IMPACT OF SCHEMAS ON FALSE MEMORY

by

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Schemas help individuals organize and interpret the world around them. Past research has shown that schemas play a role in the creation of false memories, like assuming you saw a cow at a farm, since farms have cows. False memory is thought to arise when individuals rely on gist rather than specific information, making memories vulnerable to distortion. This study hypothesized that schema-driven false memories would be counteracted by prompting the recall of specific details. Participants were shown images of scenes with schema-consistent objects overlaid on them (e.g., a farm with a cow, hay, wheelbarrow). They were then tested twice on their memory of the objects. First, they were asked to determine if seen objects and other not-seen but schema-consistent objects were originally present in the scene by making old/new judgments. Then, participants were asked to place the same objects in the scene at their original locations. Consistent with prior results, participants falsely remembered schema-consistent objects, even though they weren't seen previously. As a main measure of interest, we examined the frequency of change in response before and after the location probe. Results indicate that participants who were willing to change their belief on whether schema-consistent objects were seen or not, changed their belief to the correct one significantly more than a change to an incorrect belief. The results of this study advance our understanding of the extent to which schema impacts the formation of false memories.

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Introduction

False memory, a distorted recollection of an event (APA, n.d.), affects our day-to-day lives. If you walk into your professor's office for a meeting, you would not think twice about seeing a computer, books, or a desk. If you were asked what was in the professor's office after you left, you would most likely use your typical idea of an office to inform your response. Even if there were no paper supplies, you might still say a notebook was in the office. In this case, false memories form due to our expectation of a typical sequence of events, known as schema. Schemas help organize the world around us quickly, facilitating the processing of new information. While they are adaptive in helping to inform our daily behaviors, an overreliance on schema can result in the generation of false memories. Though the impact of schema on false memory is well documented (Bower et al., 1979; Brewer & Treyens, 1981; Pezdek et al., 1989; Lampinen et al., 2001), the extent to which schema-driven false memories can be counteracted is unclear. The current study seeks to determine the extent to which we can counteract schema-based false memories. This open question was investigated by examining how promoting the recall of specific details influences participants' ability to amend previous false recall.

What are False Memories?

False memory is a cognitive phenomenon when individuals recall events or details that did not actually occur (American Psychological Association; Loftus & Pickrell, 1995; Devitt & Schacter, 2016). Rather than stemming from failures in memory systems, false memories are now understood as byproducts of normal cognitive processes that facilitate inference (Reyna & Brainerd, 1995; Roediger & McDermott, 1995). This is an important aspect of our memory because it allows for shortcuts in our knowledge. The cognitive processes that underlie false

memory have adaptive advantages and allow us to be more efficient in the storage of information.

False memory may occur, according to the Fuzzy-Trace Theory, when individuals rely on gist traces, which reflect the general meaning of an event, rather than on verbatim traces, which capture specific details. This mechanism makes memory vulnerable to distortion (Reyna & Brainerd, 1995). Further exploration of this reveals that the mechanisms contributing to false memories emphasize the roles of semantic overlap and cognitive reconstruction (Brainerd et al., 2001; Garoff-Eaton et al., 2006). False memories arise from normal cognitive processes, allowing memories to be inferred and reconstructed based on meanings. One theory revolving around false memories is laid by Deese (1959), who demonstrated that false memories may occur when semantically related words trigger recollection errors. One important aspect of this study was a critical lure, an overarching category word that was not present in the word list. For example, if participants were given the following word list (candy, bitter, good, honey, tooth, sour, sugar, soda, nice, taste) they might have recalled ‘sweet’ during the recall task along with the others. This is because all of the words related to the word ‘sweet’ somehow, making participants likely to have falsely remembered the word ‘sweet’ being in the word list.

What are Schemas?

Schemas are cognitive frameworks that help individuals organize and interpret information, guiding both comprehension and memory. Scripts, a form of schema, are clusters of information that can explain or predict, within a particular context or a typical sequence of events (Bower et al., 1979; Owens et al., 1979). They facilitate recall but can also lead to memory distortions when people "fill in gaps" with plausible but incorrect information (Bower et al., 1979).

Using these ideas in a real-life setting experiment, individuals were brought into a room, and then later asked what objects were in the room. Alongside correct recalls, participants reported objects that were not in the room, but were schema-congruent to the type of room they were in (Brewer & Treyens, 1981). One example is that books were often recalled in a graduate student's office, yet no books were actually in the office. Instead, the books acted as a common object that a schema-informed decision would make (Brewer & Treyens, 1981). The strength of a schema also influences the rate of false recognition, with high false alarms being caused by highly schematically related items, also known as "lures" (Lampinen et al., 2001; Hess & Slaughter, 1990).

