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Corrigendum: Constructing Rich False Memories of Committing Crime

Original article: Shaw, J., & Porter, S. (2015). Constructing rich false memories of committing crime. *Psychological Science, 26*, 291–301. doi:10.1177/0956797614562862

When the Shaw and Porter (2015) data set was shared with Nicholas J. L. Brown and James A. J. Heathers, they brought to the authors' attention that the original article contained some incorrect calculations. For a couple of the calculations, incorrect cells had been included in the analysis. Also, Microsoft Excel was used for these calculations, which yielded imprecise results for rounding of values and for confidence intervals. Table 1 lists all of the corrections that are being made to the article.

Main Findings

Only one finding of interest in the original article was nonsignificant in the corrected analysis: The article reported that "participants were found to be significantly more likely to report adopting multiple perspectives (i.e., being able to see themselves in the memory as well as to see things from their own perspective) in the true than in the false memory" (pp. 297–298); however, as shown in Table 1, that difference was not significant

Table 1. Comparison of Values From the Original Analysis (Shaw & Porter, 2015) and the Recalculated Analysis

Section and statistic	Original analysis	Recalculated analysis
Criminal false memories		
Mean recall for police-specific details in assault cases (assault and assault with a weapon; p. 296, para. 1)	12.18 (95% CI = [8.14, 16.22])	11.91 (95% CI = [5.36, 18.46])
Mean recall for police-specific details in theft cases (p. 296, para. 1)	4.00 (95% CI = [2.05, 5.95])	4.00 (95% CI = [–8.71, 16.71])
Mean total details (p. 296, para. 2)	**71.76 (95% CI = [55.72, 87.80])**	**64.95 (95% CI = [50.13, 79.77])**
Mean general details (p. 296, para. 2)	59.52 (95% CI = [46.49, 72.56])	59.71 (95% CI = [45.88, 73.55])
Mean cognitive-operations details (p. 296, para. 2)	5.48 (95% CI = [4.09, 6.87])	5.24 (95% CI = [3.69, 6.79])
Mean police-specific details (p. 296, para. 2)	6.76 (95% CI = [2.94, 10.59])	6.62 (95% CI = [2.52, 10.72])
Mean assault details (p. 296, para. 2)	**75.63 (95% CI = [61.32, 89.93])**	**66.25 (95% CI = [50.36, 82.14])**
Mean assault-with-a-weapon details (p. 296, para. 2)	**71.29 (95% CI = [30.79, 111.78])**	**62.29 (95% CI = [21.71, 102.87])**
Mean theft details (p. 296, para. 2)	67.17 (95% CI = [37.29, 97.04])	66.33 (95% CI = [26.96, 105.71])
Mean visualizing (p. 296, para. 3)	5.05 (95% CI = [4.29, 5.82])	5.06 (95% CI = [4.16, 5.95])
Mean suspicion (p. 296, para. 3)	2.43 (95% CI = [1.54, 3.32])	2.43 (95% CI = [1.48, 3.38])
Mean surprise level (p. 296, para. 3)	4.95, 95% CI = [3.94, 5.97])	4.95 (95% CI = [3.87, 6.03])
Noncriminal false memories		
Number of false details in criminal vs. noncriminal conditions (chi-square analysis; p. 296, para. 4)	$\chi^2(1, N = 60) = 0.635$, $p = .425$, $r = .103$ (no significant difference)	$\chi^2(1, N = 60) = 0.341$, $p = .559$, $r = .075$ (no significant difference)
Mean total details (p. 296, para. 4)	53.30 (95% CI = [43.11, 63.49])	52.96 (95% CI = [42.18, 63.73])
Difference between number of total details (two-tailed independent-samples *t* test; p. 296, para. 4)	$t(42) = 1.94$, $p = .06$, $d = 0.59$ (no significant difference)	$t(42) = 1.38$, $p = .17$, $d = 0.42$ (no significant difference)
Mean general details (p. 296, para. 4)	49.17 (95% CI = [39.94, 58.4])	49.17 (95% CI = [39.41, 58.94])

(continued)

