SOURCE STRENGTHENING IN RECOGNITION MEMORY

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ABSTRACT

SOURCE STRENGTHENING IN RECOGNITION MEMORY

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This thesis aimed to explore the list-strength paradigm in source recognition memory. Items can be strengthened through repetition, slower representation or deeper encoding either in different lists (pure-list) or within the same list (mixed-list). The strength-based mirror effect is the finding that when items are strengthened in a pure list, hit rates increase and false alarm rates decrease compared to the weakly encoded items. When a mixed-strength list is implemented, weak items' recognition memory performance is not harmed by the presence of strong list items and strong items do not benefit from the accompaniment of weak items. This finding is defined as the null list-strength effect. The current thesis extended the strength-based mirror effect and the null list-strength effect to source recognition memory.

Keywords: Recognition memory, source memory, strength-based mirror effect, null list strength effect, source recognition

ÖZ

TANIMA BELLEĞİNDE BAĞLAM BİLGİSİNİN GÜÇLENDİRİLMESİ

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Bu tezin amacı, liste güçlendirme paradigmasının kaynak tanıma belleğinde incelenmesidir. Güçlendirme tekrar, uzun süreli gösterim veya derin işlemeye düzeyi kullanılarak listeler arası (saf liste) veya aynı liste içerisinde (karışık liste) yapılır. Güce dayalı ayna etkisi, listenin tamamı güçlendirildiğinde, tamamı zayıf kalan listeye kıyasla, isabet oranın artması yanlış alarm oranın ise azalmasıdır. Listenin yalnızca yarısı güçlendirildiğinde ise, zayıf bilginin tanıma belleği başarısı güçlü bilginin listede bulunmasından olumsuz etkilenmez. Aynı şekilde, güçlü bilginin tanınması zayıf bilgiyle aynı listede bulunmasından yarar sağlamaz. Bu etki anlamsız liste güçlendirme etkisi olarak tanımlanır. Bu tez, güce dayalı ayna etkisi ve anlamsız liste güçlendirme etkisinin kaynak tanıma belleğinde de gösterilmesini sağlamıştır.

Anahtar Kelimeler: Tanıma belleği, kaynak belleği, güce dayalı ayna etkisi, anlamsız liste güçlendirme etkisi, kaynak tanıma

To My Family,

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INTRODUCTION

1.1 Recognition Memory

Episodic memory is first defined by Tulving (1983) as a memory of an event experienced at a particular time and place. Recognition memory is an episodic memory task. The task first requires studying a list of items (words, pictures etc.) to remember. Then, new items (foils) are added to the list of previously learned items (targets). At test, individuals are required to discriminate targets from foils.

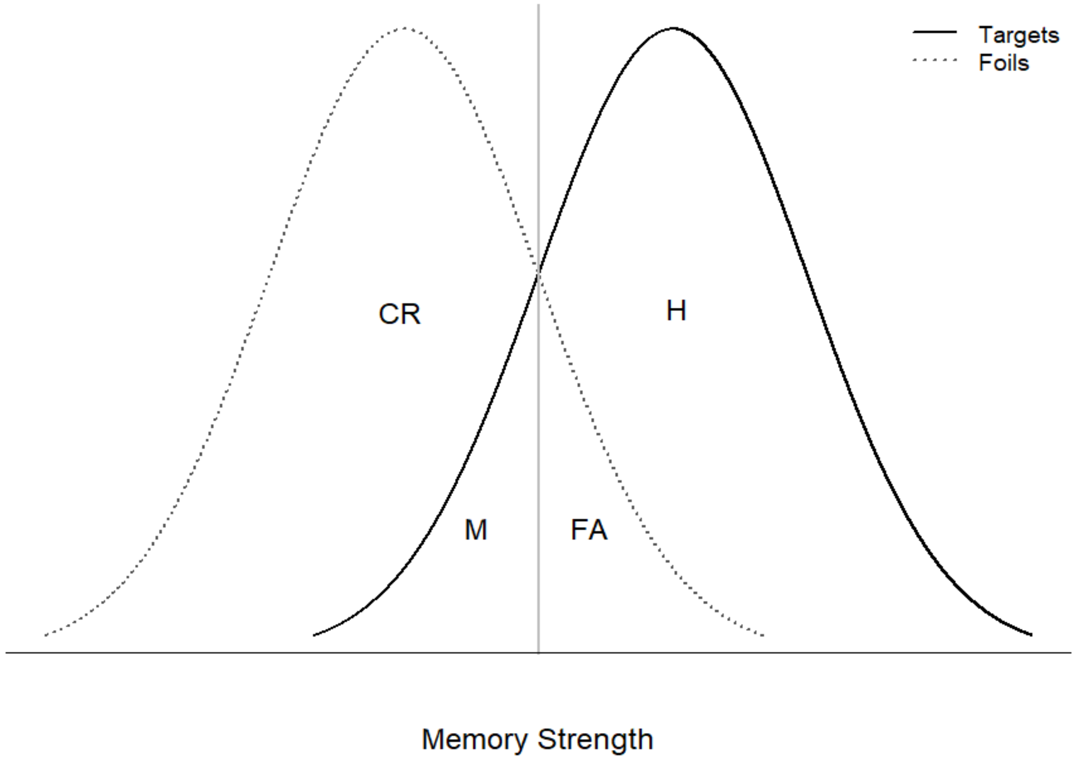

Figure 1.1 Signal detection theory

Signal Detection Theory (SDT; Green & Swets, 1966; Banks, 1970) is a measurement model applied to human memory to measure the performance. The application of SDT to human memory defines memory traces as signals that must be detected to perform the task when there are noises which are, in this case, new items that must be rejected. Memory evidence for targets and foils are assumed to be normally distributed with a greater mean evidence for targets since they are already learned. The distance between target distribution and distractor distribution gives an information about the discriminability of the set such that greater distance means greater discriminability. To make a recognition decision, a criterion is set by subjects which might reveal the best performance in the task (see Figure 1.1). As Figure 1.1 illustrates, if memory evidence of the test probe exceeds this subjective criterion, the probe is endorsed; otherwise, it is rejected.

When familiarity value of a target item exceeds the criterion and, therefore, subjects correctly identify it as old, this is defined as a hit (H). A new item also has the possibility to have greater familiarity value than the criterion set by subjects. This might result from the similarity of the item or the context to the information in memory. False alarm (FA) occurs when a new item is incorrectly accepted as old. There is also miss (M), a target item which is incorrectly rejected and defined as new, and correct rejection (CR), a new item which is correctly rejected, that can be revealed in a recognition memory task (see Table 1.1 and Figure 1.1).

Table 1.1

Type of Memory Distributions

Response/Test Item	**Target**	**Foil**
Yes	H	FA
No	M	CR

Recognition memory performance depends on the proportion of targets which are correctly endorsed as old - hit rates (HR) - and the proportion of foils which are incorrectly endorsed as old - false alarm rates (FAR). In the case that a subject sets more liberal criterion in a typical recognition memory task, both HR and FAR increase. On the other hand, if a subject sets more conservative criterion, both HR and FAR decrease.

