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FALSE MEMORIES FOR PICTURES AND DIRECTED FORGETTING

by

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Abstract

False Memory for Pictures and Directed Forgetting

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A false memory is a memory for an event that never actually occurred. Although false memories for pictures are usually difficult to find results for, Weinstein and Shanks (2010) found high levels of false memories for pictures when participants were asked to imagine an object during an intervening period between study and test. The current study introduced directed forgetting to this procedure. In directed forgetting, participants study material and are then instructed forget some of the material. In this study, participants studied a set of pictures, imagined words, and then received instructions to remember or forget the list. They then studied a second set of items and were given a recognition test. No effect of directed forgetting was found, and false memories for imagined items were only found for the second of set of items when participants received remember instructions. Explanations and suggestions for future research are discussed.

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Chapter One:

Introduction

A false memory is a memory for an event that never actually occurred or an incorrectly remembered memory. Although false memories can be induced in the laboratory (Deese, 1959; Roediger & McDermott, 1995), false memories for pictures are typically difficult to create (Israel & Schacter, 1997). Weinstein and Shanks (2010) were able to induce false memories for pictures by using an imagination task. In the imagination paradigm, participants imagine words semantically related to items they studied as pictures, and later, incorrectly recognize the words as pictures. Even when test instructions warn participants that they imagined items they did not see as pictures, they still have false memories for pictures. The goal of this thesis is to determine if participants still have false memories when the instructions explicitly state to forget half of the items, using directed forgetting.

The Deese/Roediger-McDermott paradigm (DRM) creates robust false memories in a laboratory setting (Deese, 1959; Roediger & McDermott, 1995). In the DRM paradigm, participants view a list of words associatively related to one critical word, which is not on the list. On subsequent memory tests, participants incorrectly report studying this word. This indicates a false memory because participants incorrectly believe that they saw this word on the original study list. Even when participants receive warnings that the lists are related to a critical word, or learn techniques on how to avoid incorrectly recognizing these items (Miller, Guerin, & Wolford, 2011), participants still have false memories for the critical word.

However, even in the DRM paradigm, it is difficult to find false memories when the stimulus is a picture. A possible explanation for the limitation of false memories in pictures is the distinctiveness heuristic. Literature supporting the distinctiveness heuristic (Schacter, Israel, & Racine, 1999; Israel & Schacter, 1997) theorize that participants use the additional distinctive, pictorial information from pictures to determine that a picture at test is different from what they studied (Dodson & Schacter, 2002). Therefore, participants correctly reject stimuli they have not previously seen. However, imagination has successfully induced false memories for pictures (Weinstein & Shanks, 2010). When words are imagined after studying a list of pictures, the words are incorrectly remembered as pictures on a recognition test. Even when participants are given instructions intended to invoke the distinctiveness heuristic, these imagined false memories remain.

By introducing directed forgetting methodology to this method of inducing false memories for pictures, it may be possible to discover if participants are able to forget the imagined material. In directed forgetting, participants study material and are then instructed forget some of the material (Benjamin, 2006). By combining directed forgetting with an imagination task, participants should forget the material after forgetting instructions and may be more discriminate in their answers. This would test the robustness of the imagined false memories and determine the limitations the Weinstein and Shanks (2010) methodology.

False Memories in Deese/Roediger-McDermott Paradigm with Pictures

In the Deese/Roediger-McDermott paradigm (DRM), participants recall false information when they view a list of words that are semantically related to a critical word that does not appear on the list (Roediger & McDermott, 1995). For example, if the critical word were *sleep,* some of the semantically related words would be *bed, awake, blanket, snore,* and *tired.* In Roediger and McDermott's experiment, there were fifteen semantically related words in each study list. On both recognition and free recall tests, results showed that participants frequently have false memories for the semantically related word; 93% of participants reported seeing the word. This type of false memory is a memory intrusion error. The DRM paradigm has consistently generated false memories, even when the participant knows that the researchers are investigating false memories (Gallo, Roediger, & McDermott, 2001).

Despite the robustness of the DRM paradigm, it does not generate high levels of false memories in picture recognition. Israel and Schacter (1997) created pictures from the lists used in the DRM paradigm to determine if encouraging participants to focus on distinctive details (such as pictures) would reduce false memories. In one condition, participants heard a typical DRM list. In another, participants heard and saw the words simultaneously. In the third condition, participants heard the words, but instead of seeing the words, they saw line drawings of the words. On a subsequent memory test, participants in the line drawing condition had significantly fewer false memories for pictures compared to the word or auditory presentation.

Israel and Schacter (1997) proposed that their results were explainable by the distinctive nature of pictures, which made it easier for participants to discriminate between what they had seen and what they had not seen. Memory research provides evidence that pictures and words differ in how they are processed. One example of this is the picture superiority effect, which demonstrated that pictures are more memorable than words (Nelson, Reed, & Walling, 1976). The visual information that pictures provide distinguish the picture from other items in memory, making it distinctive (Hamilton & Geraci, 2006). An item is distinctive when it stands in memory among other items (McDaniel & Geraci, 2006).

Long-term memory for visual items is termed visual long-term memory, as its characteristics are different compared to other types of long-term memory (Brady et al., 2011). In visual long-term memory, both conceptual and perceptual information about visual items is stored. Conceptual information of visual items stems from prior knowledge and allows people to place an item into a category. Perceptual information describes the item using terms that do not define it, such as shape, color, and size. For example, perceptual information about an object may tell us that it is yellow and crescent shaped. Conceptual information provides prior knowledge that identifies this object as a banana. By combining perceptual and conceptual information, memory for visual items is stronger compared to other items, such as words (Koutstaal et al., 2003, cited in Brady et al., 2011).

Distinctiveness Heuristic

Although memory for pictures is better than memory for words, this does not explain why false memories are more difficult to achieve for pictures compared to words. The distinctive characteristics of pictures may explain why pictures have fewer false memories than words (Israel & Schacter, 1997). The distinctiveness heuristic is a way of responding to a memory test in which participants expect to remember distinctive details for studied material and use the presence of such details in their responses (Schacter et al., 1999). Using the framework of the distinctiveness heuristic, the reduction of false memory for pictures is a result of participants relying on the distinctive material found in pictures. At test, participants using the distinctiveness heuristic expect certain distinctive details from pictures. When distinctive details are unavailable, participants are able to reject pictures that might be familiar, but do not exactly match their distinctive recollections. For example, when remembering if they saw a picture of an apple, they might expect to remember the apple’s skin color. Although the apple may be familiar because the participant studied a series of fruit pictures, the participant knows they did not study the apple because they cannot remember the skin color. Therefore, the absence of memory for the picture is evidence that the picture is new, no matter how familiar it may seem (Hege & Dodson, 2004).

There are three steps in using the distinctiveness heuristic: a participant must monitor what they have remembered about a test item, compare it to their expectations of what they would remember if the test item were distinctive, and then respond based on the contrast between what they remember and what they expect (Dodson & Schacter, 2002). As the distinctiveness heuristic requires comparing a test item to distinctive expectations, what they originally studied must be distinct in some way. For example, studying a word list of fruits may evoke a familiarity response for fruits not on the list because the conceptual information is familiar. However, studying a picture list of fruits would not evoke a familiarity response for fruits not on the list because although the conceptual information may be familiar, the perceptual information (e.g., color, size, perspective) is not familiar.

