EFFECTS OF ASSOCIATIVE PROCESSES ON FALSE MEMORY: EVIDENCE FROM CONVERGING ASSOCIATES AND CATEGORY ASSOCIATES PROCEDURES

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ABSTRACT

EFFECTS OF ASSOCIATIVE PROCESSES ON FALSE MEMORY: EVIDENCE FROM CONVERGING ASSOCIATES AND CATEGORY ASSOCIATES PROCEDURES

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The present study investigated the differential effects of test-induced priming on false memories evoked by Converging Associates Procedure (DRM lists) and Category Associates Procedures (Category lists). The experimental settings involved the manipulation of test order of the critical items, in relation to the list items from their corresponding lists. The significance of the study comes from the fact that it directly compares the false memories elicited by Converging Associates Procedure and Category

Associates Procedures within the same experimental settings. The results demonstrated that associative processes at test affected the proportion of false recollections elicited by DRM lists more than that elicited by Category lists. The results are discussed in relation to gist based theories of false memory and activation/monitoring account.

Keywords: false memory, memory illusion, category associates, converging associates, test-induced priming, associative processes, activation.

ÖZ

ÇAĞRIŞIM SÜREÇLERİNİN SAHTE ANILAR ÜZERİNDEKİ ETKİSİ: BİRLEŞEN ÇAĞRIŞIMLAR VE KATEGORİ İÇİ ÇAĞRIŞIMLAR YÖNTEMLERİNDEN KANIT

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Bu çalışma test sırasında oluşan hazırlayıcı etkinin Birleşen Çağrışımlar (DRM Listeleri) ve Kategori İçi Çağrışımlar Yöntemlerinin (Kategori Listeleri) yol açtığı sahte anılar üzerindeki ayırıcı etkilerini araştırmaktadır. Deney deseni, kritik kelimelerin hatırlama testindeki sıralarının kendi listelerindeki kelimelere göre değiştirilmesini içermektedir. Çalışmanın önemi, Birleşen Çağrışımlar ve Kategori İçi Çağrışımlar Yöntemleriyle ortaya çıkan sahte anıların aynı deney düzeneği içerisinde karşılaştırılmış olmasıdır. Sonuçlar,

test sırasındaki çağrışım süreçlerinin Birleşen Çağrışımlar Yöntemi'yle ortaya çıkan sahte anıların oranını, Kategori İçi Çağrışımlar Yöntemi ile ortaya çıkan sahte anıların oranından daha çok etkilediğini göstermiştir. Mevcut sonuçlar Öze Dayalı sahte anı teorileri ve Aktivasyon/ Denetleme teorisi çerçevesinde tartışılmıştır.

Anahtar Kelimeler: sahte an, bellek illüzyonları, kategori içi çağrışımlar, birleşen çağrışımlar, teste dayalı hazırlayıcı etki, çağrışım süreçleri, aktivasyon.

To Nart

Without you by my side

I could not have written this thesis

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CHAPTER I

INTRODUCTION

Memory is the unifying force that helps to hold the self together, and it is essential for the maintenance of human cognitive processes. Language, reasoning, and decision making processes rely on memory capacity for functioning. Memory serves as a data base for the computational processes of the cognitive system. The content of memory provides the raw data for perception and thinking, and thus it becomes quite important to the structure and content of memory. The investigation of memory is crucial for the understanding of human cognitive processes in general, therefore significant for Cognitive Science.

In gaining an understanding of human memory, studying how it fails is as important as studying how it normally operates; since errors arise from the same processes as normal processes (Roediger, 1996).

Currently, false memory is both a scientific and popular interest, due in part to current clinical and legal concerns about recovered memory

debate, the eyewitness testimony research as well as to renewed interest in memory illusions. The illusions of memory are studied under various paradigms (i.e. misinformation paradigm, list learning paradigm etc.) producing various theories that aim at accounting for false memories.

A line of research that pioneered the study of false memory was the list learning paradigm. Deese (1959) demonstrated that people were very likely to falsely remember an item if they had earlier been presented with related items. The paradigm was not well known and studied, until Roediger and McDermott (1995) revived it. The paradigm was named the Deese-Roediger-McDermott (DRM) paradigm after it was revived.

In the DRM paradigm (converging associates procedure) participants are presented with lists of words that are all related to one *critical* word, but the word itself is not presented in the list. For example, the list for the critical word *sleep* are *bed, rest, awake, tired, dream, wake, snooze, blanket doze, slumber, snore and nap*. A similar false memory effect is observed for list of words that are the exemplars of a higher order category, with the most prototypical member excluded as the critical word; which is known as the "category associates procedure". For instance, studying the list of the super ordinate category "four-footed animals" *cat, horse, cow, donkey, lion, tiger and lamb* leads to false memory for the most prototypical member, *dog.*

Purpose of the Study

The differences between DRM and Category lists with respect to the proportion and pattern of false recognition are of interest for the present study. The present study aims at investigating the differential effects of test induced priming at retrieval on the two lists types (DRM and Category Lists). Two other motives are to investigate the effect of word-frequency on the false memory proportions, and to test the reliability of the Turkish translation of the DRM lists.

Significance of the Study

The significance of the study comes from the fact that it directly compares the false memories elicited by DRM and Category Lists within the same experimental settings. It also tests the differential effects of test-induced priming on proportions of false recognition from the two lists.

Hypotheses

The critical manipulation in the study involves rotating the position of the critical lures in relation to their corresponding list items. This manipulation allows for creating different levels of test-induced priming. It is hypothesized that the test-induced priming will have differential effects on DRM and Category Lists. It is also hypothesized that the subjective experience accompanying false memories elicited by DRM and Category lists will differ.

In the next section (Chapter 2) the literature will be selectively reviewed. The paradigms under which false memory is studied and the theories that aim at accounting for the effect are considered, focusing on the DRM Paradigm and Category Associates Paradigm. In Chapter 3, an overview of the study will be given followed by information regarding the methodology and result of the experiments. Finally, in Chapter 4, the results will be discussed in relation to gist-based theories and activation/monitoring framework, followed by the conclusion part.

CHAPTER II

LITERATURE REVIEW

It is held that studying how a system fails is very important in gaining an understanding of how it normally operates, since errors arise from exactly the same processes as normal processes (Roediger, 1996). Keeping this in mind, perceptual illusions have been considered as an important tool for discovering normal processes of perception (Kosslyn and Osherson, 1995). Memory illusions are similar to perceptual illusions in that they reveal constructive processes in human memory. Therefore, we might expect that just like perceptual illusions, which give insight about normal processes about perception, illusions and errors can play the same role in advancing our understanding of human memory (Roediger, 1996). Viewing memory errors as ‘memory illusions’, changes our perspective on these effects, from an atypical finding that must be explained away into an important means for understanding the normal operations of the human memory system (Lampinen and Neuschatz, 1998).

Nevertheless, the use of memory illusions to gain insight about the nature of human memory does not have as long a history as perceptual illusions. Until the 1970s mainstream experimental psychologists were not usually interested in illusions of remembering that might be reflected in errors. Memory was considered inaccurate in the sense of being incomplete, but not in the sense of being false (e. g. Ebbinghaus, 1964; cited in Roediger 1996). However; there was early research, opposing the "Zeitgeist" (spirit of the time); that contributed to the study of memory distortions.

The earliest contribution comes from the work of Kirkpatrick (1894). In his study he reported some incidental illustrations of false recognition. He used the list learning paradigm in his memory experiments. He observed that, when such words as *spool, thimble* and *knife* were pronounced many of the subjects thought of *thread, needle* and *fork,* which were so frequently associated with them, and gave those words as belonging to the list. He considered this as "*an excellent illustration of how things suggested to a person by an experience might be honestly reported by him as a part of experience"* (Kirkpatrick, 1894; page 608).

The second is represented in the Gestalt tradition of memory research in which it was believed that memories changed over time in the directions that were in line with the Gestalt laws of organization. It was argued that people would remember events in a more organized fashion

when they were remembered at increasing intervals from the original event. For instance Wulf (1922; cited in Roediger, 1996) reported that visual forms were remembered as being more regular and symmetric over time.

Another major contribution during the 1930s was the publication of Bartlett's (1932) book; Remembering: A Study in Experimental and Social Psychology. Bartlett held that the interesting aspect of memory was its constructive nature, which was demonstrated by the influence of schemas on remembering. In his classic demonstration of the reconstructive nature of memory, he had people listen to a folk tale *(War of Ghosts)* from an unfamiliar culture, and later asked them to recall it from memory. He observed that the memory errors that were made by the participants brought the story more inline with their own culturally determined expectations. Consequently, Bartlett argued that both perceiving and remembering were constructive processes guided by *schemas.* However, Bartlett maintained that the reconstructive nature of memory could only be captured in elaborate verbal materials, and that lists of words were unsuitable as they only involved reproductive memory.

Approaching the study of false memory from the very paradigm Bartlett (1932) overlooked, Deese (1959) set out to describe a technique, which would be later called the Deese-Roediger-McDermott (DRM) paradigm; for predicting the occurrence of extra-list intrusions; and to

demonstrate that they were accounted for in terms of simple association[1]. Deese developed lists of 12 words, all of which were the primary associates of a critical nonpresented word. For example, the list for the critical word *sleep* were *bed, rest, awake, tired, dream, wake, snooze, blanket doze, slumber, snore and nap*. The associative lists were constructed, from the word association norms of Russell and Jenkins (1954; cited in Deese, 1959). He hypothesized that simple association caused intrusions in recall, and wanted to demonstrate this by experimenting on associatively structured list. He argued that word association norms were able to predict the occurrence of particular extra-list intrusions. His results indicated that the probability of a particular word occurring as an intrusion in immediate free recall of a list of words could be predicted from the tendency for the intruding word to occur as a response in free association to the items on the list.

In the late 60s and early 70s the study of memory illusions began to attract attention (Underwood, 1965; Bransford and Franks, 1971, Loftus, 1974). Currently, false memory is both a scientific and popular interest, due in part to current clinical and legal concerns about recovered memory debate, the eyewitness testimony research as well as to renewed interest in memory illusions (Roediger and McDermott, 1995). Due to this interest from

[1] Association between two words was operationally defined as the probability of a word occurring as a response in a free association task.

the clinical and forensic areas as well as from cognitive psychology, memory illusions have been studied under various paradigms. This interest gave rise to postulation of a number of theories aimed at accounting for the effects of false memory. Below you will find a brief review of some of the paradigms used to study false memory, and some major theories aimed at accounting for false memory effects.

II.1 THE LIST LEARNING PARADIGM

A line of research that pioneered the study of false memory was the list learning paradigm. Deese (1959) and Underwood (1965) demonstrated that people were very likely to falsely remember an item if they had earlier been presented with related items.

II.1.1 DRM Paradigm (Converging Associates Procedure)

In the DRM paradigm subjects are presented with lists of words that are all related to one *critical* word, but the word itself is not presented in the list. The lists are formed in such a way that all the words in the lists are responses to the critical word in a free association norm study (e. g. Russell and Jenkins, 1954). Later during recall most of the subjects recall the

critical lure with similar hit rates to the studied items and with very high confidence ratings, accompanied by conscious recollection.

Roediger and McDermott (1995) revived Deese's (1959) paradigm. They replicated the phenomenon of high levels of false recall following presentation of related word lists; adding significant new information. Payne et al, 1996) also replicated the basic findings under DRM Paradigm. Their findings suggested that subjects apparently experience the recollection of events that never happened as quite real, as real as the recall of the events that actually occurred. Their findings were also supported by evidence coming from the subjective experience, indicated by "remember" judgments.

