

**A NEW CONTEXT FOR
DEESE/ROEDIGER-MCDERMOTT FALSE MEMORY**

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ABSTRACT

False recognition in the Deese/Roediger-McDermott (DRM) paradigm was assessed following manipulation of encoding context. Undergraduate students at Simon Fraser University participated. Experiment 1 replicates the DRM effect using 5-item lists; Experiment 2 demonstrates that a false recognition effect also occurs for 3-item lists specifically developed to later bias the encoding context of DRM lists used in Experiment 1. Experiment 3 investigates false memory upon manipulation of list context; participants studied 8-item lists, in which either the first or last 3 items (bias items) of the list were in a different context than the remaining 5 DRM items. Findings revealed no differences in false recognition due to encoding context. Two accounts of the DRM effect are discussed: the associative activation account, and the discrepancy-attribution hypothesis.

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CHAPTER 1: INTRODUCTION

Despite all attempts to remember experiences precisely as they occurred, people consistently remember things that never actually happened. Such illusions bring a valuable perspective into memory research – they reflect the processes that would usually guide people to form accurate accounts of their past. Systematic memory mistakes highlight memory as a constructive process, exemplifying that what we remember does not solely depend on the physical world around us. Rather, what we remember depends on a number of factors, many of which can be manipulated in the laboratory.

The constructive nature of memory is well portrayed in Sir Frederic Bartlett's 'War of the Ghosts' experiment conducted in 1932. Bartlett asked participants to read a short story and then, after various time intervals, recall as much as they could. Bartlett found that as time passed, although a considerable amount of detail was lost from participants' recollections, responses retained information that was vital to the theme of the story. In fact, Bartlett found that information was systematically distorted and inserted such that recollections conformed to the major thematic components of the 'War of the Ghosts.' In contrast, the information omitted from responses was generally inconsequential to the theme. Participants systematically made errors that fit their recollections with the story – they reconstructed their memories to conform to an overall theme. Such findings indicate that memory does not reproduce the past, but rather reconstructs the past based on what is plausible.

The idea that memory is constructive was picked up by Bransford and his colleagues in the early 1970's. In one experiment, Bransford and Franks (1971)

presented participants with a series of simple statements, known as propositions, such as “the ants were in the kitchen,” “the jelly was sweet,” “the jelly was on the table,” and “the ants ate the jelly.” These statements were linked into sets of one, two, or three propositions, but were never combined such that all four were presented in the training phase of the experiment. In a recognition test, participants claimed the entire set of ideas – that is, unseen four proposition statements – to be old more often than statements that had actually been presented in the training session (but had fewer propositions). Bransford and Franks concluded that participants based their recognition judgments on the theme of the information that was actually presented. The four proposition statement, while a false memory, contained more information about the theme than was conveyed in the one, two, or three proposition statements. These results are consistent with Bartlett’s original idea that memory is constructed around themes.

Bransford, Barclay and Franks (1972) demonstrated that memory is also inferential. In the training session of their experiment, participants were either exposed to a statement such as “three turtles rested *on* (italics added) a floating log, and a fish swam beneath them,” or “three turtles rested *beside* (italics added) a floating log, and a fish swam beneath them.” The recognition items consisted of inferences that could only be made based on one of these statements. For example, based on the first statement (but not the second), it can be inferred that the fish swam under the log. Accordingly, Bransford et al. found that participants who were exposed to the first statement erroneously claimed the recognition candidate “three turtles rested on a log and a fish swam beneath it” to be old; those participants who were exposed only to the second training statement did not falsely recognize the target item. These results again indicate

that what a person remembers is constructed according to what is plausible, given their past experience.

Taken together, the contributions of Bartlett (1932), Bransford and Franks (1971), and Bransford et al. (1972) clearly indicate that the human memory is prone to systematic error. As described in this introduction, many of these errors are constructed based on the theme of actual experiences, including the memory mistake that is the subject of this thesis: Deese/Roediger and McDermott false memory.

Deese/Roediger and McDermott False Memory

In 1959, Deese discovered that his participants made recurring “verbal intrusions” upon recalling word lists organized around themes. Participants falsely recalled words that were not part of the list they were exposed to, but were related to its theme. Words such as NOSE, BREATHE, SNIFF, and AROMA, for example, are all highly related to the unrepresented word, SMELL. Deese found that participants falsely reported words on approximately 25% of trials in which they were trained on associated lists. As Deese noted, this type of intrusion is consistent with the systematic errors discussed by Bartlett: participants intruded items because they were related to the theme of the original list.

After briefly publishing on these intrusions, Deese continued to pursue his research on order effects in recall and the false memory effect remained unexplored until the 1990’s when Roediger and McDermott (1995) and Read (1996) independently revisited his findings. Both investigations refined Deese’s original paradigm with the primary goal of investigating the verbal intrusions. In the Roediger and McDermott

design, word lists of the highest associates to a critical unrepresented word (known as the prototype) were shown to participants for subsequent recall and recognition. Upon retrieval, Roediger and McDermott revealed an even higher tendency towards falsely remembering the prototype than Deese (1959) had observed, with participants falsely recalling and recognizing the prototype on 55% and 72% of trials, respectively. Since this replication, there has been an enormous accumulation of research on false memory, with many studies employing some variation of the original Deese/Roediger-McDermott (DRM) paradigm.