Table 1. *(continued)*

Section and statistic	Original analysis	Recalculated analysis
Mean cognitive-operations details (p. 296, para. 4)	4.09 (95% CI = [2.43, 5.74])	3.78 (95% CI = [2.06, 5.50])
Mean animal-attack details (pp. 296–297)	52.00 (95% CI = [34.27, 69.73])	51.86 (95% CI = [29.74, 73.98])
Mean accident-injury details (p. 297)	46.61 (95% CI = [32.90, 60.35])	45.88 (95% CI = [29.66, 62.09])
Mean lost money details (p. 297)	61.13 (95% CI = [39.78, 82.47])	61.00 (95% CI = [35.20, 88.80])
Mean visualizing (p. 297, para. 1)	4.58 (95% CI = [3.84, 5.32])	4.58 (95% CI = [3.71, 5.45])
Mean suspicion level (p. 297, para. 1)	2.70 (95% CI = [1.79, 3.6])	2.70 (95% CI = [1.73, 3.66])
Mean surprise level (p. 297, para. 1)	4.65 (95% CI = [3.84, 5.47])	4.65 (95% CI = [3.79, 5.51])
True memories		
Mean total true-memory details (p. 297, para. 3)	91.98 (95% CI = [82.04, 101.92])	91.98 (95% CI = [81.84, 102.13])
Mean true general details (p. 297, para. 3)	85.75 (95% CI = [76.48, 95.02])	85.75 (95% CI = [76.29, 95.21])
Mean true cognitive-operations details (p. 297, para. 3)	6.23 (95% CI = [4.95, 7.51])	6.23 (95% CI = [4.93, 7.51])
Mean vividness level (p. 297, para. 4)	4.67 (95% CI = [4.35, 4.99])	4.67 (95% CI = [4.34, 4.99])
Mean confidence level (p. 297, para. 4)	5.20 (95% CI = [4.91, 5.49])	5.20 (95% CI = [4.90, 5.50])
Difference between the number of true- and false-memory details (p. 297, para. 5)	$t(43) = 5.49$, $p < .0001$, $d = 1.66$ (more details for true memories)	$t(43) = 6.19$, $p < .0001$, $d = 0.93$ (more details for true memories)
Difference in perspective (pp. 297–298)	True-memory tellers were significantly more likely to report multiple perspectives than false-memory tellers (***p* = .0079**)	Not significant (***p* = .20**)

Note: Boldface indicates values that have changed substantially (by more than a raw value of .5) between the original analysis and the reanalysis. CI = confidence interval.

in the corrected analysis. Other changes of note include the following. The mean number of total details recalled for false memories was 64.95 (not 71.76). This was because incorrect cells were included in the original calculation of the details for participants told they had committed assault and assault with a weapon. The mean number of details recalled for assault was 66.25 (not 75.63), and the mean number of details recalled for assault with a weapon was 62.29 (not 71.29).

All Data

Calculations in Table 1 show the differences that emerged between the values reported in the original article and the new analysis. As can be seen, many of the values (particularly the confidence intervals) have changed slightly. Values that have changed substantially (by more than a raw value of .5) have been boldfaced. Values from the original manuscript that are not included here did not change after the reanalysis.

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Research Article

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Constructing Rich False Memories of Committing Crime

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Abstract

Memory researchers long have speculated that certain tactics may lead people to recall crimes that never occurred, and thus could potentially lead to false confessions. This is the first study to provide evidence suggesting that full episodic false memories of committing crime can be generated in a controlled experimental setting. With suggestive memory-retrieval techniques, participants were induced to generate criminal and noncriminal emotional false memories, and we compared these false memories with true memories of emotional events. After three interviews, 70% of participants were classified as having false memories of committing a crime (theft, assault, or assault with a weapon) that led to police contact in early adolescence and volunteered a detailed false account. These reported false memories of crime were similar to false memories of noncriminal events and to true memory accounts, having the same kinds of complex descriptive and multisensory components. It appears that in the context of a highly suggestive interview, people can quite readily generate rich false memories of committing crime.

Keywords

false memory, episodic memory, legal confession, adolescent delinquency

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If one wants to recall the details of an important life event, subjectively it may seem easy to dig into the secure memory vaults of one's mind and retrieve the relevant information. This assumption of memory as a largely reliable process traditionally forms a major part of the foundation of the legal system, in which memory accounts of witnesses—and when they confess, defendants—can play a key role in judicial decision making. Such individuals are often expected to reliably recall details of a crime, and their memory statements are generally assumed to be valid. Indeed, a confession is one of the most potent forms of legal evidence (e.g., Cutler, 2012; Gudjonsson & Pearse, 2011; Kassin, Bogart, & Kerner, 2012). However, although the assumption of memory being generally reliable may be intuitively appealing, many studies have yielded evidence of reconstructive processes and distortions in memory in many legally relevant situations (e.g., Frenda, Nichols, & Loftus, 2011; Nash & Wade, 2008), and only in a few situations does it seem that memory is particularly resistant to distortion (e.g., Oeberst & Blank, 2012).

Researchers have been able to induce participants to generate various types of false autobiographical accounts, including accounts of getting lost in a shopping mall (Loftus, 1997), being involved in an accident at a family wedding (Hyman, Husband, & Billings, 1995), having tea with Prince Charles (Strange, Sutherland, & Garry, 2006), being attacked by a vicious animal (Porter, Yuille, & Lehman, 1999), and cheating on a recent test (Russano, Meissner, Narchet, & Kassin, 2005). These memories may feel "real" because rememberers can generate event details that were never mentioned by the interviewer. The mind seems to be able to construct information from internal and external sources to generate a coherent but false picture of what occurred (e.g., Frenda et al., 2011). These plausible confabulations are likely constructed from real autobiographical memory fragments but are configured in ways that depict events that did not occur

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(Conway, 2002). They are known as honest lies (Moscovitch, 1989), pseudomemories (Lindsay, Hagen, Read, Wade, & Garry, 2004), phantom recollective experiences (Brainerd & Reyna, 2002), or autobiographical false memories (Loftus, 1997).