Additionally, the effect of test instructions changes how participants use the distinctiveness heuristic (Dodson & Schacter, 2002). Dodson and Schacter (2002) compared uniformed and informed instructions while studying pictures and words. The informed instructions stated the test would be for all studied items. The uninformed instructions stated the test would only be for the items that were words and not the pictures. All participants received a test for both the picture and word items. At test, the informed instruction group had similar results to another sample of participants that only studied words. The participants did not expect the picture items and consequently did not use the distinctiveness heuristic. This indicated that the distinctiveness heuristic could be controlled based on expectations. Under normal test conditions, the distinctiveness heuristic was used automatically.

False Memories for Pictures

Although the distinctiveness heuristic is able to capture why pictures and other distinctive study materials do not typically result in high false memory rates in the DRM paradigm, there are exceptions where researchers found false memories for pictures

Hannigan and Reinitz (2001) were able to generate false memories in picture recognition, but their results were limited. In this study, participants might view a picture of a woman picking oranges off the floor and at test, they would falsely recognize a picture of a woman picking oranges off a table. The pictures were very similar perceptually and conceptually, unlike the DRM paradigm in which the items are only conceptually related. Additionally, there was also a 48-hour delay between study and test, further limiting comparisons to the DRM paradigm.

Weinstein and Shanks (2008, 2010) found false memories for pictures when participants either imagined an item or used it in a sentence. False memories were not induced at study, but during an intervening imagination/sentence creation phase between study and test. During the study phase, participants were shown two object labels on a screen; these object labels were from the same semantic category. The participant then viewed a picture of an object from that semantic category, and responded by indicating which label referred to the picture. For example, if the category was *animals*, the labels might be *tiger* and *flamingo*, the picture would be a *tiger*, and the participant would have to hit the key to indicate which label said *tiger*.

Participants then completed a five-minute distractor task, followed by the imagination phase. In this phase, participants viewed the names of pictures they saw during the study phase, and indicated if the picture they originally saw had been in color or in black and white. Some of the item names were new and had not studied as pictures. If the participant could not remember the item, they had to imagine it. In a following recognition test, participants viewed pictures and indicated if they had seen the picture previously. Weinstein and Shanks completed several experiments with different test instructions, such as asking the participants to make *remember-know* judgments. In these judgments, participants report that they either *remember* or *know* the item (Tulving, 1985). A *remember* judgment is used when the participant is able to vividly recall seeing the item previously, while a *know* judgment is used when the item is familiar, but the participant cannot recall specific details.

The results were significant, indicating that participants did falsely remember pictures they had not seen during the initial study phase. Furthermore, the proportion of falsely recalled pictures receiving a remember judgment (.29) was higher than most studies involving pictures (.17; Israel & Schacter, 1999), although not as high as associative word lists (.58, Roediger & McDermott, 1995).

Research on imagination has shown that when participants imagine pictures of words, participants are more likely to report incorrectly seeing a picture of an item they had seen as a word (Foley, Foy, Schlemmer, & Belser-Ehrlich, 2010). The imagination activation hypothesis suggests that when imagination occurs while encoding information, image-based thoughts may occur. These imagined thoughts can vary from generic to very specific, but include both perceptual and conceptual information (e.g., a generic apple vs. a green Granny Smith apple). At test, the image-based thoughts may be reactivated and participants incorrectly remember seeing pictures that they only imagined. This results in a source-monitoring error and a false memory for the picture.

However, creating the instructions to induce imagination must be precise (Foley et al, 2010). Simply imagining a label for a picture will not induce this false memory effect. When participants were asked to imagine a picture of the word (e.g., imagine you are seeing the word apple as text), the imagination effect was reversed and participants were more likely to believe they had seen a picture as a word, even when they had seen it as an image. This is because the imagined thought was for a word, rather than for a picture.

Weinstein and Shanks (2010) acknowledged that distinctive details should have assisted participants in rejecting stimuli not on the original study list, but they did not suggest an explanation as to why the distinctiveness heuristic appeared not to work (other than that their false memory effect was so strong). To further explore the nature of imagination and if the Weinstein and Shanks methodology somehow turned off the distinctiveness heuristic, the two bodies of research were combined in a previous study.

In a modified version of Weinstein and Shanks' (2010) methodology[1], test instructions were manipulated based on distinctiveness heuristic research. Prior to test, participants' instructions stated either that the test was for all items shown or that there were items from the imagination phase that were not on the original study list that should be ignored. The results of this experiment successfully replicated the Weinstein and Shanks (2010) results, with a significant effect of when participants viewed the item. Items from study had the highest proportion of correct old responses (0.70), but imagined items had a higher proportion of incorrect old responses (0.34) than new pictures from

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[1] I conducted this study last year as a first-year project. Participants either received the instruction "You will be tested on all items shown" or "You will be tested only on the items from the first task when you named pictures. Some items during the last task in which you were instructed to imagine items, did not appear on the first test." The results of when the item was shown (Study, Imagination, New-Related, New-Unrelated) was significant, F (9, 98) = 485.15, $p < .05$, observed power =1.00

the same semantic category (0.13) or unrelated new pictures (0.05). A comparison to the results found in Weinstein and Shanks (2010) are in Figure 1.

However, the results showed no effect of test instruction. There are several possible reasons why the modified test instructions had no effect. It may be that the methodology does not lend itself to an effect from the distinctiveness heuristic, but the problem might also lie in the test instructions. An alternative way to examine test instructions would be to use the very successful forgetting instructions found in directed forgetting methodology, as directed forgetting is successful in making participants forget material when they are asked to forget it.

Directed Forgetting

In directed forgetting, participants study material and then receive an instruction to forget some of it (Benjamin, 2006). Typically, this results in lower recall or recognition of the *to-be-forgotten* material, while increasing memory for the *to-be-remembered* items. There are two procedures for directed forgetting: the list method and the item method. In the item method, participants receive instructions to forget or remember an item immediately after viewing it. This contrasts the list method, in which participants view an entire list of items and then receive an instruction to forget or remember the list, and then study another list.

Foster and Sahakyan (2011) have researched the role that the forgetting and remembering instructions play in directed forgetting using the list method. Participants received either covert or overt memory instructions after a list of words, and following a second list, they reported what words they remembered for both lists on a free recall test.

The overt memory instructions were typical of directed forgetting studies—participants studied the list, and if they were in the forget condition, they were told it was only a practice list and they should try to forget the words. For participants receiving the covert instructions, they were told initially that only one list would be on the test, and after the first list, they were told only the second list would be on the test.

The results showed a significant directed forgetting effect, but there was no difference between the overt and covert instructions (Foster & Sahakyan, 2001). No matter which directions were given, if a participant was in the forget condition, there was an increase in recall for the second list and decrease in recall for the first list, compared to those told to remember both lists. The cost of directed forgetting is the reduced recognition or recall of items that the participants were asked to forget (Sahakyan, Waldum, Benjamin, & Bickett, 2009). The benefits of directed forgetting is the enhanced recognition or recall of items of list two that typically occurs when participants are asked to forget the first list.

