The Effects of Repeated Denials and Fabrication on Memory

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Abstract

In the current experiment, we investigated the impact of repeated lying on memory. Specifically, we were interested in the effects of lying (i.e., false denial or fabrication) on memory when deceptive strategies were repeatedly executed. Participants (n = 121) watched a video (i.e., electrician who committed a burglary) and immediately after and during the following ten days, they were instructed to either falsely deny, fabricate, or answer honestly to certain details of the video. Some details were discussed (i.e., denied, fabricated, or honestly answered) either once, or four times. Other details were never discussed. Finally, all participants received a memory test, in which they were asked whether they either discussed the details during the interview or saw the details during the video. Although, overall, repeated lying did not undermine memory for having discussed certain details, repeated falsely denying led to an impairment of the memory for the original event. Our findings show that lying can adversely affect memory and that repeated lying can even increase this effect.

Keywords: Repeated Lying, False Denials, Fabrication, Forgetting, Denial-induced Forgetting

The Effects of Repeated Lying and Denials on Memory

Understanding and studying the effects of lying on memory can be of vital importance in the legal context. For example, it is important to assess whether a previous act of lying can alter the statements of witnesses, victims or offenders when they decide to eventually come forward with the truth. In general, lying has been defined as: "A successful or unsuccessful deliberate attempt, without forewarning, to create in another a belief which the communicator considers to be untrue" (Vrij, 2008, p. 15). Research has shown that lying requires more cognitive resources than telling the truth (e.g., Christ, Van Essen, Watson, Brubaker, & McDermott, 2009; Vrij & Ganis, 2014). One of the reasons for this increased cognitive load is that liars have to inhibit the truth and, for example, simultaneously fabricate an alternative account for a past experience (e.g.,Walczyxk, Harris, Duck, & Mulay, 2014).

In the legal context, several deceptive strategies can be adopted by both suspects and victims of crime to withhold the truth. In order to minimize their involvement, for example, some defendants falsely deny that the crime occurred (e.g., Gudjonsson, Sigurdsson, & Einarsson, 2004; Rogers & Dickey, 1991). Victims of violent crimes (i.e., sexual abuse) may also want to delay disclosing those traumatic experiences by denying that the event ever took place (Block et al., 2012; Goodman-Brown, Edelstein, Goodman, Jones, & Gordon, 2003). Furthermore, approximately 20% to 30% of individuals who commit violent crimes claim partial or complete memory loss for the event (Cima, Merckelbach, Nijman, Knauer, & Hollnack, 2002; Pyszora, Barker, & Kopelman, 2003). Finally, offenders and/or eyewitnesses may also fabricate some specific information of an event and/or provide a false alibi with the intent to deceive the listener (Chroback & Zaragoza, 2008; Otgaar & Baker, 2017).

Recently, several studies have been conducted to understand the impact of lying[1] on memory[2] (e.g., Ackil & Zaragoza, 2011; Gombos, Pezdek, & Haymond, 2012; Mangiulli, van Oorsouw, Curci, Merckelbach, & Jelicic, 2018; Otgaar, Howe, Smeets, & Wang, 2016; Polage, in

press). This research seems to suggest that memory is differentially affected by the type of lie performed. For example, several studies have shown that (false) denials can have an impact on memory accuracy in terms of forgetting of what was talked about and sometimes even for the experienced stimuli (Davis et al., 2018; Otgaar, Howe, Smeets, & Wang, 2016; Otgaar, Romeo, Howe, & Ramakers, 2018; Polage, 2018; Vieira & Lane, 2013). A similar pattern of results has been revealed for the impact of feigning amnesia on the correct recollection of an event, wherein participants asked to feign memory loss for a mock crime showed a poorer memory performance as compared with truth-tellers (Christianson & Bylin, 1999; Bylin, 2002; Bylin & Christianson, 2002; Mangiulli et al., 2018; van Oorsouw & Merckelbach, 2004, 2006; Sun et al., 2009). Furthermore, studies on forced fabrications have shown that when participants are forced to confabulate an answer, they sometimes include those fabricated details into their memory reports for the original event (Ackil & Zaragoza, 2011; Chroback & Zaragoza, 2008; Nourkova, Bernstein, & Loftus, 2004; Van Oorsouw & Giesbrecht, 2008).

In real-life situations, witnesses or suspects who are repeatedly interviewed (Fisher, 1995) tend to adopt the same deceptive strategy in order to be consistent with their version of the event during police interrogations (Fisher, Vrij, & Leins, 2013; Mangiulli, Lanciano, van Oorsouw, Jelicic, & Curci, 2019). A critical unresolved issue is whether memory becomes increasingly exacerbated when people are *repeatedly* involved in lying. We will first elaborate on the general effects of lying (i.e., false denials and fabrication) on memory. Then, we will concentrate on the theoretical relevance of examining the impact of repeated lies on memory.

Denials and Memory

Research on the effect of (false) denials on memory has demonstrated that falsely denying information about an event can undermine memory performance (Davis et al., 2018; Otgaar, Howe, Smeets, & Wang, 2016; Otgaar et al., 2018; Polage, 2018). For example, Vieira and Lane (2013) provided participants with several pictures (e.g., an apple) and then they randomly instructed them

to either deny vs tell the truth about having seen the studied vs unstudied pictures. After 48 hours, participants received a source monitoring task about old and new pictures, and they had to honestly recognize (1) whether they had studied the pictures and (2) whether they either lied or told the truth about the presented pictures. The authors found that participants showed an impairment for memory for having falsely denied seeing a studied object but demonstrated good memory for having falsely described an unstudied picture.

In another line of experimentation, Otgaar and colleagues (2014) showed a mock crime video to participants and questioned them about presented vs. non-presented details of the video. While one group was instructed to falsely deny to each question, another group was instructed to honestly answer to each of them. After one day, all participants answered honestly to a source memory test, where they were asked whether they talked about certain details and whether they saw these details. Results showed that participants seemed to forget that they talked about items they previously denied rather than having a worse memory for the video. This effect has been called *denial-induced forgetting* (DIF; Otgaar, Howe, Memon, & Wang, 2016). Such effect has been replicated also in other studies using other stimuli (e.g., negative and neutral pictures or virtual reality scene; Otgaar, Howe, Smeets, & Wang, 2016; Romeo, Otgaar, Smeets, Landstrom, & Boerboom, 2018), different memory tasks (e.g., recall and recognition task; Otgaar, Romeo, Howe, & Ramaekers, 2018) and different age groups (e.g. children and adults; Otgaar et al., 2014). Some of those replication studies also found an impairment not only on the memory for having discussed details but also an impairment on the memory for the stimuli (e.g., Romeo, Otgaar, Smeets, Landström, & Boerboom, 2019).