Since the revival of the DRM paradigm, the origins of the DRM Paradigm and the underlying processes have been of interest to the researchers studying false memory. The significance of the paradigm comes from the fact that it is simple yet robust. Despite the fact that it includes simple list learning (which has previously been regarded as unsuitable for eliciting systematic false memories due to its lack of elaborative structure) the false memory it elicits is very robust. Moreover, the phenomenology (subjective experience) accompanied by the memory is compelling, indicated by "remember" judgments. The paradigm is also highly resistant to variables manipulated to reduce its effect.

A selection of the variables, whose potential effects on false memories elicited by DRM paradigm has been investigated, are discussed in the next section.

II.1.2 Variables Affecting the DRM Paradigm

A key question concerns the source of the associatively induced false memories: Do false memories in the DRM paradigm originate from encoding or retrieval processes? Do the nonpresented associates consciously come to mind during list presentation? Or are the nonpresented associates highly primed during the study phase, in the absence of any conscious awareness of the word?

Certain researchers have proposed encoding based effects as the locus of the false recall and recognition of semantically related stimuli. The crux of such hypotheses is that the critical lure is generated by the participant during the study phase and then misremembered as having been presented, rather than imagined (Benjamin, 2001).

One essential feature of the DRM lists is their associative nature. This supports the view that encoding processes have an effect on the paradigm, since the list associations are manipulated during encoding. In the standard versions of the DRM lists, the words that are related to the same critical lure are presented in blocks. McDermott (1996) investigated the possible effects of random presentation of words and found that blocked

representation of the words led to higher levels of false recall than random presentation. Mather et al, 1997) argued that blocking the items increased the probability that the lure would be activated at encoding and that the overall list schema would be induced by making the theme of each set more apparent. Replicating the results of McDermott (1996), they also found that rates of false recognition for lures were significantly lower than rates of correct recognition when items from various themes were intermixed instead of blocked. Robinson and Roediger (1997) manipulated the number of associates presented in lists in the DRM paradigm. Their results suggested that rate of critical intrusions in recall increased with increasing number of associates studied. They concluded it was the total associative strength of the list that predicted the critical intrusions rather than the mean associative strength, as previously proposed by Deese (1959). Sommers and Lewis (1999) obtained false memory, similar to the one obtained with semantic associates, with lists of phonological associates. Watson, Balota and Roediger (2003) found that hybrid lists of both semantic and phonological associates produce overadditive false recall and false recognition of non-presented critical items relative to pure semantic or pure phonological lists. Pesta, Sanders, and Murphy (2001) demonstrated that numbers could also produce false memory, as long as they shared a kind of association. The authors made use of simple multiplication problems in manipulating the associations; such that, if 3*8 was the lure the associated

list of multiplications included 3*7, 3*9 etc. McEvoy, Nelson, and Komatsu (1999) further investigated the associative nature of the DRM lists by making a distinction between interitem and item-lure association levels. They argued that the probability of free recalling a critical item was influenced both by its activation level and by the cuing of list words that compete for selection with the false memory item. They argued that production of false memories might follow an inverted U-shaped function. Increasing the strength of connections between list items and critical items; and the interconnections among list items produced an increase in false memories in recognition. However, in free recall, increasing the connections between the list items and the critical item increased false memory, whereas increasing the interconnections between items decreased it.

McDermott (1997) observed that associative activation of target words (via DRM procedure) was sufficient to produce priming on perceptual and conceptual implicit memory tests. Therefore she argued that critical lures came consciously to mind during the original encoding of list items. Her results made a further distinction between perceptual and conceptual priming. The level of conceptual priming induced by seeing the associates was comparable to seeing the critical item itself, while the level of perceptual priming was somewhat lower.

This finding, taken together with the findings of Roediger and McDermott (1995), Payne et al (1996) and Schacter et al (1996) of high

levels of “remember” judgments, suggest that the false memories associates with the DRM paradigm are based on memory traces generated prior to retrieval phase. The findings of Marsh, Roediger and McDermott (2004) further support the encoding view. She directly manipulated the associative processes at retrieval to investigate the possible effects of this process on false memory. However, she was unable to find a reliable effect of retrieval processes on false recognition, at least for the studied lists. Goodwin, Meissner and Ericsson (2001) proposed that the critical lures were explicitly accessed during the encoding of the items in the lists, when the words were semantically processed. They manipulated the encoding context by adding filler words to the lists that were semantically unrelated to the lure, while keeping the number of associates constant. They found that false recall was virtually eliminated when list items were selected to induce encodings unrelated to the critical lure. Moreover, the verbal reports they collected from a different set of the participants during encoding and retrieval showed that the participants reported the critical lure during encoding[2]. Related to this, Libby and Neisser (2001) showed that presenting the DRM lists in a context emphasizing a higher-order structure that excludes the key word, virtually eliminated false recall of the key words, even with long lists that encourage the strategy of gist extraction and

[2] Goodwin et al (2001) used a different set of participants to collect the verbal reports, as they reasoned that providing online verbal reports might interfere with the encoding and retrieval processes. However, the results of this set of participants were the same as the other set

discourage working memory strategy. They used the same procedure in the DRM paradigm, however the instructions they gave to their participant were different. They presented the task as a guessing game in which the participants should try to “guess” a “secret word” (the critical lure). So the participants could infer that the secret word was never actually presented, and could monitor their answers accordingly. They argued that context affected how people go about the task, as well as what they actually remembered. Their main point was that there was no automatic link from the activation of a trace to a person’s belief that this activation was evidence of a real past occurrence. Contrary to these findings, Seamon, Luo, and Gallo (1998) found that subjects falsely recognized semantically related non-studied words even when they were unable to discriminate studied words from unrelated non-studied words. They concluded that recognition of list items was unnecessary for the occurrence of the false memory effect, suggesting nonconscious activation.

To investigate the robustness of the DRM effect, Gallo, Roberts, and Seamon (1997) forewarned their participants about the nature of the false memory effect; however the manipulation only reduced the effect, not eliminating it totally. McDermott and Roediger (1998) tested the effects of warning by using immediate testing. Even under this easy task, subjects still made critical intrusions. The manipulation attenuated, but could not eliminate the effect replicating the findings of Gallo et al (1997). Multhaup

and Conner (2002) also investigated the effects of warning, by also making use of source monitoring. They included conditions in which after a "yes" response the participant could chose between different sources of the memory (e. g. an associate of list words, generated by participants themselves etc). However these instructions could not eliminate the effect either. Neuschatz, Benoit, and Payne (2003) were successful at reducing the effect. They observed that warnings reduced false recognition of critical items for HI (high identifiable) lists but not LI (low identifiable) lists. Identifiability was measured via a normative study in which people tried to identify the critical lure after being exposed to the associates. Gallo and Roediger (2002) observed that slower presentation rates yielded lower false recall. This finding can be regarded as similar to the identifiability effect as slower presentation increases the distinctiveness of the item, affecting the monitoring process.

The notion that retrieval processes are also partially effective on false memory is as old as the revival of the DRM paradigm. Roediger and McDermott (1995) argued that

> retrieval processes may contribute significantly to the false recall and false recognition phenomena we have observed. Subjects usually recalled the critical lure toward the end of the set of recalled items, so prior recall, may trigger false recall. Also in the recognition test, presentation of words in related to a critical lure often occurred prior to its appearance on the test; therefore, activation from these related

> words on the test may have enhanced the false recognition effect by priming the lure (Neely, Schmidt, and Roediger, 1983)

McEvoy et al (1999) also argued that false memories were influenced by both cuing during testing and by the accrual of activation to a memory representation for the critical item. Marsh et al (2004) argued that a retrieval account of false memory was also consistent with the activation-based accounts of the illusion. However she was not able to find evidence for retrieval effects on false memory.

Most of the evidence as to the retrieval based effects of false memory in the list learning paradigm comes from the studies that use list of category associates rather than converging associates as in the DRM paradigm. In the next section the Category Associates procedure is described first, followed by a brief discussion of the retrieval effects.

II.1.3 Category Associates Procedure

Category knowledge is often used to guide episodic recall or reconstruction. The guiding effect of category or other conceptual knowledge can help the retrieval processes by providing facilitative cues, but the same guiding knowledge can also lead to systematic memory errors. Categories tend to have graded structures in which exemplars can be seen to lie on a continuum of representativeness, goodness of membership within the category (Barsalou, 1985), and those variations in representativeness may

influence memory performance (Smith, Ward, Tindell, Sifonis, and Wilkenfeld, 2000). That is, the graded structure of category knowledge can influence the creation of false memories. Smith et al (2000) argued that although category graded structure was often measured in terms of typicality, there were other possible measures that reflected different aspects of graded structure, such as category ideals, central tendency, and category output dominance (the frequency with which an instance is given as an example of a category). Whereas typicality has been considered largely in terms of its relationship to item distinctiveness, its effects on memory have also been discussed in terms of item accessibility, on the basis of the idea that less typical category members are less accessible (e. g. Schmidt, 1996).

Smith et al (2000) believed that output dominance played an important role in cognitive tasks and argued that its effects might differ from those of typicality. Therefore, in their study they examined the effects of both output dominance and typicality of the category members. The output dominance of nonpresented category members was found to be strongly correlated with the frequency of their occurrence as intrusions, reflecting the role of category structure in created memories. However, the unique contribution of typicality was not significant. Smith et al (2000) argued that output dominance might be more a measure of retrieval fluency (Kelly and Jacoby, 1990).

Seamon, Luo, Schlegel, Greene, and Goldenberg (2000) systematically manipulated the categorized stimuli on the basis of Battig and Montague's (1968) category norms. The study procedure was conceptually similar to that employed by Roediger and McDermott (1995) with the converging associates procedure, where associates to a non-studied word were presented in a blocked manner and the strongest associates to that word normally occurred at the beginning of each list. Their results provided the first demonstration of a truly robust false memory effect for category exemplars whereby the false alarm rate for related critical lures approximated the hit rate of studied words.

According to Smith, Gerkens, Pierce, and Choi (2002), false alarms occurred in category lists because the critical items were semantically related to the materials studied. The authors investigated when, in the course of learning and remembering, semantically influenced false memories occurred.

II.1.4. Encoding and Retrieval Explanations of DRM and Category Lists

The evidence from the effects of levels of processing (Rhodes and Anastasi, 2000), blocked vs. random presentation (McDermott, 1996; Mather et al, 1997), indirect priming effects (McDermott, 1997; McKone and Murphy, 2000) observed for the DRM lists supports the encoding view. The

direct findings of Marsh et al (2004) that test position of the critical lures did not affect false memories also supports this view.

Contrary to this, Smith et al (2002) suggested that retrieval processes are effective on false memories for categorized lists. They argued that categorized lists were not chosen to selectively evoke associative responses of the critical nonpresented category members. Although the critical nonpresented members were conceptually related to the studied words in the categorized list method, the categorized lists had low backward associative strength in relation to the critical lures. However, they argued that the reason why the category lists evoke false memories despite their low backwards association strength might be that they evoke false memories for reasons other than associative responses that occur at study. As a candidate cause they offer the hypothesis that categorized structure of the categorized list might guide memory at the time of test.

Smith et al (2002) found that associative lists evoked critical items as free associates more than 10 times as often as did categorized lists. They conclude that when participants study categorized lists they are very unlikely to experience critical nonpresented category members as associative responses. They also found that studying categorized lists did not produce semantic priming of the critical nonpresented words even if these critical words were falsely recalled quite often. They concluded that categorized lists caused false memories on a test that emphasized

recollection, but not on a test in which recollection was minimized. Their manipulation of instructions at test affected the priming of nonpresented category members, supporting the hypothesis that false memories could result from processes that occur during test.