Participants also indicated what forgetting strategy they had used to forget the first list (Foster & Sahakyan, 2001). Strategies included “stopped rehearsal,” “pushed out of mind,” and “did not think of words.” Analyses of strategies indicated that using any strategy resulted in more costs and benefits in directed forgetting than doing nothing to encourage forgetting. Although the directed forgetting effects did not differ between the instruction groups, prior research showed that those in forget groups are more likely to change encoding strategies (Sahakyan & Delaney, 2003). When participants in both forget and remember groups used the same encoding strategies, the benefit of increased recall for List 2 did not occur, although the cost of decreased recall for List 1 was present. Consequently, the specific wording of instructions used does not appear to have a significant effect, but the difference between remember and forget instructions is still clear. This makes the directed forgetting very useful. However, there are some limitations.

Directed forgetting has used the DRM paradigm (Kimball & Bjork, 2002). After studying three DRM word lists, participants received overt forget instructions or remember instructions and studied three more DRM word lists. On a recall test, the benefits and costs of directed forgetting were found for studied items. However, an inverse pattern was found for the critical associated words. For critical items, forget instructions led more List 1 false alarms and fewer List 2 false alarms when compared to remember instructions. Therefore, directed forgetting can be used to examine false memories.

Directed forgetting research has also used distinctive items. As previously mentioned, an item is distinctive if it stands out in memory. Using common words (Sahakyan & Delaney, 2003) or non-words (Sahakyan et al., 2009) does not make the materials distinctive because common words and non-words do not stand out in memory when compared to items of the same characteristics. However, using pictures or changing characteristics of the materials does. Pictures are more distinctive than words, because pictures provide both conceptual and perceptual information (Foley et al., 2010). If the characteristics of some words are different within a list, they also provide additional contextual information. For example, if some of the words are a different font or color, then that additional information stands out and those items are distinctive.

Hourihan and MacLeod (2008) gave participants an item method presentation of words. If the item was presented in a blue font, the participants read the word aloud and if it was white, the participants read it silently. Participants then completed an explicit memory test, in which participants were shown words and asked if they had seen them previously, even if the item had forget instructions. On the explicit test, there was an overall directed forgetting effect for participants that viewed words. *To-be-remembered* items were recognized more frequently than *to-be-forgotten* words. There was also a distinctiveness effect of production—words that participants read aloud were remembered better than those participants read silently. However, when the results of words read aloud were examined separately, there was no directed forgetting effect. The words that were read aloud were distinctive in comparison to the words read silently, because they had the additional contextual cues (e.g., the experiences of saying the word aloud) during encoding. Consequently, these items were recognized better, because the additional contextual information was available. This heightened awareness makes distinctive items less susceptible to directed forgetting.

Pictures also have distinctive properties and the use of pictures in directed forgetting research has shown mixed results. Quinlan, Taylor, and Fawcett (2010) investigated the use of pictures compared to words when used as study material and as test material for item-method directed forgetting. Participants saw a series of pictures or words followed by a *remember* or *forget* instruction. They then completed a recognition test, which was either pictures or words, and indicated if they remembered the items. The results showed an overall directed forgetting effect, *with to-be-remembered* items recognized better than *to-be-forgotten* items. There was also picture superiority effect, in which participants who studied pictures remembered more items than who that studied words. However, there was no difference between picture and word recognition, and no interaction of recognition with the material they studied (pictures or words). Unlike Hourihan and MacLeod (2008), the directed forgetting effect was still for studied pictures, but there was a 60% decrease in magnitude in the effect.

In another study using pictures as the material (Hauswald & Kissler, 2008), complex photos were used in an item-method design. Participants studied complex photographs that included landscapes, faces, and different environments. The pictures selected because they did not have a direct verbal name that the photograph was immediately associated with. On a recognition test, an effect of directed forgetting was found. For *to-be-forgotten* items, recognition of the picture was lower than *to-be-remembered* items. Small directed forgetting effects were also observed in the list-method when visual symbols without direct names were used rather than pictures, even when the object was given a name (Hourihan, Ozubko, & MacLeod, 2009). Using distinctive materials, such as pictures, in a directed forgetting methodology does not always yield significant results for the distinctive material (Hourihan & MacLeod, 2008) and the effects may be smaller in magnitude (Quinlan et al., 2010; Hourihan et al., 2009). However, directed forgetting is not impossible to achieve using distinctive material (Hauswald & Kissler, 2008).

There is a drawback to using the list method with recognition tests. As previously mentioned, directed forgetting is supposed to result in an increase in memory for *to-be-remembered* material (the benefit), while memory for the *to-be-forgotten* material decreases (the cost) (Benjamin, 2006). Yet, when a recognition test is used with the list method, the results do not match this. Frequently, the use of a recognition test has the increased memory for the *to-be-remembered* material, but no decrease for *the to-be-forgotten* material (Benjamin, 2006). In a study using pictures with the list-method and a recognition test, neutral pictures and emotionally arousing pictures were used (Payne & Corrigan, 2007). Although the directed forgetting effect was observed on the recognition test for the neutral items, there was no cost or benefit of directed forgetting when emotional pictures were studied, possibly due to the added contextual cues of emotion. The added context of emotion makes the material distinctive, and the issue may not be with the recognition test, but with the distinctive materials.

Attempts to find the cost of directed forgetting using recognition tests have had some success. By using nonwords as stimuli instead of words, a decrease in memory for the forget material was found, but the benefit for the *to-be-remembered* words was not found (Sahakyan, et al., 2009). The cost of directed forgetting has been observed when using words, if the recognition test is designed to recover specific details from the study lists. Sahakyan and colleagues were able to achieve this by having a recognition test with similar distractors. For example, if the participants studied *cloud,* the recognition test might include *clouds.* Using this recognition test, the decrease in recognition for the forget items was found, but the increase for remember items was not found. This reduced familiarity-based recognition and encouraged participants to consider the exact details that they had seen. Therefore, creating a situation that encourages participants to recover precise details from the study may increase directed forgetting effects when using recognition tests. This is comparative to distinctiveness heuristic studies, as participants who use the distinctiveness heuristic are using precise details from encoding (Schacter et al., 1999).

Another way to achieve encourage participants to consider details is to use a source monitoring task, as it is a more sensitive measure of list-method directed forgetting compared to standard recall or recognition of the studied material (Gottlob & Golding, 2007). In the first of two experiments, Gottlob and Golding presented participants two lists of words, but half of the words were in either lower case or upper case font. Participants completed two recognition tests, one for the first list and the other for the second list. On the tests, the items were in both upper and lower case font and participants indicated which case they had seen the item in originally. The results did not show a standard directed forgetting effect, but when correct case identification (the source monitoring task) was examined independently, there was a directed forgetting cost for the *to-be-forgotten* words. However, there was no benefit for the *to-be-remembered* list. Additionally, when the words were in different colors, an overall directed forgetting effect was found, including the cost. However, no benefit to the *to-be-remembered* words was found.

Present Study

The present study attempted to use test instructions within the directed forgetting paradigm to reduce false memories for imagined items as pictures within the Weinstein and Shanks (2010) methodology. By adjusting the experimental design to match that of directed forgetting, but keeping the critical imagination task, it may be possible to determine if the false memories created by imagination can be forgotten. A prior attempt to use test instructions to decrease false memories under the distinctiveness heuristic failed[2], so the increased strength of directed forgetting may reduce false memories when the distinctiveness heuristic did not.