Fabrication and Memory

The effect of fabrication on memory has, for example, been investigated by adopting the *forced confabulation paradigm* (e.g., Ackil & Zaragoza, 1998, 2011; Zaragoza, Payment, Ackil, Drivdahl, & Beck, 2001). In this paradigm, participants are presented with some stimuli (e.g.,

video) and, after a delay, they are instructed to provide a fabricated description of the stimuli presented vs. not presented during the encoding. Specifically, the forced confabulators have to answer all questions even if they do not know the answer. After one week, participants receive a source memory task 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. Many studies using this paradigm have revealed that participants remember seeing the previously mentioned forced confabulations resulting in commission errors when genuinely recalling the event (e.g., Ackil & Zaragoza, 2011; Chroback & Zaragoza, 2008, 2012; Zaragoza et al., 2001) and in no specific effects on the memory for having discussed specific details.

Research conducted by Polage (2004; 2012) has also demonstrated that fabrications can affect memory for an event. In her studies, participants completed an interview about the false accounts previously provided. The participants' belief ratings regarding the likelihood that the event had happened was tested after another week or five-weeks. Overall, results demonstrated better memory for people who had lied, suggesting that lying can consolidate the memory for the truth. However, Polage also showed that deliberate lying, in particular intentionally fabricating, can lead to *fabrication inflation* (Polage, 2012; 2018), meaning that participants' beliefs for self-created events increased after lying about them, resulting in some confabulators to believe in their own lies.

Other research on the effect of fabrication on memory showed that memory impairment occurred only for fabricated details and not for the whole memory for the event (Pickel, 2004). This study demonstrated that participants who lied reported fewer correct details and more omissions and commission errors when asked to provide their memory but only for the recall of fabricated details (Pickel, 2004).

Theoretical Frameworks

There is limited work on the mechanisms underpinning the effect of lying on memory. Recently, the Memory and Deception (MAD) framework has been proposed to explain which

mechanisms might underlie the effects of lying on memory (i.e., false denials, feigned amnesia and fabrication) (Otgaar & Baker, 2017). In the MAD model, memory errors are considered the results of different types of lying. These different deceptive strategies, and their corresponding memory outcomes, are structured along a continuum. Otgaar and Baker (2017) argued that false denials and feigning amnesia require fewer cognitive resources than fabricating a different version of the event. When the act of lying involves fewer cognitive resources, omissions errors are likely to occur when recalling the genuine memory for the event. In contrast, when more cognitive resources (i.e., fabrication) are required, more distortions and commission errors might take place.

When fewer resources are required (e.g., false denial and feigned amnesia), individuals' memory impairments might be explained by a lack of rehearsal. That is, because rehearsal consolidates the storage of information, the lack of rehearsal of correct information does not permit the consolidation of the correct information and, hence, might lead to omission errors or forgetting (Anderson, Bjork, & Bjork, 1994; Anderson & Green, 2001; Christianson & Bylin, 1999; van Oorsouw & Merckelbach, 2004). On the other hand, when people fabricate details or an entire narrative, memory impairments can be explained in terms of source monitoring errors. Specifically, when people fabricate details, these false self-generated details may be confused with the true-original ones causing source monitoring errors (e.g., Johnson et al., 1993; Johnson, Raye, Foley, & Foley, 1981). However, the MAD framework is mute on the effect of *repeated* lying on memory. Indeed, no studies have investigated whether, for example, the *denial-induced forgetting* effect occurs also when false denials are repeatedly performed. Polage (2018) found that repeating fabrication could impair the ability to recognize lie from the truth. As such, the aim of the present experiment was twofold. First, we examined whether the DIF effect takes place even for *repeated* false denials. Second, we investigated whether a similar detrimental mnemonic outcome occurs when participants repeatedly fabricate new information about an event.

What does (related) research tell us about how repeated lying might affect memory? Several forgetting phenomena seem to be related to denial-induced forgetting, hence it might be informative to evaluate how repeated lying can affect memory. Indeed, using different paradigms, many scholars supported the idea that inhibition of the stimuli during the encoding phase can justify forgetting (e.g., *Directed forgetting,* Basden, Basden, & Gargano, 1993; *Think/No Think* paradigm, Anderson & Green, 2001; *retrieval-induced forgetting*, Anderson, Bjork, & Bjork, 1994).

However, although similar phenomena (i.e., directed forgetting or retrieval-induced forgetting) refer to forgetting of encoded stimuli, the denial-induced forgetting typically reflects a detrimental mnemonic effect for having talked about specific details. Nonetheless, the reviewed studies suggest that inhibition might play a role also in denial-induced forgetting cases. That is, the act of denial might lead to forgetting because the details that are denied are inhibited and this makes retrieval of those details difficult. However, to our knowledge, there are no studies that have shown whether inhibitory effects can increase with repetition. Hence, a critical question in denial-induced forgetting is whether this effect persists or can even become larger when people have to repeatedly deny.

The idea that repeatedly lying can have a larger detrimental effect on memory than when a lie is executed once converges with studies on the effects of repeated suggestions on memory (e.g., Ceci, Loftus, Leichtman, & Bruck, 1994; Hyman & Billings, 1998; Mitchell & Zaragoza, 1996; Porter, Yuille, & Lehman, 1999). For example, Zaragoza and Mitchell (1996) found that repeated exposure to suggestions increased the likelihood to report false memories. Based on the work on different forgetting phenomena (e.g., directed forgetting) and work on repeated suggestions on memory, repeated lying (e.g., false denials and fabrication) might increase the deteriorating effects on individuals' memory performance as well.

The Present Experiment

In the present experiment, participants were shown a video regarding a burglary, and were later questioned about the video. Next, participants were asked to either (falsely) deny, or fabricate, or honestly answer to certain questions. In the following ten days, some participants repeatedly (i.e., for three times) lied about certain details. Finally, all participants received a final memory test in which they were asked to tell the truth regarding their memory for the interview (recognition task) and memory for the video (recognition task and recall task).

Our main prediction was that forgetting for having discussed and seen items (recognition task), as a result of denying, would be increased for items that were repeatedly denied than for items that were denied only once. In addition, referring to the recall task, we expected the following for those items that participants were asked to repeatedly lie (i.e., falsely deny or fabricate) on: Participants who fabricated new items would have more commission errors than truth-tellers and deniers and participants who fabricated new items would have more commission errors for details lied more times than once.