In such a situation, the recollective experience may signal to a rememberer that what is in his or her mind is a memory of an actual autobiographical experience. Finding false memories even in superior-memory individuals suggests that these reconstructive mechanisms underlying false memory may be fundamental to episodic remembering (Patihis et al., 2013). Even memories for stressful and emotional events seem highly vulnerable to modification by exposure to misinformation (Morgan, Southwick, Steffian, Hazlett, & Loftus, 2013). Studies also suggest that false memories can be largely indistinguishable from true memories in both emotional content (Laney & Loftus, 2008) and brain activation (Stark, Okado, & Loftus, 2010).

During interviewing, asking leading questions, introducing new and inaccurate information, and pressuring or expecting the interviewee to report memory details may facilitate such an inaccurate account (Loftus, 2005). In legal contexts, interviewing techniques such as guilt-presumptive and confrontational approaches are thought to facilitate false confessions and promote inaccurate witness accounts (e.g., Kassin et al., 2010), which can ultimately lead to procedural injustice and wrongful imprisonment (Leo & Davis, 2010). Although evidence supports the existence of other kinds of false confessions as well (e.g., voluntary false confessions and compliant false confessions; see Kassin et al., 2012), it has been suggested that so-called internalized false confessions involve the individuals actually coming to believe that they have committed a crime (e.g., Gudjonsson & Lebegue, 1989; Kassin & Kiechel, 1996).

A post hoc analysis of wrongful-conviction cases suggests that a predictable sequence of events typically occurs prior to and during the internalization of a false accusation. As detailed by Kassin et al. (2012), part of this process can involve the presentation of allegedly incontrovertible evidence, such as false eyewitness evidence, by the investigator. The suspect may then be led to presume that he or she must have repressed or otherwise forgotten the event. At this point, the individual may make an admission of possible guilt, using inferential language. This admission of possible guilt may be aggressively pursued, and the suspect may begin to incorrectly create specific details of his or her involvement in the crime in memory. Although case studies and legal anecdotes substantiate this process, no research has examined the extent to which such false memories for crime are possible or whether they can be distinguished from real memories (Kassin & Kiechel, 1996; Laney & Takarangi, 2013). An empirical demonstration of such false memories for crime and corresponding false confessions would carry major legal implications.

The Present Study

In the research reported here, we explored whether complete false memories of committing crimes involving police contact could be generated in a controlled experimental setting. If so, we wanted to explore how prevalent they would be and how their features would compare with those of both false memories of other emotional events and true memories. If supposed corroboration by caregivers informs young adults that they committed a crime during adolescence, can they generate such false memories, or do they reject the notion?

Method

Sample

One hundred twenty-six undergraduate students at a Canadian university were included in the screening phase of this study. Of this sample, 70 students met the participation criteria, and the first 60 eligible students participated in the interview stage (Phase 2) in exchange for $50. Participants in Phase 2 were on average 20 years old (range: 18–31), were predominantly Caucasian (5 were non-Caucasian), were in their second year of their bachelor's program, were English native speakers (5 were nonnative speakers), and were predominantly female (43 females).

Procedure

This study used a modified familial-informant false-narrative paradigm to attempt to convince young adult participants that they had committed a crime when they were between the ages of 11 and 14. We followed the same basic procedure as previous studies (e.g., Lindsay et al., 2004; Porter et al., 1999; Wade, Garry, Read, & Lindsay, 2002) and used the same basic interview script as Porter et al. (1999). The only modification that was made to the script was that instead of participants being asked only to recall the true memory during the first interview session, they were asked about both the true and the false memory in each of the three interviews. Participants were told that this was done because the researchers wanted to get as much information as possible for both memories. We made this modification to try to minimize participants' potential suspicion as to why the experimenter scheduled them for three sessions.

In the screening phase, 126 undergraduates provided consent for the researchers to send an extensive memory

questionnaire to their primary caregivers. The questionnaires were returned by the caregivers of 91 participants, of whom 70 were deemed eligible to participate. Eligibility was based on the caregiver reporting that the participant had experienced at least one highly emotional event in the specified time frame, had not experienced any of the target criminal events, and had never had police contact. Additionally, the caregiver had to report in some detail at least one highly emotional event (of any kind). Individuals were ineligible if their caregivers mentioned any kind of police contact or reported events that resembled the target events at any point during adolescence. On the questionnaire, caregivers were asked whether their child had experienced any of six negative emotional events, three of which were criminal (assault, assault with a weapon, and theft) and three of which were noncriminal (an accident, an animal attack, and losing a large amount of money). For each recalled event, caregivers were asked to write a description of what they could remember, including the location, people present, time of year, age of the participant, and how confident they were that the event had occurred. The questionnaire consent form and cover letter instructed caregivers to not discuss any of the events with the participants under any circumstances until the end of the study. (For more information on the screening questionnaire, see the Supplemental Material available online.)

After the questionnaires were returned, eligible participants were identified and contacted to schedule the interview component of the experiment. Data collection was halted earlier than anticipated because the higher-than-expected rate of success in inducing false memories allowed the hypotheses of interest to be tested with a sample size of 60.

In Phase 2 of the study, participants completed three interviews, at approximately 1-week intervals. The interviews were on average around 40 min long. The same researcher, who used a scripted interview for all sessions, conducted all interviews. In the first interview, two of the events from the questionnaire, one that the participant had experienced (true event) and one that the participant had not experienced (false event), were verbally presented to the participant. The true event was always presented first in an effort to maximize the researcher's credibility.

