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The Effects of Blocked and Random Word Lists on the Production of False Memories

Melonie Williams
University of Central Florida, melonie.sexton@gmail.com

THE EFFECTS OF BLOCKED AND RANDOM WORD LISTS ON THE PRODUCTION OF FALSE MEMORIES

by

MELONIE A. WILLIAMS

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ABSTRACT

This study separated participants into four different conditions based on a 2 (blocked or random study trials) x 2 (blocked or random test trials) between-subjects design. Using the Deese-Roediger-McDermott (DRM) paradigm the researcher investigated whether or not false memories were produced at the time of study or the time of test. According to the paradigm, participants who view a series of categorical words (*mad, fear, hate, rage, temper*) are thought to semantically associate critical lures (*anger*), as a part of the list presented, more frequently than participants who see a string of unrelated terms. The production of false memory is commonly accredited to the priming effect and the relationships among categorical terms. The current study explored whether manipulating blocked versus random word lists had an effect on false memory rates and further examined the conditions under which false memories are produced, in order to gain a better understanding of the phenomenon. Participants' responses were assessed based on their recall under either blocked or random conditions in both the study and test phases. Using measures of recognition and reaction time (RT), the results indicate that false memories are created primarily during original study and not during the test of recognition. However, although the highest rates of false memories occurred during the blocked-study condition, the fastest reaction times for false memories were seen during blocked-test. These findings can contribute to the theoretical understanding of the origin of false memory. After comparing false memory rates and reaction times, concluding whether or not the mind exclusively produces these memories during the encoding process has yet to be determined.

DEDICATIONS

To my family, especially my parents. I could be the most successful person in the world, but without you by my side, none of it would matter. Thank you for your love and support. You truly are my biggest fans.

And to Jason, for your patience and constant motivation, thank you for believing in me.

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INTRODUCTION

What is False Memory?

The idea that people claim to "remember" words and events that were never experienced is a phenomenon that psychological researchers are currently attempting to understand. Interest in "false memory" has grown within psychology over the past few decades. The goal of this experiment is to study the conditions under which false memory is created; and using reaction time as a measure, it seeks to determine whether the production of false memories occurs at the time of study (i.e., when the words are viewed) or at the time of test (i.e., when the words are recalled). It also seeks to determine whether learner reaction times (RTs – see Appendix A for list of acronyms) of actual studied words and non-studied words will have significantly differing latencies. By comparing the RTs for true memories and false memories, researchers can identify if participants are able to discriminate between the two types of memories.

An early investigation by Deese (1959) reported that words that were not studied by learners nonetheless appeared during recall. Those concepts closely associated to other semantically similar words were retained in memory and then elicited by the test words during the free recall. These "intrusions" were termed "critical lures" in the Roediger and McDermott (1995) study, which demonstrated that learners created false memories when there was an association between critical lures and actual studied words. When participants studied a list of related terms such as *mad, fear, hate, rage, temper,* etc., there were significant incidences of false memories for words never listed; in this example, the critical lure being *anger*. Based on the "DRM" experimental paradigm developed by

Deese and then modified by Roediger and McDermott, it was determined that words appeared to be categorized in the human mind. By observing items from these grouped lists, participants were likely to mentally associate all of the list items even when many were not physically presented. In Roediger and McDermott's results, non-represented words produced significantly high false recall (40%-55%), a rate comparable to that of the correct recall rate. Thus, participants could not easily differentiate between studied items and their associated counterparts.

Social Relevance and Application

The theoretical problem of false memory first arose at the turn of the twentieth century, when Freud revealed what he called False Memory Syndrome. In 1896, Freud presented data to support his theory that patients who suffered from symptoms of hysteria were actually suppressing traumatic memories of childhood sexual abuse. Freud claimed that, in nearly all of his sessions, he was able to work with his patients and allow them to "discover" these allegedly suppressed memories. After Freud retracted his theory in a 1905 article, much suspicion arose as to the validity of his technique and his patients' so-called memories. Gleaves and Hernandez (1999) reported that Freud may have, whether intentionally or unintentionally, implanted false memories of childhood sexual abuse in his patients. His therapeutic methods included using "suggestive, forceful methods for retrieving memories of sexual abuse from his patients," and he "would not take 'no' for an answer" when asking patients questions about whether they had experienced such abuse. One reported technique described as "forceful," goes so far as to describe a physical therapy method in which he would place his hands on his patient's head and apply pressure to bring forth what he claimed were repressed memories. It is clear from research into his study that few if any patients recalled scenes of childhood rape before he verbally and physically coerced them into creating such memories (Gleaves and Hernandez, 1999).

Because it is possible to elicit or even create false memories through suggestive therapy sessions, it is critical that psychologists explore the mechanisms and contexts in which false memories are created so that therapists and other professionals can consciously avoid accidentally implanting them. This protects the validity and sanctity of psychological science, and more importantly, it protects patients from trauma created by incorrectly believing they are recalling traumatic repressed memories. Additionally, since false memories can be created in patients outside of therapy (for example, during dreams or daydreams), studying false memory gives therapists an additional tool in helping patients work through the complexities of their memories by being able to help them differentiate between false memories and veridical memories.

One of the more recent controversies and debates about false memory involves its presence in the legal system. In the courtroom, the innocence, guilt, freedom, and even life of a defendant may depend upon the eyewitness testimony of a sole individual. Studies are increasingly finding that false memories exist in eyewitness testimonies, thereby creating an obvious problem regarding the validity of the final verdict. In over half of the cases reopened by *The Innocence Project*, an organization that seeks to have old convictions overturned in light of new DNA evidence, it was found that a memory error on the part of the eyewitness had led to a wrongful conviction. Indeed, recent research has suggested that there are many factors present in the structure of our legal system that allow for incorrect information to be processed. A prevalent issue is the way in which police officers and lawyers question their suspects and witnesses (Brewer and Williams, 2005). Loftus, an expert in the field of false memory regarding eyewitness testimonies and law, believes that mere suggestibility can play a role in the production of false memory (Gerrie, Garry, and Loftus, 2005). In a 1974 study, participants were asked to view a film of a car accident and then describe how fast the cars were going when they made contact. When researchers phrased the question as, "How fast were the cars going when they *smashed into* each other" versus "how fast were the cars going when they *hit* each other," participants reported the cars as traveling at higher speeds when questioned with the words "smashed into" (Loftus and Palmer, 1974). Further evidence of false memory in testimony can be observed in yet another study, where participants saw a film of an automobile accident that was later followed up by suggestive questioning. Researchers asked half of the participants if they had seen "*a* broken headlight" and the other half if they had seen "*the* broken headlight". Results showed that participants were more like to answer "yes" to questions with the definitive article *(the)*, even though no broken headlight existed in the clip they had viewed (Loftus and Zanni, 1975).

Another factor to consider when using critical evidence that rests exclusively on a person's memory is that with increasing retention intervals, memory is easily and very likely to become distorted. Even though the amount of attention that a person focuses on in any given event can increase his or her knowledge and recollection of it for later reference, there is still the possibility of details becoming vague and inconsistencies taking the correct memory's place. Witnesses and by-standers are not typically warned to pay close attention to what they are about to see. Memories tend to diminish as time passes and witnesses become exposed to new, outside information that may affect their recollection of the past event (Loftus et al., 1978).

Greene, Flynn, and Loftus (1982) discovered that when participants were instructed to carefully read a narrative and remember as many correct descriptions as possible, they were better able to detect discrepancies during recall, than those who had rushed through the narrative. Many times eyewitnesses do not have time or foreknowledge to focus carefully on an event that is taking place around them. In the chaos of a criminal act, it is no surprise that bystanders may have felt rushed, or otherwise not had their entire attention focused on the event. In light of Greene, Flynn, and Loftus' study, this would imply that even with the most carefully worded questions, false memories may be created simply because the witness is forced to fill-in the gaps in their recollection. This might best be explained by the source monitoring framework theory which explains how people attribute recalled memories to incorrect sources.

It should be understood that such a critical occurrence like that of false memory cannot be taken lightly in decisions dealing with human life. Whether intentional or not, misleading questions can come from the police that appear at the scene of the crime or from the opposing attorney during trial (Brewer and Williams, 2005). The usage of witness testimony is being increasingly discussed today among politicians and psychologists alike. While it is known that a number of techniques can create false memory, it is important to gain further insight about the processes by which they are created. Until society creates a method to facilitate in the discrimination between false memories and true memories, it is safest to refrain from using eye-witness memory statements as the only means leading to criminal sentencing.

Theories of False Memory Processing

Currently, the best explanations as to how false memories are formed are provided by two theories: implicit associative response theory (Underwood, 1965) and the spreading activation theory (Collins and Loftus, 1975). Underwood's theory assumes that words are associated through stimulus-response relationships. In this view when we stimulate the mind with one word, other associated words are also triggered. The premise of the spreading activation theory is that memory is arranged in a sorted network of nodes (much like a web that branches out from a central point to other sub points). Taken together the implicit associative response theory explains false memory as it spontaneously occurs and the spreading activation theory describes how memory is organized.