Method

Participants

Using G*Power (Faul, Erdfelder, Lan, & Buchner, 2007), an a priori power analysis for a factorial ANOVA between three groups with a power of 0.80 and medium effect size ($f = 0.25$) indicated a sample of 120 participants was needed. A total sample of 121 students (M_{age}=23.01, *SD*=4.39, range 18-49, 89 women) from Maastricht University was recruited. There were no exclusion criteria and the study was conducted in a psychological laboratory, where participants were tested individually. The experimenter reminded participants that there were other sessions at the end of each one. After receiving their instructions, participants received an example on how correctly answer to the questions. Participants received credit points or vouchers for their involvement at the end of the final session. All the participants completed the five sessions and adhered to the instructions of each phase. The ethical committee of the Faculty of Psychology and

Neuroscience of Maastricht University approved the study. This study was preregistered (osf.io/whxzk) and all the data and materials can be accessed on the Open Science Framework: osf.io/2a4mf .

Materials

Video. We used a video that has been successfully used in previous memory studies (Otgaar et al., 2014, 2016; Takarangi, Parker, & Garry, 2006). The video is called "Eric the electrician". In the video, Eric enters a house and steals several items (e.g., jewellery, CD) in that house while he was doing some electrical jobs. The duration of the video was 6.5 minutes.

Design and Procedure

The experiment used a 3 (Condition: False Denial, Fabrication, Truth telling) x 3 (Repetition: Never, Once, Four) mixed design with condition as between-subjects factor and repetition as within-subjects factor. The dependent variables were the three recall scores for the memory of the original event (i.e., correct details, omissions and commissions) and the two source monitoring scores (i.e., having discussed items vs. having seen items). Participants were randomly divided into the three different conditions. The study was composed of five sessions carried out in two weeks.

Session 1

Stimulus Presentation. After signing the informed consent, participants watched the video "Eric the electrician". Then for five minutes, they were involved in a distractor task that required to solve some mathematical problems (i.e., equations).

Baseline Memory Test. Immediately after the distractor task, in order to ascertain whether participants properly encoded the crime stimulus (i.e., video), a baseline memory test was performed. Participants answered 10 questions regarding details that were present in the video (e.g., "*What vehicle did Eric arrive with?"*) and provided a memory rating question for each item (e.g., "*Do you actually remember seeing what vehicle Eric arrived with?";* 1 = no memory at all, 8 =

clear and complete memory; Scoboria et al., 2004). Then, they engaged in a filler task for 5 minutes (i.e., play a game).

Lying Phase. After the baseline memory test, participants received a total of other 12 questions pertaining to the video. The questions were asked by the experimenter. In this phase, participants in the truth-telling condition were instructed to answer honestly to all questions (e.g., *"What vehicle did Eric arrive with?"*, correct answer: *blue van*), while participants in the false denial condition were instructed to deny in response to each question (e.g., *"What vehicle did Eric arrive with?"*, answer instructed: *"Eric did not arrive with a vehicle"*). Finally, participants in the fabrication condition were instructed to fabricate a new version for each item (e.g., *"What vehicle did Eric arrive with?"*, possible fabricated answer: *green bus*). The task contained 8 questions concerning true information shown in the video (also asked on the first memory test; i.e., true items, e.g. "*In which room did Eric open a window?"*) and 4 additional questions pertaining to details that were not presented in the video (i.e., false items, e.g., "*What kind of pet was in the living room?")*.

Sessions 2-4

Repeated Lying Phase. In the ten days following the first session, participants were subjected to the repeated lying (i.e., false denials and fabrication) manipulation. That is, across other three sessions (i.e., sessions 2-4), participants answered to some of the questions we provided them during session 1. To be more precise, by following the same instructions given at session 1 (i.e., false denial, fabrication and truth telling) participants responded to 6 of the previously presented 12 questions (i.e., 4 true and 2 false questions).

Final Memory Test. Finally, a memory task was assessed. Before starting the final memory test, the experimenter administered an example of questions to participants in order to assure that participants really understood what they had to do. Then, all participants (i.e., false denial, fabrication and truth telling) genuinely answered to 16 questions. Note that of these 16 questions, 10 were related to true[3] details (5 were asked only once at session 1 – of which 3 were asked four

times from session 1 to 4 – and 5 were never discussed) and 6 were related to false[3] details (3 were asked only once at session 1 – of which 1 was asked four times from session 1 to 4 – and 3 were never discussed) (see Appendix A). Each question referred to (a) information discussed both during session 1 and sessions 1-4 (e.g., "*When we spoke during the very first session, did we discuss what vehicle Eric arrived with?"* and "*In the previous sessions, did we discuss what vehicle Eric arrived with?"*, respectively), and (b) recognition and recall of information seen in the video (e.g., "*When watching the video, did you see what vehicle arrived Eric with?"*). Additionally, each item had a memory rating question for the details seen in the video (e.g., "*Do you actually remember seeing what vehicle Eric arrived with?";* 1 = no memory of the event at all; 8 = clear memory of the event). The final memory test contained 8 items asked once in session 1, 4 items asked four times in sessions from 1 to 4 and 8 items never asked (see Appendix A). Finally, participants were thanked and debriefed.

---- insert Figure 1 about here ------

Scoring

Each answer was scored based on (i) three recognition memory performance indices [i.e., 1. items seen in the video; 2. items discussed[4] at session 1; 3. items repeatedly discussed in the sessions from 1 to 4, respectively]. To calculate the three indices of recognition, one point was assigned for each correct answer at the first three sub-questions [e.g., 1) items seen in the video *"When watching the video, did you see what vehicle arrived Eric with?";* correct answer*: yes;* 2) items discussed at session 1 *"When we spoke during the very first session, did we discuss what vehicle Eric arrived with?";* correct answer*: yes;* 3) items repeatedly discussed *"In the previous sessions, did we discuss what vehicle Eric arrived with?";* correct answer: *yes*].

Furthermore, (ii) three recall memory performance (open question: "*When watching the video, did you see what vehicle arrived Eric with*") indices were identified (1. correct recall of items seen in the video; 2. omissions and 3. commissions). To calculate the indices of recall, 1. one point

was given for each correct answer (e.g., *"When watching the video, did you see what vehicle arrived Eric with?";* correct answer: *blue van*), while a half point was assigned for a partially correct answer (e.g., *van*). When participants provided no answer (e.g., "*I do not remember"*) or provided an incorrect answer (e.g., *green bus*) a zero score was given. Additionally, errors in terms of omissions and commissions were calculated. 2. For omission scores, one point was given when participants provided no answer (e.g., *I do not remember*). 3. For commission scores, one point was assigned when participants gave a wrong answer (e.g., *green bus*) or a half point was given when participants provided a partially distorted answer (e.g., *white van*).