To use directed forgetting in a manner that is most congruent with the Weinstein and Shanks (2010) model, the list-method was used. Using the item-method would have altered the methodology to the extent that the results might not be extendable to prior results. Additionally, as the materials are pictures, a recognition test was used. Although the combination of list-method directed forgetting, distinctive items like pictures, and a recognition test has yielded mixed results in several instances (Benjamin, 2006; Hauswald & Kissler, 2008), the combination of all three elements produced significant results when the pictures were not emotionally charged (Payne & Corrigan, 2007). To maximize the chance of finding an effect of directed forgetting, a source-monitoring task was used with the recognition test, in which participants will be asked where they originally saw the item. This was based on the finding that source monitoring may be

[2] See previous footnote regarding study from first year project

more sensitive toward directed forgetting than a yes or no recognition question (Gottlob & Golding, 2007).

Therefore, the present study replicated Weinstein and Shanks' overarching method (2010), but modified the grouping of items into multiple lists. It was expected that participants would be able to correctly identify pictures that they saw and remember the source being a picture, because the contextual details of pictures suggests that the items are distinctive. It was also expected that there would be a cost of directed forgetting effect and recognition of items participants were asked to forget should be lower than items they were asked to remember. There may also be a beneficial effect of directed forgetting, and participants who forget the first list may remember the second list better. When participants are asked to remember both lists, it was expected that there would be high levels of source misattribution for List 2 and participants would incorrectly identify items they only saw as words as items they saw as pictures. This would (conceptually) replicate the results of Weinstein and Shanks (2010).

Chapter Two:

Method

Participants and Design

A total of 120 students in psychology classes participated in the experiment, as fulfillment of course requirements or as extra credit. Participants enrolled via ResearchPool. All participants were 18 years of age or older and completed an Informed Consent form which is found in Appendix C. A total of 18 participants were removed from analyses. One participant was excluded because they were colorblind. The remaining 17 were removed for poor performance (below chance) on the picture naming task because of language difficulties or extreme inattentiveness.

The design was a 2 (Instruction: forget word list vs. remember word list) x 2 (Item Type: picture vs. word) x 2 (List: List 1 vs. List 2) mixed-factor design. Instruction was manipulated between-subjects with 49 participants receiving the forget instruction and 53 participants receiving the remember instruction. Item Type and List were manipulated within-subjects. There were two dependent variables: the proportion of hits on a recognition test (items correctly remembered with the correct source) and the proportion of source-monitoring false alarms (items remembered but incorrectly attributed to the wrong source).

Materials

Participants were tested in front of a computer with a display of 1084x768 pixels. The experiment was run using the e-Prime software, which recorded responses from keyboard strokes. Printed mazes were used as distractor tasks. The materials were based on those from Weinstein and Shanks (2010), using the categories animals and household items. A total of 65 items from each category were used. All items were verified as prototypical items from these categories from another pilot study[3]. Item names were collected from Weinstein and Shanks (2008; 66 items) and the International Picture Naming Project (cited in Johnson, Dent, Humphreys, & Barry, 2010; 64 items). A full list of these items is in Appendix B.

Items were presented on a white background, without any shadows and were 500x500 pixels in dimension. The 30 most typical images from each category were used as the critical items. Ten items from both categories were randomly assigned to act as the critical picture items, word items, and the related filler items. The remaining 35 items from each category were used in the picture and word lists, but did not appear on the final recognition test. Ten items each from the additional categories of musical instruments and food were used as unrelated filler items on the recognition test.

Procedure

Participants were told that the study was about memory for pictures. Participants were randomly assigned to remember or forget instruction conditions. Participants viewed a picture list, then a word list, and then received the remember or forget instruction. This was followed by a second picture list and a second word list. List order was randomly determined.

[3] Participants in pilot study were shown "prototypical" and "atypical" versions of pictures and asked to name the picture and choose which version of the picture was most similar to what they would imagine when they thought of the item. All items used had more than 80% agreement of name and typicality decision.

For each picture list, participants studied 45 pictures. They were shown two object labels from the same semantic category (animals or household items) on a screen for 400 ms. Following the labels, a picture was shown for 250 ms. The picture shown was the same as one of the labels. The participant's task was to identify which label matched the picture. For example, if the labels were flamingo and tiger, the picture would then be a tiger, and the participant would have to respond that the picture matched the label tiger. Half of the pictures were shown in black and white, while the other half were in color. This provided a basis for the subsequent word (imagination) list task. Following each picture list, a five minute distractor task was given (mazes).

During the word list, participants were presented with 45 names of pictures, five of which were different from the picture list. Participants were asked if the picture was in black or white or color when they saw it as a picture. As in Weinstein and Shanks (2010), participants were instructed to imagine a picture if they could not remember it. The name of the object appeared for 4000 ms before the participant could respond.

Following the conclusion of the first word list, half of the participants received instructions to forget the picture and word lists that came before it. While in list-method directed forgetting, the forgetting cue can be overt or covert (Foster & Sahakyan, 2011), an overt forgetting cue was used to be as clear as possible. Participants in the forget cue condition were told that both lists they just saw were for only practice, their memory for those items would not be tested, and they should try to forget the items. Participants in the remember cue condition were told to remember the both lists they just saw as the items would be on a memory test later.

After the instruction, participants viewed the second 45-item picture and 45-item word lists. The procedure was the same. An untimed recognition test followed, consisting of 80 pictures. Ten of the items were from each picture list, ten from the each word list (that were not on the picture lists), 20 new items from the same conceptual categories of animals and household items (related filler items), and 20 unrelated filler items (furniture and musical instruments pictures). Participants indicated if they had seen the items as pictures or words using a source-monitoring task. They indicated if they saw the item as both a picture and word, just a word, or if they did not see the item. Following the completion of the test, participants were thanked for their participation and debriefed.

Chapter Three:

Analysis

Results were analyzed using a 2 (Instruction: forget vs remember) x 2 (Item type: picture vs. word) x 2 (List: List 1 vs. List 2) mixed-factor multivariate analysis of variance (MANOVA) on two dependent measures: hits (items correctly remembered with correct source) and source-monitoring false alarms (items remembered but incorrectly attributed to the wrong source). Data for 18 participants were removed prior to any analysis (see Participants section).

Data Transformations

The Kolmogorov-Smirnov non-parametric test of normality was significant on the dependent measures hits and false alarms, $p < .05$. The histograms for all of the variables revealed that all of the dependent measures were highly negatively skewed. The data were consequently transformed into dichotomies in which the distribution was cut in half at the median.

Results for Hits

There were no main effects of the MANOVA for the combined set of the dependent variables, or either of the dependent variables independently, $p > .05$. However, the MANOVA indicated that the combined set of dependent variables was significant for the interaction of Instruction and Item Type, $\Lambda = .92$, F (2, 99) = 4.27, $p < .05$, $\eta^2 = .08$, observed power = .73. The univariate test indicated that this interaction was only significant for the hits dependent variable, F (1, 100) = 7.89, $p < .05$, η2= .07, observed power = .79 and not the false alarm dependent variable, $p > .05$. Post-hoc analyses revealed a significant difference for words between remember (*M* = .46, *SEM* = .05) and forget (*M* = .72, *SEM* = .05) instructions, $p < .05$. There was no difference between remember and forget instructions for pictures, $p > .05$. There was also a significant difference for the hits dependent variable for pictures (*M* = .57, *SEM* = .06) and words (*M* = .72, *SEM* = .05) for forget instructions, p < .05, but not for remember instructions.