The DRM effect has been extraordinarily persistent throughout manipulations of the original paradigm (for a review, see Gallo, 2006). The effect occurs for lists with as few as three associates (although longer lists tend to elicit higher rates of false remembering), as well as when filler items (that is, items which are not related to the prototype) are added to training lists (Robinson & Roediger, 1997). Furthermore, the effect occurs in both delayed (e.g., Roediger & McDermott, 1995) and immediate (e.g., Whittlesea, Masson, & Hughes, 2005) tests, as well as when lists are presented in blocked (e.g., Read, 1996) and mixed (e.g., Meade, Watson, Balota, & Roediger, 2007) fashions. One particularly impressive finding is that the effect occurs even with severe warnings. When informed about the effect, given examples of the effect, and explicitly told to avoid making the memory error, participants still falsely remember prototypes (e.g., Gallo, Roberts, & Seamon, 1997; Whittlesea, 2002). Despite the persistence of the effect, Gallo (2006) points out that the standard DRM method involves presenting fifteen associates blocked together in order of descending associative strength to the

prototype, at a rate of approximately 1.5 seconds per word, with a free recall or recognition test following shortly thereafter.

With research amassing on DRM false memory, the theoretical basis of the DRM has remained under investigation since Roediger and McDermott published their paper in 1995. Many different accounts have been proposed, however it is two of these accounts that this thesis will now focus on: the associative activation account advocated by Roediger and McDermott (1995), and the discrepancy attribution account developed by Whittlesea and Williams (1998). The former of these accounts is based on spreading activation proposed by Collins and Loftus (1975), while the latter is based on the Selective Construction and Preservation of Experiences framework (Whittlesea, 1997).

The Associative Activation Account

The most obvious fact about the DRM effect is that it is largely a result of the association between list items and the unrepresented prototype. Not surprisingly, many theoretical accounts make associative mechanisms the central point of their explanation. Indeed, this idea is paramount to the most widely used theoretical account of DRM false memory: the associative activation account, which is based on spreading activation between related concepts in the semantic memory (Collins & Loftus, 1975). This theory begins with the assumption that throughout the course of their lives, people develop mental representations of words and concepts. As a person builds their lexicon, it is assumed that these mental representations become organized semantically, such that links between related concepts form with experience. Thus, the spreading activation account suggests that semantic memory is organized as a network of inter-related

concepts, and that activation of any concept will spread to related (i.e., linked) concepts. This activation is assumed to occur automatically, unconsciously, and rapidly.

According to the activation account, presentation of each training item in a DRM experiment results in the semantic concept for that item becoming activated. Because each item is related to the prototype, activation will automatically spread to the prototype. For example, the concepts NOSE and BREATHE are both related to the prototype SMELL, and thus the presentation of NOSE and BREATHE will automatically activate SMELL. This form of activation is assumed to occur within the vast network of semantic associations – in other words, this activation is semantic priming. Semantic priming is the increased speed of response on certain nonremembering tasks (commonly lexical decision tasks), when target items immediately follow related items. For example, participants are faster at determining that DOCTOR is a word when NURSE precedes it, as opposed to when it is preceded by an unrelated word such as TIGER.

Semantic priming is well known to be short lived (usually no more than two seconds), and therefore the associative activation account includes an additional assumption in order to account for the fact that the DRM effect persists far beyond the time span of semantic priming (Meade, Watson, Balota, & Roediger, 2007). It is assumed that when participants are given instructions to episodically retrieve information from a training phase, this will cause the already activated semantic concept of a prototype to become episodically marked. Episodic marking, in turn, causes participants to believe they have had the experience of being exposed to the

word in training. Thus, the DRM effect has been explained by the spread of activation from presented list items to the unrepresented prototype.

The theory of spreading activation itself has gained support through numerous experiments, notably those on semantic priming (for a review, see Hutchison, 2003). According to associative activation advocates, the facilitation in response that occurs when an associated word precedes the target is due to activation of the related target item within the semantic network. Needless to say, this interpretation lends itself to the associative activation account of the DRM. Indeed, the finding that the DRM effect occurs in recall serves as support for the notion that the prototype becomes activated during a DRM experiment. That is, the mere coming to mind of a prototype is evidence that it is, in some way, active during a DRM experiment (Gallo, 2006).

Beyond the fact that even recall can produce memories of the prototype, one finding taken as support for the associative activation account is that the false memory effect increases as a function of the training list's semantic association (i.e., list length) to the prototype (Robinson & Roediger, 1997). The associative activation account interprets this finding as meaning that lists with more associates lead to more activation of the prototype, which in turn leads to higher rates of false remembering. Robinson and Roediger even found that when list length was held constant with filler items (that is, items unrelated to the prototype) but the number of associates to the prototype was manipulated, the same effect was found. Because filler items do not dilute the activation strength of a list, associative activation advocates assume that this activation occurs automatically: the spread of activation from presented list associates to semantically related prototypes persists even in the presence of semantically unrelated concepts.

Perhaps the most compelling evidence in favor of this account is that the associative strength from the list items to the prototype, known as backwards-associative strength (BAS), is the best predictor of the effect (Roediger, Watson, McDermott & Gallo, 2001). BAS reflects the probability that the prototype will be generated from an item on a free association task. In their multiple regression analysis, Roediger et al. determined that the BAS of DRM lists was a better predictor of falsely remembering prototypes than characteristics of the prototype itself (such as prototype length, frequency, and concreteness), other list characteristics (such as forward associative strength, or inter-item associative strength), as well as a better predictor than accurate recall of list items. Associative activation advocates have taken this as evidence that a similar mental process occurs within the semantic network. That is, since BAS reflects the probability of overtly generating the prototype, lists with high BAS will lead to higher rates of mentally generating the prototype. This, in turn, would result in activation of the node for the prototype within a semantic network, therefore leading to false memories of prototypes.

The Discrepancy Attribution Account

While the role of associations remains fundamental to the DRM effect, it is not the only important factor to consider. In particular, the subjective experience of discrepancy has been suggested to play an integral role in understanding DRM false memory (Whittlesea & Williams, 1998; Whittlesea, 2002). The discrepancy attribution account suggests that the high incidence of DRM false memory is based on the attribution of processing discrepancies to prior experiences. However, in order to describe the discrepancy attribution account, a brief discussion of its origins within the

Selective Construction and Preservation of Experiences (SCAPE) framework is warranted.