All the scores were separately summed considering for the items discussed once (maximum score: 8), the items discussed four times (maximum score: 4), and the items never discussed (maximum score: 8). For all the scores, proportions were calculated dividing the score obtained by the maximum score. Additionally, the recognition and recall scores were summed considering the true and false items discussed once (maximum score: 5 and 3, respectively), four times (maximum score: 3 and 1, respectively) and never discussed (maximum score: 5 and 3, respectively)[5]. Also for these scores, proportions were computed dividing the score obtained by the maximum score.

Results

Baseline Memory Performance

A one-way ANOVA was conducted on the baseline memory performance between groups (false denial, fabrication, truth-telling). The overall mean proportion baseline memory performance across groups was .68 (*SD* =.17, range .30-1.00) suggesting that the video was not too difficult and complex for all the participants. The statistical analysis showed that the truth-telling (*M* = .66, *SD* =.18), false denial (*M* = .72, *SD* =.17), and fabrication (*M* = .68, *SD* =.16) groups did not statistically differ from each other in terms of memory performance, $F(2, 118) = 1.34$, $p = .27$, $\omega^2 = .03$.

Final Memory Performance

(i) *Recognition Task*. Three 3 (Condition: false denial, fabrication, truth-telling) x 3 (Repetition: never, once, four times) repeated measures ANOVAs, with the first factor being as between-subjects, were conducted on participants' recognition scores (source monitoring task). Specifically, ANOVAs were performed on participants' memory for (a) having seen items in the video, (b) having discussed items at session 1, and (c) having repeatedly discussed items from session 1 to 4, respectively.

1. Items Seen in the Video. To begin with, regarding participants' ability to recognize information originally displayed in the video, only a statistically significant main effect of repetition was observed, $F(2,118) = 56.18$, $p < .001$, $\eta_p^2 = .32$. Other main or interaction effects did not reach significance, $Fs(4,236) < 2.16$, $p > .07$. That is, we found that participants' memory performance concerning information seen in the video was better when information was discussed once ($M = .70$, 95% CI [.67, .74]) than when it was not discussed at all ($M = .51$, 95% CI [.47, .54], $p < .001$, 95% CI [.16, .23], $d = 1.05$). Additionally, we also found statistically significant differences between participants' memory for items seen in the video when items were discussed four times ($M = .69$, 95% CI [.65, .73]) than when items never discussed ($p < .001$, 95% CI [.14, .22], $d = .73$). By contrast, no statistically significant difference was found on participants' memory for items seen in the video between items discussed once and items discussed four times ($p = 1.00$). Other effects were not statistically significant (all ps > .05).

2. Items Discussed during Session 1. Regarding the memory for just having discussed items at session 1, analyses showed neither statistically significant main nor interaction effects, $Fs(2,118) < 2.81$, $p > .06$.

3. Items Discussed from Session 1 to 4. Finally, with respect to participants' memory for having discussed items at sessions 1-4 (repeated discussion), analyses showed a statistically significant condition by repetition interaction effect, $F(4,236) = 2.93$, $p = .02$, $\eta_p^2 = .05$, and a statistically significant main effect of repetition, $F(2,118) = 38.55$, $p < .001$, $\eta_p^2 = .25$. The main

effect of condition was found not statistically significant, $F(2,118) = 1.73$, $p = .18$, $\eta_p^2 = .03$. Simple effect analyses demonstrated that participants' memory performance for the discussion for the items that were falsely denied once ($M = .68$, 95% CI [.62, .74]) was statistically lower than for items never falsely denied ($M = .89$, 95% CI [.84, .94], $p < .001$, 95% CI [-.27, -.15], $d = -1.08$). Memory performance was also statistically lower for items that were falsely denied four times ($M = .72$, 95% CI [.65, .79]) than for items never falsely denied ($p < .001$, 95% CI [-.26, -.08], $d = -.61$). Furthermore, among those who were instructed to fabricate new information, participants' memory performance for the interview was statistically lower for items fabricated once ($M = .73$, 95% CI [.68, .79]) than for items never fabricated ($M = .87$, 95% CI[.82, .92], $p < .001$, 95% CI [-.18, -.08], $d = -.78$). Other differences of our interest were not statistically significant (all $ps > .05$).

(ii) *Recall Task*. Three 3 (Condition: false denial, fabrication, truth-telling) x 3 (Repetition: never, once, four times) repeated measures ANOVAs, with the first factor being as between-subjects, were conducted on participants' recollection for what was seen in the video, with respect to correct scores, and omission and commission error scores, respectively.

1. Correct scores. Regarding the correct recall scores, a statistically significant condition by repetition interaction effect was found, $F(4,236) = 4.67$, $p = .001$, $\eta_p^2 = .07$. Also, the main effect of repetition was statistically significant, $F(2,118) = 79.04$, $p < .001$, $\eta_p^2 = .40$. However, the main effect of condition was not, $F(2,118) = 0.16$, $p = .85$, $\eta_p^2 = .003$. Simple effect analyses revealed that participants reported correct information that was never falsely denied to a statistically lower extent ($M = .27$, 95% CI [.21, .32]) than both information falsely denied once ($M = .60$, 95% CI [.54, .67], $p < .001$, 95% CI [-.41, -.26], $d = -1.46$) and four times ($M = .48$; 95% CI [.40, .55], $p < .001$, 95% CI [-.29, -.12], $d = -.78$). More interestingly, recall scores were also statistically lower for items falsely denied four times than for items falsely denied once ($p < .001$, 95% CI [-.18, -.08], $d = -.83$). Furthermore, with respect to fabricated items, participants' correct recollection for items that were never fabricated ($M = .36$; 95% CI [.29, .43]) was lower than for items fabricated once ($M = .52$;

95% CI [.46, .59], $p < .001$, 95% CI [-.25, -.09], $d = -.64$). No statistically significant differences were found between items never fabricated and fabricated four times and between items fabricated once and four times (all *ps* > .05). (see Fig.1 a).