The results of the analysis can be seen in Figure 2. Although there were no main effects, the interaction of Instruction and Item Type suggested that while there was no overall effect of testing instructions for pictures, there was a significant effect of testing instruction for words, where participants recognized more words overall when receiving forget instructions compared to remember instructions. When participants received forget instructions, they also recognized more words than pictures, but there was no difference between pictures and words when they received remember instructions.

Results for False Alarms

The MANOVA indicated that the combined set of dependent variables was significant for the interaction of List and Item Type, $\Lambda = .92$, $F\ (2, 99) = 4.53$, $p < .05$, $\eta^2 = .08$, observed power = .76. However, the univariate test indicated that this interaction was only significant for the false alarm dependent variable, $F\ (1, 100) = 5.83$, $p < .05$, $\eta^2 = .06$, observed power = .67 and not the hits dependent variable, $p > .05$. Post-hoc tests revealed a significant difference for pictures on List 1 (*M* = .54, *SEM* = .05) compared to List 2 (*M* = .56, *SEM* = .05), $p < .05$ for false alarms. However, there was no difference for words, $p > .05$. There was also no difference between pictures and words on List 1 or

List 2, $p > .05$. As can be seen in Figure 3, participants had fewer false alarms for pictures on List 1 when compared to list 2, but there were no other significant differences.

Additionally, the MANOVA indicated that the combined set of dependent variables was significant for the three-way interaction of Instruction, List and Item Type, $\Lambda = .89$, $F(2, 99) = 6.42$, $p < .05$, $\eta^2 = .12$, observed power = .90. The univariate test indicated that this interaction was also only significant for the false alarm dependent variable, $F(1, 100) = 12.94$, $p < .05$, $\eta^2 = .12$, observed power = .95 and not the hits dependent variable, $p > .05$. Post-hoc analysis revealed a significant difference between remember ($M = .26$, $SEM = .07$) and forget ($M = .47$, $SEM = .07$) instructions for picture items on List 2, $p < .05$. There was also a significant difference for pictures with the remember instruction between List 1 ($M = .58$, $SEM = .07$) and List 2 ($M = .26$, $SEM = .07$), $p > .05$. There was also a significant difference between words ($M = .53$, $SEM = .07$) and pictures ($M = .26$, $SEM = .07$) on List 2 when participants received a remember instruction, $p < .05$. No other post-hoc comparisons were significant, $p > .05$.

As can be seen in Figure 4, participants had fewer false memories on List 2 for pictures when they received remember instructions compared to forget instructions. Additionally, participants had more false alarms for pictures from List 1 compared to pictures from List 2 when they received remember instructions. Finally, participants had more false alarms for words than pictures on List 2 when they were told to remember both lists.

Chapter 4:

Discussion

Directed Forgetting

The results of the analyses did not support our hypotheses regarding directed forgetting. It was expected that there would be a cost of directed forgetting and participants that received the forget instruction should have had lower recognition (hits) for the first list compared to participants who received the remember instruction. It was also expected that there might be a benefit to directed forgetting, where participants given the forget instruction would have increased recognition (hits) for the second list compared to participants that received the remember instruction. There was no interaction between instruction and test list, indicating that there was no effect of directed forgetting. However, test instructions did have an effect upon item type. When participants received forget instructions, they remembered more words than pictures.

Although this seems counter-intuitive, cognitive and perceptual load theories of attention may be able explain these results (Lavie, 2005). When information is being processed, increasing the perceptual demands of the task (e.g., increasing the number of items that need to be perceived simultaneously) requires a large amount of attentional resources (Lavie, Hirst, Fockert, & Viding, 2004). Consequently, other irrelevant information is not processed when the perceptual demands of the task are high. In contrast, when the cognitive load demands of a task are high (e.g., switching back and forth between two tasks), attentional resources are used to meet the cognitive load demands of processing the information (Lavie, 2010). Consequently, irrelevant or distracting information is processed when the cognitive load demands are high (Lavie et al., 2004).

Cognitive and perceptual load are incorporated into directed forgetting research under the cognitive load hypothesis, in which forgetting of the *to-be-forgotten* material is dependent on the processing of the *to-be-remembered* material (Lee, 2012). Lee and Lee (2011) conducted a study of item-based directed forgetting in which in which cognitive load was manipulated during the post-item remember or forget instruction. While participants received a remember or forget instruction, half of the participants were also instructed to count backward from a number that also appeared on the screen. Participants in the control group were instructed to ignore the number. Additionally, the length of time that participants viewed the post-item instruction was either short (1.5 s) or long (6 s).

The results showed that participants with the additional count task recalled fewer *to-be-remembered* items than participants that did not count (Lee & Lee, 2011). The authors suggested that the counting task increased cognitive load and limited the participants' ability to rehearse the material. Additionally, the length of time the post-item instruction was viewed had an effect on recall for the *to-be-forgotten* items. Although there was no effect of time length for participants who did the counting task, the control participants who viewed the instruction screen for the longer period recalled more *to-be-forgotten* items. This suggests that *to-be-forgotten* items were processed involuntarily, and this process only stopped when attentional resources were taken away by either viewing the following item or engaging in the counting task. In list-based directed forgetting, processing time has not shown the same effect, but increasing the number of items on the second list has been shown to decrease the number of *to-be-forgotten* items recalled (Pastotter & Bauml, 2010).

The cognitive load hypothesis may explain why participants in this study correctly recognized more words when they received the forget instruction compared to participants who received the remember instruction. In standard directed forgetting studies, participants only have to remember the items shown. In contrast, participants in this study imagined the word when they viewed it and attentional resources were taken from rehearsing the words. Therefore, participants who received the forget cue may have released the information they were holding about the *to-be-forgotten* material and allocated cognitive resources to a smaller amount of information.

Participants correctly recognized more words than pictures when they received the forget instruction. Typically, pictures are remembered better than words because there is additional information about pictures that is encoded in memory (Nelson et al., 1976). However, when participants received a forget instruction, they may release this additional distinctive information and it was no longer available to the participant for the recognition test. Consequently, this may have led to lower recognition for pictures than words following a forget instruction.

False Alarms

Overall, the results of the analyses did not support our hypotheses for false alarms. It was expected that participants asked to remember both lists would have more false alarms than participants asked to forget the first list. It was also expected that words would have more false alarms and false alarms for pictures would be minimal. Instead, we found that participants who were asked to remember both lists had more false alarms for pictures from List 1 than List 2. Additionally, participants who were asked to forget the List 1 had more false alarms for pictures from List 2 compared to participants who were asked to remember both lists. None of the false alarm rates for word levels differed from one another.

Although we did not have any predictions for false alarm rates for the studied pictures, Lehman and Malmberg (2009) examined false alarm rates in list-method directed forgetting. They found more false alarms for the remember instruction than the forget instruction for both lists. Additionally, there were more false alarms for List 2 compared to List 1 for either instruction. In contrast, when using the DRM lists, Kimball and Bjork (2002) found more false alarms for the DRM critical item on List 1 compared to List 2 following a forget instruction. However, our false alarm results do not match either pattern of false alarms. We found that participants had more false alarms for List 1 than List 2 after a remember instruction and participants had fewer false alarms for the remember instruction than the forget instruction on List 2. There is a limited body of research on false alarm rates in directed forgetting, and no other study examining false alarms has used a recognition test or pictures as the stimuli.