Schemas also play a role in memory consolidation, as schemas have been found to accelerate the assimilation of new information through a consolidation process (Tse et al., 2007). Since there is already previous knowledge helping to sort information, new information can easily be placed within a schema, allowing for faster sorting because new categories are not being created. Schemas also hold a dual role in memory encoding by integrating new information with existing knowledge to enhance long-term memory storage (Van Kesteren et al., 2012; Eichenbaum et al., 2012). This ability enables new information to connect with existing information, facilitating memory storage and recall.

How Do False Memories and Schemas Interact?

Exploring the relationship between false memory and schemas can help us to better understand the malleability of our memories. Schema-driven memory processes inherently involve filling in gaps based on expectations, which can lead to systematic errors. Brewer and Treyens (1981) demonstrated that scene-based schemas often cause people to falsely recall items consistent with their mental model of an environment, concluding that schema knowledge fills in

missing details based on one's expectations of what should be. Lampinen et al. (2001) reinforced this finding, showing that schema-based false recognition may happen when people assume information consistent with their expectation of the typical, but is not presented. Similarly, scripts may guide memory by encouraging inferences, which may sometimes be falsely remembered as actual events (Bower et al., 1979; Hannigan & Reinitz, 2003).

Can Schema-Driven False Memories be Counteracted?

Despite extensive documentation of schema-driven false memories, the extent to which these memories can be counteracted remains a critical and underexplored question in the literature (Bower et al., 1979; Brewer & Treyens, 1981; Pezdek et al., 1989; Lampinen et al., 2001). Understanding whether false memories can be amended carries significant real-world implications, particularly in legal and clinical contexts where the accuracy of recalled details can have serious consequences (Loftus & Palmer, 1974; Loftus & Pickrell, 1995). Eyewitness testimony, therapeutic memory retrieval, and clinical assessment all depend on the reliability of memory, making the ability to correct false recollections not merely a theoretical concern but a practical one. The current study seeks to address this gap by determining the extent to which schema-based false memories can be counteracted. This open question is investigated by examining how promoting the recall of specific details influenced participants' ability to amend previous false recall, with the broader goal of informing strategies for improving memory accuracy in real world settings.

To test this question, a paradigm was developed that was expected to evoke schema-driven false memories. This study displayed scenes filled with schema consistent objects. Then participants saw the same objects along with novel schema consistent objects, as previously described as lures, providing an opportunity to form schema-driven false memories that the lures

were originally present in the scene (Miller & Gazzaniga, 1998). To give an opportunity to correct these false memories, participants were then asked the location of all the schema-congruent objects, with an option for the objects to not have been present at the original viewing.

This study hypothesized that participants would correct their false memories when pressed for more details about each object. Having to recall the location of the object, requires recalling more scene details rather than relying on the gist of the scene to inform their decision. While prior work showed the prevalence of schema-based false memories, fewer studies addressed whether they can be counteracted. The goal of this study is to see if participants can correct false memories that were created during the initial recognition phase when asked to recall more specific information.

Methods

Participants

Sixty-seven young adults (18-35 years old) were recruited through the University of Oregon Psychology Human Subjects Pool. Five participants were excluded from data analysis due to an experimenter error, resulting in a final sample of 62 participants (48 females, 13 males, 1 nonbinary; mean age = 19.02 years, *SD* = 1.05, range 18-24). All participants provided written informed consent and received academic credit for their participation. All procedures were approved by the University of Oregon's Institutional Review Board. Data collection took place during the Spring 2025 and Fall 2025 terms.

Materials

The procedure for the present examination was a modified version of the task used in Webb et al. (2016). The stimuli in this study were 2 scenes, beach and farm, with twelve accompanying schema congruent items. In addition, there were twelve objects shown that were schematically related to one another (office supplies) but unrelated to either scene of interest. While each scene had twelve supporting schematically related objects, each scene participants viewed contained only six of the schematically related objects (see Figure 1). The remaining six schema-congruent objects served as lures during recognition and placement tests.

Tasks

Scene Viewing. In the first phase, participants viewed two distinct scenes for twenty seconds each, one after the other, with a white fixation cross on a black screen between the two scenes (see Figure 1). Scene-viewing order was counterbalanced across participants, such that approximately half of participants viewed the beach scene first and the other half viewed the

farm scene first. There were also two sets of each scene, with half the schema-congruent objects in each. Which version of each scene participants viewed was also counterbalanced across participants.