Underwood's (1965) analysis of how conceptual schemes are stimulated introduced the notion of implicit association. He proposed that verbal units are processed in two stages; the first is the representational response (RR) and the second is the implicit association response (IAR). When a person sees or hears a word, he or she is engaged in the act of perceiving it; this then elicits the associative response, which is caused by the stimulus properties of the first reaction. For example, upon encountering the word *black* (the representation response), participants may simultaneously think *white* (the implicit associate response). Underwood's study produced strong evidence supporting that the frequent occurrence of IARs in language (and in the experiment) creates confusion between IARs and RRs. Essentially, participants were mistaking the critical stimulus words (listed items) with the false-alarm words (critical lures or non-listed items). The underlying idea is that the RR creates a semantic generalization causing participants to believe they have studied the non-represented terms.

The spreading activation theory takes this one step further by assuming that words, phrases, and concepts intersect based on relational links. For instance, the concept of *red* links to the concept of *color,* which then connects with many other color- related words in the network. When properties or similar characteristics of terms are activated, other associates of that mental category are "primed" and ready to be called upon for future reference (Collins and Loftus, 1975). The activation process, however, is dependent on the relational strength between the concepts. As the tagging sequence continues, it is natural for learners to lose track of prior words and concepts from node to node. The spreading activation theory also explains the importance of associative structures. In addition to recognizing critical lures, participants tend to falsely recall other associative terms that were not on the studied list. Parks, Shobe, and Kihlstrom (2005) demonstrate how other lists with lower associative strengths resulted in students incorrectly remembering the non-studied semantic associates and not the critical lures. Links that mediate the production of false memory may rely on levels of word association, as opposed to subordinate and superordinate level associates.

These two theories posit how false memories are essentially formed during the study period when encoding takes place. However, there is another theory that explains how these memories might occur during the test session. The source monitoring framework (SMF) is an extension of the reality monitoring theory that examines a person's ability to differentiate between true experiences and imagined ones. This theory suggests that the processes by which people remember events are due to attributing certain details to particular sources. These processes are usually semantically linked. However, failure in source monitoring can occur if some contextual details are lost. Moreover, since the process occurs quite rapidly, not always allowing for conscious retrieval to take place, individuals will sometimes attribute memories to the incorrect source. This error explains the incidence of false memories during the time of recall. When learners wrongly associate a term to a particular source because of its relation to other related terms, a false memory will be elicited (Lindsay and Johnson, 2000).

The Priming Effect

The lexical decision task (LDT), an experimental technique that focuses mainly on the effects of priming, has been used in a number of studies to try to understand its relation with false memories. The lexical decision task works by placing related terms in various locations among word lists and then observing the reaction time for participants to identify a letter string as a word. For example, a participant would more quickly respond "yes" to the letter string, *BIRD* than to respond "no" to the letter string, *FLARK*. Associated words seen following primes tend to have faster reaction times during recall. Even when two paired associates were separated, the decision to identify the latter as a word string resulted in quicker reaction times. In their experiments, Meyer and Schvaneveldt (1971) found that participants responded faster to primed words such as seeing *nurse* after seeing *doctor* (*doctor-nurse)* than when those words were not primed by an associate (*butter-nurse*). Their discussion raises the idea that retrieval modes are dependent on word recognition and provides evidence that words are categorically stored in memory. While the task causes participants to engage in backward checking of former primes, it also increases sensitivity toward the target words (Neely, 1991).

The lexical decision task produces a psychological effect known as the "priming effect." The priming effect demonstrates that associated items are semantically linked, and because of the proximity between the associated items, the structure of the mind allows for a faster accessing of information for a lexical decision following the introduction of an associated word. Manipulating the process of the task within word lists could possibly cause higher levels of false recall to appear. By using DRM lists, which already appear in a blocked formation, the study words are constantly priming one another and possible non-represented words. The use of the lexical decision task and the priming effect could also lead to significant changes in the reaction time for studied words and critical lures.

Findings from other studies have shown that certain methods of priming (readying one term by the use of a similarly associated one) affected false memory production, while other types did not. To obtain a faster or equal reaction time to that of a true memory, the test would have to be an explicit (conscious) one by which participants responded based on prior, repeated perceptual cues. The lexical task works via target priming, relying on the semantics of past familiar knowledge for the present processing. The critical lures were elicited simply from the implication of those seen during study (McKone, 2004). However, other research suggests that multiple primes have no long-term memory effects. Specifically, it was demonstrated that presenting 12 primes (i.e., *garage, drive, transportation, crash, chauffeur, freeway, parking, wheel, bus, jeep, race,* and *taxi*) did not create a long lasting memory of the critical lure (*car*). Zeelenberg (2002) suggests that words are primed based on the recency and presentation of stimuli, not the quantity. Further research into this subject has taken a closer look at the influence of multiple primes. When learners are tested by pairing two related primes (LION-STRIPES- TIGER) and comparing their influence to word lists with one related prime (KIDNEY- PIANO- ORGAN), data revealed that multiple-related primes produced an additive effect, further supporting the theory of the LDT's influence. Moreover, it was concluded that semantic priming facilitates even the most basic of word pairs. The use of multiple-related primes creates outcomes equal to those of one related prime (Balota and Paul, 1996).

Dodson and Hege (2005) attempt to understand false memory reduction by comparing two different mechanisms, one called the *distinctiveness heuristic* and the other *impoverished relational encoding. Distinctiveness heuristic* refers to the strategy used when people eliminate novel items due to a lack of familiarity. In *impoverished relational encoding,* a person must focus on distinct characteristics of a particular term so as to reduce any chance of association. By manipulating the time participants had to respond to items, they found that the concept of *distinctiveness heuristic* is a more viable approach, however, people must be given enough time to process and eliminate the presented items. Under self-paced test conditions, people are allowed to engage in the recollection process and correctly identify information (Dodson and Hege, 2005).

Both of these strategies reinforce the notion that the occurrence of false memories increases with each presentation of similar words and concepts. The two methods try to avoid the priming effect and spreading activation by having people consciously focus on items thereby suppressing the production of false memories.

Processing and the Significance of Applying Meaning

There have been many studies that attempt to explore the ways by which false memories occur and ways to reduce their production. A few of these are based on the idea of "levels of processing," which concludes that deeper levels of processing during study assist in better remembering. Levels of processing refer to the amount of dedicated attention a participant spends to study words. There are three types of levels of processing; semantic, phonemic, and graphemic. Semantic processing is considered the deepest of the three types because it involves the task of understanding the meaning of the words being studied. Deeper levels of processing tend to be better retained in memory, because there is more meaning attached to the word (Craik and Lockhart, 1972). At graphemic and phonemic levels, participants only had to visually recognize the presented words or segments of the presented words. Findings by Kronlund and Whittlesea (2005) support the idea that while deeper processing may add more meaning to items and, therefore produce a better recall of true memory, there is an additional increase in false memory. In their experiments, participants were asked to process word lists using three different levels of processing based on questions during study. Those asked at the semantic level had better recollection than those at the phonemic level, and those at the phonemic level had better recollection than those at the graphemic level. An increase in the depth of study led to about a 10% increase in recall with each level (graphemic, 30%, phonemic, 40%, and semantic, 50%). However, greater depth of processing also led to an increase in false alarm rates (22%, 25%, and 30%, respectively). These findings suggested that deeper levels of processing result in stronger activations of true memory ("hits"), but also result in an increase in false memories. Semantic levels of processing may lead to higher recall accuracy than the graphemic and phonemic levels, but they also create more false memories.

According to the spreading activation theory, these results are due to the arrangement of nodes in memory. Spreading attention by adding meaning to words causes the memory network to activate other related terms that help define what it is being presented. Underwood's IAR theory would suggest that this encoding creates an activation of associates upon the immediate presentation of related words. The strength of the activation, however, is dependent on the level of processing that took place (Rhodes and Anastasi, 2000). By grouping associates high in relation to one another it is assumed that more semantic relationships will be present, thereby producing higher levels of false memory.

Another type of processing paradigm that has been investigated is research for the generation effect. The "generation effect" refers to the recall and recognition advantages that are associated with learner-produced acquisition terms in relation to experimenter-provided items. Participants must either generate a word on their own in association with a term or concept given to them by the researcher (e.g., B__KER: one who cooks). In the "read" condition, participants are provided the answers and are instructed to read the cue then write down the correct response (e.g., BAKER: one who cooks). Generative processing research uses a different experimental procedure to test false memory. This form of encoding involves a two-step process by which participants are encouraged to discriminate among similar item concepts using word-fragmenting. Findings have shown that generative processing leads to an increase in "hits" (The mean recognition scores for the generate and read groups were 80.73% and 70.32% respectively). When using encoding conditions designed to induce the processing of multiple cues and multiple references, results suggest that this technique assists recall accuracy (Soraci et al., 1999). Moreover, generative processing actually reduces the chance of a participant creating false memories (Soraci, Carlin, Toglia, Checile, and Neuschatz, 2003). As supported by their experiments, Soraci et al. showed that facilitation can produce higher hits with no cost (or rather there was no trace of an increase in false memories).