Memory models assume that there are three different kinds of information that might have a role in human memory. These are item, context, and associative information. Item information refers to semantic, orthographic, and phonological properties of the to-be-remembered item (Murdock & Anderson, 1975). For example, item information includes semantic, phonetic, or visual properties of a word or visual content of a photograph. Context information includes both internal and external factors associated with the situation in which learning occurs. That is, context information refers to environmental factors such as the experimental room or time as well as internal factors such as the mood of the participants when the experiment is run (e.g., Murnane, Phelps, & Malmberg, 1999). Finally, associative information is the information of co-occurrence of items (Murdock & Anderson, 1975). But mostly the models assert that item and context information have an effect in recognition memory (Mensink & Raaijmarkers; Shiffrin & Steyvers, 1997).

In recognition memory, retrieval success is determined by the similarity between the test probe and traces in memory. Different memory models rely on different sources of information for this similarity. For example, context noise models (e.g., Bind Cue Decide Model of Episodic Memory; BCDMEM; Dennis & Humphreys, 2001) assume that context information is the main source of interference whereas item noise models (e.g., McClelland & Chappell, 1998; Shiffrin & Steyvers, 1997) assume that the main source of interference is other items in memory.

1.2 The Strength-Based Mirror Effect

A mirror effect refers to an increase in correctly endorsing old items and, at the same time, a decrease in incorrectly endorsing foils for a particular class of items compared to the others. Mirror effect can be thought as: “Performance on new items *mirrors* performance on old items” (Glanzer & Adams, 1985, p.8). One common example is the *word frequency mirror effect* which refers to that low frequency words (e.g. hippopotamus) are correctly recognized more and incorrectly false alarmed less than high frequency words (e.g. fish) (Glanzer & Adams, 1985). Another example is the *list-length mirror effect* which is the finding that shorter lists have higher hits and lower false alarms than longer lists (Ratcliff & Murdock, 1976; Murnane & Shiffrin, 1991; Cary & Reder, 2003). The list-length mirror effect which suggests that adding new items in a list impairs memory performance is an extremely robust effect. Such that, the list-length mirror effect is not only found in recognition memory but also in free recall and cued recall (Cary & Reder, 2003).

Strength manipulation is another one that constantly elicits a mirror effect. Repetition, longer study time, or deeper level of encoding (e.g. focusing on the semantic information of the item) are the paradigms used to increase the strength of an item. Strengthening can be manipulated either in different lists (pure list) or within the same lists (mixed lists). This may result in three types of lists: pure weak list, pure strong list, and mixed list. Let’s assume that repetition paradigm is used to increase strength. A pure weak list is when all items in a list are presented only once. A pure strong list is when all items in a list are presented, for example, five times. Finally, a mixed list refers to when half of the items in a list are presented only once and the other half in the list are strengthened with additional study for five times.

Suppose a group of items are presented only once in a pure weak list and another group of items are presented five times in a pure strong list. When items are strengthened in the pure strong list, the likelihood of recognizing these strong items increases and the likelihood of accepting foils as studied decreases compared to weakly encoded items (Glanzer & Adams, 1985). This is called the s*trength-based mirror effect* because as Glanzer and Adams (1985) states that the foils' performance mirrors the targets' performance. Significant number of studies has indicated this strength-based mirror effect (SBME) in item recognition (Cary & Reder, 2003; Criss, 2006; 2009; 2010; Criss, Aue, & Kılıç, 2014; Glanzer & Adams, 1985; Kılıç, Criss, Malmberg, & Shiffrin, 2017; Shiffrin & Stevyers, 1997; Starns, Ratcliff, & White, 2012; Starns, White, & Ratcliff, 2010; Stretch & Wixted, 1998).

1.3 The List-Strength Effect

Items can be strengthened through repetition, longer presentation, or deeper encoding either in a pure list or in a mixed list. Mixed list strengthening is when some items in the list are strengthened with one of the strength paradigms but not the others in the list. The question regarding what happens to the weak items in the mixed study list when the other items in the same list are strengthened has long been discussed. The study conducted by Tulving and Hastie (1972) explored this question in free recall. Their results revealed two important outcomes: weak items presented only once has impaired memory performance when the other items in the list are strengthened, and the strong items oppositely elicit higher memory performance in free recall when the weak items accompany them in the list. This result is referred to as a (*positive) list-strength effect.*

Ratcliff, Clark, and Shiffrin (1990) later examined the list-strength effect (LSE) in a more inclusive study including the tasks of free recall, cued recall, and recognition memory. After studying a group of strong items with another group of weak items, a positive LSE in free recall was again clearly revealed as in Tulving and Hastie (1972) study. That is, weak items studied along with strong items recalled worse when compared to weak items from pure list. On the other hand, strong items took an advantage of being studied with weak items and recalled better than strong items from pure list. For the cued recall task, similarly, a positive but less clear LSE was revealed. The most amazing result from this study was that strength manipulation in the mixed list design revealed completely different effect for recognition memory: when half of the items in the list was further studied while the other half was studied only once, recognition accuracy was comparable for weak/strong items across the mixed- and the pure-list conditions (Ratcliff, Clark, & Shiffrin, 1990). In other words, weak targets were not worse recognized when they were presented along with strong targets. Similarly, strong targets were not better recognized when they were studied in the mixed list compared to being studied in the pure list. This result is called a *null list-strength effect*. In order to explain these results, Shiffrin, Ratcliff, and Clark (1990) proposed that stronger items are represented by a single episodic memory trace - unlike extra items represented by different traces – and the activation of strong traces at test is unlikely by an unrelated item probe in which case is referred to as differentiation. The effect has been widely replicated since its initial discovery by Ratcliff et al. (1990; Murnane & Shiffrin, 1991; Yonelinas, Hockley, & Murdock, 1992; Hirshman, 1995) and memory models have been since developed to explain properly the null LSE in item recognition (e.g. REM; Shiffrin & Steyvers, 1997; BCDMEM; Dennis & Humphreys, 2001).

How strengthening a group of information affects memory performance of the weak information in the same list has since drawn considerable interest for memory researchers. Investigating the LSE in different types of information has proven its theoretical importance. For instance, Osth and Dennis (2014) conducted a study to examine the LSE in associative memory paradigm. There were two experiments in the study, and they were the same except that the first experiment was conducted with yes-no recognition task and the second one was conducted with two-alternative forced choice (2AFC) task. In the condition where all pairs in the list was kept weak by studying only once, half of the pairs was tested as intact or rearranged pairs. In the mixed list condition, half of the pairs was studied only once, and the other half was studied four times. At test after the mixed list study phase, first weak pairs then strong pairs were tested again either as intact or as rearranged pairs. Results, as in item recognition, revealed the null LSE which suggests that associative recognition performance for weak pairs was not affected by strong pairs. Thus, the null LSE was generalized to associative recognition, which in fact measures the association among a pair of items.

The list-strength paradigm has been studied numbers of times in item memory to understand its underlying processes. However, the paradigm has not been investigated yet in source memory. Exploring the list-strength paradigm in source memory was important because results obtained from this study would broaden the knowledge on the effect of additional learning on human memory. More importantly, this study would give an information about the representation of source information in memory as well as how additional learning of information in the same or different source/s affects source memory and its retrieval. Therefore, this thesis aimed to examine first the effect of source strengthening in a pure list on source memory, and then the effect of strengthening in a mixed list on recognition of strong and weak sources.

