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False memories of expectancy-consistent and expectancy-inconsistent images in a paired-association memory task

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Abstract

The current research utilized a paired-association task previously developed to evoke false memories to determine whether people would be more likely to falsely recall having viewed expectancy-consistent vs. expectancy-inconsistent images. Participants were shown a series of 60 expectancy-consistent and expectancy-inconsistent images and were then asked whether they recognized 120 partially redacted images (60 previously seen, 60 new). When they reported seeing a redacted image, they were asked which version (either the expectancy-consistent or the expectancy-inconsistent) they remembered having seen. We found that when participants falsely recognized redacted images, they were significantly more likely to select the expectancy-consistent version of the image. Surprisingly, we also found that accurate memories were more likely for expectancy-consistent images. These findings suggest that this paired-association task can be useful in evoking false memories of images.

Keywords: false memories; expectancy-inconsistent; expectancy-consistent; images; memory

False Memories of Expectancy-Consistent and Expectancy-Inconsistent Images in a Paired-Association Memory Task

Because memory serves a critical role in human experience, researchers have long aimed to better understand the multitude of ways in which our memory can fail us. One particular research goal is understanding the phenomenon of individuals recalling events that didn't actually take place. Many paradigms have been developed over the years to investigate mechanisms that may contribute to the recollection of false memories. Research has focused on components ranging from investigator implantation of fabricated childhood memories (Loftus & Pickrell, 1995); to thematic word lists that omit an obvious, relevant word with the intention of causing participants to recall the omitted target word (the DRM paradigm; Roediger & McDermott, 1995); to the influence of implicit gender stereotypes on false memories in a paired-association task (Macrae et al., 2002). It has been well documented in memory failure research that false memories are more likely when consistent with the individual's expectations, including expectations due to held stereotypes (Ehrenberg et al., 2001; Macrae et al., 2002).

In 2002, Macrae et al. developed a novel approach using a paired-association task that relies heavily on gender stereotypes to produce false memories. They presented participants with a series of distinctly male and female forenames that were randomly paired with one of two occupations: mechanic or hairdresser. After a distractor task, participants were asked whether they recognized a series of names (combining previously viewed and new names) and, for only the names they claimed to have recognized, whether that individual had been a mechanic or a hairdresser. When participants remembered seeing a name that had not previously appeared, they were more likely to state that the name was linked to its expectancy-consistent occupation, rather than the expectancy-inconsistent occupation. For example, if the name Barbra was remembered despite not previously appearing, participants were more likely to identify Barbra as a hairdresser rather than a mechanic. Moreover, when asked to select between “remembering” vs. “knowing” (as defined by Gardiner, 1988) a name-occupation pairing, participants more frequently reported the sensation of knowing when referencing their false memories. The authors concluded that participants were using expectations from previous knowledge, specifically gender stereotypes, to fill in gaps when presented with this memory task (Macrae et al., 2002).

It is worth noting that while the major finding in Macrae et al.’s 2002 paper was the creation of stereotype-specific false memories, the researchers analyzed additional results, including comparing the total number of accurate expectancy-consistent and accurate expectancy-inconsistent memories. Macrae et al. found that participants tended to have better memory for expectancy-inconsistent pairings (i.e., a masculine forename paired with “hairdresser”). This finding aligns with a meta-analysis revealing that memory tends to be increased for expectancy-inconsistent vs. expectancy-consistent information across 54 relevant studies (Stangor & McMillan, 1992). These overall findings suggest that details of false memories can be influenced by gender stereotypes (Macrae et al., 2002). Further, the results demonstrated a valuable, underutilized paired-association task that leads to creation of truly independent false memories, rather than false memories that are simply inaccurate details of real memories.

A remaining question is whether expectations of visual scenes rather than word pairings can also lead to false memories. In 1998, Miller and Gazzaniga took images with clear themes and created false memories of schema-relevant exemplars missing from those images. For example, an image of a beach setting was edited to remove a beach ball, an object strongly associated with the schema of a beach. The study revealed that participants would remember having seen the beach ball despite only viewing a beach setting without one. Further, the authors found that the false recall of items in themed photographs was consistently correlated with false recall of critical lures in the DRM paradigm (Miller & Gazzaniga, 1998). However, the visual false memories encouraged by this paradigm were limited to small additions to veridical (i.e., correct) memories of scenes, rather than entirely new memories (such as those found by Macrae et al., 2002).