The Role of Word Lists

Based on the premises of the priming effect and the idea that applied attention and deeper processing may lead to false memory creations, it is important to consider the research on blocked versus random ordered lists. If false memories occur when words are primed by categorical words situated close together, then a blocked list should create higher critical lure false alarms than a random list. A blocked list consists of a series of similar terms placed collectively; a randomized list does just the opposite by scattering the terms within the list. An example of a blocked list would be *sour, candy, sugar, bitter, good, etc.*, words that elicit the critical lure *sweet.* A random list would present a variety of differing words such as, *sour, boy, note, hot, white, etc.* Each of these terms could be grouped with others of like characteristics but, instead, appear mixed in with the others. As the lexical decision task shows, association pairing is a powerful factor in reaction time. In accordance with the implicit associative response and spreading activation theories, it is assumed, that by pairing similar words, the participants are "primed" to expect other words from the category (this is the underlying cause of false memory). By employing blocked lists for the current study, the expectation is that the closely-related terms will evoke the production of false memories/critical lures. Using this technique will make it possible to identify the point in time when false memories are activated.

Further data have been collected exhibiting how the construction of word lists may strengthen associations between words (Park, Shobe, and Kihlstrom, 2005). Some lists seem to have higher false recall rates than others. When comparing BAS (Backward Associative Strength) means and FAS (Forward Associative Strength) means, it was found that word lists that were high in BAS means and high in connectivity were the best predictors of creating the most false recall. For instance, relevant list associates for the word *bitter* are also those relevant to the word *sugar,* (*sour, taste, sweet, candy, etc*). The two words differ in their ability to produce false recall, regardless of the fact that they share related speech properties and refer to similar ideas. S*weet* held a mean probability of 54%, while *bitter* yielded false memories at only 1%. The explanation for such results is portrayed through the spreading activation theory, in that participants unknowingly become aware of associated concepts during presentation and activate those terms. Via the lexical decision task, the subconscious activation arouses the non-presented words and inadvertently produces the feeling within participants that those same critical lures had in fact been seen earlier (Roediger, Watson, McDermott, and Gallo, 2001).

A correlation between recognition failure and false alarms has been supported by many research studies throughout the years. Apparently, participants produce fewer false alarms when given free association tasks than when given a recognition task. This is because participants must decide when and where an item has occurred and not simply whether or not it did occur. Bartling (1991) presented students with critical pairs (e.g., *ground-COLD*) and then observed the recognition failure rates between the group tested with free association and the groups tested with recognition tests. The group that had the higher number of experimenter-generated distracters (critical lures) also had the highest false alarm percentages (91.6% for participants with 48 distracters and 98.2% for the group with 58 distracters). Those who had taken the free association task received no experimental distracters and thereby had fewer false alarm rates (35.7%).

For the purpose of the current study, it seems that to create the most false memories/ false alarms within participants, researchers must employ a blocked list of associates, high in recognition distracters (lures), and high in backward associative strength means, in order to obtain the optimal results. Using random lists high in critical lures and backward associative strength averages should also lead to an increase in false alarm rates, but not to the same extent as blocked lists.

Production of False Memories

The goal of this study is to determine whether manipulating word lists has an affect on false recall and to explore the conditions by which false memories are produced. Early research on the subject can be traced back to Kirkpatrick (1894) who hypothesized that false memories take place because of the processing that occurs during the time of study. By constructing a list of commonly associated words, his research aimed to determine how words are retained and the relationship between recall and recognition. Among both older and younger students, results of his research showed how mental images of the words seemed to be better remembered than the words themselves; for the students were able to recall concepts of the studied material but not always the exact words themselves. The acts of writing and vocalizing during study seem to play a role in recognition but not necessarily recall.

Studying paired associates compared to studying single words also supports the theory of false memory association occurring at the time of study. When presented with a pair of words such as "*spool-climb*" and then tested with "*thread*" (a common associate of "*spool*"), learners responded similarly when they had been shown the single word "*spool*" and then the test word "*thread.*" Words studied in pairs and tested as single words had no significant difference in associative production occurrence from those both studied and tested. There was no evidence of IARs occurring at the time of test (Underwood and Reichardt, 1975).

In Rosenberg and Rollins' (1978) experiment, it was suggested that young children created better storage and retrieval methods when they were able to categorize the items at the time of study. The children produced higher accuracy rates when studied lists were presented in a blocked fashion. Keister (1972) writes that, while blocking may cause quick categorization, there is relatively little semantic processing taking place, thereby leading to an increase in false recall. The increase in false memory is because of the decreased speed in learning after list organization occurs. As observed in the levels of processing findings, simply seeing word lists does not develop the semantic properties needed for later lasting memory. Participants who viewed randomized lists had fewer false alarm rates. They postulate that this is due to the extra attention it took to come up with a meaningful, reliable method of retrieval during the test time.

Some recent studies have investigated the manifestation of false memories at the test period. Marsh, McDermott, and Roediger (2004) found that priming during the test phase does little to influence the number of false memories. Using DRM lists, it was discovered that the location and manipulation of critical lures during testing does not affect the creation of false recognition. While this experiment follows the idea that activation occurs during the time of study, other researchers, (Smith, David, Benton, and Hyun, 2002) suggested that false memories occur due to factors presented at testing time. The association/activation processes that elicit IARs do not necessarily happen at the time of study. They believe that instructions given at the time of recall play a role in the creation of false recall. It has been suggested that forced instructions, which involve having participants write down as many words as they can remember, resulted in three times more intrusions and lower confidence rates than free recall instructions, which allow participants to freely fill-in provided recall spaces (McKelvie, 1999).

Seamon, Lee, Toner, Wheeler, Goodkind, and Birch (2002) suggested that mere verbalization might be all that is needed to produce false memory. Whether participants thought about critical lures or were distracted during study seemed to have no impact on the amount of false recall. All groups demonstrated high rates of false memory during rehearsal (2s presentation while silent -74%, 2s presentation while overt -73%, 5s presentation while silent -76% and 5s presentation while overt -60%).

In a series of experiments done by Hancock, Hicks, Marsh, and Ritschell (2003), findings suggested that false recall may occur during the study period and are reinforced during recall. Their studies found that when using DRM lists, critical lures had high activation levels during the time of study. In fact, superadditive priming appeared to be present. The critical lures had shorter latency periods than actual studied items, suggesting that participants responded faster to the false memories as though they were true items seen on the studied lists. Their data further suggests that while IARs and association cause the production of false memories during the study phase, participants fail to eliminate these critical lures as non-studied items due to a malfunction in their source monitoring. The source monitoring theory which asserts that the conscious goes through an editing phase, implies that because of spreading activation and association, participants are unable to reject the similar, yet unstudied, misleading term.

Purpose of the Present Research

The purpose of the research is essentially to compare Kirkpatrick's (1894) hypothesis to Deese's (1959), and to discover when the creation of false memories takes place. Kirkpatrick would predict production to occur during the time of study, while Deese would expect it to be an event experienced during the test trial. Findings from this study may introduce several important implications. Research on false memory seems to be indecisive about when false memories first occur. The present experiment is intended to determine whether false memories are created during the time of encoding or the time of retrieval by using a recognition measure rather than free recall. Although the basic methodologies from past research in this area were used, the experimental design seen in this study is unique in that is applies two types of word lists (blocked or random) to both the study and test conditions. The current factorial design will allow the researcher to better compare the data produced by the four conditions, thereby making it easier to identify which situation elicited the most false memories and when.

It is hypothesized that the activation among networked words can happen at both the time of study (encoding) and the time of testing (retrieval). By using blocked lists at both study and test trials to evoke the critical lures and randomized lists as a control, results should support the theory that categorizing similar terms at any given point can produce false recognition. Half of the participants will be given either a blocked list or a random list to study. During the test trial, half of the blocked list study group (a quarter of the total participants) will be tested using the same blocked lists condition. The other blocked list study participants will be tested under the randomized condition. The same procedure will be used with the other half of the participants who studied under the random list condition. It is hypothesized that both (study and test) instances of blocked list procedures will result in high false recognition rates. Participants studying blocked lists and then tested using blocked lists for recall methods will have the highest rates of false recall. Those that receive randomized lists on both occasions are predicted to have the lowest false alarm rates. However, if Kirkpatrick's hypothesis is correct then the blocking/random manipulation will have the greatest effects during study rather than test and if Deese's hypothesis is correct then the blocking/random manipulation will have the greatest effects during test rather than study.

Unlike many other studies on this topic, this research study will also investigate the reaction times it takes for participants to respond to studied items. By comparing the response rates of a studied term (true memories) versus a non-studied term (namely the critical lure/false alarm), conclusions can be drawn about a person's ability to differentiate between the two. The hypothesis is that the reaction times of critical lures will be similar to, if not faster than, a true studied word.