1.4 Two Accounts for the Strength-Based Mirror Effect

When items are strengthened with either repetition, or slower presentation, or deeper level of processing in a pure list, it is not surprising that correct endorsement of strong items as old increases because their memory evidence are getting increased due to additional learning. However, more puzzling result is the decrease in the probability of incorrect endorsements of new items. One can intuitively expect no change in memory evidence of new items because they are presented for the first time in the test phase. So, why would an encoding manipulation affect them? Underlying encoding process causing a change in memory strength and subjective decision criterion are the two factors that current theories employ to explain the SBME in recognition memory. There are two different accounts that accurately explain the decrease in false alarms after an additional study, namely the differentiation account and the criterion-shift account. These two accounts are proposed based on how these two factors change across weak and strong encoding conditions. In order to give the readers a detailed information about these two accounts, first, the criterion shift account will be explained in this section and later will be followed by the differentiation account.

1.4.1 Criterion Shift Account

The criterion shift account asserts that the decision mechanism is the only factor that is responsible from a change in the likelihood of accepting foils as old across strength conditions (Cary & Reder, 2003; Starns, Ratcliff, & White, 2012; Stretch & Wixted, 1998; Verde & Rotello, 2007). This account suggests that additional learning of other items results in strengthened encoding of them in memory, but this does not affect memory strength of foils which are displayed for the first time at test. Therefore, memory evidence for foils is assumed to be comparable across pure strong and pure weak lists. Instead of a change in memory strength of foils, the criterion shift account specifically proposes a strength-based change in the subjective decision criterion to explain the decrease in the probability of acceptance of foils as studied. According to this account, participants set a more stringent criterion for the strongly encoded items than the weakly encoded items to make a recognition decision (see Figure 1.2). Eventually, the probability of saying “old” to the foils decreases because individuals now need more evidence in order to consider them as “studied” and the familiarity value of them is not likely to exceed the current stricter criterion (see Figure 1.2).

When looking at the increase in the likelihood of endorsement of the strongly encoded items specifically, this increase in hits results from the increase in memory strength after an additional learning as Figure 1.2 illustrates. In other words, the criterion shift account assumes that additional learning leads items to be encoded in memory better.

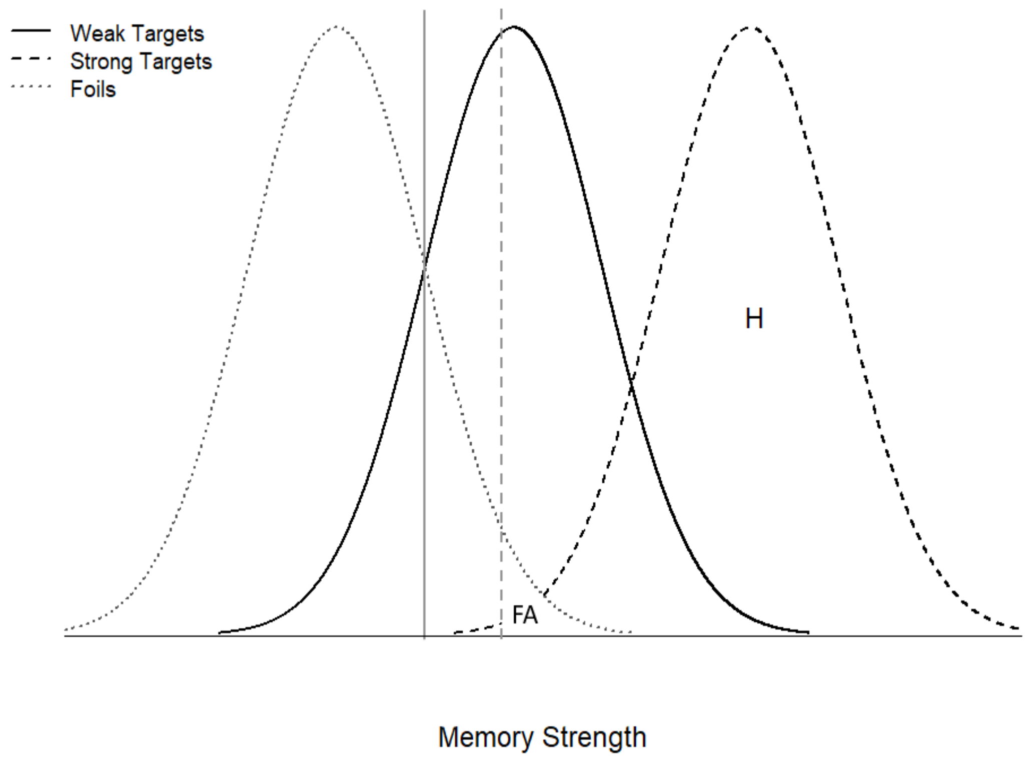

Figure 1.2 An illustration of the criterion shift account

Researchers has since conducted several studies to manipulate the decision mechanism based on list strength. The decision mechanism is suggestible to the external factors such as costs and rewards or information given by the experimenter (Criss, 2006). Thereby, the most frequent paradigm is to give an exact information about the strength of the test list to cause a change in the familiarity criterion. That is, after participants study a mixed list with varying item strength levels, they are tested with pure lists including either weak or strong items. More importantly, they are explicitly informed by the experimenter about the nature of the test content prior to each test block. Thereby, they are forced to determine a new familiarity criterion according to the strength of the test list rather than the study list. Results of these studies reveal the decrease in false alarms – and the increase in hits too – when testing with only strong items along with foils (pure strong test list) compared to when testing with only weak items (pure weak test list) even though those items were studied in the same list (Starns et al., 2010; Kılıç et al., 2017). The criterion shift account explains these results very well without any further need for additional mechanism. This is because the criterion shift account assumes that the decrease in false alarms is a result of a change in the decision criterion as the studies has already demonstrated that false alarms decrease when participants adjust a new conservative criterion based on the test content which includes only strong targets.

To conclude, the criterion shift account explains the decrease in the endorsement probability of foils with a change in the subjective criterion after an additional study. As a natural consequence of adapting stricter criterion, false alarms decrease. The probability of accepting targets as studied increases since memory strength of strong targets increases with an additional study.

1.4.2 Differentiation Account

The differentiation account assumes that both an increase in hits and a decrease in false alarms after an additional study is a natural consequence of encoding processes (Shiffrin, et al., 1990; Criss, 2006; 2009; 2010; Criss, Wheeler, & McClelland, 2013). Specifically, using strength paradigms results in storing more information in the same episodic image. Such that, each representation of an item produces a more accurate and a more complete representation of the item in episodic memory. Thereby, the match between the target probe and its corresponding episodic memory trace increases with an additional study. Similarly, the more information stored in the episodic memory image, the less similar the image becomes to and the more it differentiates from other traces. Therefore, the match between foils and the episodic traces in memory decreases after strengthening items compared to the condition in which the items remained weak.

Unlike the criterion shift account, the differentiation account assumes two different familiarity distributions for foils based on whether the study list is pure strong or pure weak. After studying a pure strong list, the familiarity distribution of the foils moves away from the familiarity distribution of the strong targets because the foils become more dissimilar to the targets (see Figure 1.3). Thus, the likelihood of endorsements of foils decreases. As in the criterion shift account, the memory strength of the strong targets increases with an additional study; therefore, the probability of hits increases (see Figure 1.3). That is, both the differentiation account and the criterion shift account suggest that the same factor causes an increase in the likelihood of the target endorsements but a decrease in false alarms is explained with an implementation of weak foil distribution to the SDT in the differentiation account.