Participants were randomly assigned to one of two false-memory conditions. Participants in the criminal condition were told that they had committed a crime resulting in police contact; one third of them were told that they had committed assault, another third that they had committed assault with a weapon, and the remainder that they had committed theft. Participants in the noncriminal condition were told that they had experienced an emotional event; one third of them were told that they had had a powerful emotional experience during which they injured themselves, another third that they had been attacked by a dog, and the remainder that they had lost a large sum of money and gotten in a lot of trouble with their parents. Thirty participants were assigned to each condition, and 10 were assigned to each specific event. We used three events of each type in the interest of increasing generalizability, not with the aim of comparing the events within a condition with one another.

Participants were asked to explain what happened during each of the events in turn, after the interviewer provided some accurate cues from the caregiver questionnaire, including the city that the participant lived in and the name of a friend the participant had at the time of the alleged event (a friend who was supposedly present during the event). The interviewer also provided a number of cues, including the participant's age at the time of the event, the season when it took place, and an indication that the caregiver was involved after the event occurred; for the true event, these were accurate cues, and for the false event, they were randomly assigned inaccurate cues. As expected, participants successfully provided an account of the true event but were unable to provide an account of the false event in the first interview. The fact that no participants immediately recalled the false event helped rule out the possibility that participants had actually experienced such an event (see Porter et al., 1999). When participants had difficulty recalling the false event, the interviewer encouraged them to try to remember it, and (falsely) told them that most people can remember these kinds of memories if they try hard enough. Then, participants were told that the study was an examination of memory-retrieval methods, and they were asked to use context reinstatement and guided imagery to retrieve the memory. They also were told to practice visualization of the false event each night at home. These methods have been shown to effectively generate details that form the foundations of false memories (e.g., Henkel & Carbuto, 2009).

In all three interviews, as in the study by Porter et al. (1999), the interviewer kept as close to the script as possible and tried to behave in a consistent manner with all participants. To this end, and to try to maximize the chances of inducing false memories, the interviewer used a number of verbal and behavioral tactics consistently and systematically in all interviews and both conditions. For a basic measure of interview consistency, we conducted a word-count analysis (using Linguistic Inquiry and Word Count; Pennebaker, Booth, & Francis, 2007) examining whether the total number of words spoken by the interviewer in each interview differed between the two memory conditions (criminal and noncriminal). In a two-way between-subjects t test, the effect of condition was not significant, $t(58) = 0.72$, $p = .476$, $d = 0.19$, which

indicated that the interviewer used a consistent number of words in the two conditions.

The strategies that were employed throughout all interviews in this study were based on literature regarding factors that facilitate the generation of false confessions (e.g., Kassin et al., 2012). The tactics that were scripted into all three interviews included incontrovertible false evidence ("In the questionnaire, your parents/caregivers said. . ."), social pressure ("Most people are able to retrieve lost memories if they try hard enough"), and suggestive retrieval techniques (including the scripted guided imagery). Other tactics that were consistently applied included building rapport with participants (e.g., asking "How has your semester been?" when they entered the lab), using facilitators (e.g., "Good," nodding, smiling), using pauses and silence to allow participants to respond (longer pauses seemed to often result in participants providing additional details to cut the silence), and using the open-ended prompt "what else?" when probing for additional memory details. We also used the tactic of presumed additional knowledge if participants asked about the accuracy of details. In other words, participants were told that the interviewer had very detailed information about the event from their caregiver but was able only to vaguely confirm details (e.g., "this sounds like what your parents described," "I can't give you more details because they have to come from you"). Further, when participants reported that they could not recall the false memory, the interviewer seemed disappointed but sympathetic (while saying the scripted line "That's ok. Many people can't recall certain events at first because they haven't thought about them for such a long time.") and scribbled down a note on her clipboard. Finally, the interview office had a bookshelf intentionally filled with very visible books on memory and memory retrieval to help increase the interviewer's credibility as a memory researcher.

In the second and third interviews, participants again were asked to provide as many details as possible for both the true and false events. The nature of participants' memory for the true and false events was probed each time an event was recalled by asking follow-up questions regarding their perspective in the memory (i.e., whether they recalled it from their own perspective or could see themselves in the memory), the vividness of the memory, sensory details included in the memory, and their confidence in the memory. Participants were also asked to rate the anxiety they experienced at the time of the event. At the conclusion of the third interview, participants were paid $50 for their participation and informed that their second memory was false. Next, before a more extensive debriefing that explained the false-memory process, participants were asked how often they had visualized the memory at home, how surprised they were that one of the memories was false (scale from 1 to 7), and how suspicious of the interviewer they had been (scale from 1 to 7). They were also asked whether they had believed that the false event had actually happened. (For more information on the interviews, including the full interview scripts, sample transcript excerpts, and the debriefing script, see the Supplemental Material. Also, the primary author, and sole interviewer, is available to provide interview training for researchers who hope to replicate this study.)