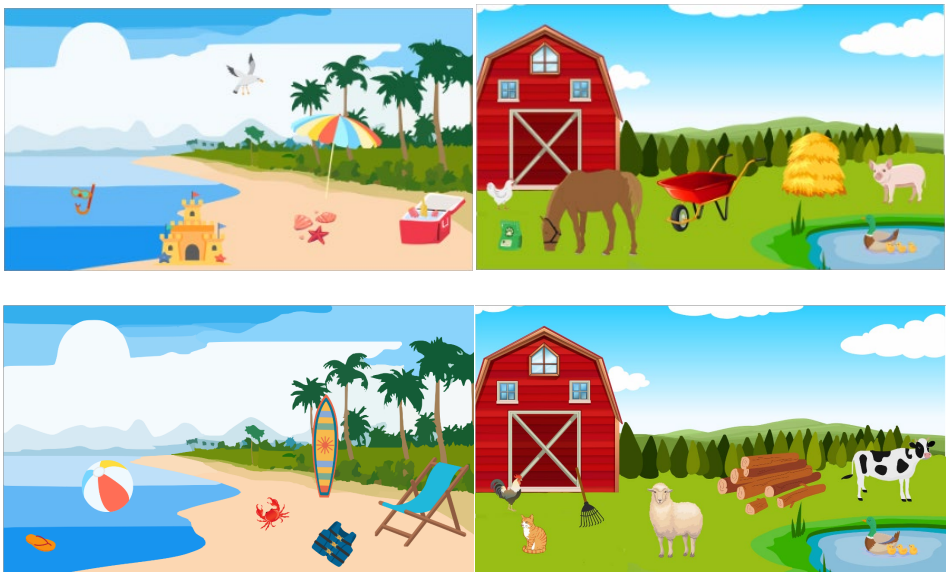


Figure 1. Participants were shown a beach scene and a farm scene for twenty seconds each. Which version of each scene shown was determined by condition type.

Math Distractor. After passively viewing the scenes, participants completed a math distractor task where participants were asked if simple math problems (e.g. 20 + 6 = 26, 16 - 7 = 18, 8 + 14 = 22) shown on the screen were true or false. If true, participants responded by pressing the '1' key on the keyboard. If false, they responded by pressing the '2' key on the keyboard. Participants had to respond to twenty math problems before moving on to the first test. This task was used to prevent participants from rehearsing the information they acquired during scene viewing so they had to retrieve the information from their memory during the following tests.

Recognition Test. In the third phase, participants were shown thirty-six objects and were asked to make old/new judgments for each object (see Figure 2). Twelve of the objects were

previously presented (targets), twelve were schematically related to what was presented (lures), and twelve were novel objects (foils). For each object, the participants were asked to make one of the four following confidence judgments: “definitely old, probably old, probably new, definitely new.” A judgment that stated ‘new’ meant the participant believed they had not seen the object in the scene shown prior. A judgment that stated ‘old’ meant the participant believed they had seen the object in the scenes shown prior. Definitely old and definitely new indicated a higher confidence in the participant's choice, while probably old and probably new indicated a lower confidence in their choice. Participant responses on the recognition test were collapsed into binary old/new judgments, such that "probably old” and “definitely old” responses were classified as “old”, and “probably new” and “definitely new” responses were classified as “new”. The four point scale captured nuances in participant certainty, while collapsing responses provided a more straightforward measure of recognition accuracy that allowed for a clearer distinction between items recognized as old versus new. Participants did not have a time limit on their response, but the test would not progress until an answer was given. Between each object, a white fixation cross on a black background was shown.

