 4.85$, $p = .43$, Cramer's $V = .22$. Interestingly, when we focused on participants who had a false belief, 52% ($n$ = 13) selected the false event while 48% ($n$ = 12) identified the wrong event. Furthermore, of the 23 participants who picked the wrong event, 17 were (somewhat) certain about their decision. This certainty did not statistically differ between the two groups ($t(97) = 1.15$, $p = .25$, Cohen's $d = .24$.

[2] We also conducted a non-parametric Mann-Whitney U test and once more, no statistically significant effect emerged ($p = .57$).

Table 5. *Mean False Belief and Recollection Ratings (standard deviations in parentheses) as a Function of Condition*

| | Single | Repeated |
|---|---|---|
| False Belief | 3.85 (2.42) | 3.14 (2.40) |
| False Recollection | 2.88 (2.19) | 2.59 (2.12) |
| False Belief after Imagination | 3.85 (2,43) | 3.17 (2.36) |
| False Recollection after Imagination | 2.90 (2.32) | 2.69 (2.22) |

## Discussion

The false memory implantation method has played a significant role in false memory research. However, this paradigm is limited insofar as it is a time-consuming paradigm that also relies on extensive training to score false memory reports (e.g., Shaw, 2018). The prime purpose of the current experiment was to test the merits of a new method to create false autobiographical memories. Inspired by the literature on memory blindness and due to the Covid-19 pandemic, we devised a false memory implantation method that can be used online (but also offline); something we refer to as "blind implantation". Specifically, participants received information that they experienced five events and that these events were selected because they previously indicated they experienced the events. Out of the five events, one was falsely suggested as being experienced, while actually the participants indicated that they did not experience it.

Our most canonical finding was that we succeeded in implanting false beliefs and false memories using this new paradigm. We found that depending on the memory type, between 9% and 30% of participants were susceptible to our suggestions. These percentages are in line with

the range of percentages observed in previous standard false memory implantation studies (see Calado et al., 2021; Scoboria et al., 2017). For example, Pezdek and colleagues (1997; Experiment 1) found that 6% ($n$ = 3) of the participants fell prey to an implausible false event, while Hyman and Billings (1998) showed that 27% of their 66 subjects created false memories.

So, in general, our implantation rates echo those detected in the implanted false memory literature. Nonetheless, caution should be taken when relating our implantation rates with previous false memory implantation studies. Specifically, in most of these studies, false memories were scored by exclusively focusing on participants' narratives of the events (but see Calado et al., 2021; Otgaar et al., 2013). The issue here is that researchers have sometimes used different scoring methods which might have led to different false memory rates across studies (see for a discussion Shaw, 2018; Wade et al., 2018). Therefore, scholars have advocated for the use of standard scoring methods and, when doing so, observed that about 30% of participants' narratives in previous false memory implantation could be labeled as false memory (Scoboria et al., 2017). Furthermore, instead of solely concentrating on scoring participants' reports, researchers have argued that self-report ratings of belief and recollection might be an important measurement to examine whether participants falsely believe and/or remember an event (Otgaar et al., 2013). In our newly constructed paradigm, the focus was on these belief and recollection ratings.

We also explored the impact of event frequency on the formation of false beliefs and memories. This purpose stemmed from discussions that false memory studies are limited because they focus on single occurring events while child sexual abuse frequently concerns repeated events (Blizard & Shaw, 2019; Brewin & Andrews, 2017). In our participants, one group of participants was suggested that the false event was experienced once (Single group), while in the

other group, participants were misinformed that the false event was experienced more than once (Repeated group). Our findings concerning this issue are mixed. On the one hand, false memories were equally likely to be elicited in the Single and Repeated group. A similar pattern was detected in the belief *and* recollection ratings that did not statistically differ between the Single and Repeated group. This result aligns with Calado's et al.'s (2021) study showing that implanted false memory rates also did not statistically differ when the suggestion pertained to a single or repeated occurring event.

On the other hand, false beliefs were more easily elicited in the Single than Repeated group and this effect was also present when participants provided event-related details. Several explanations can account for these findings. First, the finding that false beliefs were more easily induced in the Single than Repeated group is related to the nested model by Scoboria et al. (2004). According to this model, before people believe and remember that an event occurred, they first need to deem the event as a plausibly occurring event. Suggesting a false event happened once may be more plausible than suggesting an event happened repeatedly, leading to higher false belief rates in the Single than Repeated group. This latter explanation is linked to research on the memorability strategy and false memory rejection (Ghetti, 2008). That is, people in the Repeated group might have reasoned that if they would have repeatedly experienced the false event, they would have remembered it. The fact that they did not remember the false event made them reject the suggestion.