Despite most of our predictions about false alarms not being met, the expected results were found for List 2 when participants received remember instructions. Participants incorrectly identified words as pictures more often than they incorrectly identified pictures as words. This may have only occurred in List 2 with the remember condition because it was the scenario that most closely resembled Weinstein and Shanks paradigm (2010). Participants in Weinstein and Shanks' experiments studied 90 pictures and 90 words and were responsible for remembering all of the information. While studying List 2 items, information learned in List 1 may have interfered with encoding the information and participants may have been rehearsing List 1 items even while studying List 2. Consequently, to see similar false alarm rates for List 1, more items may need to be studied to better match the procedure of Weinstein and Shanks (2010).

Conclusions

The effect of directed forgetting on false memories for pictures within this experiment differed from the expected results. There was no effect of directed forgetting, and false memories for words (incorrectly remembered as pictures) were only found on List 2 when participants were given a remember instruction. Further research is necessary to explain these results. According to the cognitive load hypothesis, cognitive resources affect how well *to-be-forgotten* items are forgotten (Lee, 2012). Consequently, future research should manipulate the cognitive load by altering the difficulty of the encoding tasks. This may be achieved by adding additional semantic categories to reduce the cognitive load, like in the Weinstein and Shanks (2010) study. Additionally, list size should be increased from 45 items to 90 items to determine if it is list size that is critical for the false memories of pictures.

The present study successfully combined research on false memories for pictures and directed forgetting. Although the results were not as expected, this only indicates that further research in this area needs to be conducted. By merging false memory, picture, and directed forgetting research, previously separate areas of cognitive psychology are joined together. The benefits of merging separate areas of research are plentiful—prior research is not only tested to determine if it is replicable in new situations, but memory theories can be related to one another and a larger view of how memory works may emerge.

APPENDICES

Appendix A: Figures

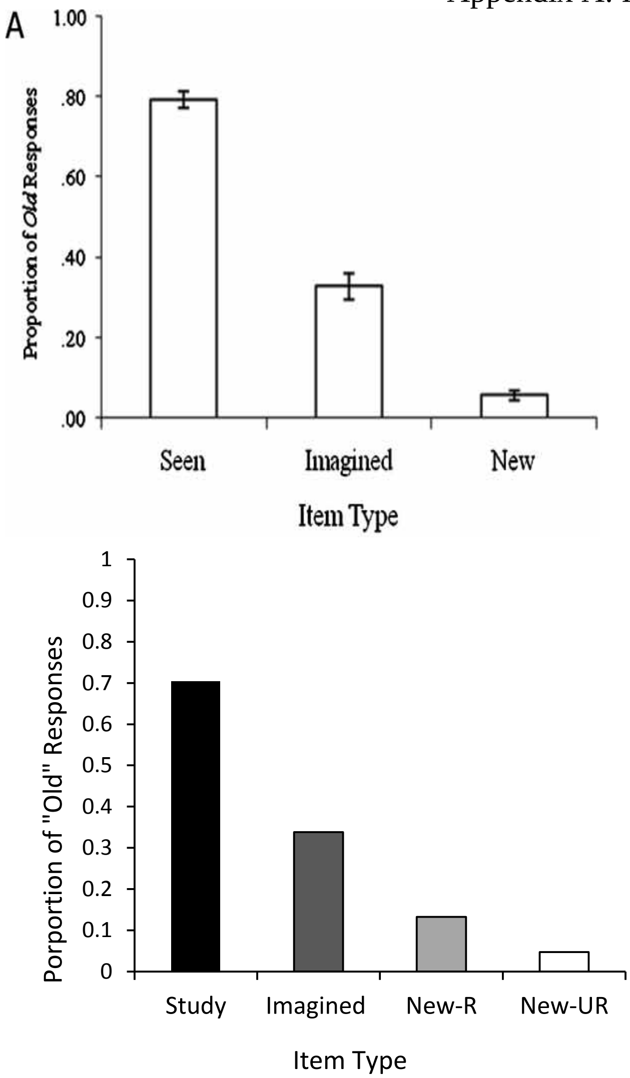

Figure 1. Mean proportion of old responses from Weinstein and Shanks (2010) on left compared to those found in replication on right

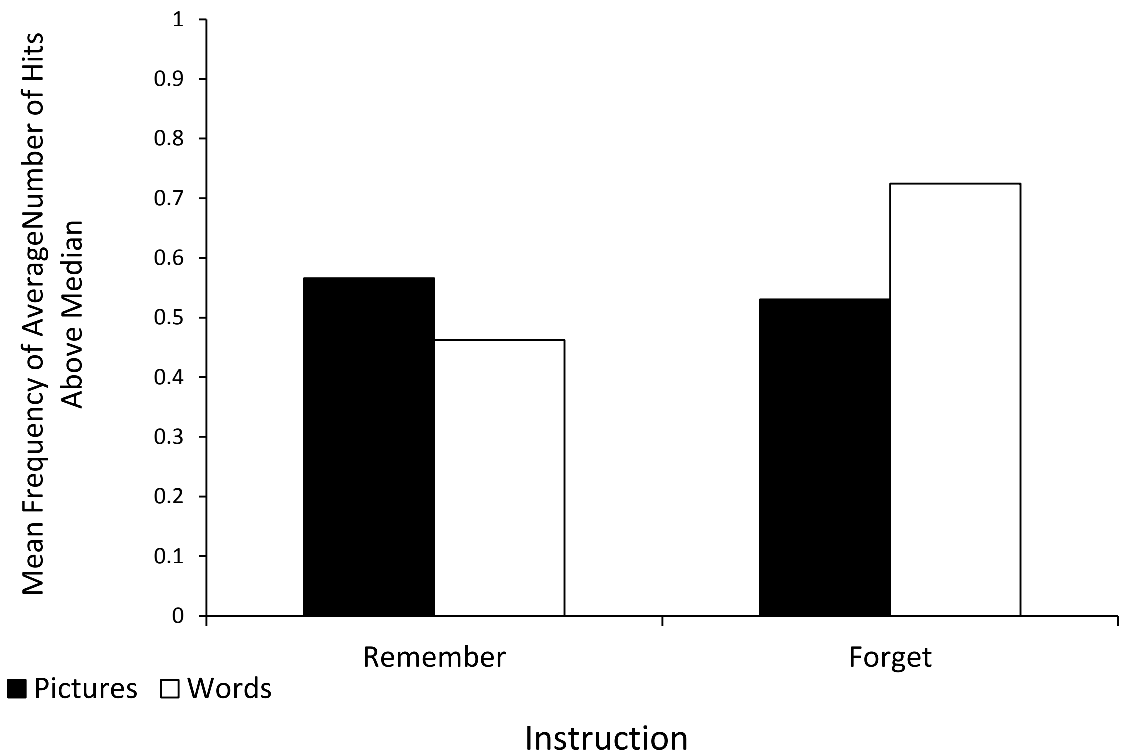

Figure 2. Mean frequency of the average number of hits above the median comparing instruction and item type