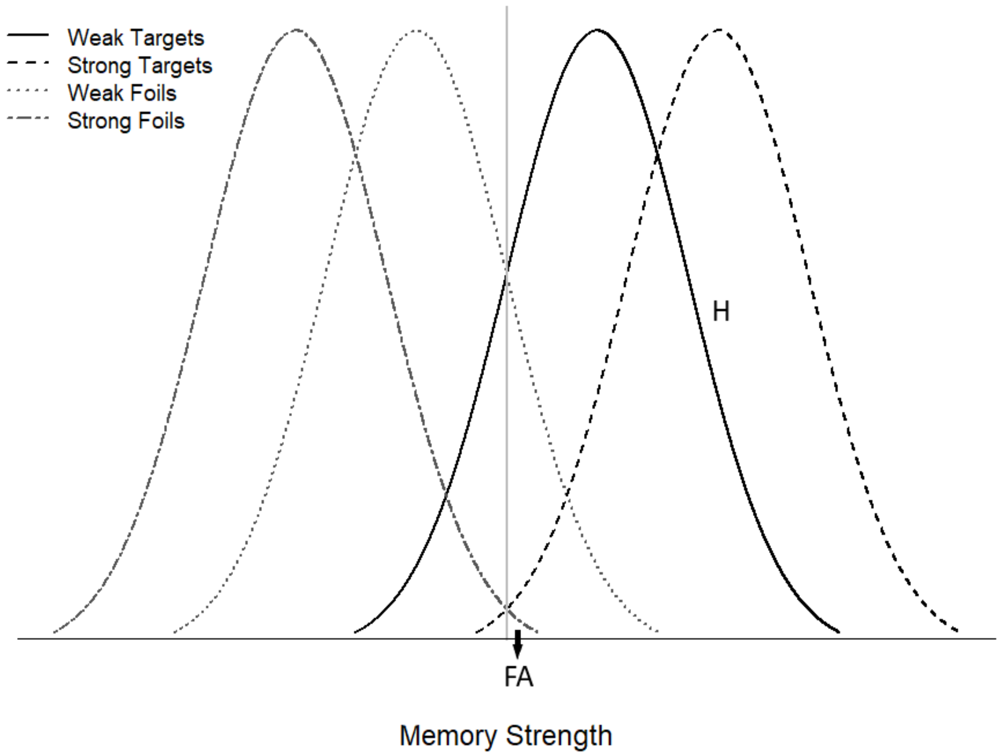

Figure 1.3 An illustration of the differentiation account

Koop, Criss, and Pardini (2019) recently conducted a study showing the SBME in recognition memory that can only be explained with the differentiation account (or the mnemonic account as they refer in their article) because a change in the subjective decision criterion is impossible due to the design they used. Specifically, they conducted several experiments as explanatory to test their design before testing the validity of the differentiation account on the SBME. At the end, the preregistered fifth experiment was conducted in which a deeper level of processing (by asking “Is this word pleasant?”) was applied to increase memory strength and a shallow level of processing (by asking “Does this word contain the letter e?”) to keep items weak was used with two short pure lists consisting of only ten items. They chose levels of processing paradigm for the strength manipulation because participants should not be aware of the strength in contrast to several studies demonstrating that participants are very good at repetition judgments (for a review, see; Koop, Criss, & Pardini, 2019). They also specifically tested participants’ awareness by asking them a single question of how well they would do at test prior to each test block. The results revealed the SBME in the case that participants were unaware of the list strength due to the levels of processing strength manipulation. Participants were also not able to change their decision criterion throughout the test due to using short lists including only ten items. This experiment well supports that differentiation is definitely responsible from the SBME when the strength-based shift in the familiarity criterion is unlikely.

Overall, the differentiation account explains well both an increase in the probability of acceptance of studied strong items as old and a decrease in the probability of recognition of non-studied new items by only assuming a change in memory strength for both foils and targets after an additional learning. The change in foil distribution is also assumed by the differentiation account like the change in target distribution because targets and foils become more dissimilar to each other with additional study of targets.

1.5 Retrieving Effectively from Memory Model

Retrieving Effectively from Memory (REM; Shiffrin & Steyvers, 1997) model was developed based on the differentiation account. In the pure item noise version of the model, memory is assumed to consist of several separate images represented as vectors, which contain feature values. Feature values represent semantic, orthographic, or phonological information as well as any information related to the item itself. During study, each item is stored in memory as an episodic image and this image is an incomplete and error-prone copy of the studied item. Once a feature is stored, the REM model assumes that its value does not change throughout the experiment. But the empty values are replaced by feature values with an additional study. In other words, an additional learning results in replacing zeros - representing no information - with the information related to the item. Therefore, the episodic image becomes more accurate, more complete, and more similar to the information itself presented at study.

At test, retrieval occurs based on the matching process of the probe item presented at test - which is either a target or a foil - to all traces representing the studied items in episodic memory. As a result of the matching process, if the similarity of the item probe is higher than the subjective decision criterion the item is recognized as old. On the other hand, if the similarity of the probe is lower than the subjective decision criterion, a new decision is given for the presented item (Shiffrin & Steyvers, 1997).

When looking at the outcome of strengthening, the strengthened memory evidence after additional study leads to an increase in the match between the target probe and its memory trace because the similarity of the strong target to its memory trace increases. Similarly, the match between the foil item and memory traces decreases because memory traces become more dissimilar to the new information after additional study.

1.5.1 REM.4

In an alternative version of the REM model (REM.4; Shiffrin & Steyvers, 1997), context information is also represented as a vector containing feature values. The vector representing the context information is assumed to concatenate to the item vector. As a result, concatenated two vectors which consist of features belonging to both item and context information is stored in episodic memory as a representative image of specific item information acquired in a specific context (see Figure 1.4).

$$[context_{\mathrm{A}}]\ [item_{1}]$$

$$[context_{\mathrm{B}}]\ [item_{2}]$$

$$[context_{\mathrm{C}}]\ [item_{3}]$$

Figure 1.4 Concatenated context information to item information

Since episodic memory contains numerous numbers of images that represent the information learned up to now, it is unlikely and obviously effortful process that the probe item matches all the information stored in memory. Therefore, the REM.4 model proposes a two-step recognition memory model. In the first step, all images in the relevant list/context are activated based on the context features only. After the activation of all images in the relevant context, in the second step, a recognition decision is made by comparing the probe item to each memory trace in the activated set of images (see Figure 1.5). Let's come up with an example for illustrating the two-step recognition memory model. Assume that a group of pictures belonging to human faces is studied in the laboratory. Two days later, participants are required to do a recognition task with the list including the human face pictures they studied two days ago and new faces. In this case, the REM.4 model assumes that memory works like this: first, only the faces learned in the laboratory two days ago are activated based on the context information. In this case, the context is where – the laboratory - and when – two days ago - the information is learned. Then, each presented picture whether it is a studied human face, or a new human face is matched against all the faces activated shortly before based on the context information. Finally, a recognition decision is made based on that the familiarity value of the test probe exceeds the criterion or not.