The SCAPE framework posits that memory operates as a unitary system, and that everything we remember (accurately or not) is a creation of the interaction between stimuli, tasks, contexts, and prior experience (Whittlesea, 1997). The interaction between these components forms a stimulus complex; SCAPE suggests that memory is composed not of the experience of a stimulus by itself, but the experience of processing that stimulus, as represented by the stimulus complex. This framework places greater emphasis on what a person does with a stimulus than on qualities that are inherent to a stimulus alone. Much like Bartlett, the SCAPE framework takes a constructive perspective on the nature of memory.

SCAPE further suggests that the construction of mental events is based on two primary functions of the mind: the production of responses (dictated by the principle of transfer appropriate processing) and the evaluation (or subjective monitoring) of these responses (Whittlesea, 1997). Put more broadly, production is what a person does and evaluation is how a person feels about what they do. Thus, production leads to motoric, perceptual, or cognitive events and evaluation leads to some attitude (e.g., feelings of familiarity, pleasantness, or surprise) about these events. These two functions are assumed to occur together and interact as we engage in any task that requires cognition.

To illustrate the roles of production and evaluation, consider the hypothetical situation presented by Whittlesea (2003): when two people are exposed to a sequence of word pairings (including, for example, the pairing ONION-SOUP) and are later given ONION as a cue and asked to produce its pair word, both people may experience the

word SOUP coming to mind. However, while one of these people may have a positive attitude with respect to the word SOUP (leading to the correct response that SOUP is the pair word), the other person may evaluate the word SOUP differently. Perhaps the other person would disregard SOUP as the correct response, and instead attribute its coming to mind to the fact that they recently had onion soup for dinner, or that onion and soup are commonly paired with each other. That person will therefore fail to report SOUP as the pair word, and in this case we would say that they have failed in their task. In these two cases, the production function (that is, the coming to mind of the word SOUP) was the same; it was two different evaluations, or attitudes, that led to two entirely different responses.

As the evaluation function is involved in making inferences and attributions about performance, it is a crucial component in explaining the origin of the feeling of familiarity. Whittlesea and Williams (1998) observed that the feeling of familiarity was the result of attributing the perception of discrepancy to prior experience, which led them to develop the discrepancy attribution hypothesis. Essentially, Whittlesea and Williams modified the fluency attribution hypothesis proposed by Jacoby and Dallas (1981) – rather than familiarity being an attribution about sheer fluency in processing (i.e., repetition priming) as Jacoby and Dallas suggested, Whittlesea and Williams’ discrepancy attribution hypothesis posits that the feeling of familiarity arises when people perceive certain aspects of their processing to be *surprisingly* fluent. Whittlesea and Williams dubbed this surprising fluency the perception of discrepancy. Essentially, the subjective perception of discrepancy is the feeling of strangeness – that something is

out of place. This perception occurs unconsciously; that is, participants are not aware of the discrepancy.

In their work, Whittlesea and Williams (1998) presented participants with three types of stimuli: natural words (such as RAINBOW), orthographically regular nonwords (such as HENSION), and orthographically irregular nonwords (such as LICTPUB). In the test phase, participants were asked to say each word out loud and make a recognition judgment. Whittlesea and Williams reasoned that if fluency alone (as measured by speed of pronunciation) was responsible for the feeling of familiarity, then regular words should be the subject of more false alarms than either regular nonwords or irregular nonwords; similarly, irregular nonwords should be associated with the least incidence of false alarms. Fluency of processing was indeed greatest for regular words and lowest for irregular nonwords, however this trend did not correspond to the pattern of false alarms. Rather, participants showed the highest levels of false alarms for regular nonwords. These results indicate that the feeling of familiarity is not, as Jacoby and Dallas (1981) proposed, based solely on fluency. Instead, Whittlesea and Williams demonstrated that surprising fluency of processing is key.

The surprising fluency outlined by Whittlesea and Williams (1998) reveals how a participant's evaluation is critically important in making old/new decisions. Regular words, for example, are immediately processed fluently, leading to the expectation that they will turn out to hold some meaning. This expectation is validated at the time participants realize the definition of the word they are pronouncing. Irregular nonwords are not processed fluently, and the participant will not form the expectation that irregular nonwords will turn out to hold meaning. This expectation is also validated.

Both of these occurrences will be experienced with the subjective perception that everything is proceeding in a coherent fashion; there is a match between expectations and outcomes in both of these situations. However, the ease with which regular nonwords are processed will lead to an expectation that these items will turn out to be known words; this expectation is later violated, leading to a discrepancy between a participant's expectation and the actual outcome. Regular nonwords are thus surprisingly fluent – they are evaluated as remarkably easy to process (i.e., pronounce) for nonsense items.

In 2002, Whittlesea extended the discrepancy attribution hypothesis to the DRM effect. When evaluated as a memory candidate, the prototype fits with the experience of the training stimuli. However, because the prototype was never actually presented, a perception of discrepancy between what actually occurred (the prototype was not presented) and what the participant would expect to have occurred (that the prototype was part of the training list) arises. Much like the HENSION items used by Whittlesea and Williams (1998) were surprisingly fluent for nonwords, prototypes are surprisingly fluent for items that were not part of the training set. When this perception arises (and no immediate source of the discrepancy is clear), the feeling of discrepancy can be mistakenly attributed to having seen the item before. This leads to a feeling of familiarity with respect to the prototype, and thus false memory of the prototype.

Whittlesea et al. (2005) demonstrated the essential nature of surprise in eliciting DRM false memories. To prevent surprise, Whittlesea et al. asked participants to generate a theme word for each list after it was presented in training. Essentially, this required subjects to produce the prototype prior to the recognition phase. Generating a

prototype before the recognition test was expected to eliminate any feelings of surprise upon encountering it at test – because participants deliberately generated it, they would know exactly where to attribute fluent processing of the item, and thus its coming to mind would not be perceived as surprising. Participants successfully generated the prototype on 39% of trials; more importantly, on these trials, participants made the false memory error only 5% of the time. In contrast, on trials where participants did not generate the prototype, they made the memory error 17% of the time. The decrease in false recognition observed by Whittlesea et al. is particularly noteworthy, as we have seen before that the effect is extraordinarily persistent. However, when surprise was prevented, the DRM memory error was substantially reduced. Whittlesea et al. concluded from this that the perception of discrepancy is essential to the memory illusion.