Miller & Gazzaniga's work is part of a wide variety of research aimed at better understanding how humans process visual information. Other such studies have focused on determining the underlying factors of how people process both ordinary and unusual visual stimuli. Researchers in this area have examined people's responses to photographs containing unexpected or unusual objects that don't fit with the background. Participants tend to take longer to recognize the unusual objects in these photos (Chun & Jiang, 1998; Davenport & Potter, 2004; Rieger et al., 2008) and are also less accurate when doing so (Biederman, 1972). This suggests that these images are more difficult for participants to process (Truman & Mudrik, 2018). While much is known about the effects of scene-object congruency on object processing, the relationship between scene-incongruent objects in an image and false memory rates remains understudied.

The current study attempted to adjust the Macrae et al. (2002) paired-associate false memory task to show participants expectancy-consistent and expectancy-inconsistent images—with constancy determined by the match between an image's background and a central object in the foreground—rather than name/occupation pairings. We first attempted to identify whether veridical memories (correct recognitions or 'hits') were higher in expectancy-consistent or expectancy-inconsistent images using this task. We hypothesized that participants would recognize previously viewed, expectancy-inconsistent images with higher accuracy and that they would also recall the correct version of previously seen expectancy-inconsistent images with more accuracy. Finally, we hypothesized that when participants did falsely recognize partially redacted images, they would report that the expectancy-consistent version was the version that they saw.

Method

Participants

54 undergraduate participants (37 female, 3 transgender or nonbinary, mean age = 20.2, SD = 2.55) at the University of Indianapolis received course credit for their participation. This sample size was determined using G*Power (Faul et al., 2007) to provide 95% power for a 2-tailed alpha of .5 and a medium effect size (*dz* = .5).

Materials

Stimuli were 120 image pairs—one expectancy-consistent version and one expectancy-inconsistent version of each scene—created by Truman and Mudrik (2018), who described them as having been designed to minimize confounding differences between matched pairs.

Specifically, these image pairs featured a background associated with easily recognizable schematic actions such as using an oven in a kitchen or kayaking on a river. However, a central foreground component of each image had been digitally altered to render the image expectancy-inconsistent (e.g., a person putting a chessboard in the oven or paddling the kayak with a stop sign). Each image had a complimentary expectancy-consistent version (e.g., putting a pizza in the oven or paddling the kayak with a standard paddle) in which an expectancy-consistent object from a different image replaced the original object. While this had no impact on the interpretation of the consistent images, it ensured both versions of an image underwent similar amounts of digital editing. These images were presented using PsychoPy software (Peirce, 2007; 2009).

Procedure

This within-subjects experimental design utilized randomized partial counterbalancing. The procedure loosely followed that used by Macrae et al. (2002). After giving informed consent, participants were asked to read instructions and told to click to begin. Each participant was exposed to 60 images (30 expectancy-consistent and 30 expectancy-inconsistent) in the first phase of the experiment. The order of image presentation, which 60 images were selected to be viewed in the first phase, and whether the participants saw the expectancy-consistent vs. expectancy-inconsistent version of a given image was randomized for each participant. Each trial began with a fixation-cross placed in the center of the screen to ensure the participants were prepared for where the images would appear. The fixation-cross remained on the screen for 2 seconds, which was followed by presentation of an image for 2 seconds. This 2-second fixation-cross/2-second image presentation was repeated until 60 randomly selected images (30 expectancy-consistent and 30 expectancy-inconsistent with randomized order appearance and version) were presented. After completing Phase I, participants were asked to complete a distractor task in which they named as many cities and towns from their home country as possible in 5 minutes. After 5 minutes passed, participants clicked to begin Phase II, the second image viewing session.

In Phase II, participants saw all 120 images, presented one at a time in random order. These images included the same 60 images participants saw in Phase I and 60 images previously unseen. Initial presentation of images in Phase II differed from that of Phase I in that the object of interest (the section of the image that was digitally edited to be expectancy-consistent or expectancy-inconsistent) was redacted using a black rectangle superimposed on the image. The rectangle was made to be as small as possible to ensure participants could still see a large portion of the image. As each of the 120 images were presented, participants were asked whether they had previously seen the image. Every time the participant responded "yes" to having previously seen an image, they were then presented with both the expectancy-consistent and expectancy-inconsistent version of the image and asked to select which version they had previously seen. Expectancy-consistent and expectancy-inconsistent placement on the selection page was randomized. Moreover, even in the case that participants incorrectly identified having seen an image, they were asked to select which version they had seen. After each of the 120 redacted images had been presented to the participants, they were thanked for their time and given credit for their participation.

Analysis

Data analysis was conducted using SPSS (IBM Corp., 2017). Possible differences in recognition rates were examined using paired-samples *t*-tests. We additionally report means and standard deviations of total recognition for each image category, as well as 95% confidence intervals of category differences and Cohen's *d* (mean difference score/standard deviation of the difference score).