II.2 DIFFERENCES BETWEEN TRUE AND FALSE MEMORIES

Some variables have differential effects on true and false memories. This is significant since it implies dual processes for the formation of true and false memories. Related to this, Seamon, Luo, Kopecky, Price, Rothschild, Fung, and Schwartz (2002) observed the effect of retention interval on true and false memories. They found that accurate and false memories were both diminished by increases in retention interval (from no delay to 2 months). False memory persistence was evident for recall and recognition. On the other hand, greater persistence for false memory than for accurate memory was more readily observed for recall than recognition. Benjamin (2001) investigated the effects of repetition on false memory. He observed that when young participants were tested under normal conditions true recognition increased, and false recognition decreased with repetition. However, when young participant were tested under speeded conditions, or when older participants were tested; true recognition improved with

repetition while false recognition increased as well. His results provided strong evidence for multiple contributions to the recognition decision. According to Benjamin (2001) the spreading activation process was the process underlying the sense of familiarity, and the monitoring process functioned to search for an appropriate source for the phenomenological sense of familiarity. Therefore, repetition increased the familiarity of semantic associates but also allowed for a more stringent criterion to be imposed on the recognition decision. Seamon et al (2002) also observed that, depending on stimulus exposure duration, repetition could affect accurate and false recognition similarly or differently. Seamon, Luo, Shulman, Toner, and Caglar (2002) investigated the effects of directed forgetting instructions on false memory. The instructions worked on the list items, while false memories survived the instructions to forget.

The differences between true and false memories have also been investigated by examining the phenomenological characteristics of false memories. The results are mixed, in some conditions the phenomenology of false memories differs from that of true memories while they show similar effects in some cases. Roediger and McDermott (1995) argued that false memories appeared to be able to share phenomenological characteristics with true memories. They could be rated with remember judgments, indicating a conscious awareness and supporting memories for an event that never occurred. On the contrary, Mather Henkel, and Johnson (1997)

demonstrated that even when subjects had relatively little contextual information available for veridical memories of old words, the phenomenal characteristics of false memories differed from true memories.

The phenomenological characteristics of false memories are generally investigated by collecting judgments about the subjective experience of the memories. The most prevalent procedure used is the Remember/Know procedure by Tulving (1985). Reports of “remembering” are said to reflect the operation of and episodic memory system that enables retrieval of specific information about prior encounter with an item. In contrast, reports of “knowing” are attributed to more automatic memory processes that give rise to an undifferentiated feeling of familiarity. In other words, “remember” items are those items for which subjects can mentally relive the experience of when the item was presented in the experiment. “Know” items are those for which the subject is confident that the item was presented in the list, but yet they are not able to mentally re-experience the item being presented.

The first study that employed Remember/Know responses to study the nature of conscious experience was the study of Tulving (1985). The proportion of the remember responses declined as the cues provided at test increased. The remember responses declined more with retention interval relative to the overall recognition performance.

Several authors have used the Remember/Know distinction to examine false memories (e. g. Lane and Zaragoza, 1995; Mather et al, 1997; Payne et al, 1996; Roediger and McDermott, 1995; Schacter, Verfaellie, and Pradere, 1996). Gardiner and Java (1990), demonstrated that Remember/Know judgments have different forgetting rates over a period of 6 months.

II.3 EXPLANATIONS OF FALSE MEMORY

II.3.1 Implicit Associative Response Theory (IAR)

Activation is a basic concept in associative theories. Anderson (1983) defines activation as the transfer of information from long-term to short-term memory, that is, the transformation of information from a latent to a conscious state. In general associative models of memory predict that a person will falsely remember an event when the concepts that are activated during study are associated with a non-activated concept, which is activated via the process of spreading activation. When a person is later asked to remember what was studied, all of the activated concepts will come to mind and the person will be unable to distinguish between the correct and incorrect concepts, as a failure in source monitoring.

The IAR theory of Underwood (1965) is an associative theory accounting for false memory. Underwood (1965), like Deese (1959), also studied intrusion errors within the list learning paradigm. He proposed that exposure to a studied list item produced incidental activation of words that were strongly related to the studied item; which he called the Implicit Associative Response (IAR). He argued that this activation caused the non-presented strongly associated items to be encoded along with actual studied items. That is, he suggested that when subjects studied words, they also activated representations of the highest semantic associate of the item. Underwood (1965) observed that participants falsely recognized the critical word more than any other word, and this probability increased as a function of the number of associates seen before.

II.3.2 Constructivism

Constructivism explains false memories as products of the integration of surface memory representations into semantic memory representations (Bransford and Franks, 1971). Constructivism assumes that memory distortions occur because direct experience and elaboration of experience are integrated (e.g. Bartlett, 1932). Surface and meaning representations of information are integrated into a single semantic code that is guided by schemata. Individuals encode information so as to make it consistent with their understanding of the particular information and acquire general

abstract ideas from the integration of separate inputs (Bransford and Franks, 1971). Constructivists argue that successful retrieval depends on the semantic consistency between the testing cue and the schemata established in memory. Much work in this tradition showed how what a person already knew, or the context in which information was presented, determined whether and how it would be remembered.

Bransford and Franks (1971) contributed to the study of false memory under constructivism account by demonstrating that recalling information often depended on engaging constructive processes by which information was related to prior knowledge or schemas at encoding. They showed that people were very likely to falsely claim that stories included information that was not actually presented in the story, but could only be inferred based on prior schemas or knowledge. In other words their subjects failed to distinguish between presented and non presented sentences so long as they were consistent with the overall idea. They found that, as sentence complexity increased, confidence levels that the sentence had been previously presented increased regardless of whether it was actually been presented or not (*linear abstraction effect*). They argued linear abstraction occurred because longer sentences expressed more of a complete idea, therefore more closely matching the integrated schema. They concluded that subjects acquired general abstract ideas from the integration of separate inputs.

Related to this, Sulin and Dooling (1974) investigated the effect of schema related information on false memory, and found that providing subjects with information that enabled them to form a schema about the task increased their false memory reports. They provided their subjects with characteristics of certain individuals, later they gave the names of the persons to half of the subjects. During recognition at a later time, the subjects that knew the identity of the individual falsely recognized the sentences about the particular individual that were not actually presented but were consistent with schema.

Pezdek (1995; cited in Hyman and Pentland, 1996) also found that people were more likely to create false memories for experiences about which they have schematic knowledge than for which they do not. She argued that without script information about a suggested event, memory construction might be impossible.

II.3.3 Misinformation Paradigm

The work of Loftus on eyewitness memory and the Misinformation Paradigm also contributed to demonstrating the constructive nature of memory. Loftus and Palmer (1974) presented participants with a scene, followed by a narrative that described the event. On some occasions the narrative included misleading information about the event, hence misinformation. They observed that people that were given misinformation

after an event were more likely to remember the event inaccurately. They suggest that, when presented with misleading post event information, people may later become confused as to the source of their memories. Such confusion can lead to subject's misattributing a memory from one source as having occurred in another. Schema Theory (Constructivism) explanations posit that the post event information is stored with the original event and erases, or overwrites the original information. It emphasizes other sets of knowledge activated by the suggested information, and that the underlying knowledge may be changed by the suggested event. On the other hand Source Confusion explanations counter that both pieces of information are stored independently in memory. When trying to retrieve the information, the post event information may come to mind and the person may erroneously claim that the source was the original event.

Misinformation is usually presented from external sources. The technique of having subjects produce the misinformation themselves after it had been presented externally leads to more powerful misinformation effects than other conditions that use external misinformation (Roediger, Jacoby, McDermott, 1996). This condition is obtained by giving the subject a forced choice test in which the subject is bound to produce his own misinformation as the forced choice test does not include the true answer. The effect of repetition has also been observed on misinformation. Misinformation effect is greater after repeated exposure to the

misinformation. This effect is due to the fact that recall is affected by all the previous recollections of the event that is recalled, and that the information retrieved from the most recent account of the event may be a more powerful determinant of the current recollection than the original event itself (Roediger et. al. 1996).

II.3.4 Prototype Theory

Rosch (1975) observed that studies by herself and others demonstrated that categories, in general, have best examples (called prototypes), and developed what has since been called “prototype theory”. Prototype theory states that when a person is presented a set of stimuli for purpose of learning, they abstract the commonalities among the stimulus set and the abstracted representation is stored in memory. Rosch (1975) argued that all of the human capacities played role in categorization, and human categorization was a matter of both human experience and imagination- of perception, motor activity, and culture on the one hand, and of metaphor, metonymy, and mental imagery on the other.

She described “Family resemblance”, borrowing from Wittgenstein (1953), as the idea that members of a category may be related to one another without all members having any properties in common that define the category. She put forward the “prototype effect”, which she describes as the fact that people judged certain members of a category as being more

representative of the category than other members. She called these most representative members of a category the “prototypical members”.

The typicality effect observed in categories supports the Prototype Theory. Typicality ratings of category members are considered to measure the similarity of items to the “conceptual core” of the category as determined by a category prototype.

Prototype theory is related to the false memory observed in lists of category associates that will be described in the following sections. Smith et al (2000) pointed out that category typicality was a function of the similarity of the items in a category to the category’s ‘conceptual core’, and that retrieval of an item from a categorized list was therefore more likely to occur for the typical members of the category than the atypical ones.

II.3.5 Cohesion Failure and Illusory Conjunctions

It is argued that recognition of the prototype may not imply separate systems for learning category-level and item-level knowledge or a memory trace of a prototype may not result from the extraction of the central tendency from a set of similar experiences (Kroll, Knight, Metcalfe, Wolf, and Tulving, 1996). Rather the false memory for a prototype memory may be the result of binding failure. Kroll et al (1996) presented evidence in support of the hypothesis that one source of memory illusions was the defective process of binding or cohesion. They argued that the pursuit of

the cohesion hypothesis might contribute to the knowledge of the workings of memory as a whole. Their study suggested that components of perceived items could be mismatched in the course of post perceptual processing, with the consequence that some of the items that are stored not corresponding to items presented at study. With respect to this they argued that memory binding was similar to perceptual binding postulated by Treisman and others (Treisman and Schmidt, 1982). They further argued that hippocampal damage resulted in binding failure. Their results from the hippocampal amnesic and normal subjects suggested that binding was an important early process in the consolidation process, and that the hippocampal system played a critical role in the binding of memory components. They concluded that the ability of the hippocampal amnesics to remember components, combined with their inability to restrict the binding process was what allowed them to form prototypes even when the individually experienced items were not well remembered.

Reinitz, Lammers and Cochran (1992) also proposed that illusory conjunctions were evident in memory. They argued that memory for stimulus parts was dissociable from memory for stimulus wholes, that is, the information by which stimulus features were bound in episodic memory was independent or dissociable from the features themselves. The findings of Reinitz, Verfaellie, and Milberg (1996) suggested that both amnesics and control subjects were susceptible to memory illusions that resulted from the

miscombination of parts of previously experienced stimuli (“shotgun” and “handstand” miscombined into “handgun”); with amnesics showing differential deficit in remembering global stimulus structure.

II.3.6 Source Monitoring Framework (SMF)

The Source Monitoring Framework (Johnson, 1988; cited in Lindsay and Johnson, 2000) is an elaboration of the reality monitoring model of Johnson and Raye (1981). The reality monitoring model focused on the processes by which people differentiate between memories of actual vs. imagined experiences. The Source Monitoring Framework addresses the more general issue of how people differentiate between memories between different sources. A core idea of the Source Monitoring Framework is that thoughts, images, and feelings that are experienced as memories are attributed, by the rememberer, to particular sources of past experience (Lindsay, and Johnson, 2000). That is, thoughts and images do not include abstract tags that specify their sources. Aspects of source are inferred from the perceptual, semantic and affective content of the thoughts, images, and feelings that come to mind, and then the memory is attributed to a particular source. According to Source Monitoring Framework, false memories arise from the same types of memory qualities and cognitive processes that give rise to accurate memories. Like accurate memories false memories vary in richness of detail, the confidence with which that are held, and the particular

combination of factors that contribute to an individual's belief in them. Source Monitoring Framework proposes that false memory phenomena arise when thoughts, images, and feelings from one source are attributed to an erroneous source. Proponents argued that this might occur because the mental event has characteristics of a source other than its actual source, or the test situation discourages careful source monitoring (Lindsay et al., 2000) or because activated information is incomplete or ambiguous, or the evaluative process responsible for attributing information to source are imperfect (Johnson, and Nodle,1996).