CHAPTER 2: EXPERIMENTAL STUDIES

Regardless of the theoretical perspective one takes on the DRM effect, one thing is clear: processing the theme of a DRM list is crucial. Indeed, it is this processing that is at the heart of the DRM effect – understanding the theme of DRM lists leads participants to systematically think of (and falsely report) related words. Since the theme of the list becomes apparent to participants when lists are presented, encoding manipulations are of particular interest to those of us who endeavor to understand the mental processes that guide false remembering.

The critical role of encoding context was dramatically portrayed by Goodwin, Meissner and Ericsson (2001). In one condition of their study, they presented lists in which DRM associates were alternated with items that were contextually unrelated to the prototype, yet related to the preceding DRM items. For example, the DRM list for SOFT (which, in standard form, begins with HARD, LIGHT, PILLOW) was presented as HARD, HAT, PILLOW, CASE, LIGHT, BULB and so on; each DRM associate was immediately followed by an item that placed it in a specific context, thus dictating its semantic meaning. As a result, each DRM item was interpreted as being semantically unrelated to the other list items, as well as to the prototype. This manipulation reduced false recall of prototypes to 9%. In other conditions, when the contextually unrelated items were included in the lists but not in close proximity to their related DRM associates (e.g., HARD, LIGHT, PILLOW... HAT, BULB, CASE), false recall was not appreciably affected, with participants making the error 19% of the time. In yet another condition of their study, the DRM effect was nearly eliminated by presenting the DRM items and their related fillers in direct pairs (e.g., HARD-HAT/ LIGHT-BULB/

PILLOW-CASE). Following this form of training, false recall of prototypes occurred only 2% of the time. Thus, Goodwin et al. (2001) demonstrated that when related filler items are directly alternated or paired with DRM items, the DRM effect is substantially reduced or eliminated.

These findings illustrate several important issues regarding DRM experiments. Firstly, they reinforce the importance of grouping associates in DRM training sessions. Recall that in some conditions of Goodwin et al. (2001), the contextually related items were grouped separately from their related DRM associates and did not affect false memory of prototypes. Grouping associates is thought to facilitate processing the theme of the list, thereby increasing false memory. On a related note, the findings of Goodwin et al. reinforce the need for processing associates as related to the prototype: when items are perceived as unrelated to the prototype, the false memory error does not occur (essentially, this manipulation removes the special properties from a list's prototype, making it not unlike an unrelated filler item). Most importantly, Goodwin et al. highlight encoding context manipulations as a viable method of tampering with the interpretation of DRM lists, and thus false reports of prototypes. This idea is central to the experiments presented in this thesis.

The present series of studies aimed to follow up on the work of Goodwin et al. (2001) by employing a less drastic encoding context manipulation to alter the incidence of falsely reporting prototypes. This thesis introduces a novel encoding context manipulation, in which DRM lists include additional words designed to place a new emphasis on the DRM associates without changing their semantic relationship with their prototype. That is, items were specifically developed for biasing DRM associates

without removing the association between DRM associates and prototypes. For example, the biasing items DOZEN, THORN, and PETAL were designed to place the list for SMELL (NOSE, BREATHE, SNIFF, AROMA, and HEAR) in a new context (ROSE). These items were combined such that the bias items were encountered as the first or last three items in a list. Essentially, participants were presented with a series of blocked, yet biased, DRM lists.

When the bias items were processed as the first words in a list, I expected that participants would encode the list in the context of a biased theme. Encountering PETAL, DOZEN and THORN at the beginning of the SMELL list (e.g., PETAL, DOZEN, THORN, SCENT, EXHALE... etc.) was expected to place all subsequent DRM associates in the context of ROSE. Thus, I expected that when bias items appeared before DRM items, the encoding context of subsequent DRM items would be biased, and there would be a resultant increase in false recognition of the bias prototype (ROSE), relative to when these items occurred in the last positions of the list. When the list was encoded with bias items in the last three positions, I hypothesized that the list would be processed in the DRM context: SMELL. The research question under investigation was whether the location of bias items (the encoding context) would affect false reports of bias and DRM prototypes.

Despite the change in context, it is important to reiterate that the addition of biasing items does not remove the semantic association between DRM lists items and their prototype, and as a result false memory for the prototypes should persist. Recall that in Goodwin et al. (2001), false memory of prototypes was nearly eliminated when the meaning of each list associate was changed to an entirely different sense of the

word. However, the manipulation presented in this thesis does not change the meaning of other list items. PETAL and DOZEN, for example, do not change the semantic meaning of NOSE or BREATHE – rather, they place the items NOSE and BREATHE in the context of a particular fragrance. These pairings were chosen as they did not remove the intended relationship between DRM associates and their prototypes. In a sense, the biasing items simply act to cause a more specific interpretation of the DRM items. The current study thus avoids the drastic change in meaning that occurred in the experiments by Goodwin et al., and instead focuses the general theme of the DRM list to something more specific.

One other notable departure that this research takes from the work of Goodwin et al. (2001) is the use of recognition (as opposed to recall) in the test phase. Thomas and Sommers (2005) revealed a similar recognition effect to that found in recall by Goodwin et al. – false recognition of prototypes was substantially reduced when the semantic association from list items to the prototype was decreased at encoding. The use of recognition over recall in this thesis was made based on the finding that although false recall for lists with few associates is extremely low, false recognition rates are generally quite high (see Gallo, 2006). With only three bias items, the choice of recognition was made in an attempt to increase the chances of detecting the expected effect.