$[item_{probe}]$

$[context_A]$ $[item_1]$	$[context_A]$ $[item_1]$
$[context_A]$ $[item_2]$	$[context_A]$ $[item_2]$
$[context_A]$ $[item_3]$	$[context_A]$ $[item_3]$
$[context_A]$ $[item_4]$	$[context_A]$ $[item_4]$
$[context_A]$ $[item_5]$	$[context_A]$ $[item_5]$
$\downarrow$	$\downarrow$
1. Step	**2. Step**
Activation of all traces in the relevant context	Comparison of the probe item in the activated set of

Figure 1.5 The two-step recognition memory model (REM.4)

1.6 Source Memory

Source memory represents the ability to specify the context in which the information is learned. Thereby, source memory refers to a variety of characteristics including spatial context, temporal context, social context of the event, through whom the event was perceived, and modality of apprehension. All these pieces of information help to state how the remembered information was formed (Johnson, Hashtroudi, & Lindsay, 1993; Lindsay, 2008). Identifying the source of to-be-remembered information is essential for memory tasks. For instance, in recognition memory task, individuals have to differentiate the items studied in the experiment from the newly presented items at test, which might seem familiar due to the other sources the particular item was encountered with.

Beyond helping to discriminate studied items from new ones, source memory is also separately tested to understand its nature. Source memory tasks require the discrimination between two or more sources. In a typical source memory task, participants first study a list of items in different contexts; for example, a group of information is given from a female voice and another group of information is learned from a male voice. Later, at test participants are asked to identify source information, which is either male or female voice in this case for the presented item. Source memory task might also follow an item recognition task including foils as well at test. In this case, participants are first required to make an item recognition decision for the test probes. Then, participants are expected to make source judgments for the test probes recognized as old in item recognition test.

One research conducted by Starns and Ksander (2016) investigated effects of additional learning of the information either in the same or different source/s on both item memory and source memory. Specifically, a list of information was presented only once without any repetition while another list of information was displayed three times in the same context (same-source repetition), and finally last group of information was repeated three times in different contexts (different-source repetition). In the first experiment, participants were required to make a source discrimination for the presented words using 6-point confidence scale. The second experiment was similar to the first experiment except that participants first made an old-new decision and then a source discrimination for each item. Results of this study revealed that the different-source repetition condition produced the same improvement in item recognition memory with the same-source repetition condition. Moreover, repetition of items in different sources decreased performance on source memory whereas repetition of items in the same source improved source memory performance when compared with the no-source repetition condition.

Therefore, results from Starns and Ksander's (2016) experiments indicated that strengthening items in a single source improves source memory whereas strengthening items in multiple sources creates interference in source memory. This was the first study in the memory literature that reveals additional study of sources also increases the probability of retrieval of strengthened sources from memory like item information. It also demonstrated that learning the same information from different sources creates interference on retrieval of source information and decreases source memory performance.

1.7 Aims of the Thesis Research

At the most general level, the aim of the current thesis was basically to investigate source memory performance after an additional study of an item either in the same source or in different sources in pure (separate) lists, and then to further examine the effect of strengthening of item information both in the same source and in different sources in mixed (same) lists. The proposed study might indicate whether the differentiation account could be generalized to context information by employing a source recognition task and allow an additional test for the context noise version of the REM model (REM.4; Shiffrin & Steyvers, 1997). Although the REM.4 model does not specify any mechanism regarding the retrieval of source information, its representation of context information is comparable to item information. Therefore, the list-strength paradigm was explored in source memory by assigning a recognition task. This was the starting point of this thesis.

In the list-strength paradigm, items are strengthened within the same list context. Even in pure list conditions, the source of the items is kept constant and only the item information is assumed to be strengthened. In the proposed study, items were strengthened either in the same context or in different contexts while item repetition was kept constant across changing contexts. Thus, firstly, item recognition task was employed to examine whether strengthening an item in multiple contexts affects item recognition in general by comparing the probability of correctly identifying a studied item across different source strength conditions. It was hypothesized that the item strength would increase in accordance with the number of item repetition regardless of the changing context (Starns & Ksander, 2016).

Later, a source recognition task was employed in order to test the list-strength paradigm in source memory. At study, items were repeated three times but either three times in the same context or three times in three different contexts or two times in one context and once in an additional context. Hence, different strength levels were created for source information while keeping the item strength same across conditions. In the second phase of the test after item recognition task, items were again presented but either in the same source they were obtained in the study phase (source target) or in a new source they have never encountered before at the study phase (source foil). Participants were required to make a source recognition decision for the presented sources using a yes-no decision task.

The first goal of the current thesis was to evaluate whether repetition of an item in a single source results in an increase in the likelihood of acceptance of that source (HR) as well as a decrease in the likelihood of acceptance of source foils (FAR). Starns and Ksander (2016) suggest that repetition of items in the same source increases source memory performance for that particular sources. Thereby, in this thesis, higher hit rates were expected for strong sources compared to weak sources. Further, since source recognition task gave the opportunity to examine memory performance of source foils, a decrease in the probability of identifying source foils as old after studying for an additional repetition of sources was also expected. In short, an SBME in source recognition, similar to that in item recognition, was expected in the contexts that are repeated in the pure strong lists compared to the weak contexts.

The second goal was to explore source recognition performance when some information in the list were studied repeatedly in the same context while the others were studied in multiple context (the mixed list). That is, how strengthening a group of contexts while keeping the others weak affects source memory performance of strong and weak sources would be investigated. The mixed list strength effect in item recognition has repeatedly revealed a null LSE effect which demonstrated that the discriminability between the foils and strong targets - or weak targets - in the mixed list are not different from the discriminability between the foils and strong targets – or weak targets – learned in the pure lists. This suggests that memory strength of weak items does not decrease due to the accompaniment of strong items in the same list compared to weak items in the pure weak list. Similarly, strong items' memory performance does not increase because they are studied along with weak items when compared to being studied in pure strong lists.

CHAPTER 2

EXPERIMENT 1

2.1. Method

2.1.1 Participants

52 undergraduate students from Middle East Technical University (METU) participated in the study and received a partial course credit. Two participants were removed before running the analysis since they did not comply with the instructions: One gave no response to and the other always pressed "yes" in source recognition task. After removing these two individuals, 50 participants (*M* age= 21.4, *SD* age = 1.77) were used in the final analysis. 60% of the participants were females and 74% were right-handed. All participants were native Turkish speakers with normal color-vision and normal or corrected-to-normal visual acuity.

2.1.2 Materials

The words were randomly selected from Turkish Word Norms (Tekcan & Göz, 2005). The database contains 905 words in total ranging from three to eight letter. 796 words remained after removing less than 4- and more than 7-letter words and color words such as "blue", "yellow" or "black". There were eight blocks each including 24 study words and 30 test words including six foils along with all targets. In total, 240 words were randomly sampled for each experimental session. Thereby, each word was used as a representation of information itself.