2. Omission error scores. With respect to the omissions scores, a statistically significant interaction effect, $F(4,236) = 4.05$, $p = .003$, $\eta_p^2 = .06$, was found. A statistically significant main effect of factor repetition was also found, $F(2,118) = 173.31$, $p < .001$, $\eta_p^2 = .60$, while the main effect of factor condition was not, $F(2,118) = 0.30$, $p = .74$, $\eta_p^2 = .005$. Simple effect analyses showed that omissions were statistically significantly lower for items falsely denied once ($M = .16$; 95% CI [.11 .20]) than for items never falsely denied ($M = .57$; 95% CI [.52, .62]; $p < .001$, 95% CI [-.49, -.34], $d = -1.80$). Omissions scores were also statistically lower for items denied four times ($M = .16$; 95% CI [.10, .23]) than for items never falsely denied ($p < .001$, 95% CI [-.49, -.32], $d = -1.51$). No statistically significant difference was found between items denied once and denied four times ($p = 1.00$). The same effects were also found for the fabrication group. That is, omissions were significantly lower for items fabricated once ($M = .26$; 95% CI [.19, .33]) than for items never fabricated ($M = .49$; 95% CI[.43, .55], $p < .001$, 95% CI [-.30, -.16], $d = -1.01$). They were also statistically lower for items fabricated four times ($M = .21$; 95% CI [.12, .30]) than never fabricated ($p < .001$, 95% CI [-.37, -.19], $d = -1.01$). Again, the difference between items fabricated once and items fabricated four times was not statistically significant ($p = 1.00$). (see Fig.1 b)

3. Commission error scores. Finally, we only found a statistically significant main effect of repetition, $F(2,118) = 36.88$, $p < .001$, $\eta_p^2 = .24$, on participants' commission error scores. That is, commission errors were higher for items discussed once ($M = .24$, 95% CI [.21, .27]) than for items discussed four times ($M = .15$, 95% CI [.12, .17], $p < .001$, 95% CI [.06, .12], $d = .55$). Moreover, commissions were higher for items discussed once than for items never discussed ($M = .11$, 95% CI [.08, .14], $p < .001$, 95% CI [.09, .16], $d = .58$). No other effects were statistically significant (all *p*s > .05). (see Fig.1 c)

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Discussion

We aimed to experimentally investigate the impact of repeated lying (i.e., false denials and fabrication) on memory for a crime. The main findings of the current study can be summarized as follows. First, considering the recognition scores of having discussed items during the interviews, we found that participants who were instructed to falsely deny details of the crime event were less likely to recognize those items during the final interview as compared with other information not subjected to the denial. Second, with regard to recall scores, participants were less likely to correctly recall details that were denied four times than items that were denied only once. We will now discuss the relevance of our findings for understanding the relation between lying and memory.

To begin with, our findings on the recognition scores for having discussed items during the interviews did not show the specific *denial-induced forgetting* effect (DIF; Otgaar et al., 2016), where typically participants asked to falsely deny have more difficulty to remember having discussed items than participants in other conditions. This is in contrast with previous studies (e.g., Otgaar et al., 2014; Otgaar et al., 2016; Otgaar et al., 2017; Otgaar et al., 2018). Specifically, we found that the ability to accurately remember which items were discussed or not during the final interview was affected by only the act of having denied. We do not know what the exact reason for this might be. Perhaps, the reason could be the different design adopted in the current experiment, where our participants were asked to deny details once, repeatedly, and never, respectively. Indeed, in line with this idea and to some extent related to DIF, we showed that, within the denial group, denied details (once or four times) were less well remembered as being discussed than items that were never denied. This does imply that the act of denial impaired participants' ability to retrieve items that were mentioned during the interview.

Regarding the data for what was seen in the video, we found that discussing details repeatedly made participants more able to recognize those aspects irrespective of having previously lied or honestly accounted for those details only once. Arguably, repeatedly denying, fabricating or honestly discussing about details of an event might paradoxically produce rehearsal effects, thereby consolidating memory for having seen details in the video. Interestingly, our findings showed that participants exhibited an overall good recollection for items they had to repeatedly lie about and not only for those that were repeatedly honestly discussed. Perhaps, while repeatedly rehearsing all items, participants were more aware of those they had to lie about and this benefitted the recollection of both seen and not-seen items. Indeed, rehearsal increases recollection of information in a subsequent retrieval due to a better consolidation of the information (e.g., Anderson et al., 1994; Christianson & Bylin, 1999; Dark & Loftus, 1976; Turtle & Yuille, 1994).

Referring to recall scores, our data showed that the repeated act of false denials increased the detrimental effects on memory. However, we unexpectedly found a better correct recall when details were denied once than when details were never denied. The same pattern of results was showed for fabrication. These findings seem to support the idea that having rehearsed details of the video once resulted in an enhancement of memory, irrespective of the deceptive strategy adopted. Furthermore, and interestingly, we showed that deniers reported fewer correct details for items repeatedly denied than for items denied once as well. On the contrary, we did not find such an effect for fabricators. Those latter results suggest a DIF effect not only for memory for having discussed items but also for recall performance for the video. This is in line with research by Romeo, Otgaar, Smeets, Landström, and Boerboom (2019) who also found that false denials impaired memory for the stimuli. The idea that forgetting can be a result of falsely denying is sustained by the recall scores of fabrication and truth-telling groups that have demonstrated no significant differences between memory for what was seen when the items were discussed once and when the items were discussed more times.

What could be the explanation for the denying effect? Drawing on Otgaar and colleagues' suggestion (2016), this observed forgetting might be explained with the idea that when people have to deny having seen details, lying about such details might inhibit the memory for those details. Hence, when it is asked to recall which details were seen or not, deniers are less able to retrieve the memory of them. For that reason, we argue that having repeatedly falsely denied specific details of the event resulted in a larger inhibition effect of the original memory.

With respect to the omission scores, we found lower omissions for items falsely denied and fabricated than for items never falsely denied and fabricated. In particular, omissions were lower for the items both denied and fabricated more times than for the ones denied and fabricated once. Moreover, relative to commission scores, we found that commissions were highest for items lied once than never lied or lied more times. These findings suggest that having repeatedly lied (falsely denied or fabricated) impact memory for the event. However, the repeated lies impaired correct recollection, rather than increasing memory errors (e.g., omissions and commissions).

Limitations

Several limitations of the present experiment need to be addressed. First, our sample was composed only by undergraduate students who can differ in many ways from individuals who provide a testimony to the police. Furthermore, although our participants carefully watched the crime stimulus in a quiet test room, such exposure to the crime differs from real life situation wherein several factors may jeopardize individuals' ability to properly encode the event (e.g., bad lightning conditions). For those reasons, our findings may have limited ecological validity.