Analysis

One hundred eighty videotaped interviews (60 participants interviewed three times each) were transcribed, and the transcriptions of the memories were coded for details by two independent researchers who had an excellent interrater Krippendorf's alpha of .89, as calculated with ReCal (Freelon, 2010). Details were coded as "general" if they related to single units of information pertaining directly or indirectly to the event in question, as "police-specific" if they were single units of information pertaining directly to the police contact for the event in question, and as "cognitive operations" if they pertained to intrinsic perceptions of the event (e.g., emotions, thoughts, and tactile feelings). The number of each type of detail was tallied across the three interviews for each participant.

Memory taxonomy. The partial-complete memory dichotomy used in previous research is a useful categorization for examining the extent to which participants confabulate details and accept an account as their own memory. Indeed, we intended to use this dichotomy. However, the methodology in this study unexpectedly facilitated the confabulation of very extensive false-memory details in a high proportion of participants, such that very few participants would have qualified as having experienced partial rather than complete false memories. Therefore, we adopted a different approach in an attempt to meaningfully differentiate among participants' responses.

Our categories were loosely adopted from the internalized/compliant dichotomy Kassin et al. (2012) used for false confessions and the partial/complete dichotomy from the false-memory literature. Participants who were classified as having false memories (as defined in the following section) could be said to be most akin to what have been referred to as participants with "internalized" false memories in the previous literature. Participants who provided 10 or more details of the false event but did not claim at the debriefing that they had believed the event actually happened were classified as compliant; they could be seen as having simply acquiesced to the

	≥ 10 Details Reported	< 10 Details Reported
Believed Event Happened	False Memory ($n = 44$)	Acceptance ($n = 6$)
Did Not Believe Event Happened	Compliance ($n = 6$)	No False Memory ($n = 4$)

Fig. 1. Classification taxonomy. Participants were classified into one of four categories according to the number of unique details of the false event they reported over the course of the three memory interviews and according to whether they responded "yes" or "no" at the debriefing to the question "Did you believe that you had forgotten the event and that it actually happened?" The diagram shows the number of participants classified in each category after completion of the last interview.

situational demands. On the flip side, participants who provided fewer than 10 details but claimed at debriefing that they had believed the event actually happened were classified as being accepting of the false memory event. They seemed immune to significant memory generation despite appearing to believe that the event had happened to them. The acceptant and compliant groups most closely correspond to the partial-false-memory category in previous studies, as participants in that category were presumed to be merely accepting that the false memory occurred or to be speculating about it (Lindsay et al., 2004). Finally, participants who provided fewer than 10 details and asserted at debriefing that they had not believed the event happened to them were classified as having no memory of the false event. (See Fig. 1 for a schematic of the memory taxonomy we used.)

Defining false memories. We used a conservative definition of false memory that was modeled after the definitions used in previous studies. For example, according to Hyman and Billings's (1998) definition, participants exhibited false memories only if their reports included critical misinformation (of spilling punch) and if the elaborations and details in their reports were consistent. Wade et al. (2002) used a similar definition, according to which participants had to report details of the critical event and provide elaborations. The most comprehensive operational definition of false memory to date was elaborated by Porter et al. (1999). In their study, participants were considered to have false memories if they reported remembering the event, agreed with or incorporated information cues that had been provided, reported details beyond the four cues provided, did not remember the incident immediately, and reported during debriefing that they had not discussed the event outside the lab.

Guided by these definitions, we used the following objective and participant-subjective criteria to identify which participants had generated a false memory. First, the individual had to indicate that he or she remembered the suggested event during the final interview by reporting details about it. Second, the participant's report by the third interview had to include the critical pieces of false information presented by the interviewer (including at least the location and the name of the friend who was supposedly there when asked, "Where exactly did the event occur?" and "Who was present during the event"). Third, the individual had to provide a basic account of the false event in response to the instruction "tell me everything you remember from start to finish," and this account had to include more details than those provided by the experimenter (at least 10 unique details in total). Fourth, the participant could not have recalled the false event immediately upon its initial presentation. Fifth, the participant had to indicate that he or she had not talked to his or her primary caregivers about any part of the parental memory questionnaire (i.e., during debriefing, answered "no" to the question "Did you talk to your parents?"). Sixth, after being informed that the false event had not actually happened (during debriefing), the participant had to answer "yes" to the question "Did you believe that you had forgotten the event and that it actually happened?" Overall, this definition of false memory is a very conservative one.

Results

This section presents the results of the memory interviews. For the false events, all results presented are for only those subjects who were classified as having false memories. For the true events, results are reported for all subjects, as well as separately for only those subjects who were classified as having false memories. The former statistics provide a general overview of the true memories, and the latter allow the reader to see within-subjects differences between true and false memories. Results for participants categorized as compliant, as acceptant, or as having no false memories are not discussed here because the samples were very small.

Table 1. Participants' Ratings of Their Anxiety During the Remembered Events, Their Confidence in Their Memories, and the Vividness of Their Memories

	Anxiety		Confidence		Vividness	
Condition and memory type	Mean	95% CI	Mean	95% CI	Mean	95% CI
Criminal condition (n = 21)						
False memory	5.48	[5.09, 5.86]	2.86	[2.37, 3.36]	2.68	[2.19, 3.17]
True memory	4.76	[4.26, 5.27]	5.30	[4.92, 5.67]	4.73	[4.29, 5.17]
Noncriminal condition (n = 23)						
False memory	4.52	[3.96, 5.08]	2.76	[2.27, 3.24]	2.59	[2.11, 3.07]
True memory	5.30	[4.92, 5.68]	5.24	[4.80, 5.67]	4.66	[4.18, 5.13]

Note: This table reports data only for those participants who were classified as having false memories. Ratings of anxiety, confidence, and vividness were made on Likert scales from 1 to 7. CI = confidence interval.