METHODS

Participants

Eighty participants were selected from a large, metropolitan research University located in the Southeastern United States, with an enrollment of approximately 45,000 students. The students who participated received extra credit for an introductory psychology course.

Design

The experiment used a between-subjects 2 (study) x 2 (test) factorial design. There were two levels for each of the two factors: blocked or random lists during study or test conditions. The first participant group viewed blocked lists at both the study and test phase. A second group viewed blocked lists at the study phase and random lists at the test phase. A third group viewed random lists at the study phase and blocked lists at the test phase. And finally, the fourth group viewed random lists during both phases.

Materials

Researchers selected 32 of the 55 item-lists high in Mean Backward Associative Strength used in the Roediger et al. (2001) study. Each list consisted of the 8 words highest in association strength to the critical lure (see Appendix D). The Cedrus SuperLab Pro 2 computer program was used to present the study words from the item-lists, test items, and collect responses. Random lists were set up without regard to category. Blocked lists were constructed by placing the items of each list in descending order from strongest associative strength to the weakest. Of the 32 lists, 16 were randomly used as the studied items and the remaining 16 were randomly used as non-associates. Non-associates were words that were not related to any of the items seen during study. To ensure that there would be no confounding influences, the backward associative strength (and forward associative strength) averages for both sets of lists were confirmed not to be significantly different from one another. The list of study words had a mean BAS of 0.312 and a mean FAS of 0.07 while the list of non-associates had a mean BAS of .332 and a mean FAS of 0.07 (see Appendix D).

Procedure

The procedure was designed to closely replicate the methods used in the Roediger and McDermott study (1995). Participants were tested at independent computer stations with no more than three participants during each scheduled appointment. Upon arrival at the lab, the researcher randomly assigned participants to one of four conditions. Before starting the experiment, participants were instructed that they were to engage in an orienting task that took place on the computer screen, and that afterwards, they were to be tested on their memory of the words studied earlier using the keyboard to answer "yes" or "no" to whether words were presented in the lists. After the study trial, participants completed a two-minute filler task, which involved completing a visual maze, before continuing on to the test phase. The lists were either presented in a blocked or random fashion depending on the participant's group assignment. In the study condition, the Cedrus SuperLab Pro 2 program maintained a 1.5-s display of each word, and a 1-s blank screen between each of the items within the lists. In the test condition, items were displayed for 5-s with a 1-s blank state between each item. Any response that occurred after the 5-s interval was considered a "timed-out" response and not included in the analysis.

During the test phase, students were directed to use keys from the number keypad to answer as quickly as possible if the test word had been presented or not during the study phase. Key number 1 was the "yes" and key number 2 was the "no" response. Critical lures and non-associates were only present in the test condition. For the blocked-test conditions, non-associates were arranged just as the other blocked lists, with words sequenced from high BAS to low BAS. The responses and data collected from the experiment were measured as variables dependent on study list conditions. Researchers had to consider the number of correct answers, the number of incorrect answers, and the reaction time of each response. "Hits" were defined as participants answering "yes" to an item actually presented during study. "Correct rejection" was when a participant responded "no" to a misleading item or critical lure. When a participant responded "yes" to an item that had not been presented at study, this was considered a "false alarm". In this particular study, there were two kinds of false alarm present. A normal FA (false alarm) was defined as any of the distracters added to the test phase to act as misleading terms. A FA-CL (false alarm- critical lure) represented the terms that were associated to other studied items but never actually presented during the viewing phase. Finally, "misses" were defined as answering "no" to items that had been present during the study condition. Reaction time was measured as the number of ms it took a participant to respond to a test item.

RESULTS

Separate 2 (blocked or random study trials) x 2 (blocked or random test trials) Analyses of Variance (ANOVAs) were conducted on each of the dependent measures and all reported effects were significant at the $p < .05$ level.

Table 1 shows the mean response rates for hits, misses, false alarms, and correct rejections for all experimental conditions. The mean reaction times for each condition are shown in Table 2.

Hits

Hit rates were coded as a "yes" response to a list item presented at study. This represented a true memory recall. A main effect of study was found in which blocked study conditions had higher hit rates ($M = 71\%$) than the random study condition ($M = 62\%$), $F(1, 76) = 5.70, p = .019$. Figure 1 shows the main effect of study on hit rates. There were no main effects of test or interaction for hit rates.

Figure 2 shows there was also a main effect of test for hit RTs. Learners in the blocked test condition had faster RTs ($M = 824$ ms) than learners of the random test conditions ($M = 939$ ms), $F(1, 76) = 8.71, p = .004$, indicating that participants tested in blocked list conditions were faster to respond than participants test in random conditions. There were no main effects of study or interaction for hit RTs.

Misses

Misses were coded as a "no" response to a list item presented at study. Consequently, misses were calculated as the inverse of hit responses and were not put into a figure illustration. There was a main effect of study found for misses, $F(1, 76) = 5.92, p = .017$. Participants in blocked study condition had fewer miss rates ($M = 29\%$)

than participants in the random study conditions ($M = 37\%$). Just as learners in these groups correctly remembered more words (hence the hit rates), they also forget fewer of the previously studied items. No other main effects of test or interactions were found for miss rates or for miss RTs.

False Alarms

False alarms were coded as a "yes" response to a list item not presented at study. These responses represented the false memories in the experiment. In the first ANOVA analysis, false alarms reported a main effect in study. Blocked study conditions had fewer false alarms ($M = 9\%$) than random study conditions ($M = 17\%$). Figure 3 shows these main effects. False alarms rates for blocked study were found statistically significant, $F(1, 76) = 8.31, p = .005$. There were no main effects of test or interaction found for false alarm rates.

Because false alarms were the central focus of the study, a 2 (study) x 2 (test) x 2 (error type) mixed ANOVA was performed comparing the two types of possible false alarms: critical lures and distractors. Table 3 shows the mean response rates for critical lures and distractors for each condition. The mean reaction times of the false alarms for each condition are shown in Table 4.

In blocked study conditions, false alarm rates for critical lures were especially high compared to the other conditions. Participants of blocked study conditions were more likely to mistake critical lures (false memories) as a studied item (true memories) compared to other conditions. These learners were also prone to more false memories than they were to regular misleading items (distractors). There was a main effect of test item and study x test type interaction found for study condition. Figure 4 displays where the analysis revealed that false alarm rates were almost three times higher for critical lures ($M = 36\%$) than for distractors ($M = 13\%$). This relationship was found statistically significant, $F(1, 76) = 238.97, p < .001$.

Statistical significance was even found for measures in timing. False alarm RTs for critical lures ($M = 1038$ ms) were faster than for distractors ($M = 1136$ ms) in every condition. Figure 5 presents the difference between critical lure and distractor RTs. Moreover, an interaction between study x test type was obtained which proved to be significant, $F(1, 76) = 5.84, p = .018$.

Correct Rejections

Correct rejections were coded as a "no" response to a list item not presented at study. These responses were calculated as the inverse of false alarm responses and were not put into a figure illustration. Nevertheless, a main effect of study for correct rejection rates was found, $F(1, 76) = 7.92, p = .006$. The blocked study conditions had more correct rejection rates ($M = 89\%$) than random study conditions ($M = 82\%$). Participants who studied blocked word lists were able to better identify non-listed items (critical lures and distractors) and discard them as misleading. No main effect for test or interaction were revealed. Additionally, no significant effects were found for correct rejection RTs.

DISCUSSION

The overall pattern of the results suggest that when the DRM paradigm is used, false memories are produced largely during study. This is indicated by the high rates of critical lure recognition seen in the blocked-study condition as compared to the other groups. It was hypothesized that blocked lists would inherently activate semantic links present among the studied items regardless of learning and recall conditions. The data, however, suggest a correspondence between hit rates and critical lures for blocked study participants, indicating that although memory for list items improved, it also carried the negative consequence of increasing false memories. This is supportive of Kirkpatrick's (1894) hypothesis suggesting that false memories are primarily produced during the time of encoding. The results are also supportive of the levels of processing concept. It is evident that associations made during the study phase strongly influence participant memory, yet the overall effect is still problematic. Deeper levels of processing seem beneficial to memory only on a large scale. In other words, while an individual may remember the general memory, specific details of an event may be lost along the way or new information added during the learning experience. In accordance with the spreading activation and implicit associative response theories, the initial links to related terms linger within memory until later triggered when the word appears in a recognition task.

On the other hand, the fact that hit RTs were affected by test conditions suggest that some false memory functions may occur during memory retrieval. In addition to faster hit RTs, participants of the blocked test condition also exhibited faster critical lure RTs, regardless of their study condition. As implied by Deese (1959) and the source monitoring framework theory (Lindsay and Johnson, 2000), recognition cues during test might influence learner response towards critical lures via reaction timing. It could be suggested that false memories are associated words or concepts that have the potential to be considered veridical, but do not fully form or present themselves as real, until called upon by contextual clues which make them appear relevant.