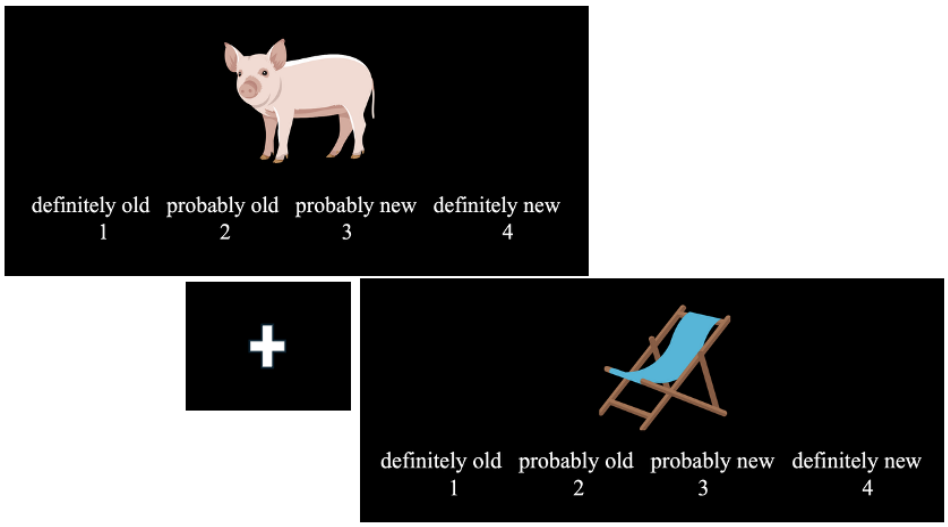


Figure 2. On each test trial, participants indicated via button press whether they had seen the displayed image as part of an initially presented scene or not, and how confident they were in their response.

Location Recall. In the fourth and final phase, participants were shown a version of the scenes previously viewed with no objects present, leaving only the background of the scene (see Figure 3). Participants were instructed that one object at a time would be presented below the scene background and they had to make one of three choices: "If you have seen the object before, you will click on the screen where you saw it. If you are unsure if you have seen the object please click 'not sure' at the bottom of the screen. If you have never seen the object before click 'never seen' at the bottom of the screen." The participants were shown all the schematically related objects (24 objects in total) for the beach and farm scenes. The objects and scenes were randomized, so participants were tested on both scenes during this task. No office schematically-congruent objects were shown for this test.

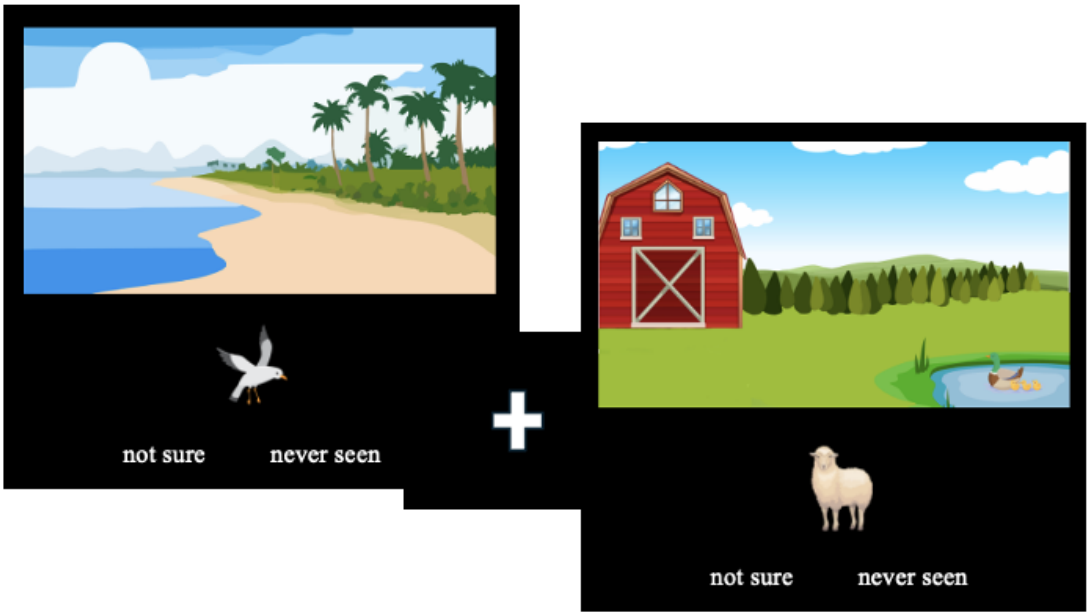


Figure 3. On each test trial, participants indicated via a mouse click on the screen whether they had seen the displayed image as part of an initially presented scene or not, or if they were not sure. If they had seen the image prior, they were tasked with clicking where on the scene the image had been.

Measures and Data Analysis

Objects presented during encoding were designated as targets. Schematically related objects not shown during encoding were designated as lures. Objects that were not schematically related to the scenes were designated as foils.