According to the SMF memories from different sources, normally differ in their average qualitative characteristics. These differences can be used to judge the source of a memory. However, Source monitoring errors may occur when memory records lack sufficient discriminating information or when potentially available source information is ignored in favor of or salient but less differentiating information. Mather, Henkel, and Johnson (1997) argued that the more memories from different sources overlap in their various characteristics, the more difficult it would be to correctly attribute them to their original source. They maintained that increasing the semantic, perceptual or both semantic and perceptual similarity between memories from various sources would decrease source accuracy.

Johnson and Nodle (1996) found that thinking about one's emotions led to poorer source monitoring, at least for older adults. Their results

demonstrated that focusing on one's emotions helped make a statement memorable, but it not necessarily allowed one to identify later the origin of the information. They argued that focusing on one's emotions reduced the processing directed at perceptual and other features of the event that are needed to identify its source.

II.3.7 Attributional Model of Memory: The Fluency Account

Kelley and Jacoby (1990) developed an attributional view of memory that was similar to the Source Monitoring Framework. They borrowed from Attribution Theory where emotional states were thought to arise from particular combination of physiological arousal, and appropriate cognitions induced by the situation. Similarly, they conceived of remembering as a combination of fluent processing of an event with the mental set that attributes the fluency to past experience, or to remembering. Therefore; according to the "attributional model of memory" subjective experience of oldness did not arise directly and exclusively from the retrieval of memory traces. Rather, the feeling of remembering arose from rapid and often unconscious decision processes through which cognition at test were attributed to memory. They argued that when ease of processing was subtly manipulated by changing structural characteristics of the situation, misattribution of this ease of processing produced illusions of memory (Jacoby and Whitehouse, 1989). Kelley and Jacoby (1996) argued that

enhanced fluency from a prior event that is not remembered might create a strange sense of familiarity. Memory illusions that are explored under this fluency account are seen as the results of misinterpretations of what is actually an effect of the past in ways that alter one's subjective experience of a current event.

Lindsay and Kelley (1996) found that manipulations that caused non-studied words to come easily to mind caused illusions of familiarity; by manipulating this ease in response to cued-recall probes. The effect was not eliminated by informing the participants that the familiarity might be illusory. The authors concluded that ease of processing was a basic component of familiarity. Moreover they argued that the fluency based illusion of familiarity is not easy to escape. To further investigate these effects of fluency, Kelley and Jacoby (1996) gave anagrams to the participants. The studying of the anagrams in the first phase led to later faster solution of the anagrams in the later phase. The subjects attributed these ease or fluency to the ease of the anagram rather to their previous experience with the anagram, resulting in false memories.

II.3.8 Fuzzy Trace Theory

Fuzzy Trace Theory is a comprehensive theory of reasoning remembering and their relationship. Fuzzy Trace Theory posits that memory representations can be described as two independent types: "gist", the

essence or general meaning and “verbatim”, the surface details (Titcomb, 1996). Verbatim representations are the memory traces that correspond to the individual items presented to subjects during the study phase. The gist representation specifies the more general semantic content of the list items without a precise specification of the unique items in the list (Payne et al 1996).

Fuzzy Trace Theory has four basic principles which will be briefly mentioned. The first one is parallel storage of verbatim and gist traces. It is suggested that encoding of targets initiates parallel storage processes. Brainerd and Reyna (1998) give the word-superiority effect (in which words are recognized before the recognition of their constituent letters), as an example of the findings in support of parallel storage. The second principle, the dissociated verbatim-gist retrieval principle, is also supported by evidence coming from the differential effects of forgetting rates for parallel vs. gist traces (Roediger and McDermott, 1995; Payne et al, 1996; Reyna and Brainerd, 1995a); verbatim traces becoming inaccessible more rapidly than gist traces. The proposed reason is that the memorial basis for hits shifts over time while that for false alarms remains stable. It is argued that responses produced early in the recall test are generally dependent upon verbatim representations whereas those items produced late in the test depend upon gist representations. The third principle is about the nature of explicit recollection and argues that the retrieval of verbatim memories

supports feelings of item-specific recollections of targets, whereas feelings of nonspecific resemblance are supported by retrieval of gist memories. The last principle is about the identify non-identity and similarity processes. In Fuzzy Trace Theory, two processes of memory retrieval and comparison have been used to explain false memory (Brainerd and Reyna, 1998). One process involves retrieval of *verbatim traces* and comparison of those traces to the surface forms of test probes. Such comparisons support all-or-none judgments of identity when there is a match between retrieved verbatim traces and the surface forms of probes, and all-or-none judgments of non-identity when there is a mismatch. The other process involves retrieval of *gist traces* and comparisons of theses traces to the meaning content of probes. Such comparisons normally support graded judgments of similarity about retrieved gist memories and the meaning of probes. A key difference between gist-based and verbatim-based judgments is that false-alarm rates will increase as the meaning overlap between targets and distractors increase when gist is retrieved, but not when verbatim traces are retrieved. It follows from the principles that the verbatim representations should support accurate responding, and the gist representation should support responses indicating a false memory for a nonpresented item.

Fuzzy Trace Theory offers a straightforward account of why people often incorrectly recognize lures that are semantically related to previously seen items (i.e. DRM Paradigm). It suggests that such errors occur when

experimental conditions encourage a reliance on gist-based memories. The prototypical foils, theoretical lures, are favored on recognition tests that especially draw on gist representations (Schooler, 1998). Erroneous identification of related lures in DRM paradigm is assumed to involve the accurate remembering of the gist of the memory in the absence of access to the verbatim component.

II.3.9 Activation/Monitoring Framework

Activation/monitoring framework (Roediger, Watson, McDermott and Gallo, 2001) borrows its activation account from the IAR theory of Underwood (1965) and the monitoring account from the Source Monitoring Framework (Johnson, 1988; cited in Lindsay and Johnson, 2000). The theory proposes that processing the list items in the DRM paradigm (at study or test) activates the critical nonpresented associate, and false remembering reflects a failure to correctly monitor the source of this activation. This activation could be automatic spreading activation within the semantic network or conscious thought of the item due to more explicit associations. The theory does not make a distinction with respect to the level of consciousness related to the activation. In either case the activation leads to false remembering when the subject mistakenly attributes this activation to the item's occurrence during study. According to the theory the associative strength of the lists is critical for eliciting false memory, since

the process that result in false memories rely heavily on associative processes at encoding. The activation/ monitoring framework's notion of differential activation levels from lists that have different degrees of associative strength is able to account for the compelling phenomenology of false recognition as indicated by "remember" responses in the DRM paradigm. They argue that the additional activation elicited by lists with more associative strength may have made the items more retrievable and more familiar at test.

To sum up, the Activation/Monitoring Framework posits that the creation of false memories in the DRM paradigm involves at least two factors. First one is the activation or encoding of information that potentially causes the false recollection. The second one is the monitoring or editing processes that modulate the extent to which the information yields false remembering (Gallo and Roediger, 2002).

CHAPTER III

EXPERIMENT

III.1 OVERVIEW

Considering the previous research reviewed, we can argue that possible effects of encoding and retrieval processes on the proportion of false memory in list learning paradigm have been investigated by many researchers; both for converging associates procedure, and category associates procedure. However, the research on these procedures is done separately in different experimental settings.

The present study aims to investigate the possible effects of retrieval on converging associates and category associates within the same experimental settings. This will allow for the direct comparison of the two procedures that give rise to robust false memory effects.

The experimental manipulation is modeled after Marsh et al (2004) and involves the manipulation of the test order of the critical lures in relation to the list items from its corresponding list. The order of the lures are

manipulated in such a way that they are tested after zero, three, or six list items from their corresponding list in the recognition test.

Hypotheses:

1- Test-induced priming will have differential effects on DRM and Category Lists.
    a. False memory proportions for DRM lures will increase as a function of accrual of activation at test.
    b. False memory proportions for Category lures will not benefit from the accrual of activation as much as the DRM lures.
2- The subjective experience of false memories will differ for DRM and Category Lists.
    a. DRM Lures will receive more “remember” responses indicating implicit associative responses at encoding.
    b. Category lures will receive more “know” responses indicating gist-based comparison of similarity at retrieval.
3- Frequency count of the critical non-presented words will contribute to their false memory proportions, in that; high-frequency critical lures will have larger proportion of false memory.

The first hypothesis rests on evidence from the previous literature of the highly associative nature of the DRM Lists; and the findings that category lists do not necessarily share this associative nature.

The second hypothesis rests on the notion that the converging associates procedure benefits from associative processes, while the category associates procedure benefits mostly from gist-based processes at retrieval. These retrieval processes involve the comparison of the lures with the gist extracted from the studied list or the schema evoked by it. These comparisons with the gist or schemas will provide similarity judgments which will presumably be accompanied by "know" responses, indicating familiarity. As for the DRM lures since they are hypothesized to be produced as IARs during encoding, they are expected to receive mostly remember judgments, as an indication of recollection.

The motive behind the third hypothesis is to investigate the possibility that the critical lures words have some inherent characteristic that may also affect the proportion of false recognition. The evidence from a number of studies (Whittlesea, 2002;Marsh et al, 2004) suggest that the critical lure words cause false memories even when their corresponding list had not been seen[3]. The present study investigates the effects of frequency as a possible cause of the so called "life effect".

[3] Whittlesea (2002) argues that the words selected for forming DRM lists are probably not random words use to generate other, instead they are special words that possibly differ from other in frequency concreteness or some other characteristics. He uses the term "life effect" to refer to such effects.

III.2 LIMITATIONS OF THE STUDY

The lists that were used were translated from the Stadler et al (1999) norm study, as there were no Turkish association norms available to form the DRM lists from scratch. Generally the list items in the DRM lists are presented in an increasing order of association to the critical lure. However for the present study the variable was not under control, due to the lack of association norms for the Turkish language and culture.

Another weakness was for the Category lists, the category norms were collected by Peynircioğlu in 1988, so the norms were not up to date. However neither the lack of ordering in the DRM lists, nor did the old category norms seemingly cause any decrease in the false memory proportions. The false memories observed were comparable to the findings in the previous literature.

III.3 METHOD

III.3.1 Participants

A total of 48 Middle East Technical University students (11 male, 37 female) participated in the study. The mean age of the participants was 19.65

(1.96). The participants received extra course credit for their participation. All of the participants were tested individually.

III.3.2 Materials

The stimuli consisted of a total of 36 lists, each containing 12 words. 18 of the lists were DRM lists, which were selected form Stadler et al (1999) norms, and translated into Turkish. The lists that would be less problematic to translate into Turkish were selected. The lists containing many words that did not have any close equivalent in Turkish were not selected. However, even with the selected 18 lists it was not possible to translate all the 15 words into Turkish, as they sometimes did not have any Turkish equivalent, or a number of words in the lists had the same Turkish correspondent (i.e. “glass” and “pane” both meaning *“cam”*; “good” and “nice” both meaning *“iyi”*), or the meaning of an English word was represented with two words in English (i.e. “loud” meaning *“yüksek sesli”*). Therefore, by eliminating these words the lists in Turkish 12 associates of the critical lures were obtained instead of 15. Rarely, in cases where either an English word had no meaning in Turkish, or when two English words had the same meaning in Turkish; a word from Turkish that is associated with the rest of the lists was used instead of the problematic word (i.e. “county” was translated as *“ilçe”*, “candy” was replaced with *“lokum”*). From the 18 lists selected from Stadler et al (1999), 12 of them happened to be from the highest 18 lists in the

norm, and six of them happened to be from the lowest 18 lists in the norm. The order of the words in the original norms was from the strongest to the weakest associate; however the order was not rearranged for Turkish.