Nevertheless, few studies have been done measuring the RTs of critical lures as compared to RTs of studied words. Jou, Matus, Aldridge, Rogers, and Zimmerman (2004) found that the mean RTs for critical lures (2,170 ms) were significantly longer than mean RTs for hits (1,874 ms). Their results are consistent with the findings in this study. In addition to measuring reaction time, they also had participants report confidence ratings. When comparing critical non-presented words to list words, the study found that participants had lower confidence when making false alarms.

In summary, false memories appear to be created mostly during the time of study while learners are encoding the presented information. However, due to semantic associations that occur during retrieval processes, some false memories may arise while testing. Whether or not participants can differentiate between true and false memories is a question that requires further research. The lag in timing between hit rates and critical lures suggest that the disassociation that is often thought to go along with false memories may not be as prevalent as past research implies. False memories may be activated quite easily in association with true memories, but to conclude that they are represented in the same manner is still debatable.

Using present methodology, future research can be done by introducing a range of new variables to be measured. Researchers should include some measure of participant confidence towards their responses. Comparing confidence ratings with actual RTs can help in determining if there is some awareness of differences in true and false memories. Another factor to add to the study could be an increase in the amount of time participants are given to complete the filler task. The current study allotted learners a 2 min. gap in order for the studied words to transfer into long-term memory. Increasing the time span would create a more realistic approach of memory encoding and retrieval processes. Finally, to better explore the depth to which participants actually can remember, future research could be done by changing the presentation style of the test phase. Although measuring the ability of the retrieval condition to produce false memories would be more difficult, replacing the recognition task with a free recall task would more accurately portray a participant's memory of a given word. The method used in this research allows learners to view many words and respond to them based on familiarity. This essentially influences memory because learners are no longer relying on their internal cues to remember.

The next step in understanding false memory is to apply research such as this and other similar studies in a setting outside of the laboratory. Although the methods used are on the most basic level, findings from this field of research can be used to explain the false memory phenomenon seen in everyday life. Anyone can have a false memory and, although the impact of such an experience is not always significant, there are instances in which they profoundly change a person's life. Thus far, false memories have received the most attention regarding their manifestations in the courtroom testimonies and alleged repressed memories retrieved during therapy. False memories studies, while looking at the origin using simple vocabulary words, extend far beyond an experimenter's computer. This study suggests that these memories are probably created when a person is "taking in" the current event. As the results show, people are more likely to remember the "big picture" and not specific information. However, when forced to recall such details, the mind tries to help by filling in the gaps with details that are very likely to have happened and fit very well with the big picture that has been portrayed. In conclusion, it is important that research in false memory continue. Even though researchers may not be able to solve the problem of these fictitious memories, further exploration may lead to ways pf preventing the creation of false memories or possibly a way to differentiate between the two types of memories.

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APPENDIX A: Acronyms

BAS – Backward Associative Strength

CL – Critical Lure

DRM – Deese Roediger McDermott

FA – False Alarm

FAS – Forward Associative Strength

IAR – Implicit Associative Response

LDT – Lexical Decision Task

RR – Representational Response

RT – Reaction/Response Time

SMF – Source Monitoring Framework

APPENDIX B: Tables

Table 1.

Mean response rates as a function of presentation condition- Between-Subjects

	Hit Rate (%)	Miss Rate (%)	False Alarm Rate (%)	Correct Rejection Rate (%)
Blocked- Blocked	70.93	28.97	11.28	88.54
Blocked- Random	68.8	30.81	7.61	90.69
Random- Blocked	61.09	38.82	19.08	80.92
Random- Random	64.44	35.45	16.84	81.54
Total Average	66.32	33.51	13.70	85.42

Note – There was a main effect of study found ($p < .05$)

Table 2.

Mean reaction times as a function of presentation condition- Between-Subjects

	Hit RT (ms)	Miss RT (ms)	False Alarm RT (ms)	Correction Rejection RT(ms)
Blocked- Blocked	783.67	1057.65	1265.78	831.45
Blocked- Random	954.27	1092.84	1243.66	957.54
Random- Blocked	853.66	937.23	1062.25	885.14
Random- Random	919.51	1006.94	1016.61	928.39
Total Average	877.78	1023.67	1147.08	900.63

Note – There was a main effect of test found ($p < .05$)

Table 3.

Mean response rates as a function of presentation condition- Within-Subjects

	Critical Lure Rate (%)	Distractor Rate (%)
Blocked- Blocked	38.44	11.02
Blocked- Random	38.44	8.08
Random- Blocked	33.75	18.59
Random- Random	32.19	15.77
Total Average	35.7	13.37

Note – There was a main effect of test item and study x test type interaction found ($p < .05$)

Table 4.

Mean reaction times as a function of presentation condition- Within-Subjects

	Critical Lure Reaction Time (ms)	Distractor Reaction Time (ms)
Blocked- Blocked	975.1687	1171.072
Blocked- Random	1109.41	1153.723
Random- Blocked	1003.738	1091.193
Random- Random	1060.188	1126.686
Total Average	1037.126	1135.669

Note – There was a main effect of test item and study x test type interaction found ($p < .05$)

APPENDIX C: Figure Captions and Figures

Figure Captions

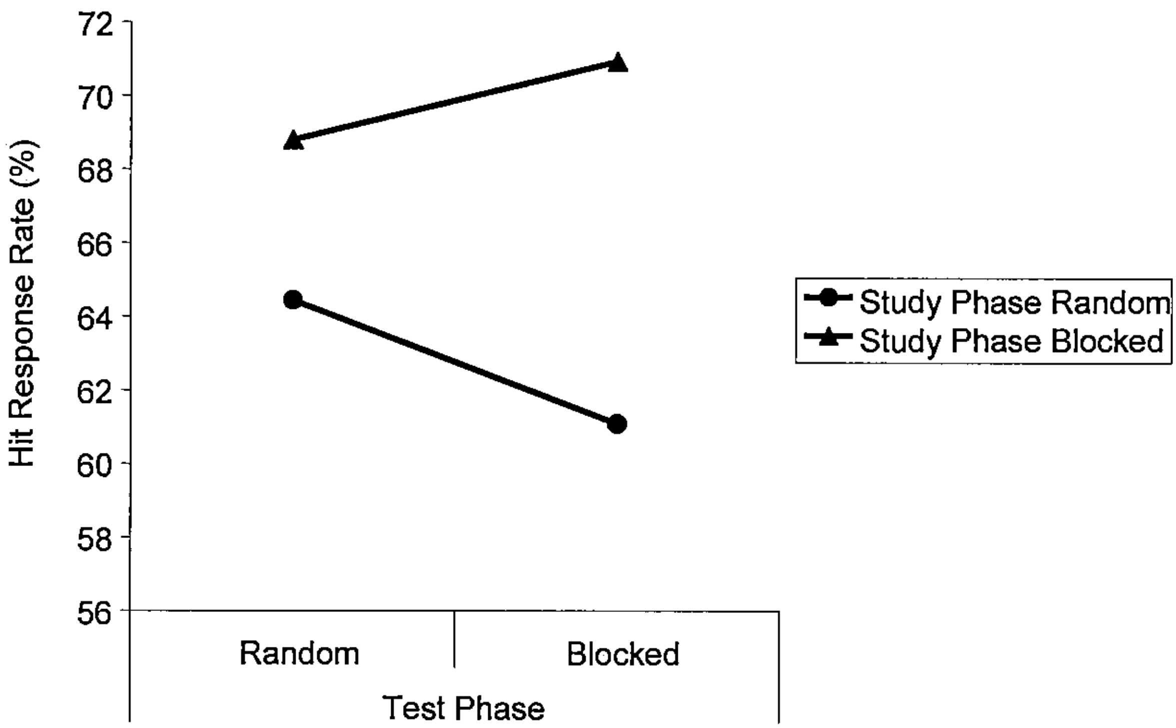
Figure 1. Mean hit rates as a function of study and test presentation conditions.