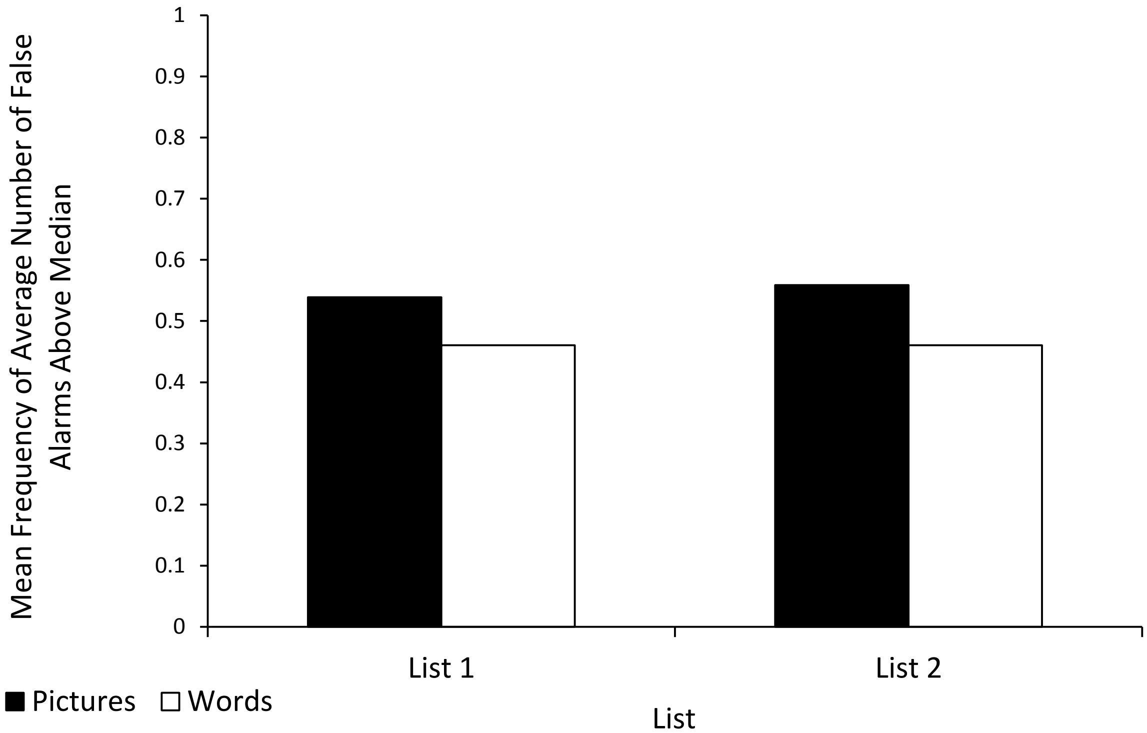

Figure 3. Mean frequency of the average number of false alarms above the median comparing list and item type

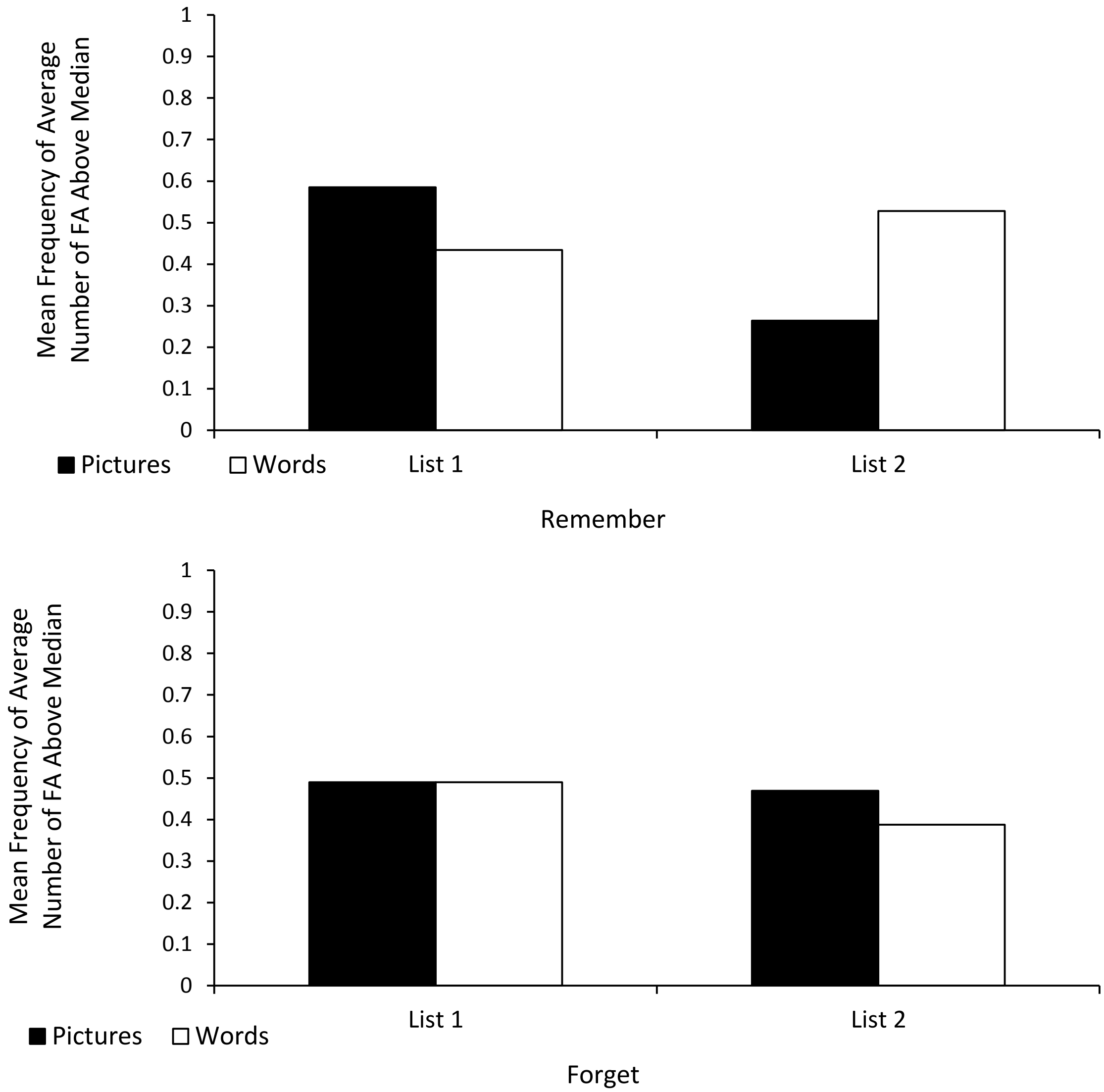

Figure 4. Mean frequency of the average number of false alarms above the median comparing instruction (remember: top, forget: bottom), list, and item type