The other 18 lists were formed on the basis of category associations. Peynircioğlu's (1988) semantic category norms for Turkish were used to construct the 18 category lists, each having 12 category members; with the most frequently cited example (the critical lure) excluded. The lists were formed by selecting the first 12 most frequently cited exemplars of a category. The order of items in the category associates lists were from the most cited to the least cited exemplar. In cases in which the same word was used in more than one category; the word was left in the category that included the word as a more frequently cited exemplar. For the category that included the word as a least cited exemplar, it was replaced with another word lower down in the list (i.e. *"palamut"* was used in the fish category (3rd exemplar) rather than in the trees category (10th exemplar)). The same procedure was used fort the words that were both in a DRM list and a Category list.

The design of the experiment is modeled after Marsh et al (2004). The difference between the present design and the design of Marsh et al (2004) is that they used 36 DRM lists while the present study used 18 DRM and 18 Category lists. For counterbalancing purposes the 36 lists were divided into two sets of 18 lists (Set1 and Set2), each set containing nine

DRM lists and nine Category lists. Each list in Set 1 was paired with a list in Set 2. Each set, then was divided into three subsets, preserving the original pairings (Subsets 1X, 1Y, 1Z of Set1, 2X, 2Y, 2Z of Set2). There were three category and three DRM lists in each set. These six subsets were needed for manipulating the study conditions, and the test order. 24 participants studied the 18 lists in Set 1 (1X, 1Y, 1Z); and the other 24 studied the 18 lists in Set 2 (2X, 2Y, 2Z). Two different random study orders were created for each set, resulting in a total of four study conditions (Set1 x Random1, Set1 x Random2, Set2 x Random1, Set2 x Random2) that were counterbalanced across participants.

The memory test was constructed so as to manipulate the test order of the critical lures. Each critical lure was rotated through three conditions, so that it was tested after 0, 3 or 6 list items. The memory test fulfilled a number of constraints that were used by Marsh et al (2004). No more than two items from the same list were tested consecutively, nor there were more than five consecutive old or new items. The recognition test contained 297 items; 6 list items from (the first 6 items) each of the 36 lists (18 studied, 18 non-studied), 36 critical lures and 45 unrelated filler words. A filler item was always tested before each critical lure. The rest of the filler words were placed at the beginning and end of the test.

The experimental manipulation of the test order involved three groups across which test order was counterbalanced for each critical lure.

The lures were selected so that each would be from a different set (one from Set X, one from Y, and one from Z), thus, test triplets were formed. The lures in each triplet were either all DRM lures or all Category lures. A lure was either placed before all the six list items, or after three list items, or after all the six list items. The order of the list items never changed. The rotation of the 12 test triplets overlapped. The length of the test, the filler words interspersed, and the overlap in the test triplets helped disguise the test structure. The manipulation of the study conditions and test order finally led to 12 versions of the experiment.

III.3.3 Design

The experiment was a 2 x 2 x 3 within design. The independent variables were list type (DRM vs. Category), Study Condition (Studied vs. Non-studied), and Test Order (Zero-associate, Three-Associate, Six-associate). The effect of Item Type (Critical Lure vs. List Item) on the proportion of false recognition and its phenomenology was also assessed by a item type x study condition ANOVA.

III.3.4 Procedure

Each participant was seated at a computer. The experiment was presented via Super Lab Pro for Windows Software. All the instructions were presented written to the participant. The participant read the instructions,

followed by clarification by the experimenter. The participants were told that they would see 18 lists each containing 12 items, and that they should try to remember the items for a later memory test. They were also told that the words would be presented on the screen at a rate of one word per second, and they would see a “NEXT LIST” prompt between each list.

Each word was presented for 1 second in black text on a light gray background; there was no significant inter-stimulus-interval. The “NEXT LIST” prompt was presented for 2 seconds. After the presentation of the 216 items (18x12), the experimenter gave instructions about the retrieval. The participants were told that they would be tested for 297 items, each of the words presented on the screen would be numbered and the number would correspond to a number in the answer sheet. They went about the task with their own pace by pressing any key on the response box. They were told that they should check the box corresponding to “yes” (evet) if they think that they have seen the item in the study phase, and check “no” (hayır) if they do not. For the items they have chosen “yes”, they made an additional judgment, They chose either “remember” or “know” , or “guess” depending on the subjective experience of recollection.

The instructions for subjective experience were modeled loosely after Rajaram (1993). “Remember” *(“Hatırlıyorum”)* was defined as confident memory that the particular item was seen in the study phase. The item should be accompanied by conscious recollection of the moment of

presentation, and details about that moment. “Know” *(“Biliyorum”)* was defined as confident memory that the item was seen in the study phase that was not accompanied by conscious recollection of the moment of presentation. “Guess” *(“Tahmin Ediyorum”)* was defined as simply guessing that the item might have been presented with no accompanied confident memory of the presentation whatsoever.

After the process was over the participants were asked about their guesses about the aim of the experiment to assess their awareness of false memory or the present experimental manipulation. Then they were informed about the purpose of the study and thanked for their participation.

III.4 RESULTS

The main effects and interactions that are not reported below were found to be non-significant.

III.4.1 True vs. False Memories

Recognition: In order to compare the effects of item type a 2 (Item type) X 2 (Study Condition), ANOVA was conducted on the proportion of "yes" responses (See Table 1). The main effect of study condition was found to be significant, F (1, 47) = 522.00, MSe =.02, p<.001. The words from the

studied condition received more "yes" responses. Also the study condition by item type interaction was significant, *F* (1, 47) = 37.38, MSe =.01, p<.001. Post-hoc revealed that while the proportion of "yes" responses to the list items were significantly lower than that of the critical lures in the non-studied condition (.22 vs. .28) it was significantly higher than that of the critical lures in the studied condition (.76 vs. .69), Tukey HSD = .04.

	STUDIED				***NON-STUDIED***			
	O	**R**	**K**	**G**	**O**	**R**	**K**	**G**
List Item	0.76	0.35	0.21	0.20	0.21	0.02	0.05	0.14
Critical Lure	0.69	0.21	0.18	0.30	0.28	0.03	0.06	0.19

Table 1 Mean values of false memory proportions of critical lures and list items, pooled for list type.
O: Old **K**: Know **R**: Remember **G**: Guess

Phenomenology: The differences in the phenomenology were also assessed by a 2 (Item type) X 2 (Study Condition) ANOVA on the proportion of “remember”, “know” and “guess” responses (See Table 1). For the “remember” responses, the main effects of item type *F* (1, 47) = 35.01, MSe =.01, p<.001 and study condition *F* (1, 47) = 157.33, MSe =.02, p<.001 were significant. Moreover, they were qualified by a significant item type by study condition interaction. *F* (1, 47) = 42.08, MSe =.01, p<.001. Post-hoc revealed that while the proportion of “remember” responses given

to list items and critical lures were comparable (.02 vs. 03) in the non-studied condition; the proportion of “remember” responses given to the list items was significantly higher than that of the critical lures in the studied condition (.35 vs. .21). For the “know” responses the main effect of study condition was significant *F* (1, 47) = 100.51, MSe =.01, p<.001. The words in the studied condition received more “know” responses. As for the “guess” responses the main effects of item type F (1, 47) = 45.82, MSe =.01, p<.001 study condition *F* (1, 47) = 24.11, MSe =.01, p<.001 were significant. Critical lures received more “guess” responses. The item type by study condition interaction was marginally insignificant *F* (1, 47) = 3.54, MSe =.01, p=.066.

III.4.2 False Memory

Recognition: A 2 (list type) X 2 (study condition) X 3 (test order) ANOVA was conducted on the proportion of lures falsely recognized, as indicated by a “yes” response. All the three main effects were significant. DRM lures received significantly more “yes” responses than Category lures *F* (1, 47) =17.67, MSe =.07, p<.001 (See Tables 2 and 3). Lures from studied condition received more “yes” responses, *F* (1, 47) =223.41, MSe =.1, p<.001 (See Table 4). Test order also exerted a significant main effect *F* (2, 94) =.8.73, MSe =.07, p<.001. Post-hoc revealed no significant differences in the pairwise comparisons Tukey HSD = .13. The list type by test order

interaction was also significant F (2, 94) = 4.08, MSe =.06, p<.05. Post-hoc analysis revealed a significant difference between the zero-associate and six-associate conditions for DRM lists. There was also a significant difference between the list types. The proportion of "yes" responses for the six-associate condition of the DRM lists was significantly higher than that of Category Lists, Tukey HSD = .14.

Category Lists	***STUDIED***				***NON-STUDIED***			
	O	**R**	**K**	**G**	**O**	**R**	**K**	**G**
Zero	0.58	0.15	0.18	0.25	0.17	0.01	0.06	0.10
Three	0.68	0.12	0.21	0.35	0.28	0.03	0.04	0.22
Six	0.67	0.10	0.16	0.40	0.24	0.01	0.05	0.19
Mean	0.64	0.13	0.18	0.34	0.23	0.02	0.05	0.17

Table 2 Mean values of false memory proportions of critical lures for Category Lists. **O**: Old **K**: Know **R**: Remember **G**: Guess.

DRM Lists	***STUDIED***				***NON-STUDIED***			
	O	**R**	**K**	**G**	**O**	**R**	**K**	**G**
Zero	0.70	0.33	0.15	0.22	0.24	0.03	0.06	0.15
Three	0.71	0.28	0.19	0.24	0.30	0.03	0.06	0.20
Six	0.79	0.25	0.20	0.34	0.44	0.04	0.08	0.32
Mean	**0.73**	**0.29**	**0.18**	**0.26**	**0.33**	**0.04**	**0.07**	**0.22**

Table 3 Mean values of false memory proportions of critical lures for DRM Lists. **O**: Old **K**: Know **R**: Remember **G**: Guess.

Phenomenology: The change in the phenomenology of false memories as a function of test position was also of interest. 2 (list type) X 2 (study condition) X 3 (test order) ANOVAs were separately conducted on the proportion of lures falsely recognized, as indicated by “remember” , “know” and “guess” responses (See Tables 2-3-4).

DRM - Category	***STUDIED***				***NON-STUDIED***			
	O	**R**	**K**	**G**	**O**	**R**	**K**	**G**
Zero	0.64	0.24	0.17	0.23	0.20	0.02	0.06	0.12
Three	0.69	0.20	0.20	0.30	0.29	0.03	0.05	0.21
Six	0.73	0.18	0.18	0.37	0.34	0.02	0.07	0.25
Mean	0.69	0.21	0.18	0.30	0.28	0.03	0.06	0.19

Table 4 Mean values of false memory proportions of critical lures, pooled for DRM Lists and Category Lists.
O: Old **K**: Know **R**: Remember **G**: Guess.

For the “remember” responses, lures from DRM lists received significantly more “remember” responses than lures from category lists F (1, 47) =29.81, MSe =.04, p<.001. Also lures from the studied condition received more “remember” responses than lures from the non-studied condition F (1, 47) =62.82, MSe =.07, p<.001. However these two main effects were also qualified by a list type by study condition interaction F (1, 47) =23.74, MSe =.03, p<.001. Post-hoc revealed significant difference

between the proportion of “remember” responses given for DRM lures in the studied condition and non-studied condition (.29 and .04), Category lures in the studied condition and Category lures in the non-studied condition (.13 and .02). There was also a significant difference between the DRM and Category Lures in the studied condition (.29 and .13), however for the non-studied condition there was no such a difference between two list types Tukey HSD = .09.

For the “know” responses only the effect of study condition was significant, lures from studied condition receiving more “know” responses F (1, 47) =51.22, MSe =.04, p<.001.