Memory research endeavors to expose the underlying operations of memory, such that we can maximize usage of this great resource. The following experiments investigate the importance of how we interpret the information presented to us – or

contextual information – in the operations of memory. As Bartlett said in his 1932 book, *Remembering*:

Remembering is not a completely independent function, entirely distinct from perceiving, imagining, or even from constructive thinking, but it has intimate relations with them all. To the study of these relations we shall now turn. (p. 13)

Experiment 1: False Memory for DRM Prototypes

Experiment 1 demonstrates that the DRM effect occurs reliably with the current stimuli.

Method

Participants. Twenty-three students at Simon Fraser University participated in this study. Participants were recruited through the introductory psychology subject pool and received course credit for their participation. An English proficiency criterion was set in advance and was maintained in all experiments discussed in this thesis; participants whose first language was not English, had spoken English for five or fewer years, and did not speak English at home were removed from the analysis. Each of the twenty-three participants who participated in Experiment 1 met English proficiency standards.

Materials. Sixteen 5-item DRM lists taken from the Stadler, Roediger and McDermott (1999) norms were used in Experiment 1. These lists contained the first five associates to the DRM prototype, with the exceptions that the lists for ARMY,

DOCTOR, and SMOKE did not include associates 5, 3, and 1 respectively. These associates were removed and used as members of the bias stimuli in the subsequent experiments described in this thesis. Consequently, the next highest associate was used, such that there were still five items per list (for example, item 5 was removed from the ARMY list, and instead the ARMY list consisted of items 1, 2, 3, 4 and 6). A Macintosh computer presented stimuli to participants. An external button box was used to record recognition decisions. This box contained three buttons: one each to indicate “yes” and “no” recognition decisions, and one to indicate “ready to continue.”

Procedure. The experiment was conducted in individual fifteen-minute sessions in a lab room of Simon Fraser University. Prior to entering the experiment, informed consent was obtained and participants completed a demographic questionnaire, indicating their age, sex, and proficiency in English. A trained research assistant read instructions from a script.

Participants were asked to read words aloud as they appeared on the screen; they were asked to study these words and informed that a memory test would follow. After the researcher left, a ‘READY’ prompt appeared on the screen and remained there until participants pressed the “ready to continue” button to indicate they wished to begin the experiment. Uppercase words then appeared in the center of the computer screen on at a time. Items were presented in order of descending associative strength to the prototype. Each word was presented for two seconds. After two seconds, each item disappeared and the next word in the list appeared below. Thus, no item was presented in training for more than two seconds. After an entire list had been presented, a blank screen

appeared for two seconds, after which time presentation of a new list began.

Presentation order of the 16 lists was independently randomized for each participant.

After presentation of the training lists, the research assistant returned to the experiment room and gave the participant instructions for the test phase. Participants were informed that words would appear on the computer screen one at a time, and that they would have to answer the question “was this word presented in the training phase?” Participants were told that each item would remain on the screen until a recognition decision had been made. Participants were instructed to press one button on the external button box to indicate “yes” and another to indicate “no”. The computer recorded recognition decisions. After the research assistant left, a ‘READY’ prompt appeared on the screen until participants pressed a button to indicate they were ready to begin the test phase. Recognition items included 16 prototypes, 48 list associates (3 from each list), and 48 unrelated filler items. Presentation order of recognition stimuli was independently randomized for each participant. After the test phase, participants were debriefed and given a chance to ask questions.

Results and Discussion

The level of Type I error control was set to .05 for all statistical procedures in this paper. As shown in Table 1, participants accurately recognized associates as being old 73% of the time, and made the false memory error in response to prototypes on 46% of trials. False alarms on filler items were made only 6% of the time. A paired samples *t* test was conducted to determine whether proportion of false recognition of DRM prototypes was different from the proportion of non-prototype (filler item) false alarms.

Prototype false alarms were 40% more common than false alarms on filler items $t(1,22) = 9.722, p < .000$.

Table 1

Experiment 1: Probability of claiming prototypes, associates and filler items old

Item Type	p(old)
DRM Prototype	.46(.21)
Associate	.73(.14)
Filler	.06(.09)

Note: Standard deviations in parentheses.

Experiment 1 reveals a false memory illusion for prototypes prepared by five item DRM lists. The incidence of false recognition of prototypes is consistent with rates found in previous studies; for example, Robinson and Roediger (1997) revealed a 50% effect for six item lists in which the items were studied for two seconds each. The results are important on two levels: firstly, they reveal that the five item lists intended for use in the encoding context manipulation produce reliable effects, and secondly they reveal the rate of false memory for DRM prototypes that are prepared without an encoding context manipulation.

Experiment 2: False Memory for Bias Prototypes

After replicating a standard DRM effect for five item lists, the question of whether or not the bias items would be successful in eliciting false memory of the bias prototypes needed to be addressed. These items had not been previously tested, and

establishing whether they could produce a reliable effect was the purpose of Experiment 2.

Method

Participants. Twenty-nine students at Simon Fraser University participated in this study. Participants were recruited and compensated in the same manner as in Experiment 1. All participants met the English proficiency standards.

Materials. Sixteen 3-item bias lists were used in Experiment 2. These lists contained three associates to the bias prototype and were developed for later pairing with a specific DRM list. For example, the bias list for AIRPLANE (FLIGHT, PILOT, and JET) was designed for later pairing with the DRM list for HIGH (LOW, CLOUDS, UP, TALL, and TOWER). Bias stimuli were formed with the following goals in mind: firstly, that of eliciting false reports of their own prototypes; secondly, that of not changing the meaning of DRM items; and lastly that of being able to bias the encoding context of DRM lists in later experiments.

Procedure. The procedure of Experiment 2 was identical to that of Experiment 1, with the exceptions that the training stimuli consisted of the three item bias lists, and in testing the recognition candidates included the bias prototypes, sixteen associates (one from each list), and twenty filler items.