An alternative explanation, and linked with our result that false memory formation (and belief/recollection ratings) did not differ as a function of Group, is related to script theory (Schank & Abelson, 1975). People might have a general script of what happens when someone loses their swim outfit. The suggestion that this false event unfolded once or repeatedly might

both parallel with what would be expected from the script of this event making the suggestions equally familiar. If so, this might have led to no statistical differences in false memory rates between groups.

Although our result that false memories were equally evoked in the Single and Repeated group mirrors that of Calado's et al's finding, our results offer a new advancement in the area of false memory formation. That is, when using a different implantation method, false beliefs were more difficult to evoke for repeated than single events. This is the first time that such a result has been detected but could be due to various reasons. For example, future work should attempt to replicate this effect by using other events to single out the possibility that our results are driven by the choice of the false event. For example, an option could be to include somewhat plausible events (e.g., being lost in a shopping mall) that were used in previous false memory implantation studies (Loftus & Pickrell, 1995).

It is important to stress that our new method not only differs substantially from the standard false memory implantation method but also from other methods using suggestion such as the misinformation paradigm. For example, in the misinformation paradigm, participants first receive some stimuli (e.g., a video of a bank robbery) and then receive misinformation in the form of for example suggestive questions (e.g., telling participants that the robber had a gun while no weapon was present). Research has revealed that many participants report the misinformation in their final memory reports, a finding termed the misinformation effect (Loftus, 2005). In our new method, participants produce false memories for *autobiographical* experiences which is oftentimes not the case for the misinformation paradigm. A more critical difference is the following. In the misinformation method and in our new method, participants receive suggestions from an external source (e.g., an experimenter falsely telling them that they

experience a certain event). However, in our new method, participants are made believe as if the content of the suggestion (i.e., that the participants experienced a certain event) originated from themselves.

False memories can exert egregious effects in the courtroom (e.g., Frenda et al., 2011). An illustrative example is when someone falsely remembers being abused and makes an accusation to the police which could culminate in a costly legal case and possible conviction of an innocent person. It is therefore unsurprising that psychologists have manufactured different methods to study false memories in the laboratory. Ranging from methods eliciting spontaneous false memories for words (i.e., DRM paradigm) to the implantation method evoking false autobiographical memories, the realm of false memories has been important in discussions of the authenticity of claims of sexual abuse (e.g., Howe et al., 2018; Loftus, 2005; Roediger & McDermott, 1995). To provide a concrete example, the implantation paradigm has been influential in the bitter controversy on whether recovered memories in therapeutic settings refer to authentic or fictitious experiences (e.g., Loftus, 1993; Otgaar et al., 2019). Our findings are promising in terms of successful false memory implantation but need replication. Future research might use different events and attempt to replicate previous false memory findings such as that plausible and implausible false events are likely to be implanted in memory (Strange et al., 2006). Whatever the research direction, the current experiment offers an elegant and rather straightforward way to implant false autobiographical memories. Using this method might continue to offer crucial insights on the conditions that make memory accurate or prone to error.

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## Author statement

HO designed the study, VM and MM helped in the data collection, HO, VM, and MM analyzed the data, HO wrote a first draft, and the others provided critical comments

## Appendix

### List of Events

1. Going to a theme park
2. Experiencing a car crash
3. Going to a swimming pool and that your swimming trunks fell off
4. Being hospitalized and undergoing surgery
5. Having a tooth extracted by a dentist
6. Building camps with friends
7. Going ice skating on natural ice in the winter
8. Going camping with your family in tents
9. Falling off your bike as a child and wounded yourself
10. Having a verbal fight with your friends at school
11. Going on a hot air balloon ride
12. Going to Disneyland Paris and meeting your favorite figure
13. Breaking something valuable in a store
14. Going to a doctor to suture a wound
15. Falling off the trampoline and broke something
16. A plaster of a broken arm or leg written full by classmates, family, etc
17. Going on a skiing holiday
18. Experiencing a move to another place
19. Going to a fair and going into an attraction
20. Going to a national theme park