Another important step for the next studies could be to include a feigning amnesia group in order to assess the effect of repeated feigning amnesia on memory. As for false denials and fabrication, many studies have been conducted to understand the effect of simulating amnesia on memory, but very little is known about the effects of feigning amnesia if it is performed several times. Indeed, research on feigning amnesia has shown that this strategy undermines memory

(Bylin & Christianson, 2002; Christianson & Bylin, 1999; Mangiulli, van Oorsouw, Curci, Merckelbach, & Jelicic, 2018; Newton & Hobbs, 2015; Van Oorsouw & Merckelbach, 2004; Van Oorsouw & Merckelbach, 2006) and this undermining was explained with the lack of rehearsal of information cued by simulating amnesia (Christianson & Bylin, 1999; Sun, Punjabi, Greenberg, & Seamon, 2009). Moreover, another critical point is that the study was designed only to evaluate the effect of lying on memory, but our data restricts us to provide an explanation for the mechanisms that might have played a role when individuals are asked to repeatedly lie as well as do not permit to quantify the impact on memory of each lying occasion. Hence, future work might try to fill in these gaps.

Practical Implications and Conclusion

To conclude, in the current experiment, we found evidence that repeated lying might, under certain circumstances, impairs memory more than when lying is exerted only once. That is, participants that repeatedly denied certain items were less likely to remember having seen these details than when items were denied only once. The results of the present experiment might shed new light on the understanding of the effects of lying on memory and whether these effects might become more pronounced when lying is performed repeatedly. Despite the fact that an experimental situation differs on many levels from real situations, our findings might have practical implications in the forensic context. Specifically, police officers and legal professional should be aware that when eyewitnesses who previously lied about an event come forward with the truth, the act of lying might adversely affect their original memory for such event. This seems to be even more harmful when lying is repeatedly exerted. Moreover, because of detrimental effects on memory due to the act of lying, our findings suggest that jurors should carefully weigh eyewitnesses' memory reports when there is risk that lying might have contaminated those statements. Understanding whether it is possible to preserve actual memory for an event is an important issue within the legal arena. Based

on the findings of the current experiment, we encourage more research examining true recollections for criminal experiences after repeated lying.

Notes

[1] In this paper, we will be using the term "lying" when we do not want to indicate a specific deceptive strategy (i.e., false denials, feigned amnesia or fabrication), but in general we refer to the act of deceiving the listener.

[2] Throughout the paper, we will be referring to individuals' memory performance by using the term "memory".

[3] "True items" refer to items seen in the video, while "false items" to items not presented in the video.

[4] We used the expression "items discussed" to indicate the items that were honestly answered, denied or fabricated (once or four times) during the lying phases.

[5] Analyses on the true and false details scores are available on OSF (osf.io/2a4mf) as Exploratory Analyses

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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. https://doi:10.1037/0012-1649.34.6.1358

Ackil, J. K., & Zaragoza, M. S. (2011). Forced fabrication versus interviewer suggestions: Differences in false memory depend on how memory is assessed. *Applied Cognitive Psychology*, *25*, 933–942. https://doi:10.1002/acp.1785

Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20*, 1063–1087. https://doi.org/10.1037/0278-7393.20.5.1063

Anderson, M. C., & Green, C. (2001). Suppressing unwanted memories by executive control. *Nature, 410*, 366–369. http://doi:10.1038/35066572

Anderson, M. C., & Huddleston, E. (2012). Towards a cognitive and neurobiological model of motivated forgetting. In *True and false recovered memories* (pp. 53-120). Springer, New York, NY. http://doi:10.1007/978-1-4614-1195-6_3

Anderson, M. C., & Neely, J. H. (1996). Interference and inhibition in memory retrieval. In E. L. Bjork & R. A. Bjork (Eds.), *Memory: Handbook of perception and cognition* (2nd ed., pp. 237–313). San Diego, CA: Academic Press. http://doi:10.1016/b978-012102570-0/50010-0

Basden, B. H., Basden, D. R., & Gargano, G. J. (1993). Directed forgetting in implicit and explicit memory tests: A comparison of methods. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19*, 603–616. http://doi.org/10.1037/0278-7393.19.3.603

Bjork, R. A. (1972). Theoretical implications of directed forgetting. In A. Melton & E. Martin (Eds.), *Coding processes in human memory* (pp. 217–235). Washington, DC: Winston.

Block, S. D., Shestowsky, D., Segovia, D. A., Goodman, G. S., Schaaf, J. M., & Alexander, K. W. (2012). "That never happened": Adults' discernment of children's true and false memory reports. *Law and Human Behavior*, *36*, 365–374. https://doi:10.1037/h0093920

Ceci. S.J.. Loftus. E.F.. Leichtman. M.D . & Bruck. M.(I994). The possible role of source misattributions in the creation of false beliefs among preschoolers. *The International Journal of Clinical and Experimental Hypnosis, 42,* 304-320.https://doi:10.1080/00207149408409361

Christ, S. E., Van Essen, D. C., Watson, J. M., Brubaker, L. E., & McDermott, K. B. (2009). The contributions of prefrontal cortex and executive control to deception: Evidence from activation likelihood estimate meta-analyses. *Cerebral Cortex, 19*, 1557–1566. https://doi:10.1093/cercor/bhn189

Christianson, S. A., & Bylin, S. (1999). Does simulating amnesia mediate genuine forgetting for a crime event? *Applied Cognitive Psychology, 13*, 495–511. https://doi.org/10.1002/(sici)1099-0720(199912)13:6<495::aid-acp615>3.0.co;2-0

Christianson, S. A., & Merckelbach, H. (2004). "Crime-related amnesia as a form of deception," in The *Detection of Deception in Forensic Contexts,* eds P. A. Granhag & L. A. Strömwall (New York, NY: Cambridge University Press), 195–225. http://doi.org/10.1017/CBO9780511490071.009

Chroback, 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. https://doi:10.3758/PBR.15.6.1190

Chroback, Q. M., & Zaragoza, M. S. (2012). The misinformation effect. In A. M. Ridley, F. Gabbert, & D. J. La Rooy (Eds.), *Suggestibility in legal contexts: Psychological research and forensic implications* (pp. 21–44). London: Wiley Blackwell. https://doi:10.1002/9781118432907.ch2

Cima, M., Merckelbach, H., Hollnack, S., & Knauer, E. (2003). Characteristics of psychiatric prison inmates who claim amnesia. *Personality and Individual Differences*, *35*, 373–380. https://doi:10.1016/S0191-8869(02)00199-X

Cima, M., Merckelbach, H., Nijman, H., Knauer, E., & Hollnack, S. (2002). I can't remember your honor: Offenders who claim amnesia. *German Journal of Psychiatry*, *5*, 24–34.