Results and Discussion

Results from Experiment 2 are presented in Table 2. Accuracy in determining that old associates were old was 81%. Participants made the false memory error 26% of the time and falsely recognized filler items 11% of the time. A paired samples t test was conducted to determine whether proportion of bias prototype false alarms was different

from the proportion of filler item false alarms. Prototype false alarms were 15% more common than false alarms on filler items $t(1,28) = 4.518, p < .000$.

Table 2

Experiment 2: Probability of claiming prototypes, associates and filler items old

Item Type	p(old)
Bias prototype	.26(.16)
Associate	.81(.14)
Filler	.11(.08)

Note: Standard deviations in parentheses.

Experiment 2 demonstrates that the 3-item bias lists are indeed effective in producing false memories of their intended prototypes. Moreover, these results are consistent with those from Robinson and Roediger (1997), in which participants made the error 34% of the time after training with three item lists. In comparison to Experiment 1 (in which participants made the false memory effect 46% of the time), the false memory effect of Experiment 2 was notably lower. The lower incidence of prototype false alarms in Experiment 2 is consistent with previous research in which list length has been positively correlated with prototype false alarms (Robinson & Roediger, 1997).

This step in the current experiments is particularly important, as the experiment that followed hinged upon the ability of these lists to produce false alarms of their respective bias prototypes. Knowing that these lists lead to reliable rates of false memory, I then proceeded in Experiment 3 to investigate the impact that these bias lists would have on recognition decisions when added to the five item DRM lists.

Experiment 3: Encoding Context Manipulation

Having established that both the five item DRM lists, as well as the three item bias lists, lead to significant rates of falsely recognizing prototypes, Experiment 3 introduced the encoding context manipulation of DRM lists. In this experiment, bias lists and DRM lists were combined in an attempt to place a new emphasis on DRM lists. Bias items were added to specific DRM lists, with the purpose of shifting emphasis of the DRM items away from the DRM prototype and onto another theme word, referred to as the bias prototype. The goal of this experiment was to bias the encoding context of lists, leading to changes in the incidence of false memory. It was expected that when bias items were presented as the first items in the list, false recognition of the bias prototype would be higher than when the bias items were presented as the last items in the list; the reverse was expected for the DRM prototypes.

Method

Participants. Thirty-seven students at Simon Fraser University were recruited and compensated in the same manner as in Experiment 1. Of the 37 total participants, three participants did not meet English proficiency standards. Thus, data from 34 participants was included in the analysis.

Materials. The materials used in Experiment 1 and Experiment 2 were combined in this study (Appendix); that is, each five item DRM list used in Experiment 1 was combined with a specific set of three bias items used in Experiment 2. These pairings were designed to place each DRM list in a new context without changing the semantic meaning of the DRM items. For example, the DRM list for the prototype SMELL was combined with bias items PETAL, THORN, and DOZEN; these items were designed to

place the SMELL associates (NOSE, BREATHE, SNIFF, AROMA, and HEAR) in the context of a bias prototype, ROSE. Thus, sixteen 8-item lists were used in Experiment 3.

Procedure. The procedure of Experiment 3 was identical to that of the previous experiments, with the exceptions that the three biasing items were presented as either the first or last items of each list in training, and that recognition candidates from Experiments 1 and 2 were combined in the test phase. Bias type of list, as well as presentation order of lists, was independently randomized for each list for each participant, with the restriction that half of the lists were presented with bias items first. As such, each participant was exposed to eight lists with bias items first, and eight lists with bias items last.

Results and Discussion

There were two independent variables. The first independent variable was prototype, with two levels: bias prototype and DRM prototype. The second independent variable was list type, which also had two levels: bias items first and DRM items first. A 2 x 2 repeated measures ANOVA was conducted to determine whether there were differences in recognition decisions depending on list type and type of prototype.

Table 3 presents the results from Experiment 3. The average correct recognition for associates from the bias-first lists was 67%; the average correct recognition for associates from the bias-last lists was 69%. These two means were not different from each other $t(1,33) = -.679, p = .502$. Participants were 93% accurate in recognizing filler items as being new.

The interaction between list type and prototype was not significant, $F(1,33) = 1.906$, $MSE = .061$, $p = .177$ and participants were not affected by the list manipulation, $F(1,33) = .085$, $MSE = .003$, $p = .772$. The analysis did reveal a main effect of prototype $F(1,33) = 15.961$, $MSE = .516$, $p < .000$, with DRM prototypes being falsely recognized more often than bias prototypes. In the bias-first condition, participants falsely recognized bias and DRM prototypes 34% and 42% of the time, respectively. In the bias last condition, participants falsely recognized bias and DRM prototypes 31% and 47% of the time, respectively.

Table 3
Experiment 3: Probability of claiming items old, as a function of item-type and list-type

Item Type	<u>List Type</u>		
	Bias First	Bias Last	None
Bias Prototype	.67(.22)	.69(.21)	--
DRM Prototype	.42(.22)	.47(.26)	--
Associate	.34(.14)	.31(.18)	--
Filler	--	--	.06(.07)

Note: Standard deviations in parentheses.

Experiment 3 demonstrates no differences in false recognition as a function of encoding context. False recognition was consistent whether associates for the prototype were presented in the last or first positions of the list. The main effect of prototype is not surprising: list length has long been known to impact rates of false remembering (e.g., Robinson and Roediger, 1997), and this effect would therefore be expected based

on number of associates alone (bias prototypes were prepared by only three associates, compared to five associates for the DRM prototypes). Indeed, similar patterns of false memory of bias and DRM prototypes were observed in Experiments 1 and 2, in which lists were processed on their own.