Results

False Memories

In the case that participants incorrectly reported seeing a redacted image (i.e., they had a memory of having seen the image despite not having seen it), they were significantly more likely to indicate having seen the expectancy-consistent version than the expectancy-inconsistent version. Consistent with this observation, a paired-samples t-test revealed a significant difference between falsely selected expectancy-consistent versions of images (M = 9.09, SD = 9.13) and expectancy-inconsistent versions of images (M = 4.44, SD = 8.07); $t(53) = 3.58$, $p < .001$, 95% CI = [2.05, 7.27], Cohen's *d* =.49.

Veridical Memories

Participants had higher veridical source memories (or accurate version identification of correctly recognized redacted images) for expectancy-consistent images than for images containing an expectancy-inconsistent feature. Confirming these observations, a paired-samples t-test revealed a significant difference between accurate memory of expectancy-consistent vs. expectancy-inconsistent images. There was a significant difference in the total recollection scores for expectancy-consistent images (M = 19.81, SD = 6.93) and expectancy-inconsistent images (M = 18.24, SD = 7.03); $t(53) = 3.25$, $p = .002$, 95% CI = [.60, 2.25], Cohen's *d* = .44.

Incorrect Version Selection

In the case that participants accurately recognized a redacted image, but then incorrectly identified which version was previously seen, they were significantly more likely to have first seen the expectancy-inconsistent version and then selected the expectancy-consistent version than vice-versa. A paired-samples t-test revealed a significant difference between incorrectly selecting the expectancy-inconsistent version of an image (M = 1.33, SD = 2.40) and incorrectly selecting the expectancy-consistent version of an image (M = 2.35, SD = 2.99); $t(53) = 2.78$, $p = .007$, 95% CI = [.28, 1.75], Cohen's *d* =.38.

Discussion

The goal of the current research was to explore the possibility of modifying Macrae et al.'s (2002) paired-association false memory task to test participants' memories of expectancy-consistent and expectancy-inconsistent images. It was hypothesized that participants would tend to better remember expectancy-inconsistent images while indicating expectancy-consistent images when they had false memories of seeing images they had not previously seen. Results indicated that while false memories did lead to the selection of expectancy-consistent images, participants had an unexpected tendency towards selecting the expectancy-consistent images in both accurate recognition + accurate version selection and in accurate recognition + incorrect version selection.

False Memories

The main goal of this experiment was to explore the possibility of adjusting Macrae et al.'s (2002) paired-association task to create false memories of expectancy-consistent and expectancy-inconsistent scenes in images. Findings were in alignment with the hypothesis that when participants incorrectly recognized redacted versions of images they had not previously seen, they would be significantly more likely to select the expectancy-consistent version of the image than the expectancy-inconsistent version. This finding corresponds with Macrae et al.'s (2002) results and suggests that this paired-association task is effective at eliciting false memories of images. Further, the task does tend to lead participants to having false memories of having seen expectancy-consistent vs. expectancy-inconsistent versions of images.

Accurate Memories and Partially-Accurate Memories

Current findings regarding correct recognition of previously attended items diverged from Macrae et al.'s (2002) findings. Participants in the current study were more accurate at identifying the correct version of images when the images were expectancy-consistent. In addition, participants were more likely to incorrectly select the expectancy-consistent version of an image after correctly recognizing having seen the image, thus revealing an overall preference for the expectancy-consistent photos when asked to select between the two.

The differences between Macrae et al.'s (2002) findings and ours could have several causes. First, there is neurological evidence to suggest that individuals process expectancy-consistent and expectancy-inconsistent images differently (Truman & Mudrik, 2018); it is also possible that expectedness determinations for visual scenes are made via a mechanism independent of the mechanism responsible for expectedness determinations of Macrae et al.'s (2002) word pairs. Determining whether this is the case is a potential avenue for future research.

Further, the fact that the current study evaluated expectancy-consistent and expectancy-inconsistent images of scenes is far more in line with schema activation and less in line with stereotype activation. The current findings are consistent with the early cognitive schema literature, which suggested that expectancy-consistent information would be remembered better than expectancy-inconsistent information, which differs from the findings generally seen in trait and stereotype research within social psychology (Heider et al., 2005). Another explanation is that participants who were observing expectancy-consistent images may have put more effort into examining those images to search for a nonexistent inconsistent object within them, thus increasing veridical memories of expectancy-consistent images.

Conclusion

In addition to expanding the usefulness of this paired-association false memory task, these findings could be especially valuable to researchers who are trying to better understand how humans process and remember different types of visual scenes containing ordinary and unusual objects. Future work using neuroimaging techniques to investigate whether expectancy determinations for visual scenes and word pairs are made using similar or distinct neural systems could help to explain our findings, as well as help flesh out theories of false-memory formation to account for different modalities.

Open Practices Statement

The data are available at https://osf.io/jvbmh, however the experiment was not preregistered.

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