Conway, M. A., Harries, K., Noyes, J., Racsma'ny, M., & Frankish, C. R. (2000). The disruption and dissolution of directed forgetting: Inhibitory control of memory. *Journal of Memory and Language 43*, 409–430. http://doi.org/10.1006/jmla.2000.2706

Davis, J., Bayantemur, S., Seecharan, S., Unger, L., Hellgren, J., & Stone, C. (2018). Fluctuating confidence: The dynamic consequences of true/false affirmatives and denials on how a listener appraises their personal past. *Memory*, *26*, 882–893. https://doi.org/10.1080/09658211.2018.1468468

Dark, V. J., & Loftus, G. R. (1976). The role of rehearsal in long-term memory performance. *Journal of Verbal Learning and Verbal Behavior, 15*, 479-490. https://doi:10.1016/s0022-5371(76)90043-8

Depaulo, B., Kashy, D., Kirkendol, S., Wyer, M., & Epstein, J. (1996). Lying in everyday life. *Journal of Personality and Social Psychology, 70*, 979–795. https://doi:10.1037/0022-3514.70.5.979

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175–191. https://doi.org/10.3758/BF03193146

Fisher, R. P. (1995). Interviewing victims and witnesses of crime. *Psychology, Public Policy, & Law, 1*, 732-764. https://doi.org/10.1037/1076-8971.1.4.732

Fisher, R. P., Vrij, A., & Leins, D. A. (2013). Does testimonial inconsistency indicate memory inaccuracy and deception? Beliefs, empirical research, and theory. In *Applied issues in*

investigative interviewing, eyewitness memory, and credibility assessment (pp. 173-189). Springer: New York. https://doi:10.1007/978-1-4614-5547-9_7

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*, 208–214. http://doi.org/10.3758/BF03212420

Gombos, V., Pezdek, K., & Haymond, K. (2012). Forced confabulation affects memory sensitivity as well as response bias. *Memory and Cognition, 40*, 127–134. https://doi.org/10.3758/s13421-011-0129-5

Goodman-Brown, T. B., Edelstein, R. S., Goodman, G. S., Jones, D. P. H., & Gordon, D. S. (2003). Why children tell: A model of children's disclosure of sexual abuse. *Child Abuse & Neglect, 27*, 525–540. https://doi.org/10.1016/S0145-2134(03)00037-1

Gudjonsson, G. H., Sigurdsson, J. F., & Einarsson, E. (2004). The role of personality in relation to confessions and denials. *Psychology, Crime & Law*, *10*, 125–135. https://doi.org/10.1080/10683160310001634296

Hanba, J. M., & Zaragoza, M. S. (2007). Interviewer feedback in repeated interviews involving forced confabulation. *Applied Cognitive Psychology, 21*, 433–455. https://doi.org/10.1002/acp.1286

Hyman, I. E., & James Billings Jr, F. (1998). Individual differences and the creation of false childhood memories. *Memory*, *6*, 1-20. https://doi:10.1080/741941598

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin, 114*, 3–28. https://doi:10.1037/0033-2909.114.1.3

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review, 88*, 67-85. https://doi.org/10.1037/0033-295X.88.1.67

Kassin, S. M., Leo, R. A., Meissner, C. A., Richman, K. D., Colwell, L. H., Leach, A. M., et al. (2007). Police interviewing and interrogation: A self-report survey of police practices and beliefs. *Law and Human Behaviour, 31*, 381–400.

Levy, B. J., and Anderson, M. C. (2002). Repression can (and should) be studied empirically. *Trends Cogn. Sci. 6*, 502–503. https://doi.org/10.1016/S1364-6613(02)02025-9

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

MacLeod, C. M. (2012). Directed forgetting. *Encyclopedia of the Sciences of Learning*, 993-995. https://doi:10.1007/978-1-4419-1428-6_1084

Mangiulli, I., Lanciano, T., Van Oorsouw, K., Jelicic, M., & Curci, A. (2019). Do reminders of the crime reverse the memory-undermining effect of simulating amnesia?. *Memory & cognition*, 1-11. https://doi.org/10.3758/s13421-019-00939-z

Mangiulli I., van Oorsouw K., Curci A., Merckelbach H., & Jelicic, M. (2018). Feigning Amnesia Moderately Impairs Memory for a Mock Crime Video. *Frontiers in Psychology*, *9:625*. https://doi.org/10.3389/fpsyg.2018.00625

Marshall, W. L., Serran, G., Marshall, L. E., & Fernandez, Y. M. (2005). Recovering memories of the offense in "amnesic" sexual offenders. *Sexual Abuse: A Journal of Research and Treatment*, *17*, 31–38. https://doi.org/10.1177/107906320501700104

McWilliams, K., Goodman, G. S., Lyons, K. E., Newton, J., & Avila-Mora, E. (2014). Memory for child sexual abuse information: Simulated memory error and individual differences. *Memory & Cognition, 42,* 151–163. https://doi.org/10.3758/s13421-013-0345-2

Mitchell, K. J., & Zaragoza, M. S. (1996). Repeated exposure to suggestion and false memory: The role of contextual variability. *Journal of Memory and Language*, *35*, 246-260. https://doi:10.1006/jmla.1996.0014

Newton, J. W., & Hobbs, S. D. (2015). Simulating memory impairment for child sexual abuse. *Behavioral sciences & the law*, *33*, 407-428. https://doi:10.1002/bsl.2197

Nourkova, V., Bernstein, D., & Loftus, E. (2004). Altering traumatic memory. *Cognition and Emotion*, *18*, 575–585. https://doi.org/10.1080/02699930341000455

Otgaar, H. & Baker, A. (2017): When lying changes memory for the truth, *Memory, 26(1),* 2-14. https://doi.org/10.1080/09658211.2017.1340286

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 & Criminological Psychology, 15,* 229-241. https://doi.org/10.1348/135532509X471951

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. https://doi.org/10.1002/bsl.2148

Otgaar, H., Howe, M. L., Smeets, T., & Wang, J. (2016). Denial-induced forgetting: False denials undermine memory but external denials undermine belief. *Journal of Applied Research in Memory and Cognition*, *5*, 168–175. https://doi.org/10.1016/j.jarmac.2016.04.002