In the recognition test, four response categories were defined: a hit occurred when a participant correctly endorsed a target as old; a miss occurred when a target was incorrectly labeled as new; a false alarm occurred when a lure was incorrectly endorsed as old; and a correct rejection occurred when a lure was correctly labeled as new. The location recall test was coded based on the participants' recognition response. Corrected false memories were defined as lures initially endorsed as old and recalled as never seen; recovered memories were targets recognized as new and placed during recall; confused was when participants correctly recognized targets and lures but changed their belief during the location recall to the incorrect endorsement.

Hit rates (hits / (hits + misses)) and false alarm rates (false alarms / (false alarms + correct rejections)) were calculated for each participant. A corrected hit rate (corrected hit rate = hit rate - false alarm rate) was derived as the primary measure of recognition ability to control for individual differences in response bias. Paired-samples t-tests were used to compare hit rate and false alarm rate within the recognition test, and to examine whether corrected hit rate differed between the recognition test and the location recall test. To assess schema-driven false memory specifically, analyses were also conducted on the subset of objects that were incorrectly

endorsed as lures during recognition, examining what proportion of those initially false-alarmed lures were subsequently not placed during location recall. The last analysis was conducted looking at the different beliefs participants held about each object type during the different memory tests. A paired-samples t-test was conducted comparing the proportion of corrected responses to confused responses for both target and lure objects. All analyses were conducted in RStudio, version 2025.09.1.

Results

Participants demonstrated overall reliable memory recognition above chance ($t(61) = 12.02$, $p < .001$, $d = 1.514$, mean corrected hit rate = 0.60, 95% CI [0.50, 0.70]). For the old/new recognition test, consistent with prior research (Reyna & Brainerd, 1995), there was a strong negative correlation between hit rates and false alarms ($r = -.78$, $t(61) = -9.74$, $p < .001$, 95% CI [-.86, -.66]). Individuals with greater memory sensitivity correctly endorsed more targets while simultaneously rejecting more lures, rather than inflating both rates through an acquiescent response bias. Participants were above chance in both tests for both beach and farm scenes (($t(61) = 8.89$, $p < .001$, $d = 1.121$, mean corrected hit rate = 0.49, 95% CI [0.38, 0.60]); ($t(61) = 8.33$, $p < .001$, $d = 1.049$, mean corrected hit rate = 0.48, 95% CI [0.37, 0.60])). There also was no effect of scene ($t(61) = 0.16$, $p = 0.873$, $d = 0.020$, MD = 0.008, 95%CI [-0.09, 0.11], showing participants did not do significantly better for either scene.

Effect of Trial Type on Responses

A one-way ANOVA was conducted to examine whether responses to objects differed as a function of trial type (lure vs. target). A large significant difference between trial types was found ($F(1,1510) = 503.9$, $p < .001$), confirming that participants responded substantially differently to target objects compared to lures. This result validates that participants were understanding the task and confirms that recognition responses were systemically driven by item type. As seen in Figure 4, participants forgot 16.80% of targets and created schema-based false memories 34.66% of the time when answering questions about lures. The false beliefs observed here are the ones location specificity is aiming to counteract.