Source information is the information where the information itself is obtained from (Johnson, Hashtroudi, & Lindsay, 1993; Lindsay, 2008). That may refer to variety of characteristics including from where/whom or when the information is learned. In laboratory studies, very broad and different types of scales have been used to manipulate source information such as colors, locations of computer screen, woman and man's voices, faces, or temporal information. In the current thesis, source was manipulated with both locational and color information. Specifically, computer screen was divided into four and a different color was assigned to each quadrant. The reason to use both the color and location information together was to increase distinctiveness.[1]

2.1.3 Design and Procedure

Participants were instructed with a written instruction presented on the computer. They were asked to carefully read the instruction. After reading the instructions and after completion of the practice phase, if participants had any questions about the experimental process, the experimenter answered their questions. However, during the experiment participant were not allowed to ask any questions.

The experiment was a three factor (single-source, two-source, and three-source) within subject design. The practice phase was exactly the same as the experiment phase except the number of words. To be able to understand how they would proceed the experiment, participants practiced in all conditions with a smaller number of words. Total twelve words in the practice phase were randomly selected from the rest of the database (Tekcan & Göz, 2005).

In the study phase, all items were presented three times either in the same context or in different contexts. In one condition, words were presented three times in the same context (thrice in location A); in the other condition, words were presented again three times but in two different contexts (twice in location A and once in location B); and in the final condition, words were presented three times but this

[1] Several pilot studies were conducted before deciding on source manipulation. Pilots revealed that using color and location together increased distinctiveness.

time in three different contexts (once in each location A, B, C) (see Table 2.1 and Figure 2.1).

During the repetitions, all of the items were shuffled, and all of them were presented before an additional repetition occurred. That is, if an item was presented for the second time, all other items were then presented before a third presentation of any of the item was possible.

Table 2.1

Representation of Each Condition

Condition/Location	Location A	Location B	Location C	Location D
Single-Source Repetition	x3	-	-	-
Two-Source Repetition	x2	x1	-	-
Three-Source Repetition	x1	x1	x1	-

Source strength was manipulated across lists, meaning that each condition was presented separately in each block. Out of eight blocks in total, *single-source repetition* condition (*SSR*) and *three-source repetition* condition (*3SR*) were displayed in two blocks for each and *two-source repetition* condition (2SR) was presented in four blocks throughout the experiment.

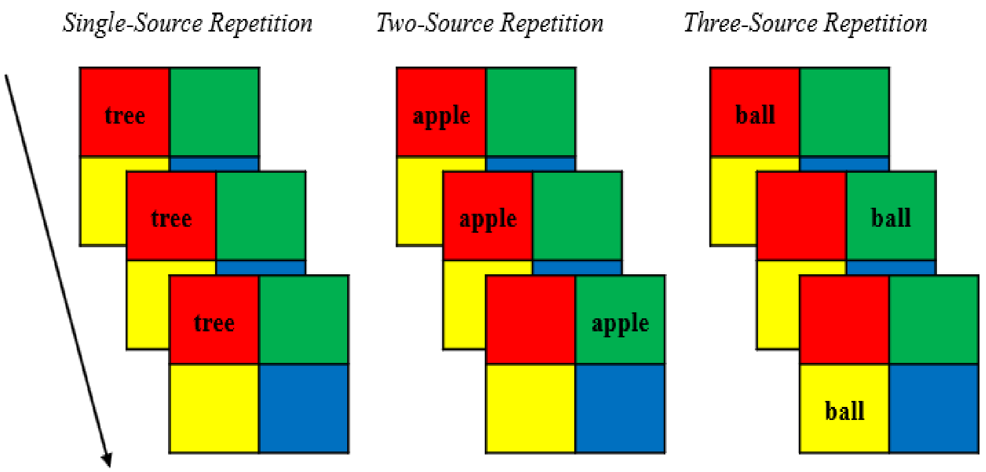

Figure 2.1 An illustration of study phase for each condition

Source and strength were counterbalanced such that each source in each condition was used in equal by preserving the strength manipulation (see Table 2.2). One should not be distracted by the fact that the number of distinct words across conditions was different. Total number of words across conditions was kept equal. In addition, total word presentation was equal in each location across each condition (see Table 2.3). Words were presented for 2000 milliseconds (msec) in their contexts and inter-stimulus interval (ISI) between the presentations was 250 msec.

Table 2.2

Number of Distinct Words Presented in Each Location for Each Condition

Condition/Location	Location A	Location B	Location C	Location D
Single-Source Repetition	6	6	6	6
Two-Source Repetition	12	12	12	12
Three-Source Repetition	18	18	18	18

Table 2.3

Number of Presentations in Each Location for Each Condition

Condition/Location	Location A	Location B	Location C	Location D
Single-Source Repetition	18	18	18	18
Two-Source Repetition	18	18	18	18
Three-Source Repetition	18	18	18	18

A distraction phase for 45 seconds was implemented between the study phase and the test phase with an aim of putting interval between the study and test phase while preventing subjects to rehearse the studied items and sources. In the distraction phase, participants were presented with random digits ranging from one to nine and required to do cumulative summation.

The test phase consisted of two stages. In the first stage, item recognition task was performed with 30 words including 24 targets and six foils presented at the center of the screen one by one without any source information. Participants were asked to respond ‘yes’ if the item was old; and they were asked to respond ‘no’ if it was new. For the items recognized as old, participants continued to the second stage in which source recognition task was performed. The source recognition task was assessed immediately after each item recognized as old. In this task, participants were again asked to respond ‘yes’ if the context in which the item presented at test was the studied context for that item; and they were asked to respond ‘no’ if the context in which the item presented at test was a new context for that item (see Figure 2.2).

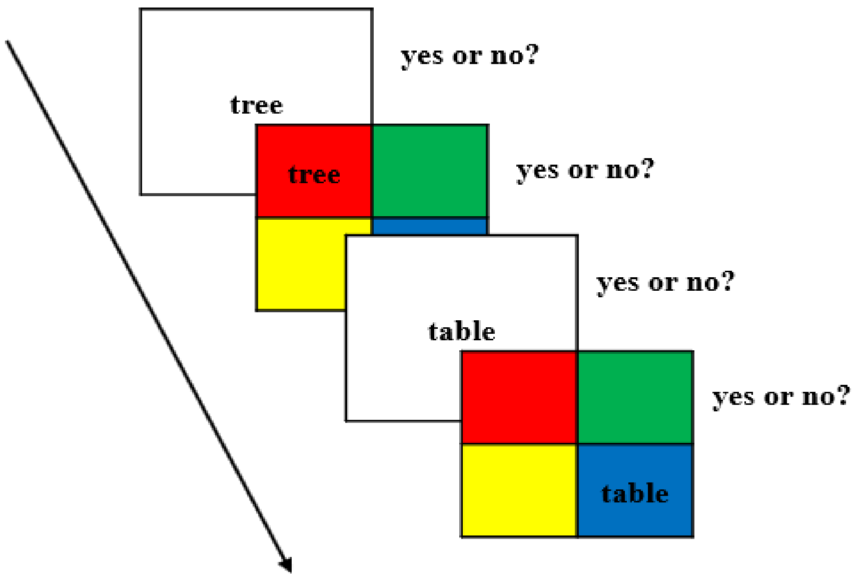

Figure 2.2 An illustration of two-stage test phase

Items were presented either in the same context with the study phase (source target) or in a different context from the study phase (source foil). There were six source foils and the rest 18 old items were re-presented in the same context with the study phase as source targets (see Figure 2.3).