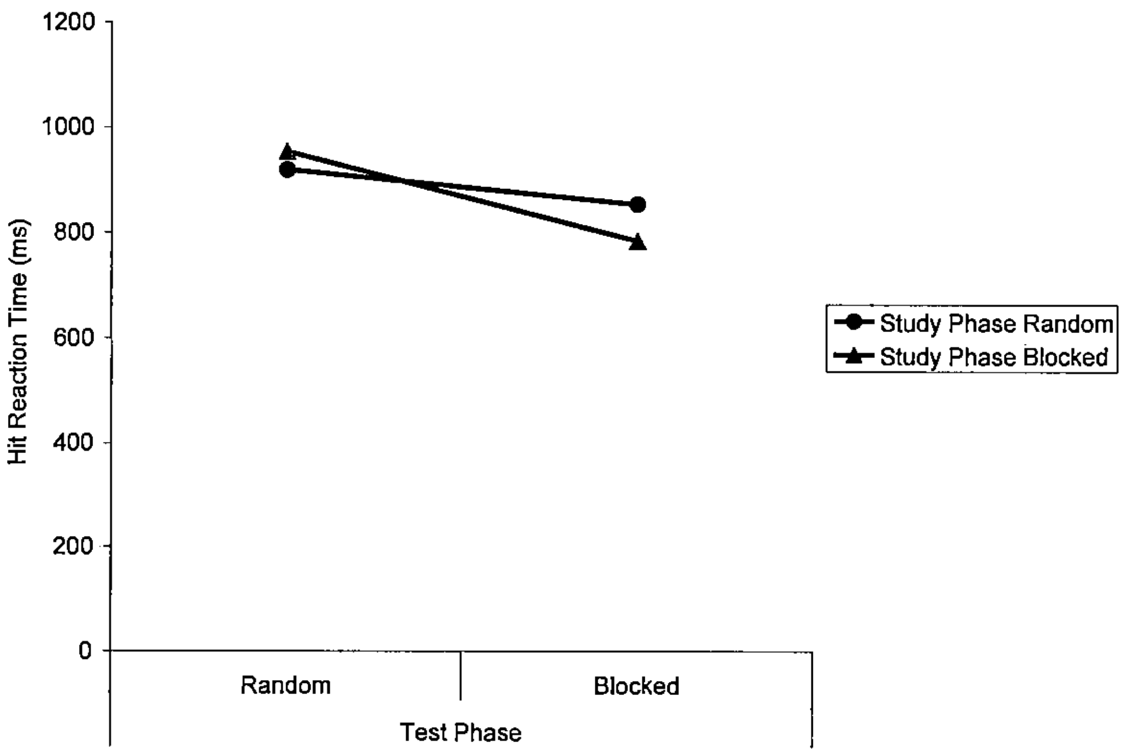
Figure 2. Mean hit reaction time as a function of study and test presentation conditions.

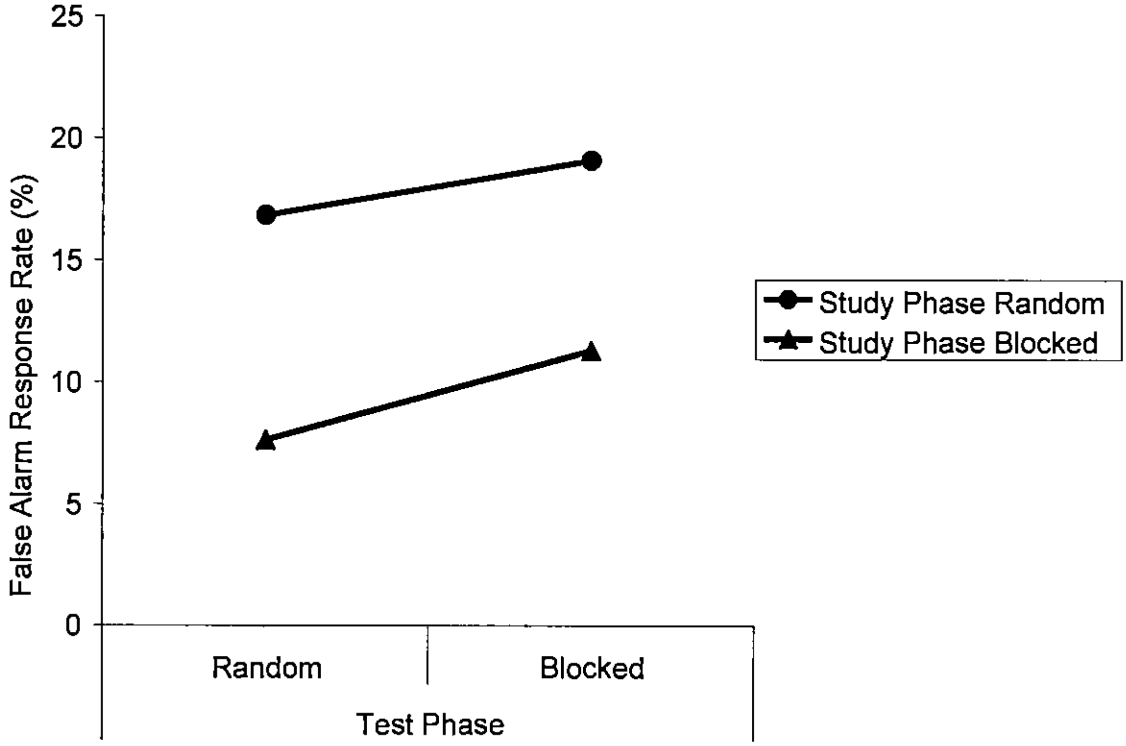
Figure 3. Mean false alarm rates as a function of study and test presentation conditions.

Figure 4. Mean critical lure and distractor rates as a function of study and test presentation conditions.

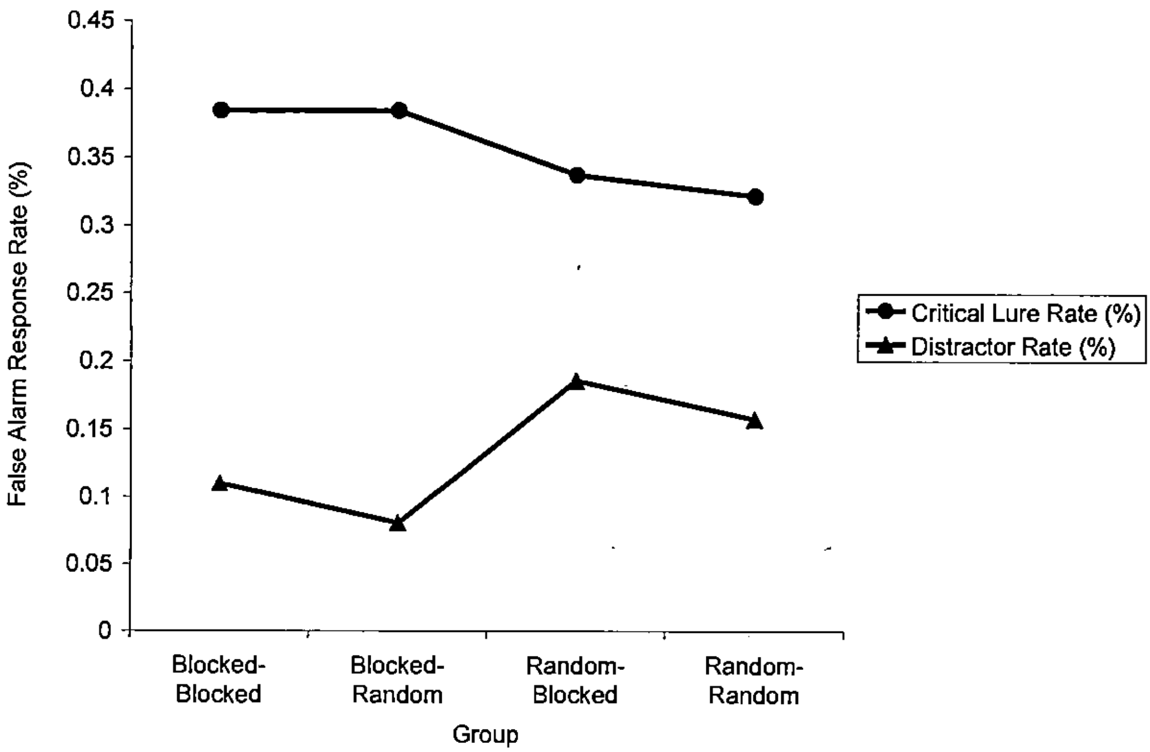
Figure 5. Mean critical lure and distractor reaction time as a function of study and test presentation conditions.


72
70
68
66
64
62
60
58
56
Hit Response Rate (%)
Random
Blocked
Test Phase
Study Phase Random
Study Phase Blocked