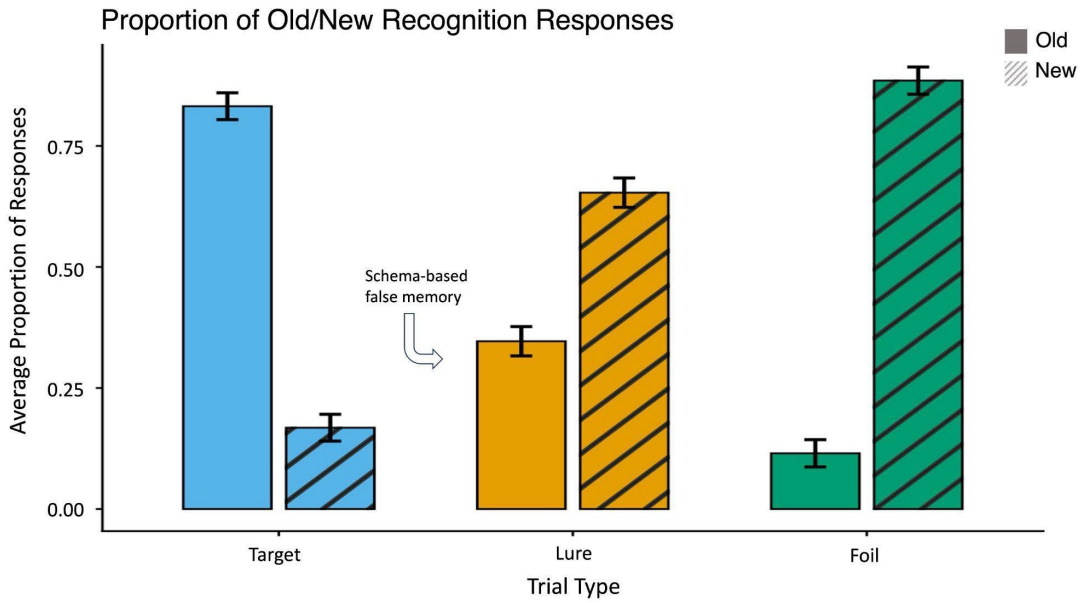


Figure 4. Proportion of Responses during the Old/New Recognition Task. Each bar represents the proportion of responses per trial type to whether participants recognized the object from the scene viewing session or not. Error bars represent the standard error of the mean.

Difference in Placement Responses for Targets and Lures

As shown in Figure 5, the proportion of each response type across trial types is displayed. Qualitatively, targets show a clear dominance of placement responses, while lures show a more mixed assortment of responses. A Pearson's Chi-squared test was conducted to test whether the distribution of placement responses (placement of object, never seen, not sure) differed between targets and lures. This revealed a significant main effect between the type of trial (lure or target) and the participants' placement response [$X^2(2) = 569.28$, $p < .001$]. As shown in Figure 5, participants were largely accurate in their belief about the location of objects for both targets and lures. The majority of targets (84.52%) were assigned a placement, while most lures were correctly identified as not having been seen (58.33%). Nevertheless, a notable proportion of lures (24.34%) were given placements, indicating that participants confidently attributed them to a specific location within the scene while they only misidentified as never seeing 8.07% of the

targets. Only 7.41% of targets and 17.33% of lures received a ‘not sure’ response. These results suggest that placement specificity allowed for a large amount of correct beliefs about the object's original location but still allowed for some schema driven memory to guide placement judgments, specifically in the continued generation of false memories for lures.

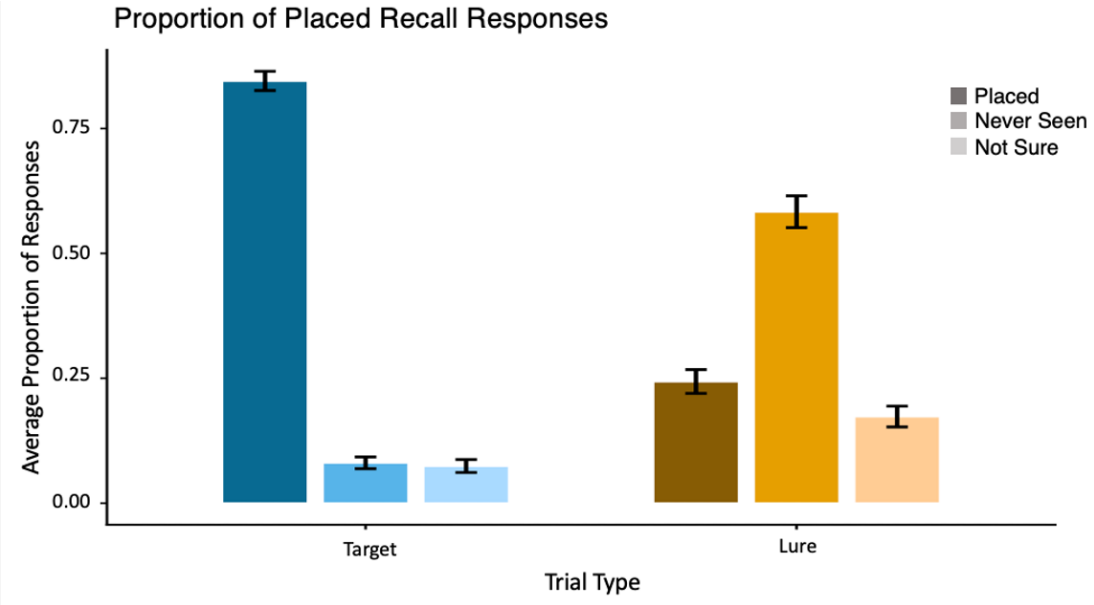


Figure 5. Proportion of Placed Responses. Each bar represents the proportion of responses per trial type to whether participants could recall where the objects from the scene viewing session were located, if they were not originally present, or if they were not sure. Error bars represent the standard error of the mean.