As for the “guess” responses, lures from studied condition received significantly more “guess” responses F (1, 47) =18.84, MSe =.08, p<.001. The effect of test order also exerted a reliable effect for the “guess” responses, F (2, 94) =14.25, MSe =.06, p<.001. Post -hoc revealed significant difference between the six-associate and zero-associate conditions Tukey HSD = .12.There was also a significant list type by study condition interaction for the “guess” responses F (1, 47) =9.49, MSe =.06, p<.005. Post-hoc revealed significant difference between the studied and non-studied conditions for the proportion of “guess” responses in Category lists Tukey HSD = .12.

III.4.3 Reliability of Lists

For testing the similarity between the original and Turkish translations of the 18 DRM lists, Pearson Correlation was conducted on the proportion of false recognition of the individual lists from the Stadler et al (1999) norms and their Turkish translations. Thirty-four percent of the variation in the Turkish translation of the lists was accounted by the variation in the Stadler et al norms r =.58, p<.01. However, when the mean proportion of false recognition was computed the means were comparable. The lists and their proportions of false recognition are given in Appendix D.

III.4.4 Effects of Word Frequency

For investigating potential correlations between the frequency of the critical lures and the proportion of false memory, Pearson Correlation was conducted on the proportion of false recognition of the individual lists from studied condition, the non-studied condition, the “life effect” and the frequency count of the lures. The frequency count for the 36 critical lure words (18 from DRM lists and 18 from Category Lists) were obtained from the METU-Turkish Corpus, which included over a million and half words. No significant correlation was found between any of the variables.

Chapter IV

DISCUSSION

The present study investigated the possible effects of associative processes at retrieval on converging associates and category associates procedures within the same experimental settings. This allowed for the direct comparison of the two procedures that give rise to robust false memory effects. The effect of test induced priming was investigated by manipulating the test order of the critical lure items in relation to the list items from their corresponding list. The manipulation affected the DRM list more than the Category lists. The results are discussed in relation to gist-based theories of false memory and activation/monitoring framework.

IV.1 FINDINGS OF THE STUDY

IV.1.1 True vs. False Memories

An item type by study condition ANOVA revealed the differences between true and false memories. While "yes" responses to list items were

significantly higher in the studied condition, "yes" responses to critical lures were higher in the non-studied condition.

Phenomenological experience: List items and critical lures received comparable and very low levels of remember judgments in the non-studied condition. However, in the studied condition the list items received more remember judgments than the critical lures. The “know” response did not differentiate between true and false memories, and both item types received comparable amounts of “know” responses. Critical lures received more “guess” responses than list items.

IV.1.2 DRM vs. Category Lists

The experimental manipulation was able to demonstrate the differences between Converging Associates (DRM lists), and Category Associates Procedures (Category lists). The critical lures from the DRM lists received more "yes" responses than the critical lures from the Category lists. The lower levels of false recognition of Category lures in the studied condition fits with the previous findings in the literature (see Seamon et al, 2000). The high levels of false recognition for the DRM lists in the non-studied condition compared to category lists might be the result of the differential effects of association on the two lists, which will be discussed further in the coming sections. The effect of study condition and test order was also found to be significant. The critical lures later in the list received more "yes" responses.

Investigating the list type by test order interaction revealed that there was a significant difference between the zero-associate and six-associate conditions for the DRM lists, but not for the Category lists. The six-associate condition for the DRM lists was also significantly different from the six-associate condition for the Category lists. However, this difference was not significant for the other conditions of test order. As seen in Figure 1, for the zero-associate condition the proportion of "yes" responses for the DRM lists is numerically higher than that of the Category lists. However, in the three-associate condition there is no difference seen. The proportion of "yes" responses from the Category lists reaches up the DRM lists. In the six-associate condition we see a dramatic increase for the DRM lists while we see a decrease trend for the Category Lists. When we inspect the effects separately for the studied and non-studied conditions we see another trend of difference (See Figure 2). For the studied condition, the DRM lists show no difference between the zero-associate and three-associate conditions. The Category lists have a lower base rate than the DRM Lists (the zero-associate condition); however, they catch up in the three-associate condition. In the six-associate condition, the proportion of "yes" responses for the Category Lists remain the same, while we see an increase in that of DRM lists. For the non-studied condition a similar pattern is seen for the zero and three-associate conditions, but the increases are more dramatic.

However, for the six-associate condition while we see a large increase in the DRM Lists we see a decrease in the Category lists.

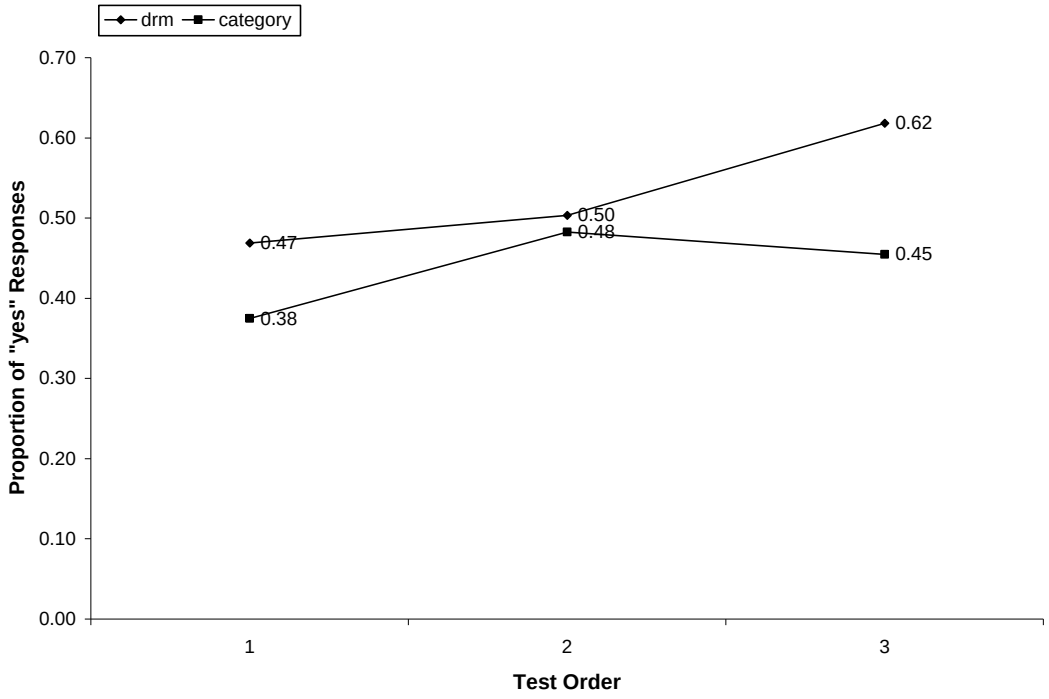

Figure1 Effect of test order on the proportion of "yes" responses for DRM and Category lists
1 zero-associate condition **2** three-associate condition
3 six-associate condition

Phenomenological experience: DRM and Category lists showed differential effects for the proportion of “remember” responses. While they received comparable levels of remember responses in the non-studied

condition, "yes" responses to DRM lures were accompanied by more “remember” judgments than the Category lures in the studied condition. The “know” judgments did not differentiate between list types. They were only affected by the study condition. As for the “guess” judgments, we also see a differential effect of study condition for list type. While there was a significant difference in the studied and non-studied conditions for the Category lists, no such difference was observable for the DRM lists.

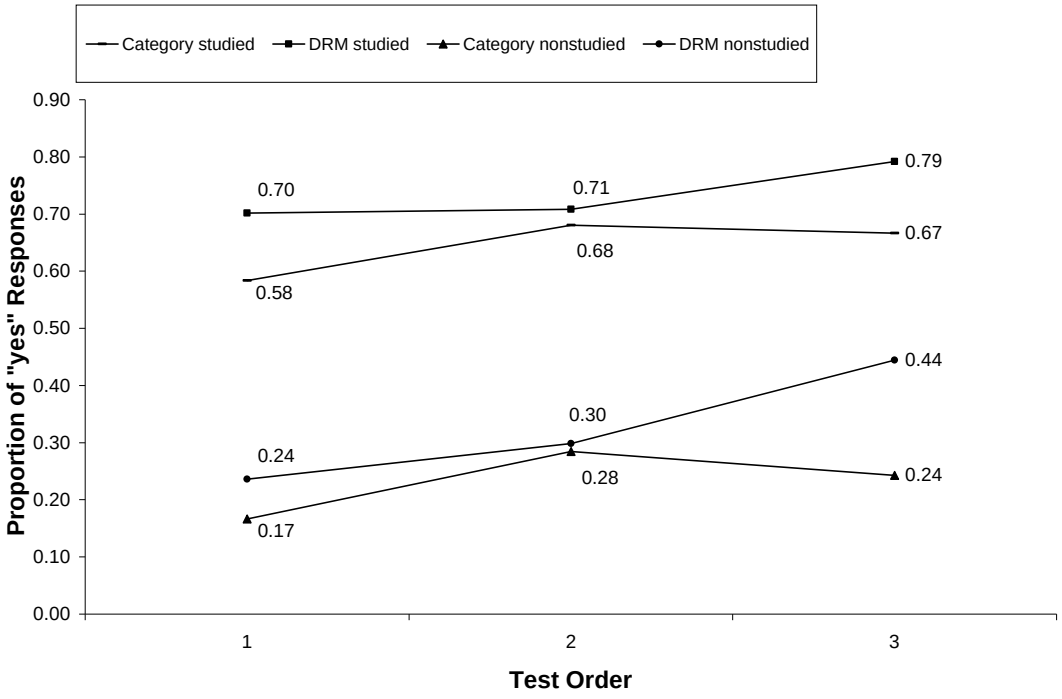

Figure 2 Effect of test order on the proportion of "yes" responses for DRM and Category lists separately for studied and non-studied conditions.
1 zero-associate condition **2** three-associate condition
3 six-associate condition

IV.2 EXPLANATIONS OF THE FINDINGS

IV.2.1 True vs. False Memories

True and false memories differed with respect to the subjective experience accompanying the memory. While list items received more “remember” judgments than critical lures, the critical lures received more “guess” judgments than the list items. As for the “know” responses the two list types showed similar levels. We can argue that familiarity, as opposed to recollection, does not differentiate between true and false memories. While people tend to show conscious recollection more for true memories than for false memories, there is no difference between the two kinds of memories with respect to familiarity.

IV.2.1 DRM vs. Category Lists

The differences, both for the pattern and amount of false recognition, between the converging associates and category associates procedures need further explanation.

The difference with respect to the amount of false recognition can be explained by taking into account the associative processes included in the development of two list types. The highly associative nature of the

converging associates procedure has been demonstrated by many researchers, by using different paradigms (Deese, 1959; McDermott, 1996, 1997; Mather et al, 1997; Robinson et al, 1997; Pesta et al, 2001; Watson et al, 2003; McEvoy, 1999). The lists, by their nature, include the highest associates of the critical lure and studying the list causes the activation of the critical lure via spread of activation. The explanation does not hold for the categorized lists. The items in the category lists are not particularly selected to activate the critical lure word. The words activate the superordinate category label which in turn activates its most prototypical member. So, we cannot say that the association between the list items and the critical lure is as high as it is in the converging associates (DRM) lists. Therefore, if the association within DRM lists is more than the category list, and we observe more false memory for that list type; then we can propose associative processes as a contributor to the false memory effect observed. The argument can be further supported by evidence from the effects of test order on the proportion of false recognition.

The results showed that the six-associate condition to be different from the zero-associate condition in the DRM lists, but not in the Category lists. This finding also supports the view that associative processes contribute to false memory in list learning paradigm. Previously, Robinson et al (1997) demonstrated that as the number of associates studied increased, false memory also increased. He argued that the increase was

due to increased probability of activating the critical lure via spread of activation. For the present case, we can argue that as the number of associates seen at test increases; the accrual of activation of the critical lure causes the increase in false recognition. For the category lists, this is not the case as they are less affected by the associative processes. The reason that Smith et al (2002) proposes is that the exemplars in the Category lists were not chosen to particularly activate the nonpresented category member, namely the category lure. Although the category lures are conceptually related to the studied words in the categorized list method, the categorized lists have lower backward associative strength[4] in relation to their critical lures.