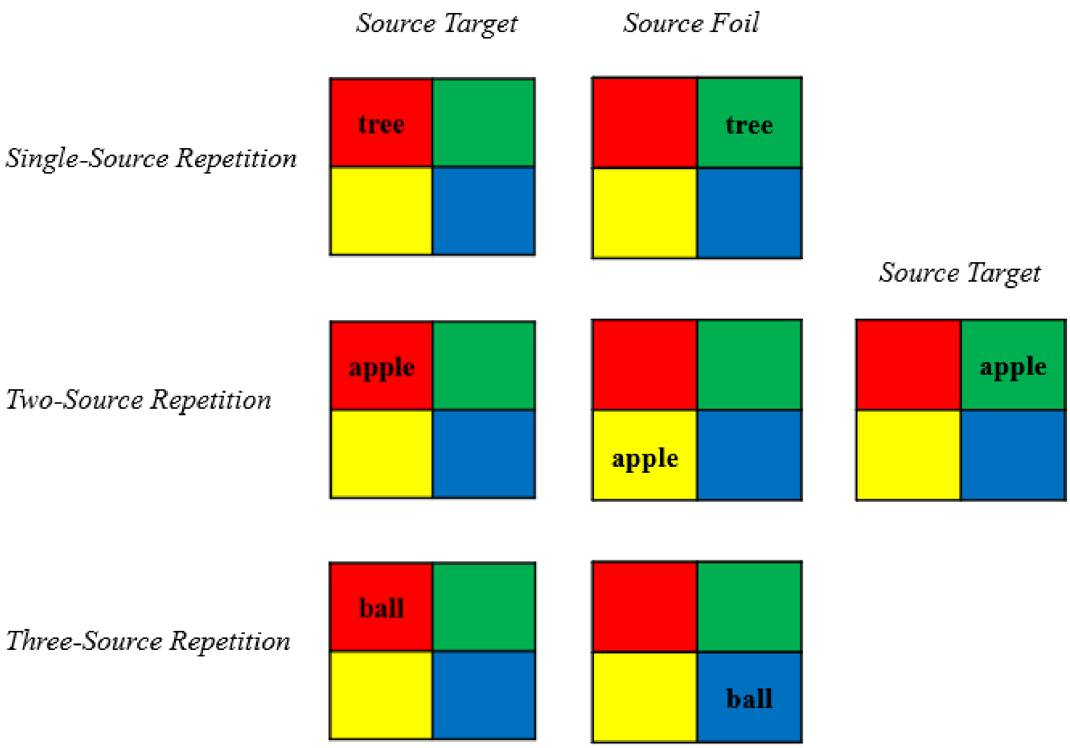

Figure 2.3 An illustration of source targets and foils throughout conditions

Selection of source targets was crucial for the current experiment. For the *SSR*, the source target was only one source in which the words were presented thrice. In other conditions, items were strengthened either in two (2SR) or three (3SR) different sources. For the *3SR*, the source targets were selected from one of the contexts in which words were presented only once. In other words, since the words belonging to the *3SR* were displayed equally - only once in each source -, any of the presented sources could be selected as a source target at test. For the *2SR*, there were two source targets: one was the source in which words were presented only once and the other was the source in which words were presented twice. At study, the *2SR* was studied for four blocks which correspond to two times more than the other conditions, SSR and 3SR, in which only two blocks were displayed. This was because both contexts of the *2SR* were considered as essential in the present experiment. Therefore, at test, both source targets of the *2SR* were used. Precisely, the source target was the context in which the *2SR* words were presented only once in half of the blocks – two blocks - and the source target was the context in which the words were presented twice in the rest of the two blocks at test.

Throughout the test phase, participants were asked to put their right and left index fingers on the predetermined keys in order to give yes/no responses for item and source recognition tasks. Participants were required to respond to each presentation and there was an upper limit - seven seconds - to be able to give a response. If participants did not respond within seven seconds, they received a warning indicating that a response must be given within seven seconds. After the warning screen, the next stimulus was presented. The reason of determining an upper limit was to eliminate attention loss during the test.

2.2 Results[2]

All analysis in this thesis was conducted in R 3.5.1 (R Core Team, 2018). In addition to the traditional null hypothesis testing, Bayes Factor (BF) was calculated to further understand how much the alternative hypothesis stating a difference between the conditions over the null hypothesis stating no difference between the conditions - or how much the null hypothesis over the alternative hypothesis - was supported with the data. BF was reported either as a BF_{10} which is the ratio of the likelihood of the alternative hypothesis to the likelihood of the null hypothesis and suggests how much the alternative hypothesis is supported by the data over the null hypothesis, or as a BF_{01} which suggests how much the null hypothesis is supported by the data over the alternative hypothesis. For example, $BF_{10} = 5$ means that the data is five times more likely under the alternative hypothesis than the null hypothesis and $BF_{01} = 81.3$ means that the null hypothesis is 81.3 times more likely than the alternative hypothesis for the data.

[2] All the data, MATLAB codes, and R codes for the analysis can be found in this link: https://osf.io/4ftmb/

2.2.1 Item Recognition

2.2.1.1 Hit Rates and False Alarm Rates

2.2.1.1.1 Normality Assumption

Before conducting Analysis of Variance (ANOVA) for repeated measures, normality assumption was checked for the residuals. Visual graphs including histogram, Q-Q plot and box plot were drawn, Shapiro-Wilk test was performed, and additionally skewness and kurtosis values were calculated in order to understand if there was any violation of normality.