The rates of false memory observed in Experiment 3 are nearly identical to the rates obtained in Experiments 1 and 2. Moreover, in Experiment 3 there was no main effect of list type. Taken together, the results of all experiments presented in this thesis demonstrate that rates of false memory of DRM and bias prototypes are the same, regardless of whether associates stand alone as independent lists (as was the case in Experiments 1 and 2) or are combined (as in Experiment 3). DRM and bias prototypes were respectfully falsely remembered with the same incidence, regardless of how their associates were presented in training.

CHAPTER 3: GENERAL DISCUSSION

In this thesis, I have replicated the DRM effect for prototypes prepared by five item lists, and have revealed that a prototype effect also occurs for previously untested three item lists. Finally, I have attempted to bias the interpretation of DRM lists by combining these lists at encoding; this manipulation was not successful in altering rates of false recognition. Overall, false recognition was not affected by the presentation of three biasing items at either the beginning or the end of training lists. However, the research did reveal differences in false recognition depending on whether a bias prototype or DRM prototype was being evaluated.

The findings in Experiment 3 can be easily explained by both the associative activation account and the discrepancy attribution account. Because the location of bias and DRM items within each training list had no impact on false recognition, the memory illusion occurred the same way that both theories have explained it previously. By the associative activation account, the results can be explained by the spread of activation between related concepts occurring as usual. The associative activation account can explain the findings by the automatic spread of activation from list items to prototypes. With the spread of activation occurring as usual, the mental activation (and therefore false memory) of prototypes was not affected by the location of other items within training lists.

Alternatively, according to the discrepancy attribution account, the results can be interpreted as meaning that the subjective perception of discrepancy was not affected by the encoding manipulation. That is, prototypes were not experienced as more (or less) surprisingly fluent depending on the encoding context of training lists. This

suggests that bias prototypes did not fit better with lists that began with the bias associates; likewise, DRM prototypes did not fit better with lists that began with DRM associates. As a result, the perception of discrepancy was not affected and prototypes were not evaluated differently depending on what type of list they were prepared by. Regardless of whether one takes the perspective of the discrepancy attribution account or the associative activation account, one thing is clear: the manipulation presented here was not successful in biasing the false reports made by participants.

The question of why this manipulation failed to reveal the expected results needs to be addressed. It remains possible that interpretation of DRM lists can be biased, but that no effect was found due to my choice of stimuli or methodology. These possibilities will be explored in the following discussion of the potential limitations associated with the way in which the manipulation was employed, as well as limitations with respect to qualities inherent to the stimuli themselves.

Both the activation and discrepancy accounts of the DRM effect acknowledge that simply encoding the theme of a list is not sufficient for eliciting false memories. Indeed, both accounts include assumptions as to the retrieval conditions that are necessary in order to produce false memories of prototypes that have been prepared by associated lists. The discrepancy attribution account submits that processing prototypes as strangely fluent at the time of retrieval is essential, whereas according to the associative activation account it is the reactivation of the prototype that is key (Whittlesea, 2002; Meade, Watson, Balota, & Roediger, 2007). Of course, these retrieval events hinge on the initial processing of the theme of DRM lists – however, the important consideration for this discussion is on the processes that occur at retrieval.

Given the importance of retrieval processes in the DRM (either the unconscious perception of discrepancy or the mental activation of a prototype), it is possible that the type of context manipulation presented in this thesis would have been more successful if it were imposed at the time of retrieval (or, alternatively, if it were imposed at encoding and again at retrieval). If the interpretation of list items were biased at retrieval – perhaps in the form of biased versus unbiased retrieval cues – the manipulation may be better suited to alter the subjective experience or mental activation of prototypes. That is, perhaps the particular combination of bias and DRM items in the training session of Experiment 3 was simply not sufficient for the goals of this project. Future research should explore a similar manipulation during the retrieval phase of a DRM experiment to determine whether such a bias manipulation affects the retrieval phase of DRM false remembering. Such a manipulation may prove to be more fruitful in eliciting the expected pattern of false recognition.

The retrieval based manipulation mentioned above may well indicate that bias during the test phase is key. However, the role of the bias manipulation at encoding would still need to be clarified. In particular, it may be the case that at encoding, participants interpret the theme of a list based on the first items they encounter (i.e., they are initially affected by the bias manipulation), but that this interpretation is not powerful enough to impact later false recognition. Essentially, this could suggest that recognition may simply be the wrong way to measure the impact of biased encoding. One way to test whether the bias items are effective in creating a particular interpretation of each DRM list at encoding would be to build on the work of Whittlesea et al. (2005), and ask participants to generate a theme word for biased lists immediately

after they are presented in training. That is, when asked to deliberately evaluate the theme of each list (as it is presented), perhaps reports of the theme of the list would reveal a tendency to interpret the list based on the first items. Thus, asking a participant to directly evaluate the theme of these lists may produce evidence to clarify whether or not the particular combination of bias and DRM stimuli used in this thesis can, in fact, bias interpretation of DRM lists at encoding. This should also be considered as an avenue for future research.

Taken together, investigating whether imposing a bias manipulation at retrieval and investigating whether reports of the theme of each list at encoding depend on the bias type of each list would clarify a great deal about why the manipulation in this thesis was not successful. Moreover, these investigations would clarify the differential processes that occur at encoding and retrieval in DRM experiments. However, the possibility remains that some quality of the stimuli themselves led to the pattern of results. It is important to acknowledge that the bias stimuli had not been tested previously and may have been the limiting factor in this research.

The members of the bias stimuli were intended to bias interpretation of DRM items, while maintaining the semantic relationship between the DRM items and the DRM prototype. In the attempt to steer clear of the drastic change in context presented by Goodwin et al. (2001), the bias stimuli created for use in this project may have turned out to be too similar in theme to their DRM counterparts. Indeed, three of the bias lists contained one of the first five associates to their paired DRM prototype, and even in those bias lists where a DRM associate was not used, the bias theme remained similar to that of the DRM list. In a sense, where the stimuli in Goodwin et al. were too

strong, the stimuli used in this project may have been too weak. In future research, a similar manipulation to the one conducted in this thesis could be employed in which there is no overlap between the words included in the bias stimuli and those in standard DRM lists.