Difference in Recall Responses Depending on Trial Type and Recognition Response

Two paired-sample t-tests established the relationship between participants' ability to counteract their false memory and their level of confusion. Since the hypothesis of this study concerns the counteracting of false memory, we compared only the lure objects that participants had originally endorsed as old, but later identified as never seen, against lures participants identified as new but then placed. Participants were counteracting their false memories significantly more than they were confusing themselves ($t(58) = 2.86$, $p = .006$). Once this main

finding was established, we looked at the ability for participants to do this for only target objects. We found that once again, participants were also able to retrieve their forgotten memories significantly more than they were confusing themselves ($t(39) = 5.18$, $p < .001$). As shown in Figure 6, these findings suggest that while schema-congruent lures successfully induced false recognition, the additional demand of specifying object location served as a more diagnostic retrieval cue, one that helped participants recover or override their initial false memory responses. For targets, participants were able to recover nearly half of their forgotten memories when asked for location. False memories of lures were corrected about 30% of the time. Through the two t-tests, we see that if participants are willing to change their belief about whether or not they originally saw the object, they change it to the correct belief significantly more than the incorrect one.

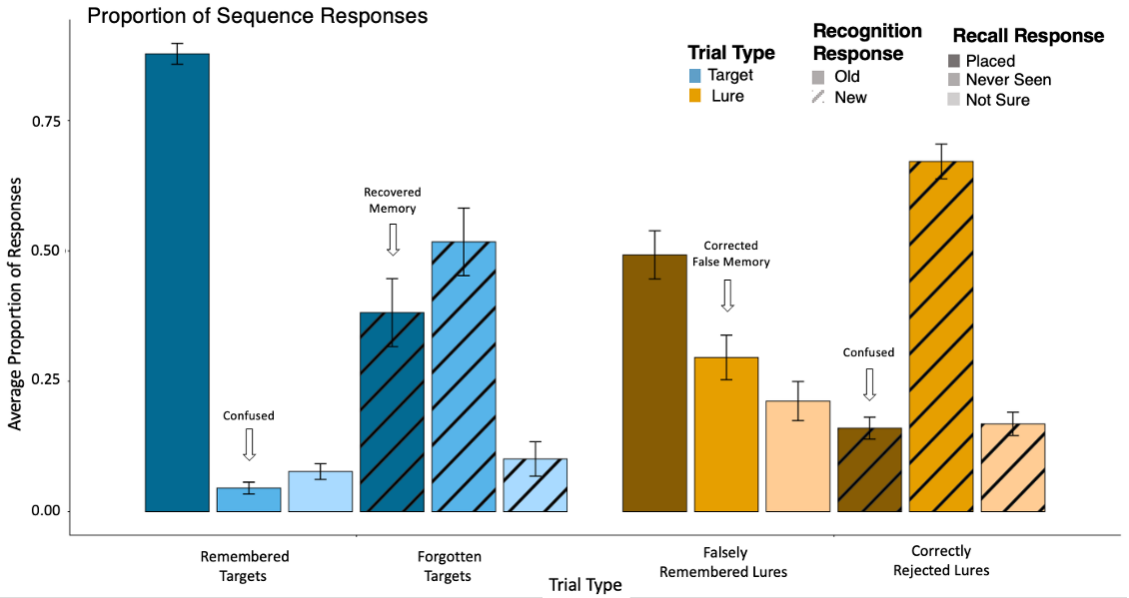


Figure 6. Proportion of Sequence Responses. Each bar represents the proportion of responses per trial type depending on if participants believed the objects were old or new and if they could recall where the objects from the scene viewing session were located, if they were not originally present, or if they were not sure. Error bars represent the standard error of the mean.

Discussion

Can schema-based false memories be counteracted? Specifically, when participants are asked to recall specific details about scenes they previously viewed. Consistent with prior literature, schema-congruent lures were falsely endorsed during the initial recognition test. Critically, however, when participants were required to specify the location of the objects within the scene, those that changed their answer were significantly more likely to correct their initial false memories than to generate new ones. Together, these findings suggest that while schema-driven false memories are robust, they are not immutable, and that retrieval cues demanding specificity may serve as a meaningful corrective mechanism.