However, for compliant and acceptant participants, the values for all variables are presented in the Supplemental Material.

Criminal false memories

Of the participants assigned to the criminal condition, 21 (70%) were classified as having false memories of being involved in the criminal event resulting in police contact. Of those 21, 8 provided an account involving assaulting another person, 6 provided an account involving a theft, and 7 provided an account involving assaulting another person with a weapon. Eleven (73.33%) of the participants who were classified as having false memories of assault or assault with a weapon reported information describing the nature of their police contact (e.g., physical descriptions of the police officers), recalling a mean of 11.91 police-specific details, 95% confidence interval (CI) = [5.36, 18.46]. Only 2 participants who were classified as having false memories of a theft reported details of the police contact, providing 4.00 police-specific details on average, 95% CI = [–8.71, 16.71].

Participants who were classified as having false memories of criminal events provided a mean of 64.95 (95% CI = [50.13, 79.77]) details for these events. More specifically, on average they provided 59.71 (95% CI = [45.88, 73.55]) general details, 5.24 (95% CI = [3.69, 6.79]) cognitive-operations details, and 6.62 (95% CI = [2.52, 10.72]) police-specific details. Broken down by type of criminal event, the means for the total number of details were 66.25 (95% CI = [50.36, 82.14]) for assault, 62.29 (95% CI = [21.71, 102.87]) for assault with a weapon, and 66.33 (95% CI = [26.96, 105.71]) for theft.

Table 1 summarizes the ratings of anxiety at the time of the criminal event, vividness of memory for the event, and confidence in memory for the event among participants who were classified as having false memories of crime. Table 2 summarizes these participants' reports of whether their memories of the criminal event had visual, auditory, olfactory, and tactile components. During the debriefing, participants who were classified as having false memories of committing a crime indicated that they had tried to recall and visualize the false event at home a mean of 5.06 times (95% CI = [4.16, 5.95]), reported having low suspicion that the interviewer was trying to manipulate them somehow (M = 2.43, 95% CI = [1.48, 3.38]), and reported having been surprised by the true nature of the study (M = 4.95, 95% CI = [3.87, 6.03]).

Noncriminal false memories

We included the noncriminal condition so that we could examine whether there were qualitative or quantitative differences between false memories of criminal events and false memories of noncriminal events. Of the participants assigned to the noncriminal condition, 23 (76.67%) were classified as having false memories. Of those 23, 7 provided an account involving an animal attack, 8 provided an account involving an accident resulting in an injury, and 8 provided an account involving losing a large sum of money. A chi-square analysis was conducted to examine whether the criminal and noncriminal conditions differed in the proportion of false memories generated, and no statistically significant difference was found, $\chi^2(1, N = 60) = 0.341$, $p = .559$, $r = .075$. Participants who were classified as having false memories of noncriminal emotional events reported a mean of 52.96 (95% CI = [42.18, 63.73]) details for these events. A two-tailed independent-samples t test revealed no statistically significant difference between the criminal and noncriminal conditions in the total number of details reported by participants who were classified as having false memories, $t(42) = 1.38$, $p = .17$, $d = 0.42$. On average, participants who were classified as having noncriminal false memories provided 49.17 (95% CI = [39.41, 58.94]) general details and 3.78 (95% CI = [2.06, 5.50]) cognitive-operations details. Broken down by type of noncriminal event, the means for the total number of details were 51.86 (95%

Table 2. Sensory Components of the True and False Memories

	Visual		Auditory		Olfactory		Tactile	
Condition and memory type	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Criminal condition (n = 21)								
False memory	0.86	[0.74, 0.99]	0.39	[0.21, 0.56]	0.14	[0.01, 0.26]	0.30	[0.13, 0.46]
True memory	0.95	[0.88, 1.03]	0.48	[0.30, 0.66]	0.23	[0.08, 0.38]	0.48	[0.30, 0.66]
Noncriminal condition (n = 23)								
False memory	0.85	[0.72, 0.97]	0.41	[0.23, 0.58]	0.15	[0.02, 0.27]	0.29	[0.13, 0.45]
True memory	0.94	[0.85, 1.02]	0.50	[0.32, 0.68]	0.24	[0.09, 0.39]	0.48	[0.30, 0.65]

Note: This table reports data only for those participants who were classified as having false memories. For a given memory, participants indicated whether each sensory component was present (1) or absent (0). CI = confidence interval. Gustatory details are omitted from this table because of very low prevalence rates.

CI = [29.74, 73.98]) for the animal attack, 45.88 (95% CI = [29.66, 62.09]) for the accident resulting in injury, and 61.00 (95% CI = [35.20, 88.80]) for losing a large sum of money.