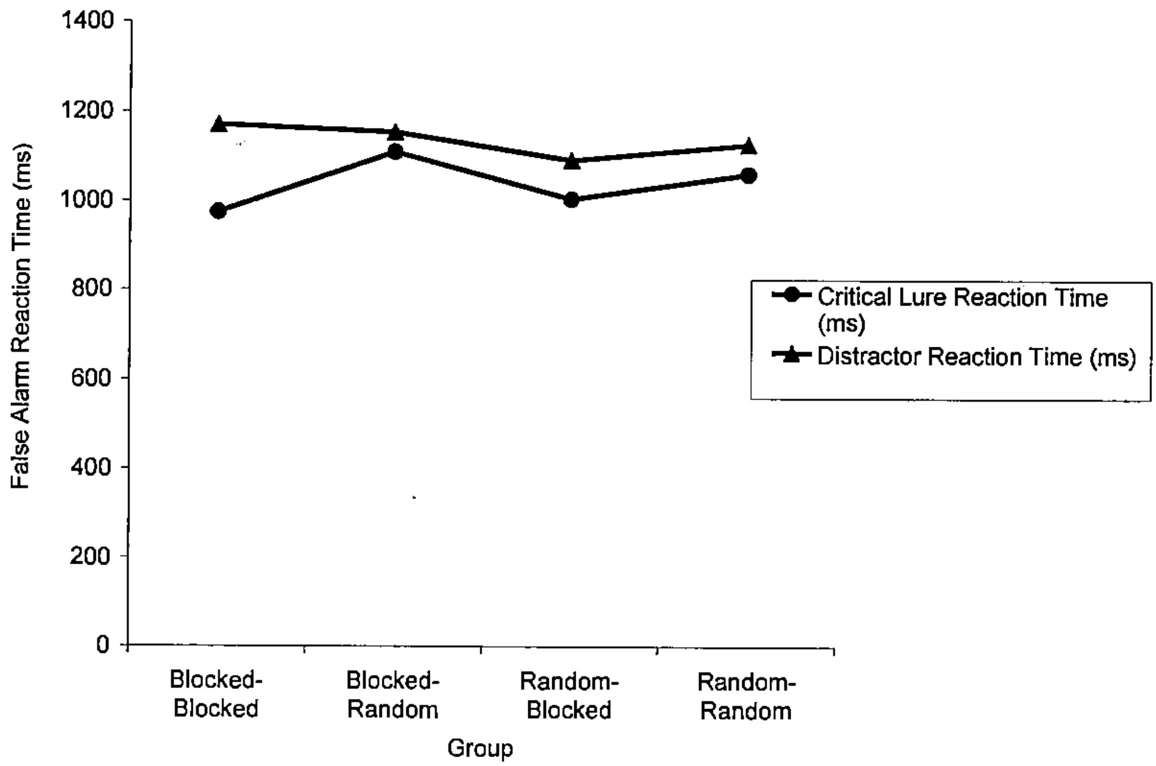

1200
1000
800
600
400
200
0
Hit Reaction Time (ms)
Random
Blocked
Test Phase
Study Phase Random
Study Phase Blocked



25
20
15
10
5
0
False Alarm Response Rate (%)
Random
Blocked
Test Phase
Study Phase Random
Study Phase Blocked



0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
False Alarm Response Rate (%)
Blocked-Blocked
Blocked-Random
Random-Blocked
Random-Random
Group
Critical Lure Rate (%)
Distractor Rate (%)


1400
1200
1000
800
600
400
200
0
False Alarm Reaction Time (ms)
Critical Lure Reaction Time (ms)
Distractor Reaction Time (ms)
Blocked-Blocked
Blocked-Random
Random-Blocked
Random-Random
Group

APPENDIX D: Experiment Word Lists and Associative Strengths

		BAS	FAS
	Anger		
	Rage	0.541	0.042
	Enrage	0.378	0
	Mad	0.343	0.412
	Fury	0.306	0
	Temper	0.182	0
	Ire	0.179	0
	Wrath	0.128	0
	Mean	0.09	0
Average:		**0.275**	**0.057**

		BAS	FAS
	Army		
	Navy	0.543	0.5
	Soldier	0.287	0.027
	Infantry	0.284	0
	Marines	0.283	0.047
	Military	0.266	0.027
	Air Force	0.133	0.014
	Draft	0.122	0
	Uniform	0.048	0
Average:		**0.246**	**0.077**

		BAS	FAS
	Black		
	White	0.655	0.557
	Gray	0.365	0
	Brown	0.338	0
	Coal	0.288	0
	Dark	0.111	0.1
	Color	0.074	0.05
	Funeral	0.034	0
	Blue	0.028	0
Average:		**0.237**	**0.088**

		BAS	FAS
	Bread		
	Rye	0.791	0
	Loaf	0.552	0.051
	Toast	0.364	0
	Butter	0.364	0.487
	Dough	0.31	0.058
	Crust	0.243	0
	Flour	0.142	0
	Sandwich	0.067	0.026
Average:		**0.354**	**0.078**

		BAS	FAS
	Car		
	Vehicle	0.74	0
	Automobile	0.709	0.133
	Garage	0.519	0
	Sedan	0.51	0
	Drive	0.48	0.122
	Van	0.448	0
	Keys	0.36	0
	Ford	0.331	0
Average:		**0.512**	**0.032**

		BAS	FAS
	Chair		
	Table	0.756	0.314
	Swivel	0.593	0
	Rocking	0.593	0.019
	Recliner	0.547	0
	Seat	0.543	0.109
	Stool	0.32	0.032
	Desk	0.29	0.019
	Couch	0.288	0.109
Average:		**0.491**	**0.075**

City	BAS	FAS
Metropolis	0.536	0
Town	0.529	0.307
New York	0.383	0.066
Urban	0.358	0
Suburb	0.265	0.01
County	0.195	0.01
Chicago	0.152	0
State	0.117	0.132
Average:	**0.317**	**0.066**

Cold	BAS	FAS
Hot	0.676	0.413
Shiver	0.669	0.011
Arctic	0.642	0
Frigid	0.57	0
Freeze	0.461	0.011
Chilly	0.395	0
Frost	0.37	0
Ice	0.364	0.098
Average:	**0.518**	**0.067**

Cup	BAS	FAS
Saucer	0.527	0.418
Measuring	0.385	0
Mug	0.268	0.025
Goblet	0.118	0
Coaster	0.096	0
Plastic	0.075	0
Tea	0.054	0.056
Coffee	0.051	0.105
Average:	**0.518**	**0.076**

Doctor	BAS	FAS
Physician	0.804	0.04
Nurse	0.547	0.379
Stethoscope	0.52	0
Surgeon	0.479	0.04
Patient	0.36	0.025
Clinic	0.3	0
Dentist	0.214	0.02
Medicine	0.152	0.066
Average:	**0.423**	**0.071**

Flag	BAS	FAS
Banner	0.687	0
Checkered	0.247	0
American	0.2	0.269
Stripes	0.177	0.014
Pole	0.157	0.193
Anthem	0.062	0
Emblem	0.048	0
National	0.027	0
Average:	**0.201**	**0.06**

Foot	BAS	FAS
Toe	0.605	0.235
Inch	0.473	0.02
Ankle	0.364	0
Shoe	0.321	0.337
Sandals	0.209	0
Sock	0.172	0
Hand	0.158	0.122
Boot	0.142	0
Average:	**0.306**	**0.089**

		BAS	FAS
	Fruit		
	Kiwi	0.709	0
	Citrus	0.426	0
	Pear	0.347	0
	Berry	0.298	0
	Vegetable	0.22	0.082
	Banana	0.215	0.065
	Orange	0.194	0.174
	Cherry	0.168	0
Average:		**0.322**	**0.04**

		BAS	FAS
	Lion		
	Roar	0.614	0.032
	Tamer	0.489	0.021
	Tiger	0.308	0.362
	Mane	0.2	0.021
	Fierce	0.112	0.021
	Den	0.097	0.021
	Cub	0.063	0.074
	Cage	0.035	0
Average:		**0.24**	**0.069**

		BAS	FAS
	Mountain		
	Climber	0.603	0.031
	Hill	0.428	0.265
	Climb	0.291	0.092
	Molehill	0.256	0.031
	Peak	0.248	0.02
	Valley	0.195	0.02
	Summit	0.108	0
	Steep	0.061	0
Average:		**0.274**	**0.057**

		BAS	FAS
	King		
	Throne	0.759	0
	Queen	0.73	0.772
	Crown	0.471	0.016
	Reign	0.383	0
	Monarch	0.317	0.039
	Royal	0.315	0.016
	Palace	0.159	0
	Prince	0.134	0.016
Average:		**0.409**	**0.107**

		BAS	FAS
	Man		
	Woman	0.595	0.66
	Lady	0.371	0.013
	Handsome	0.144	0
	Male	0.131	0
	Person	0.122	0
	Suit	0.074	0
	Uncle	0.07	0
	Beard	0.055	0
Average:		**0.195**	**0.084**

		BAS	FAS
	Music		
	Band	0.432	0.02
	Concert	0.395	0
	Jazz	0.367	0
	Symphony	0.329	0
	Orchestra	0.309	0
	Rhythm	0.277	0
	Radio	0.27	0.041
	Melody	0.243	0.02
Average:		**0.328**	**0.01**

		BAS	FAS
	Needle		
	Thread	0.758	0.424
	Syringe	0.52	0
	Haystack	0.418	0.03
	Injection	0.331	0
	Pin	0.289	0.212
	Thimble	0.218	0
	Sewing	0.181	0.224
	Knitting	0.135	0
Average:		**0.356**	**0.111**

		BAS	FAS
	River		
	Mississippi	0.654	0.031
	Creek	0.397	0
	Stream	0.321	0.118
	Flow	0.283	0.063
	Bridge	0.197	0
	Brook	0.161	0.016
	Lake	0.142	0.118
	Barge	0.047	0
Average:		**0.275**	**0.043**

		BAS	FAS
	Shirt		
	Blouse	0.647	0.135
	Sleeves	0.347	0.038
	Collar	0.342	0.032
	Shorts	0.252	0.013
	Button	0.24	0.064
	Pants	0.185	0.269
	Polo	0.177	0
	Jersey	0.174	0
Average:		**0.296**	**0.069**