Otgaar, H., Romeo, T., Howe, M. L., & Ramakers, N. (2018). Forgetting having denied: The "amnesic" consequences of denial. *Memory & Cognition*, *46*, 520–529. https://doi.org/10.3758/s13421-017-0781-5

Otgaar, H., Scoboria, A., & Mazzoni, G. (2014). On the existence and implications of non-believed memories. *Current Directions in Psychological Science*, *23*, 349–354. https://doi.org/10.1177/0963721414542102

Pezdek, K., Lam, S. T., & Sperry, K. (2009). Forced confabulation more strongly influences event memory if suggestions are other-generated than self-generated. *Legal and Criminological Psychology, 14*, 241–252. https://doi.org/10.1348/135532508X344773

Pezdek, K., Sperry, K., & Owens, S. M. (2007). Interviewing witnesses: The effect of forced confabulation on event memory. *Law and Human Behavior, 31,* 463–478. http://doi.org/10.1007/s10979-006-9081-5

Pickel, K. (2004). When a lie becomes the truth: The effects of self-generated misinformation on eyewitness memory. *Memory, 12*, 14–26. https://doi.org/10.1080/09658210244000072

Polage, D. C. (2004). Fabrication deflation? The mixed effects of lying on memory. *Applied Cognitive Psychology, 18*, 455–465. https://doi.org/10.1002/acp.995

Polage, D. C. (2012). Fabrication inflation increases as source monitoring ability decreases. *Acta Psychologica, 139*, 335–342. https://doi.org/10.1016/j.actpsy.2011.12.007

Polage, D. C. (2018) Liar, liar: Consistent lying decreases belief in the truth. *Applied Cognitive Psychology*. https://doi.org/10.1002/acp.3489

Pyszora, N. M., Barker, A. F., & Kopelman, M. D. (2003). Amnesia for criminal offences: a study of life sentence prisoners. *The Journal of Forensic Psychiatry*, *14*, 475-490. https://doi:10.1080/14789940310001599785

Rogers, R., & Dickey, R. (1991). Denial and minimization among sex offenders. *Annals of Sex Research*, *4*, 49–63. https://doi:10.1007/bf00850139

Romeo, T., Otgaar, H., Smeets, T., Landström, S., & Boerboom, D. (2019). The impact of lying about a traumatic virtual reality experience on memory. *Memory & Cognition*, *47*, 485- 495.

Scoboria, A., Mazzoni, G., Kirsch, I., & Relyea, M. (2004). Plausibility and belief in autobiographical memory. *Applied Cognitive Psychology*, *18*, 791–807. https://doi.org/10.1002/acp.1062

Sporer, S. L., & Schwandt, B. (2006). Paraverbal indicators of deception: A meta-analytic synthesis. *Applied Cognitive Psychology, 20*, 421–446. https://doi.org/10.1002/acp.1190

Suchotzki, K., Verschuere, B., Van Bockstaele, B., Ben-Shakhar, G., & Crombez, G. (2017). Lying takes time: A meta-analysis on reaction time measures of deception. *Psychological Bulletin*, *143*, 428-453. https://doi.org/10.1037/bul0000087

Suengas. A.G., & Johnson, M.K. (1988). Qualitative effects of rehearsal on memories for perceived and imagined complex events. *Journal of Experimental Psychology: General, 117.* 377-389. https://doi:10.1037/0096-3445.117.4.377

Sun, X., Punjabi, P. V., Greenberg, L. T., & Seamon, J. G. (2009). Does feigning amnesia impair subsequent recall? *Memory & Cognition, 37*, 81–89. https://doi.org/10.3758/MC.37.1.81

Takarangi, M. K. T., Parker, S., & Garry, M. (2006). Modernising the misinformation effect: The development of a new stimulus set. *Applied Cognitive Psychology, 20,* 583-590. https://doi:10.1002/acp.1209

Tysse, J. E. (2005). Note: The right to an imperfect trial—Amnesia, malingering, and competency to stand trial. William Mitchell Law Review, 32, 353.

Tysse, J. E., & Hafemeister, T. L. (2006). Amnesia and the determination of competency to stand trial. Developments in Mental Health Law, 25, 65–80.

Turtle, J. W., & Yuille, J. C. (1994). Lost but not forgotten details: Repeated eyewitness recall leads to reminiscence but not hypermnesia. *Journal of Applied Psychology*, *79*, 260. https://doi:10.1037/0021-9010.79.2.260

Van Oorsouw, K., & Merckelbach, H. (2004). Feigning amnesia undermines memory for a mock crime. *Applied Cognitive Psychology, 18,* 505–518. https://doi.org/10.1002/acp.999

Van Oorsouw, K., & Merckelbach, H. (2006). Simulating amnesia and memories of a mock crime. Psychology, *Crime&Law, 12*, 261–271. https://doi.org/10.1080/10683160500224477

Van Oorsouw, K., & Giesbrecht, T. (2008). Minimizing culpability increases commission errors in a mock crime paradigm. *Legal and Criminological Psychology*, *13*, 335–344. https://doi.org/10.1348/135532507X228539

Vieira, K. M., & Lane, S. M. (2013). How you lie affects what you remember. *Journal of Applied Research in Memory and Cognition*, *2*, 173–178. https://doi.org/10.1016/j.jarmac.2013.05.005

Vrij, A. (2008). Detecting lies and deceit: Pitfalls and opportunities. Chichester: Wiley.

Vrij, A., & Ganis, G. (2014). Theories in Deception and Lie Detection. Credibility Assessment, 301–374. https://doi.org/10.1016/b978-0-12-394433-7.00007-5

Walczyk, J. J., Harris, L. L., Duck, T. K., & Mulay, D. (2014). A social-cognitive framework for understanding serious lies: Activation-decision-construction-action theory. *New Ideas in Psychology, 34*, 22–36. https://doi.org/10.1016/j.newideapsych.2014.03.001

Zaragoza, M. S., & Mitchell, K. J. (1996). Repeated exposure to suggestion and the creation of false memories. *Psychological Science*, *7*, 294-300. https://doi:10.1111/j.1467-9280.1996.tb00377.x

Zaragoza, M. S., Payment, K. E., Ackil, J. K., Drivdahl, S. B., & Beck, M. (2001). Interviewing witnesses: Forced confabulation and confirmatory feedback increase false memories. *Psychological Science, 12*, 473–477. https://doi.org/10.1111/1467-9280.00388