Tables 1 and 2 report the results for ratings of anxiety, vividness, and confidence and for the presence of sensory components for participants who were classified as having false memories of the noncriminal event. During the debriefing, these participants indicated that they had tried to recall and visualize the false event at home a mean of 4.58 times (95% CI = [3.71, 5.45]), reported having low suspicion that the interviewer was trying to manipulate them somehow (M = 2.70, 95% CI = [1.73, 3.66]), and indicated that they had been surprised by the true nature of the study (M = 4.65, 95% CI = [3.79, 5.51]).

Repeated t tests with Bonferroni correction were conducted on the number and type of details reported; on the ratings of confidence, vividness, and anxiety; and on the presence of sensory components (visual, auditory, olfactory, tactile, gustatory) in the memory reports. These tests revealed no statistically significant differences between criminal and noncriminal false memories. Additionally, no significant gender differences were found.

True memories

We asked participants to describe true memories so that we could examine whether a given individual's recall of a true memory differed qualitatively or quantitatively from his or her recall of a false memory. The 60 participants reported a mean of 91.98 (95% CI = [81.84, 102.13]) details for their true memories. On average, they provided 85.75 (95% CI = [76.29, 95.21]) general details and 6.23 (95% CI = [4.93, 7.51]) cognitive-operations details. Note that the veracity of the details for the true events was confirmed only broadly by the written accounts provided by the participants' caregivers. Thus, the specific details of the true memories remain largely unverified.

On average, participants rated their anxiety at the time of the true event as 5.0 (95% CI = [4.68, 5.32]), the vividness of their memories of the true event as 4.67 (95% CI = [4.34, 4.99]), and their confidence in these memories as 5.20 (95% CI = [4.90, 5.50]). There was a strong positive correlation between the total number of details reported and confidence rating for both false memories (r = .57, n = 44, p < .001) and true memories (r = .54, n = 60, p < .001), indicating that confidence may be generally related to the number of details generated in interviews for memories.

Because within-participant comparisons are considered the most meaningful way to explore differences between true and false memories, we focus on those comparisons here. Table 1 summarizes ratings of anxiety, vividness, and confidence for the true memories among participants who formed false memories, and Table 2 summarizes these participants' ratings of the presence of sensory components in their memories of the true event. For participants who were categorized as having false memories, we conducted a series of two-tailed dependent-samples t tests with Bonferroni correction (adjusting p to < .003) to compare true and false memories. Participants reported significantly more event details for true than for false memories, $t(43)$ = 6.19, p < .0001, d = 0.93; had more confidence in true than in false memories, $t(43)$ = 9.87, p < .001, d = 3.01; and reported that their true memories were more vivid than their false memories, $t(43)$ = 7.99, p < .001, d = 2.44. The t tests also revealed that for participants classified as having false memories, there were no significant differences between the true and false memories in the number of cognitive-operations details, reported anxiety during the event, or the presence of any of the sensory components. Finally, a two-tailed Fisher's exact test was conducted, and participants were found to be significantly more likely to report adopting multiple perspectives (i.e., being able to see themselves in the memory as well as to see things from

their own perspective) in the true than in the false memory ($p = .20$).

Discussion

This study provides evidence that people can come to visualize and recall detailed false memories of engaging in criminal behavior. Not only could the young adults in our sample be led to generate such memories, but their rate of false recollection was high, and the memories themselves were richly detailed. Additionally, false memories for perpetrating crime showed signs that they may have been generated in a way that is similar to the way in which false memories for noncriminal emotional memories are generated. False memories for committing crime also shared many characteristics with true memories. Finally, we have proposed a novel taxonomy for classifying false memories that is more in line with the current standards for false confessions than previous taxonomies are.

Our results align with the literature suggesting that exposure to misinformation provided by interviewers can lead to major distortions in memory (Morgan et al., 2013), and that malleable reconstructive mechanisms may be fundamental to episodic remembering (Patihis et al., 2013). A number of current theories, such as fuzzy-trace theory (Brainerd & Reyna, 2002), propose that a memory may be retrieved not by accessing a fixed representation of a past event, but rather by reactivating incomplete fragments that can be either distorted or accurate, and that may have arisen from other real events (Stark et al., 2010). This implies that false memories may actually be recalled in a way that is surprisingly similar to how memories for real events are retrieved. Consequently, as the results here indicate, true and false memories have many similar features—including being highly detailed and multisensory. These results are also in line with neuroimaging research showing that true and false memories evoke similar brain activation patterns (Stark et al., 2010), and that even highly emotional content may not reliably indicate memory accuracy (Laney & Loftus, 2008). Therefore, it may prove difficult in the real world to reliably tell the difference between true and false memories without independent corroboration (Bernstein & Loftus, 2009).