The pattern of developing the schema-driven false memories which are seen in the old/new recognition test, is consistent with prior literature. In 1981, participants were more likely to remember items that were not present in a room but were highly consistent with the expected schema for that environment (Brewer & Treyens, 1981). This is a direct pattern mirrored in the presented study, where participants falsely endorsed schema-congruent lures they had never seen. The previous literature suggested that schemas influence both memory encoding and retrieval, leading to systemic memory distortions. Another study conducted in 2001, demonstrated that schema-based false recognition increases when lure items are highly congruent with participants' expectations of a typical environment (Lampinen et al., 2001). Additionally scripts may encourage memory-based inference that can later be misremembered as genuine experience (Bower et al., 1979). The presented study replicated the prior literature's effects since participants not only falsely recognized lures during the recognition task, but more people continued their false belief that lures were present in the scenes viewed compared to targets that were forgotten. The strong negative correlation between hit rates and false alarm

rates observed within the recognition test supports the interpretation that the recognition responses reflect differences in memory sensitivity rather than a generalized tendency to endorse items as old. These findings together are consistent with what has been found, that schema-congruent lures are particularly effective at inducing false recognition, and that this effect is driven by the ease with which schema-consistent items feel familiar even in the absence of a true memory trace (Brewer & Treyens, 1981; Bower et al., 1979; Lampinen et al., 2001; Yonelinas, 2002).

When looking at the ways in which participants kept or changed their belief during the location recall test, nearly one third of previously falsely remembered lures were corrected to be not placed in the scene. Counter to this, only 16% of participants who correctly identified lures as new incorrectly changed their memory to the object being in the scene. One way this finding can be explained is by the notion that false memory is underpinned by a lack of memory specificity, as hypothesized in the Fuzzy-Trace Theory, which distinguishes between gist traces, encoding the general meaning or theme of an experience, and verbatim traces, specific perceptual details (Reyna & Brainerd, 1995). Using the Fuzzy-Trace Theory, participants appeared to rely heavily on gist-level representations, allowing for schematically related lures to be falsely remembered. Diverging from this, the location recall test required participants to access verbatim-level detail, the spatial location of an object within the scene. This is a demand that gist traces cannot satisfy, forcing a reliance on more precise memory representations, allowing for participants to recognize that some objects, lures, were never actually present (Slotnick & Schacter, 2004). The lack of memory specificity can also be looked at through the Activation-Monitoring Theory (Johnson et al., 1993) which combines our brain's ability to look for related ideas (spreading activation) during memory processing and the tool of monitoring

where we sourced our memory from during retrieval (Fleck et al., 2006). Through this theory, as participants were viewing the beach and farm scenes, their brains were processing the schematically-related objects while at the same time, looking for other memories that related to these scenes. Then, during the recognition test, their brains had little to distinguish where they had seen all these objects from, trying to decipher if the objects in front of them are familiar because they were presented during the scene viewing, or if they had other memories of those objects. During the location recall test, they had more guidelines for their memory retrieval, giving their monitoring process more information.

Real-world implications of this study revolve around contexts in which memory accuracy is vital. Eyewitness testimonies, for instance, heavily rely on the accurate recollection of the event being assessed, yet schema-driven distortion poses a well-documented threat to its reliability (Loftus & Palmer, 1974; Loftus & Pickrell, 1995). The current study suggests that prompting witnesses to recall specific spatial contextual details may help to induce verbatim memory traces and correct any schematic interference that had occurred. Other implications of this study extend to clinical settings, where therapeutic memory retrieval can be shaped by a patient's pre-existing beliefs and expectations. Initiating conversations or asking specific questions that encourage specific recall, rather than a general scene reconstruction, may offer a way to increase the accuracy of memories, allowing for greater insight to be had.

There are several limitations to this study. The current study design only used two scene types, beach and farm, which may limit the generalizability of the findings to other schema domains. The Webb et al. (2016) article that this task is based on, had 26 scenes as well as schematically-unrelated objects present in their scenes. The current study was unable to produce this many scenes and test unrelated objects due to a predetermined time slot for participants to

finish the study. Participants were only given thirty minutes to complete the study and testing more than two scenes and unrelated objects would have gone over the threshold. There was also no exploration of the role confidence levels played during the recognition task, more specifically their ability for participants to correct any false memories. By looking at the confidence ratings versus the binary system used in this study, we could have seen any connection between participants' confidence in their old/new recognition and their willingness to change their belief during the placed recall test. This was not looked at though, since it was beyond the scope of analysis for the present study.

In conclusion, the present study provides evidence that schema-based false memories can be counteracted when retrieval demands require access to specific, verbatim-level detail, such as location. These findings extend prior work on schemas and false memory by demonstrating that the malleability of memory operates in both directions – the same cognitive flexibility that makes us vulnerable to distortion, may also enable correction. Understanding the condition under which false memories can be amended has meaningful implications for improving memory accuracy in legal, clinical, and everyday contexts.

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