		BAS	FAS
	Pen		
	Quill	0.635	0
	Pencil	0.476	0.594
	Bic	0.372	0
	Marker	0.257	0
	Write	0.128	0.065
	Fountain	0.071	0
	Felt	0.047	0
	Scribble	0.02	0
Average:		**0.356**	**0.082**

		BAS	FAS
	Rough		
	Sandpaper	0.429	0.041
	Smooth	0.416	0.352
	Coarse	0.291	0.014
	Tough	0.192	0.048
	Rugged	0.174	0.014
	Bumpy	0.15	0.028
	Jagged	0.128	0
	Riders	0.027	0
Average:		**0.226**	**0.062**

		BAS	FAS
	Sleep		
	Nap	0.73	0
	Doze	0.682	0
	Bed	0.638	0.092
	Awake	0.618	0.143
	Drowsy	0.551	0
	Snooze	0.52	0.02
	Slumber	0.514	0
	Tired	0.493	0.092
Average:		**0.593**	**0.043**

Slow	BAS	FAS
Fast	0.598	0.527
Snail	0.486	0.02
Turtle	0.372	0.115
Sluggish	0.34	0
Quick	0.272	0
Molasses	0.17	0
Lethargic	0.142	0
Speed	0.061	0.014
Average:	**0.305**	**0.085**

Smell	BAS	FAS
Aroma	0.678	0
Scent	0.625	0.029
Whiff	0.577	0
Stench	0.562	0
Reek	0.51	0
Sniff	0.442	0.043
Perfume	0.393	0.036
Fragrance	0.389	0
Average:	**0.522**	**0.014**

Smoke	BAS	FAS
Cigar	0.507	0
Cigarette	0.449	0.323
Pipe	0.419	0.016
Tobacco	0.338	0
Puff	0.24	0
Chimney	0.24	0
Lungs	0.119	0
Pollution	0.068	0
Average:	**0.298**	**0.042**

Soft	BAS	FAS
Hard	0.564	0.509
Loud	0.333	0
Tender	0.297	0
Fluffy	0.266	0
Pillow	0.236	0.018
Downy	0.221	0
Plush	0.178	0
Cotton	0.166	0.018
Average:	**0.283**	**0.068**

Girl	BAS	FAS
Boy	0.701	0.738
Dolls	0.199	0
Pretty	0.149	0.027
Female	0.098	0.013
Dress	0.063	0
Date	0.056	0
Beautiful	49	0
Daughter	0.042	0
Average:	**0.17**	**0.097**

Sweet	BAS	FAS
Honey	0.451	0
Bitter	0.435	0.02
Sugar	0.433	0.061
Sour	0.405	0.372
Candy	0.336	0.162
Tart	0.223	0
Chocolate	0.101	0.041
Nice	0.095	0.095
Average:	**0.31**	**0.094**

		BAS	FAS
	Trash		
	Garbage	0.456	0.526
	Rubbish	0.397	0.013
	Debris	0.266	0
	Dump	0.218	0.013
	Litter	0.209	0
	Landfill	0.186	0
	Junk	0.126	0.013
	Waste	0.067	0.026
Average:		**0.241**	**0.074**

		BAS	FAS
	Window		
	Pane	0.833	0.179
	Sill	0.682	0.128
	Shutter	0.48	0
	Curtain	0.189	0.038
	Door	0.156	0.147
	Ledge	0.152	0.013
	Glass	0.144	0.256
	View	0.048	0.026
Average:		**0.336**	**0.098**

APPENDIX E: Informed Consent

Please read this consent document carefully before you decide to participate in this study.

Project Title: The Effects of Blocked and Random Word Lists on the Production of False Memories.

Purpose of the research study: The purpose of this study is to measure learners' memories using blocked and random word lists in order to determine when the production of false recall occurs.

What you will be asked to do in this study: Students are recruited and assigned appointments via Experimentrak. Volunteer participation in this research project will take place in the UCF Honors in the Major Lab located in MOD 541. Students will be given instructions and then asked to perform a memory task presented on the computer. During the 2 minute interval between the study and test condition, you will complete a filler task that consists of navigating your way through a maze. In the test session, the researcher will be recording information related to your memory and response to those words presented in the study trial.

Time Required: Approximately 30 minutes

Risks: There is no risk involved.

Benefits/ Compensation: As a direct benefit, you will receive extra credit points toward your psychology class via Experimentrak. Indirect benefits include advancing knowledge of human memory theories and gaining a better understanding of how false memory production works.

Privacy: Your identity will be kept confidential. Your name will not be used in any report. The recorded data will be identified by code numbers and reported in an aggregate form. All consent forms will be gathered and stored separately from the study data. Consent forms are to be kept in a locked filing cabinet for a period of three years after the completion of the study.

Voluntary Participation: Your participation in this study is voluntary. You have the right to withdraw from the study at any time without consequence.

More information: For more information or if you have questions about this study, contact

Melonie Williams
(813) 758-7758
Lonie1112@aol.com

Research Supervisor: Dr. Alvin Wang
Department of Psychology
(407) 823-3449

If you believe you have been injured during participation in this research project you may file a claim with UCF Environmental Health & Safety, Risk and Insurance Office, P.O. Box 163500, Orlando, Florida 32816-3500 (407) 823-6300. The University of Central Florida is an agency of the State of Florida for purposes of sovereign immunity and the university's and the state's liability for personal injury or property damage is extremely limited under Florida law. Accordingly, the university's and the state ability to compensate you for any personal injury or property damage suffered during this research project is very limited.

Research at the University of Central Florida involving human participants is carried out under the oversight of Institutional Review Board. **Information regarding your rights as a research volunteer may be obtained from:**

Institutional Review Board (IRB)

University of Central Florida

Office of Research & Commercialization

12201 Research Parkway, Suite 501

Orlando, FL 32826-3246

Telephone: (407) 823-2901

☐ I have read the procedure described above

☐ I voluntarily agree to participate in the procedure

☐ I am at least 18 years of age or older

______________________________ ______________

Participant Date

______________________________ ______________

Principal Investigator Date

APPENDIX F: Debriefing

The purpose of this study is to examine the conditions under which false memories are produced. Previous experiments in which participants were required to study word lists revealed that many participants made semantic associations during study and added to that false recall during test phases. This research seeks to understand the conditions that create false memories and to provide evidence that both conditions may influence the production of the false recall. The findings of this study will contribute to the theoretical understanding of the origin of false memory.

Please do not discuss the specifics of this experiment with your peers as some of them may not have participated yet.

Thank you for your participation in this research. If you have any further questions regarding the experiment or your participation, please contact either of the following individuals.

Melonie Williams
1381 Northgate Cir. E307
Oviedo, Florida 32765
(813) 758-7753

Dr. Alvin Wang
(407) 823-0325

APPENDIX G: IRB Committee Approval Form and Letter

THE UNIVERSITY OF CENTRAL FLORIDA
INSTITUTIONAL REVIEW BOARD (IRB)

IRB Committee Approval Form

#06-3595

PRINCIPAL INVESTIGATOR(S): Melonie Williams
(Supervisor – Alvin Wang, Ph.D.)

PROJECT TITLE: The Effects of Blocked and Random Word Lists On the Production of False Memories

[X] New project submission
[ ] Resubmission of lapsed project #_____
[ ] Continuing review of lapsed project #
[ ] Continuing review of #
[ ] Study expires
[ ] Initial submission was approved by expedited review
[ ] Initial submission was approved by full board review but continuing review can be expedited
[ ] Suspension of enrollment email sent to PI, entered on spreadsheet, administration notified _____

Chair

[X] Expedited Approval

Dated: 7-6-06
Cite how qualifies for expedited review:
minimal risk and #7

[ ] Exempt

Dated: ________
Cite how qualifies for exempt status:
minimal risk and ________

[ ] Expiration
Date: ________

IRB Reviewers:

Signed: [signature]
Dr. Sophia Dziegielewski, Vice-Chair

Signed: ________
Dr. Jacqueline Byers, Chair

Signed: ________
Dr. Tracy Dietz, Vice-Chair

Complete reverse side of expedited or exempt form

[ ] Waiver of documentation of consent approved
[ ] Waiver of consent approved
[ ] Waiver of HIPAA Authorization approved

NOTES FROM IRB CHAIR (IF APPLICABLE): First review 7/2/2006. Clarifications needed. [signature]

University of Central Florida

Office of Research & Commercialization

July 10, 2006

Alvin Wang, Ph.D.
Ms. Melonie Williams
University of Central Florida
Department of Psychology
BHC 104
Orlando, FL 32816-1390

Dear Dr. Wang & Ms. Williams:

With reference to your protocol #06-3595 entitled, "The Effects of Blocked and Random Word Lists On the Production of False Memories" I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **This study was approved on 7/6/2006. The expiration date for this study will be 7/5/2007.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

Joanne Muratori
Joanne Muratori
UCF IRB Coordinator
(FWA00000351 Exp. 5/13/07, IRB00001138)

Copies: IRB File

12201 Research Parkway • Suite 501 • Orlando, FL 32826-3246 • 407-823-3778 • Fax 407-823-3299