Our use of a context-reinstatement exercise, in which participants were to picture what it would have been like to engage in the false events, may also help explain our findings. Imagination exercises such as this one have been repeatedly associated with the generation of false memories (Pezdek, Blandon-Gitlin, & Gabbay, 2006). The relevance of imagination for false memories may be partially explained by the source-monitoring framework (e.g., Johnson, Hashtroudi, & Lindsay, 1993), which refers to people's tendency to confuse imagination with reality. Individuals who are recalling details from a visualization exercise or experimenter misinformation can forget the source of their ideas and may think they are recalling details from a genuine experience. Additionally, explanatory coherence has been demonstrated to play a role in the memory errors that result from suggestive forensic interviews (Chrobak & Zaragoza, 2013). In particular, it has been shown that forced-fabrication paradigms, such as the one used here, lead participants to incorporate causally relevant misinformation into memory over time so as to help make sense of events that participants accept or believe happened but cannot remember (e.g., Chrobak & Zaragoza, 2008). In other words, imagined memory elements regarding what something *could* have been like can turn into elements of what it *would* have been like, which can become elements of what it *was* like. Although the interviewer in this study provided only a small, predetermined set of misinformation and did not add novel misinformation across the interviews, it is possible that participants increasingly tried to make sense of the introduced false events by spinning explanatory frameworks around what they thought could have happened.

To help make sense of why participants were willing to accept the kind of erroneous memory cues provided in this study, we turn to the literature on the effects of various kinds of misinformation on memory. Research by Desjardins and Scoboria (2007) has demonstrated that rehearsal of self-relevant details like the participant-specific misinformation provided to participants in this study can significantly increase false-memory rates. This effect could be due to superior encoding and retrieval of information relevant to the self, along with a shift in beliefs about the plausibility of an event having happened. This plausibility shift has been supported by the work of Mazzoni, Loftus, and Kirsch (2001), who suggested that perceived plausibility needs to pass only a relatively low threshold in order for a personalized manipulation to produce changes in belief that may then be incorporated into memory. This may help explain why, despite possible concerns regarding event plausibility (Pezdek et al., 2006), our participants were as willing to accept false criminal accounts as they were to accept false noncriminal accounts (cf. supporting findings by Bays, 2011, and Wade et al., 2002). Incorporating true details into the false-memory account—especially the caregiver-provided details regarding the city the participant lived in and the name of a friend the participant had at the time of the alleged event—likely constituted a personalized manipulation in our study. Including these details may have contributed to increased fluency (Kelley & Jacoby, 1998) and familiarity (e.g., Koriat & Levy-Sadot, 2001) of event details, giving participants pieces of real memories that they could use as the foundation upon which to build

false memories. Combined with general participant compliance, these processes likely all contributed to participants reporting detailed false memories in this study.

Some methodological aspects of our study point to questions for further research that would carry major implications for understanding the malleability of memory. As in Lindsay et al. (2004), only one interviewer conducted all of the interviews, to satisfy a requirement of the research ethics board. This modification may partially account for the high success rate in implanting false memories, as the sole interviewer was a senior Ph.D. student who was well trained in police interview tactics and is extraverted—a personality characteristic that has been demonstrated to be related to high success rates for generating false memories (Porter, Birt, Yuille, & Lehman, 2000). Future research needs to examine the role of interviewer-specific characteristics and whether these can be modified to minimize the risk of inducing false memories in interviewees.

Future studies also need to examine the importance of each of the interview tactics used in the present study to see which are most relevant for understanding the social processes involved in the formation of false memories. Such fine-tuned examination was not the goal of the current study, but would make a significant contribution to understanding the effects of each of these tactics and how well they would map onto actual police behavior. Also, unlike in a regular police interrogation, there were probably no perceived negative consequences of confessing to the criminal or noncriminal event in the present study. This leads to questions regarding the applicability of this study to real-world policing situations.

Another important question raised by this study is the extent to which participants succumbed to lingering demand characteristics when asked after the interviews were complete whether they had believed the event actually happened. Although participants seemed surprised to learn that the study concerned false memory, and it seems unlikely that they would have perceived that telling the truth would lead to adverse consequences, it is very hard to say with certainty that participants were not deceptive in answering this question. Anecdotally, the primary investigator had contact with a number of the participants through university classes months after the study had finished, and they routinely brought up their study experiences and proclaimed their astonishment that they could have been so easily fooled to accept a false memory.

Finally, in our analysis, we did not distinguish between false memories and false beliefs, and it will be critical for future research to require participants to rate whether they "remember" or "know/believe" their reported false memories (Zaragoza, Belli, & Payment, 2007). It has been argued that false beliefs are qualitatively different from false memories, and Tulving's (1985) remember/know paradigm has been effectively applied to address this concern.

Legal systems around the world rely heavily on memory-related evidence, and the present study can help address issues of concern related to the accuracy of such accounts. Our finding that young adults generated rich false memories of committing criminal acts during adolescence supports the notion that false confessions and gross confabulations can take place within interview settings. The Innocence Project (2012) has shown that about 25% of false convictions are attributable to faulty confession evidence, which is often obtained via questionable Reid-model interrogation tactics (e.g., Kassin et al., 2010), some of which mirror the false-memory-inducing strategies used in the present study. The kind of research presented here is essential in the quest to help prevent memory-related miscarriages of justice.

Author Contributions

J. Shaw and S. Porter developed the study concept and design. Data collection, analysis, and interpretation were performed by J. Shaw under the supervision of S. Porter. J. Shaw wrote the manuscript and revised it in response to peer-review suggestions, and S. Porter provided feedback. Both authors approved the final version of the manuscript for submission.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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Supplemental Material

Additional supporting information can be found at http://pss.sagepub.com/content/by/supplemental-data

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