Appendix B: List of Items by Category

Animals		**Household items**	
Critical:	**Non-Critical:**	**Critical**	**Non-Critical:**
Alligator	Bee	Batteries	Dresser
Ant	Butterfly	Bottle	Blender
Anteater	Cow	Bowl	Broom
Bat	Crab	Brush	Calculator
Bear	Dog	Cards	Camera
Cat	Dolphin	Chair	CDs
Caterpillar	Goat	Clock	Drill
Chicken	Hippopotamus	Computer	Eraser
Deer	Kangaroo	Crib	Flashlight
Donkey	Llama	Fork	Folder
Duck	Ostrich	Glass	Hammer
Eagle	Owl	Grater	iPod
Elephant	Peacock	Hair Dryer	Keys
Flamingo	Rhinoceros	Hanger	Microwave
Fox	Seahorse	Headphones	Mirror
Frog	Seal	Jar	Whisk
Giraffe	Shark	Knife	Pan
Gorilla	Skunk	Ladder	Paper Clips
Horse	Spider	Lamp	Rolling Pin
Koala	Swan	Laptop	Washing Machine
Ladybug	Tiger	Mug	Radio
Lion	Turkey	Pen	Spatula
Lobster	Turtle	Pencil	Sponge
Moose	Vulture	Plunger	Suitcase
Mouse	Worm	Pot	Tissue Box
Octopus		Printer	
Panda		Razor	
Parrot		Refrigerator	
Penguin		Rug	
Pig		Scissors	
Rabbit		Spoon	
Raccoon		Stapler	
Scorpion		Tape Measurer	
Seagull		Teapot	
Sheep		Telephone	
Snail		Television	
Snake		Toothbrush	
Squirrel		Towel	
Wolf		Umbrella	
Zebra		Wrench	

Appendix C: Informed Consent Form

INFORMED CONSENT FORM

PRINCIPAL INVESTIGATOR: Kaitlin Ensor_________________PHONE: (908) 489-6270_____

This is a study in which we are examining the ability to remember pictures of items. In this study, you will be asked to remember a series of pictures and complete a series of tests to assess memory quality for the aforementioned pictures. A personal computer will permanently record your responses on these tests. Participation in this study will take no longer than 60 minutes.

There are no known risks associated with participation in this study. Should you become distressed or uncomfortable, the experiment will end immediately. Your participation will benefit researchers in their search to learn about the mental processes involved with memory.

Participants must be at least 18 years old.

Your participation is entirely voluntary. You do not have to participate in this study. If you choose not to participate, you may discontinue your participation at any time. You will receive 2 credits on ResearchPool for participating.

All information about your responses will remain confidential. We will not show your information to anyone outside of our research team unless you give us written permission. Your responses will never be linked to your name and will be recorded by assigned numbers only. The records of this research which identify you will be kept in locked storage cabinets in the laboratory and used for research purposes only and destroyed at a later date.

If you have any questions, you may ask them now or any time during the study. If you should questions after your participation, you may contact the researcher, Kaitlin Ensor at kensor1@students.towson.edu or Dr. Kerri Goodwin at 410-704-3202 at any time for answers pertinent to this research, your rights, or in the case of research-related injury. Any concerns about these procedures may be directed to Dr. Deborah Gartland, Chairperson of the Institutional Review Board for the Protection of Human Participants at Towson University, (410) 704-2236.

I, ____, affirm that I have read and understand the above statements and have had all my questions answered.

____ ____________________

Subject's Signature Date

THIS PROJECT HAS BEEN REVIEWED BY THE INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN PARTICIPANTS AT TOWSON UNIVERSITY.

____

Researcher's Name

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EDUCATION

Towson University Towson, MD
Master of Arts, Experimental Psychology, anticipated in May 2013
Saint Peter's University (formerly Saint Peter's College) Jersey City, NJ
Bachelor of Science, Psychology & Visual Art, in May 2010, *summa cum laude, in cursu honorum*

POSTERS & PUBLICATIONS

Ensor, K., & Hamilton, M. (MS in prep). Effect of distinctive frames on memory for pictures.

Ensor, K., & Goodwin, K. (2013). The effect of test instructions on false memories for pictures. Poster presented at the annual convention of the Association for Psychological Science, Washington D.C., USA.

Ensor, K., & Goodwin, K. (2013). False memory for pictures and the distinctiveness heuristic. Poster presented at the annual meeting the Eastern Psychological Association, New York City, NY.

Holden, L., **Ensor, K.,** Goodwin, K., & Conway, A. (2012). Working memory, source monitoring and false memory: An individual differences perspective. Poster presented at the annual meeting of the Psychonomic Society, Minneapolis, MN.

Ensor, K., & Hamilton, M. (2012). Effect of distinctive frames on memory for pictures and frames. Poster session presented at the annual meeting the Eastern Psychological Association, Pittsburgh, PA.

PROFESSIONAL EXPERIENCE

Towson University Graduate Statistics & Writing Lab Towson, MD
Graduate Statistics Tutor (Aug 2012-Present)

- Assisted graduate students in Statistic and Research Methods classes with course material
- Guided students in data analysis and interpretation via SPSS and Microsoft Excel

Towson University Psychology Department Towson, MD
Teaching Assistant: Cognitive and Educational Psychology Courses (Aug 2012-Present)

- Created and led class activities and assignments and maintained class records
- Assisted professor with administering and grading exams and papers

Towson University Psychology Department, Goodwin Lab
Research Assistant (Aug 2011-Present)

- Conducted research experiments on false memory, working memory, the distinctiveness heuristic and directed forgetting
- Designed and programed experiments in e-Prime
- Scored, entered, and analyzed data in Microsoft Excel and SPSS

Towson University Athletics Department: Academic Services Towson, MD
Assistant to Athletics Academic Advisor (Aug 2011-Aug 2012)

- Worked with the Towson University Academic Advisor for the football team to manage academic needs of 90 athletes, including monitoring grades and organizing schedules
- Offered tutoring services to student-athletes for writing, statistics, and psychology courses, improving class performance up to 30%
- Created and maintained full record of class attendance for all student-athletes

Sun National Bank Tuckerton, NJ
Summer Floating Teller (May 2011-Aug 2011)
Full-time teller for all Ocean County, NJ branches of the bank

Metro Atlantic Athletic Conference Edison, NJ
Old Spice Classic Promotions (Nov 2009)
Managed in-game promotions for the Old Spice Classic basketball tournament broadcast on ESPN networks at Disney's Wide World of Sports complex in Orlando, Florida
Production Assistant (Aug 2004–2010)
Assisted in the creation of an online photo store, resigned and updated private section of website & designed student-athlete participant t-shirts

Saint Peter's University Reading Center Jersey City, NJ
4R Camp Counselor, Teacher's Aide, & Office Assistant (May-Aug 2009, 2010)

- Assisted teacher in writing and art for students in grades 6-8 with grading classroom assignments and helping individual students as needed
- Recreational counselor in swimming, gym activities, and theater for girls grades 4 and 5
- Recorded and maintained files for all students enrolled in the camp

Saint Peter's University Psychology Department, Hamilton Lab
Research Assistant (March 2008–2010)

- Completed honors' thesis involving distinctiveness and memory for picture frames
- Ran experiments investigating memory, including differences between implicit and explicit memory and the effect of information presentation and note taking styles in a classroom environment
- Scored, entered and analyzed data in Microsoft Excel and SPSS

Saint Peter's University Athletics Department Jersey City, NJ
Work Study (Sept 2006–2010)

- Designed media guide covers for team publications, created new compliance forms for better record keeping and overall productivity & developed a series of visual advertising methods
- Supervised athlete's study hall 1-3 times a week to improve academics of student-athletes, including tutoring of students in specific courses

PROFESSIONAL ORGANIZATIONS

Alpha Sigma Nu Member
Eastern Psychological Association
American Psychological Association:
Student Affiliate
Order of the Cross Keys
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Will and Ariel Durant Society