DRM and Category lists also differ with respect to the pattern of change in the proportion of false recognition with respect to test order. This pattern of change is of interest as it reveals how the two procedures are affected by the accrual of activation.

False recognition to lures from DRM lists increase as a function of test order. However, the increase is not linear see Graph 2. We see more increase between the three and six-associate conditions than zero and three-associate conditions. This difference increases if we only consider the non-studied condition. For the category lists, the opposite pattern is seen.

[4] Backward associative strength is the probability that the critical lure is given as a response to the list item in a free association task. Compared to this forward associative strength is the probability that a list item will be given as a response to the critical lure in a free association task.

The increase shows itself in the three-associate condition. Then it remains same after six-associates in studied condition and decreases for the non-studied condition. Apparently, seeing three associates is not enough to evoke false memories in the DRM lists, but it is in the Category lists. This is supported by evidence from the non-studied condition. The effect can be explained by taking the structure of the category list into account. Upon seeing three members of a category, the category label is easily activated, activating in turn the most prototypical member. Once the category label is activated further activation is redundant. In order to explain the decrease trend after six associates in the non-studied condition, a monitoring process needs to be employed. The category label is activated after three members, however being exposed to six members from a non-studied category the monitoring process comes into play. We may argue that the participants might have "realized", after being exposed to six associates, that they have not seen such a category. In a manner such as; "*If I had seen the category, I would have at least remembered one*".[5] After that they may tend to reject the category members they see further on, including the critical lure. This process is more likely for the category associates procedure, since the whole list is linked to category label.

[5] Inspired from "If I had said it I would have remembered it", by Dodson and Schacter (2001) and "If I didn't write it why would I remember it?" by Seamon et al (2003).

The DRM lists are not affected from the monitoring processes as much as the category lists. The finding is in line with the associative theories that propose IARs as for the cause of false memories in the list learning paradigm. As the items are proposed to be automatically activated at encoding, it would be harder to cancel out the items in the monitoring process.

There is support from the phenomenology as well. Critical lures from the DRM lists received more “remember” responses than the lures from Category lists. However, further investigation revealed this difference stemmed from the difference in the studied condition only. For the non-studied condition there was no difference. These findings further support the view that false memories elicited by DRM lists are related to associative processes at encoding. The associative view maintains that the critical lures from DRM lists are activated during encoding by the accrual of activation from the converging associates. And due to this accumulated activation, they are produced as implicit associative responses (IAR). When we consider this, it is likely that they receive “remember” responses just like any other list item they are exposed to. As for the “know” and “guess” responses the two list types receive comparable amounts. We can argue that the difference in the total recognition between DRM and Category lists stem from the differences in the “remember” responses they receive.

The “guess” responses are affected by the test order, while “remember” and “know” responses are not. The proportion of “guess” responses in the six-associate condition was significantly larger than that of the zero-associate condition. We can argue that the effect of test order seen in total recognition actually stems from the difference in the “guess” judgments.

The present study has some findings that contradict the rest of the literature. Contrary to the results that I obtained, Marsh et al (2004) used the same experimental settings as the present study, and failed to obtain any effect of test order on the studied lists. They also provided converging evidence to support their findings from additional experiments using word-stem cued recall and part-set cuing. However, they regarded their lack of finding a significant effect of test order on studied lists as surprising. They suggested that the lack of a test order effect might have resulted from a ceiling effect; that of activation levels rather than of proportion of false memories. They argued that the ceiling effect might have been on conceptual priming.

Related to the phenomenological experiences the two studied also differ. Marsh et al (2004) observed an increase in the “remember” and “know” responses as a function of test order, while the present study observed a significant increase in “guess” responses only.

The “remember” responses showed differential effects for the list type and item type however they did not differ with respect to test order. As for the “know” responses they were not affected by any variable other than study condition. It follows from the present study that familiarity (as indicated by “know” judgments) does not differ either for true and false memories or for false memories evoked by different procedures.

IV.3 THEORETICAL EXPLANATIONS

In this section the present findings are discussed in relation to a number of theories that account for false memory.

IV.3.1 Gist-Based Theories

Constructivism Account, Prototype Theory, and Fuzzy Trace Theory seem to be able to account for the findings for the category associates procedure. The shared aspect in the three accounts is that the semantic overlap exerts an influence at retrieval, resulting in the phenomenological experience of familiarity. The semantic overlap is referred to as “gist” in the Fuzzy Trace Theory, the “prototype” in the Prototype Theory and “schema” in the Constructivism account. Despite the fact that the three accounts differ in theoretical level; they are similar to each other at the functional level that

they emphasize the semantic overlap between the critical lures and studied lists. Additionally, Fuzzy Trace Theory seems to be able to account for the subjective experience that is accompanied by the false memories evoked by category associates procedure. The theory proposes two processes for the judgment of the memories in retrieval; identity-nonidentity and similarity processes. The identity-nonidentity process involves the retrieval of verbatim memory representations and the similarity process is responsible for gist representations.

In the present study, false memories elicited by the category associates procedure are not affected by the accrual of activation at test as much as the false memories evoked by DRM lists. And they are mostly accompanied by “guess” judgments. According to Fuzzy Trace Theory the retrieval of gist traces involves the comparisons of theses traces to the meaning of the critical lure. The gist traces are formed by a gist extraction procedure at encoding. The comparisons at retrieval supports graded judgments of similarity about retrieved gist memories and the meaning of the critical lure (Brainerd et al, 1998). Therefore, it is likely that such memories based on similarity processes at retrieval receive “guess” responses with respect to their phenomenologies.

However, “the gist-based” theories cannot readily account for the false memories elicited by converging associates procedure. The findings of increase in the proportion of “yes” responses as a function of test order, and

the “remember judgments accompanying the "yes" responses” cannot be explained. The results necessitate an explanation that involves the accrual of activation due to priming by associates.

IV.3.2 Activation/monitoring Framework

The theory that best accounts for the results observed in converging associates procedure is the Activation/monitoring Framework. The theory, as explained in more detail in the literature review, can account for the fact that degree of association affects the proportion of false recognition, and its phenomenology. Gist or schema based theories (such as Fuzzy Trace Theory and Constructivism) have difficulty accounting for the findings that demonstrates the relationship between the degree of association and proportion of false recognition, without making additional critical assumptions (Gallo and Roediger, 2002).

The previous findings in the literature about the effect of associative processes on the proportion of false recollection involved the degree of association at encoding (McDermott, 1996; Mather, et al 1997, Robinson and Roediger, 1997, Sommers and Lewis, 1999; Watson, Balota and Roediger, 2003) or at retrieval for the non-studied lists. (Marsh et al, 2004). However, the present study found additional effects of activation during retrieval in studied lists, by manipulating the test order of the critical lures. As the number of list items seen before the critical lure increased, the

proportion of “yes” responses increased as a result of increased associative strength. In spite of the fact that the effects are seen at retrieval rather than encoding, the Activation/monitoring Framework can account for the findings. Increased activation level, at retrieval or encoding, adds to the associative strength of the lists, increasing the probability of activating the critical lure.

Activation/monitoring Framework is also able to account for the false memories in the category associates procedure. The category label is activated at encoding and at retrieval via associative processes leading to the activation of the critical lure word. The decrease trend in the non-studied condition in the six-associate condition can be explained by a stringent monitoring process. In the monitoring process possible false memories from the non-studied lists are cancelled out. The fact that category associates procedure evokes lower levels of false memory than converging associates procedure, together with the fact that it employs associative processes to a lesser extent, support the activation/monitoring view. Thus, Activation/monitoring Framework is able to explain the differential effects of the two procedures.

Chapter V

CONCLUSION

V.1 Summary and Major Findings

The present study investigated the possible effects of associative processes at retrieval on converging associates and category associates procedures within the same experimental settings. This allowed for the direct comparison of the two procedures that give rise to robust false memory effects. The effect of test induced priming was investigated by manipulating the test order of the critical lure items in relation to the list items from their corresponding list. The results were able to demonstrate the differences between DRM and Category lists, with respect to proportion and pattern of false recognition. DRM lists, which were more associative in nature than the Category lists gave rise to larger proportions of false memory.

The results as a whole supported the activation/monitoring view of false memory rather than gist-based theories. The activation/monitoring view is able to account for both the effects of test induced priming on false

recognition, and the phenomenological experience that accompanies it. The findings also favor the associative models of long term memory (LTM), and semantic lexicon rather than feature-based categorical models. However, the results are not sufficient to reach a safe conclusion about the structure of the semantic lexicon.

V.2 Implications for Cognitive Science

The study is significant for Cognitive Science as it includes the investigation of human memory and its processes. By investigating the organization or the structure of memory, one can gain insight about the organization of knowledge and language.

The findings of the present study support the view that associative processes are responsible for the false memory that is observed in the list learning paradigm. What does it tell us about the human mind in general?

The finding that associative processes are employed in the formation of false memories is in line with the associative organization of human memory and knowledge. The findings of lower levels of false memory for categorized lists support the view that association is a more important criterion in the organization of long-term memory than categorization. However, this is not to say that the processes are mutually exclusive. The members of a category are closely associated to one another, or associated

concepts may be classified as in the same category. However, the results support the view that association has priority, or more weight.

The study has significant implications for linguistics, as well. The use of list learning paradigm provides us with evidence that supports the notion that the semantic lexicon is arranged more by association than by categories or features. However, as mentioned before, the results of the present study are far from sufficient to reach a safe conclusion.

Understanding the organization of human memory and knowledge is also important to gain insight about human intelligence and learning capacities. This knowledge also forms a basis for the simulation of human intelligence or machine learning.

The results of this study have implications for language teaching as well. In both fist and second language teaching, list of concepts that are associative in nature are used. The presentation of associative words together in language teaching may have advantages or disadvantages on learning new words, which needs further research.

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APPENDIX-A INSTRUCTIONS

Lütfen deneye başlamadan önce aşağıdaki açıklamaları dikkatlice okuyunuz. Sormak istediğiniz bir şey varsa deneyi yapan görevliye danışınız.

Bir önceki bölümde, ekranda bazı kelime listeleri gördünüz. Bu bölümde ise bir kelime hatırlama testi alacaksınız. Size ekranda bir dizi kelime verilecek.

Test sırasında

- Cevap kağıdında her kelime ile ilgili olarak bir cevap işaretleyiniz; boş bırakmayınız;
- Bir kelime ile ilgili olarak vereceğiniz tüm cevaplarınızı bir sonraki kelimeye geçmeden önce veriniz;
- Bir sonraki kelimeyi görmek için herhangi bir tuşa basmasınız yeterlidir;
- Bir kelimeyi geçtikten sonra geri dönmek veya cevabınızı değiştirmek mümkün değildir.

Testte yapılması gerekenler:

- Ekranda verilen kelimelerin deneyin bir önceki aşamasında gördüğünüz kelimeler arasında olup olmadığına karar veriniz;
- Cevaplarınızı size verilecek olan cevap kağıdına işaretleyiniz. Hatırlayıp hatırlamadığınızı soracağımız kelimeler önünüzdeki ekranda art arda belirecektir. Kelimeler 1den 297ye kadar numaralandırılmıştır. Ekrandaki kelime numarası cevap kağıdında hangi satırı işaretleyeceğinizi belirtir.

Lütfen testi aşağıdaki açıklamalar doğrultusunda cevaplayınız:

A. Ekrandaki kelimeyi bir önceki aşamada görmediğinizi düşünüyorsanız:

- Kelimeyle aynı numaralı satırdaki 'Hayır' kutucuğunu işaretleyiniz; herhangi bir tuşa basarak bir sonraki kelimeye geçiniz. Başka bir işaretleme yapmayınız.