The concern of overlapping themes cannot be separated from the issue of backwards associative strength (BAS). As Roediger et al. (2001) revealed, BAS is highly correlated with false reports of prototypes and it is therefore important to note that the BAS between the three item bias lists and DRM prototypes was not taken into account. Given that some of the bias lists contained associates of DRM prototypes, the BAS of bias lists could have led participants to think of and falsely report DRM prototypes instead of their own bias prototypes. A natural follow up to the nonsignificant findings in Experiment 3 would be to redo the experiment while taking the BAS into account – this may shed light on why this thesis failed to produce a significant interaction.

While the research presented here does not present novel findings and is therefore unable to contribute to our theoretical understanding of the DRM effect, the results do lead to a number of questions as to why there was no effect. In this way, even the nonsignificant findings presented here are able to compel new research questions that may, in turn, answer some of the questions about the nature of our remembering. This research can – and should – be used to drive further research in the hopes of exposing the processes that underlie the construction of our memories.

REFERENCES

- Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic memory. *Psychological Review*, *82*, 407 – 428.
- Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology*, *58*, 17 – 22.
- Gallo, D. A. (2006). *Associative illusions of memory: False memory research in DRM and related tasks*. Philadelphia: Psychology Press.
- Gallo, D. A., Roberts, M. J., & Seamon, J. G. (1997). Remembering words not presented in lists: Can we avoid creating false memories? *Psychonomic Bulletin & Review*, *4*, 271 – 276.
- Goodwin, K., Meissner, C., & Ericsson, K. A. (2001). Toward a model of false recall: Experimental manipulation of encoding context and the collection of verbal reports. *Memory & Cognition*, *29*, 806 – 819.
- Hutchison, K. A. (2003). Is semantic priming due to association strength or feature overlap? A microanalytic review. *Psychonomic Bulletin & Review*, *10*, 785 – 813.
- Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General*, *110*, 306 – 340.
- Meade, M. L., Watson, J. M., Balota, D. A., & Roediger, H. L. III. (2007). The roles of spreading activation and retrieval mode in producing false recognition in the DRM paradigm. *Journal of Memory and Language*, *56*, 305 – 320.

- Read, J. D. (1996). From a passing thought to a false memory in 2 minutes: Confusing real and illusory events. *Psychonomic Bulletin & Review*, 3, 105 – 111.
- Robinson, K. L., & Roediger, H. L. III. (1997). Associative processes in false recall and false recognition. *Psychological Science*, 8, 231 – 237.
- Roediger, H. L. III, & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21, 803 – 814.
- Roediger, H. L. III, Watson, J. M., McDermott, K. B., & Gallo, D. A. (2001). Factors that determine false recall: A multiple regression analysis. *Psychonomic Bulletin & Review*, 8, 385 – 407.
- Stadler, M., R., Roediger, H. L. III, & McDermott, K. B. (1999). Norms for word lists that create false memories. *Memory & Cognition*, 27, 494 – 500.
- Thomas, A. K., & Sommers, M. S. (2005). Attention to item-specific processing eliminates age effects in false memories. *Journal of Memory & Language*, 52, 71 – 86.
- Whittlesea, B. W. A. (1997). Production, evaluation, and preservation of experiences: Constructive processing in remembering and performance tasks. In D. L. Medin (Ed.), *The psychology of learning and motivation* (Vol. 37, pp 211 – 264). New York: Academic Press.
- Whittlesea, B. W. A. (2002). False memory and the discrepancy-attribution hypothesis: The prototype-familiarity illusion. *Journal of Experimental Psychology: General*, 131, 96 – 115.

- Whittlesea, B. W. A. (2003). On the construction of behavior and subjective experience: The production and evaluation of performance. In J. S. Bowers & C. J. Marsolek (Eds.), *Rethinking implicit memory* (pp. 239 - 260). New York, NY: Oxford University Press.
- Whittlesea, B. W. A., Masson, M. E. J., & Hughes, A. D. (2005). False memory following rapidly presented lists: The element of surprise. *Psychological Research*, *69*, 420 – 430.
- Whittlesea, B. W. A., & Williams, L. (1998). Why do strangers feel familiar, but friends don't? The unexpected basis of feelings of familiarity. *Acta Psychologica*, *96*, 141 – 165.

APPENDIX

Combined bias and DRM stimuli, structured with bias items preceding DRM items and with respective prototypes underlined.

<u>gun</u> rifle bullet shoot <u>army</u> navy soldier united states air-force draft	<u>season</u> holiday festive fall <u>cold</u> hot snow warm winter ice	<u>airplane</u> flight pilot jet <u>high</u> low clouds up tall tower	<u>hair</u> blond shampoo ponytail <u>girl</u> boy dolls female young dress
<u>funeral</u> coffin death casket <u>black</u> white dark cat charred color	<u>coffee</u> caffeine starbucks beans <u>cup</u> mug saucer tea measuring coaster	<u>wedding</u> marriage fiancé aisle <u>man</u> woman husband uncle lady mouse	<u>rose</u> dozen petal thorn <u>smell</u> nose breathe sniff aroma hear
<u>crash</u> accident collision injury <u>car</u> truck bus train automobile vehicle	<u>law</u> court trial legal <u>doctor</u> nurse sick medicine health hospital	<u>fish</u> bait trout scale <u>river</u> water stream lake mississippi boat	<u>tobacco</u> cigarette cough nicotine <u>smoke</u> puff blaze billows pollution ashes

feather
bird
fly
plumage
soft
hard
light
pillow
plush
loud

tooth
dentist
cavity
floss
sweet
sour
candy
sugar
bitter
good

prison
jail
warden
bars
thief
steal
robber
crook
burglar
money

turtle
shell
tortoise
reptile
slow
fast
lethargic
stop
listless
snail