VEYA

B. Ekrandaki kelimeyi bir önceki aşamada gördüğünüzü düşünüyorsanız:

- Kelimeyle aynı numaralı satırdaki 'Evet' kutucuğunu işaretleyiniz.

- Sonra hemen, ikinci sayfadaki tabloda açıklanan yargılardan (Hatırlıyorum, Biliyorum, Tahmin ediyorum) sadece birini işaretleyiniz ve bir sonraki kelimeye geçiniz.

Yargı	Açıklama	Örnek
Hatırlıyorum	Kelimeyi listede gördüğünüz anı veya o kelimeyi okurken kelimeyle ilgili olarak yaşadığınız bazı ayrıntıları hatırladığınızı belirtir.	*Kelimenin listedeki yerini (hangi kelimeden önce ya da sonra geldiğini) hatırlıyorsanız. * Kelimeyi gördüğünüzde kelimenin aklınıza getirmiş olduğu bir olayı veya bir düşünceyi veya bir duyguyu hatırlıyorsanız.
Biliyorum	Kelime ile ilgili bir ayrıntı hatırlamadığınızı ama gördüğünüzden emin olduğunuzu belirtir.	*Kelimeyi gördüğünüz anla ilgili bir ayrıntı hatırlamıyorsanız. *Kelimeyi listede gördüğünüzden eminseniz.
Tahmin ediyorum	Kelimenin daha önceki aşamadaki listelerde olduğunu tahmin ettiğinizi belirtir.	*Kelime ile ilgili hiçbir ayrıntı hatırlamıyorsanız. *Kelimeyi gördüğünüzden emin değilseniz. *Kelimenin listelerden birinde olabileceğini tahmin ediyorsanız.

Önemli hatırlatma: 1. Kelime ile ilgili yargınızı kelimeye 'Evet' cevabını verdikten hemen sonra bir sonraki kelimeye geçmeden veriniz. Bir kelime için yargınızı işaretledikten aynı kelimeye dönmeniz mümkün değildir.

2. Hiçbir kelime için cevap kutucuklarını boş bırakmayınız.

YARDIMLARINIZ İÇİN ÇOK TEŞEKKÜR EDERİZ.

APPENDIX-B CATEGORY LISTS

No	**1**	**2**	**3**
Category	**çiçekler**	**renkler**	**dört ayaklı hayvanlar**
Lure	*GÜL*	*KIRMIZI*	*KÖPEK*
1	papatya	mavi	kedi
2	karanfil	sarı	at
3	menekşe	ak	inek
4	lale	yeşil	eşek
5	orkide	mor	aslan
6	sümbül	lacivert	kaplan
7	kasımpatı	kahverengi	koyun
8	leylak	pembe	keçi
9	zambak	turuncu	zürafa
10	yasemin	eflatun	kurt
11	nergis	bordo	fil
12	manolya	bej	öküz
No	**4**	**5**	**6**
Category	**meyvalar**	***akrabalar***	**ağaçlar**
Lure	*ELMA*	*AMCA*	*ÇAM*
1	armut	teyze	meşe
2	portakal	hala	kavak
3	muz	dayı	çınar
4	karpuz	kuzen	selvi
5	kiraz	anne	gürgen
6	mandalina	baba	söğüt
7	şeftali	dede	kestane
8	kavun	kardeş	ceviz
9	üzüm	babaanne	kayın
10	çilek	yeğen	köknar
11	kayısı	enişte	erik
12	ayva	yenge	dut

No	**7**	**8**	**9**
Category	**kıymetli taşlar**	***sporlar***	**vücut kısımları**
Lure	*YAKUT*	*BASKETBOL*	*AYAK*
1	elmas	futbol	kol
2	zümrüt	voleybol	bacak
3	pırlanta	yüzme	el
4	safir	tenis	baş
5	akik	atletizm	parmak
6	inci	hentbol	göz
7	opal	boks	burun
8	yeşim	güreş	gövde
9	firuze	eskrim	göğüs
10	topaz	jimnastik	boyun
11	mercan	koşu	bel
12	sedef	dağcılık	kafa
No	**10**	**11**	**12**
Category	**marangoz aletleri**	**taşıt araçları**	***müzik aletleri***
Lure	*ÇEKİÇ*	*OTOBÜS*	*PiYANO*
1	testere	uçak	gitar
2	çivi	kamyon	flüt
3	keser	tren	davul
4	tornavida	araba	keman
5	kerpeten	minibüs	org
6	rende	otomobil	saz
7	pense	motosiklet	saksafon
8	keski	tır	bateri
9	zımpara	taksi	viyolonsel
10	hızar	kamyonet	mandolin
11	matkap	troleybüs	trompet
12	eğe	dolmuş	arp

No	13	14	15
Category	**metaller**	***balıklar***	***askeri unvanlar***
Lure	*DEMİR*	*HAMSİ*	*ALBAY*
1	bakır	lüfer	yüzbaşı
2	aliminyum	istavrit	general
3	gümüş	palamut	er
4	altın	kalkan	binbaşı
5	çinko	köpekbalığı	çavuş
6	çelik	balina	yarbay
7	krom	yunus	onbaşı
8	kurşun	barbunya	teğmen
9	platin	uskumru	orgeneral
10	pirinç	levrek	korgeneral
11	kalay	kefal	amiral
12	bronz	kılç	mareşal
No	**16**	**17**	**18**
Category	**sebzeler**	**kuşlar**	***deniz taşıtları***
Lure	*ISPANAK*	*SERÇE*	*VAPUR*
1	pırasa	güvercin	gemi
2	lahana	kartal	kayık
3	kereviz	kanarya	sandal
4	domates	karga	motor
5	fasülye	şahin	yat
6	patlıcan	bülbül	sal
7	karnıbahar	papağan	transatlantik
8	havuç	martı	bot
9	patates	leylek	yelkenli
10	kabak	akbaba	şilep
11	enginar	atmaca	tanker
12	marul	kırlangıç	feribot

APPENDIX-C DRM LISTS

No	**1**	**2**	**3**
Lure	**PENCERE**	**SOĞUK**	**YUMUŞAK**
1	kapı	sıcak	sert
2	cam	kar	hafif
3	güneşlik	ılık	yastık
4	pervaz	kış	peluş
5	denizlik	buz	pamuk
6	ev	ıslak	kürk
7	açık	serin	dokunmak
8	perde	hava	pofuduk
9	çerçeve	donmak	tüy
10	manzara	titremek	tüylü
11	esinti	Antartika	ten
12	panjur	don	hassas
No	**4**	**5**	**6**
Lure	**UYKU**	**TATLI**	**SANDALYE**
1	yatak	ekşi	masa
2	dinlenme	lokum	oturmak
3	yorgun	şeker	koltuk
4	rüya	acı	sıra
5	uyanmak	iyi	şezlong
6	kestirmek	tat	kanepe
7	battaniye	bal	tahta
8	uyuklamak	gazoz	minder
9	horlamak	çukulata	tabure
10	şekerleme	kek	oturma
11	huzur	turta	sallanan
12	esnemek	çörek	bank

No	7	8	9
Lure	**DUMAN**	**DOKTOR**	**HIRSIZ**
1	sigara	hemşire	çalmak
2	üflemek	hasta	soyguncu
3	tütmek	ilaç	dolandırıcı
4	kirlilik	sağlık	para
5	kül	hastane	polis
6	puro	dişçi	soymak
7	baca	hekim	hapisane
8	ateş	muayenehane	silah
9	tütün	steteskop	kötü
10	pipo	cerrah	banka
11	ciğer	klinik	haydut
12	alev	tedavi	suçlu
No	**10**	**11**	**12**
Lure	**DAĞ**	**YAVAŞ**	**MÜZİK**
1	tepe	hızlı	nota
2	vadi	uyuşuk	ses
3	tırmanmak	dur	şarkı
4	doruk	bitkin	radyo
5	üst	sümüklüböcek	grup
6	zirve	gecikme	melodi
7	ova	trafik	konser
8	buzul	kaplumbağa	enstrüman
9	bisiklet	hız	senfoni
10	sıra	çabuk	caz
11	dik	ağır	orkestra
12	kayak	beklemek	ritim

No	**13**	**14**	**15**
Lure	**İĞNE**	**NEHİR**	**ŞEHİR**
1	iplik	su	kalabalık
2	delik	ırmak	il
3	dikiş	göl	başkent
4	sivri	Fırat	cadde
5	uç	kayık	metro
6	batmak	yüzmek	ülke
7	yüksük	akmak	İstanbul
8	samanlık	baraj	köy
9	diken	çay	metropol
10	acıtmak	dere	büyük
11	enjeksiyon	köprü	Ankara
12	şırınga	kıvrılma	ilçe
No	**16**	**17**	**18**
Lure	16	17	18
1	**ÖRÜMCEK**	**GÖMLEK**	**SİYAH**
2	ağ	bluz	beyaz
3	haşere	kollu	koyu
4	böcek	pantolon	isli
5	korku	kravat	gece
6	uçmak	düğme	cenaze
7	tarantula	şort	renk
8	zehir	ütü	keder
9	ısırık	yaka	ölüm
10	ürpertici	yelek	mürekkep
11	hayvan	cep	dip
12	çirkin	kemer	kömür

APPENDIX-D FALSE MEMORY PROPORTIONS

No	lure	frequency	stadler	studied	non-studied	type
1	pencere	320	0.84	0.88	0.21	DRM
2	soğuk	250	0.84	0.75	0.54	DRM
3	yumuşak	107	0.81	0.88	0.50	DRM
4	uyku	221	0.80	0.92	0.38	DRM
5	tatlı	153	0.78	0.63	0.42	DRM
6	sandalye	97	0.74	0.79	0.50	DRM
7	duman	96	0.73	0.71	0.79	DRM
8	doktor	230	0.71	0.58	0.21	DRM
9	hırsız	53	0.70	0.83	0.25	DRM
10	dağ	246	0.69	0.75	0.08	DRM
11	yavaş	357	0.69	0.75	0.25	DRM
12	müzik	328	0.69	0.67	0.13	DRM
13	iğne	66	0.68	0.83	0.58	DRM
14	nehir	76	0.67	0.75	0.25	DRM
15	şehir	309	0.64	0.71	0.21	DRM
16	örümcek	20	0.58	0.63	0.17	DRM
17	gömlek	109	0.54	0.46	0.25	DRM
18	siyah	182	0.49	0.71	0.17	DRM
19	gül	305		0.38	0.29	CAT
20	kırmızı	246		0.71	0.13	CAT
21	köpek	214		0.63	0.33	CAT
22	elma	53		0.67	0.25	CAT
23	amca	106		0.54	0.00	CAT
24	çam	34		0.83	0.33	CAT
25	yakut	6		0.63	0.33	CAT
26	basketbol	20		0.67	0.25	CAT
27	ayak	630		0.67	0.13	CAT
28	çekiç	70		0.83	0.13	CAT
29	otobüs	220		0.71	0.25	CAT
30	piyano	50		0.71	0.25	CAT
31	demir	150		0.79	0.17	CAT
32	hamsi	3		0.42	0.08	CAT
33	albay	8		0.83	0.25	CAT
34	ıspanak	20		0.54	0.38	CAT

35	serçe	8		0.58	0.25	CAT
36	vapur	56		0.46	0.38	CAT

No is the list number in APPENDIX B and C.
Lure is the name of the lure.
Frequency is number of occurrence in METU-Turkish Corpus.
Stadler is the false memories of the original version of the lures.
Studied is false memories of the Turkish version of the lures in studied condition.
Non-studied is false memories of the Turkish version of the lures in non-studied condition.
Type of List is the list type, either Category or DRM.