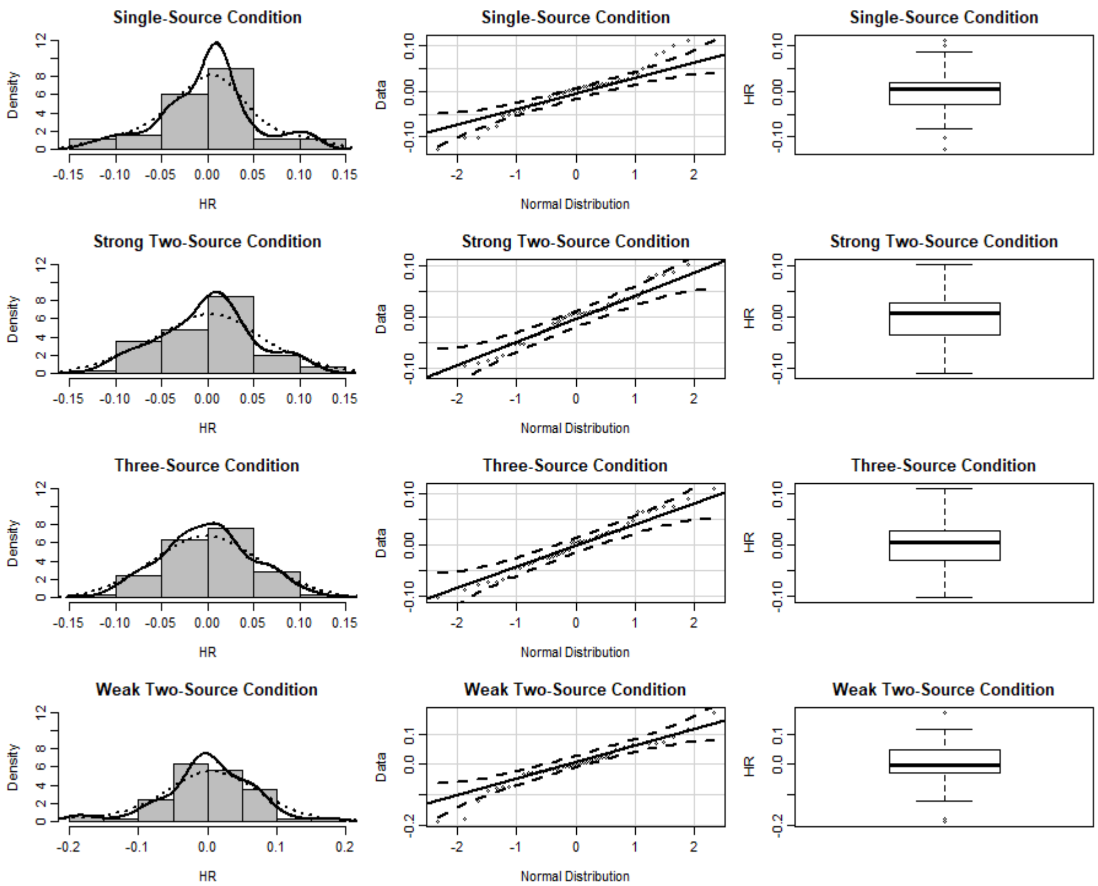

Figure 2.4 Normality analysis for hit rates in item recognition

According to the results from Shapiro-Wilk normality test, HRs in item recognition were normally distributed in the *SSR* condition [$W = 0.963$, $p = 0.118$, Skewness = -0.06, Kurtosis = 0.647], in the strong *2SR* condition [$W = 0.975$, $p = 0.374$, Skewness = -0.016, Kurtosis = -0.191], in the *3SR* condition [$W = 0.989$, $p = 0.917$, Skewness = 0.077, Kurtosis = -0.336] and finally in the weak *2SR* condition [$W = 0.959$, $p = 0.077$, Skewness = -0.498, Kurtosis = 1.522] (see Figure 2.4).

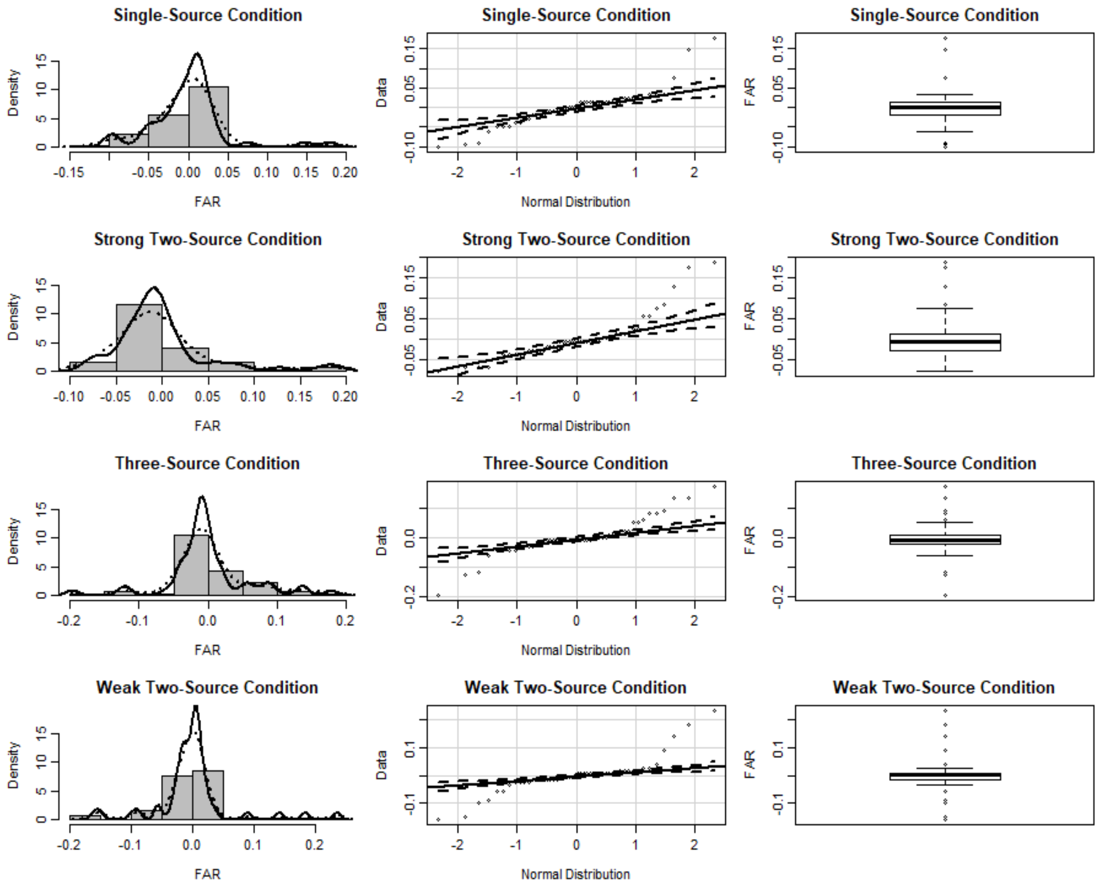

Figure 2.5 Normality analysis for false alarm rates in item recognition

On the other hand, Shapiro-Wilk test indicated that the residuals for item recognition FARs in the *SSR* condition was non-normally distributed [$W = 0.855$, $p < 0.001$, Skewness = 1.13, Kurtosis = 4.714], as well as the residuals for item recognition FARs in the strong *2SR* [$W = 0.811$, $p < 0.001$, Skewness = 1.851, Kurtosis = 4.39], as well as those in the *3SR* [W = 0.88, p < 0.001, Skewness = 0.125, Kurtosis = 2.884], and finally the residuals for item recognition FARs in the weak *2SR* [W = 0.796, p < 0.001, Skewness = 1.068, Kurtosis = 5.16] (see Figure 2.5).

2.2.1.1.2 Friedman Rank Sum Test

Since the residuals of FARs in item recognition were not distributed normally, a nonparametric Friedman Rank Sum test was conducted to test whether strengthening items in the same source or in different sources have an effect on recognition of foils or not. There was a statistically significant difference in FARs depending on that items were strengthened in the same source or not, $\chi 2$ (3) = 8.22, p = 0.042. Further, pairwise post-hoc analysis with Nemenyi test was conducted to understand that how much repetition of items whether in the same or different source/s cause a difference in the endorsements of item foils as studied. Results revealed that there were not statistically significant pairwise differences between any groups. [3]

2.2.1.1.3 One-way Repeated-Measures Analysis of Variance

Mauchly's Test for Sphericity indicated that the assumption of sphericity has not been violated for neither item recognition HRs, [χ^2 (3) = 0.821, p = 0.095] nor item recognition FARs, [χ^2 (3) = 0.833, p = 0.121]. One-way repeated-measures ANOVA revealed that neither item recognition HRs between the groups nor item recognition FARs between the groups did not differentiate from each other, [F (3, 147) = 0.393, p = 0.758] and [F (3, 147) = 1.281, p = 0.283], respectively (see left column of Figure 2.6).

[3] This might be because Nemenyi test has low power to detect a significant difference in any pair because of lower effect size Friedman Rank Sum test revealed.

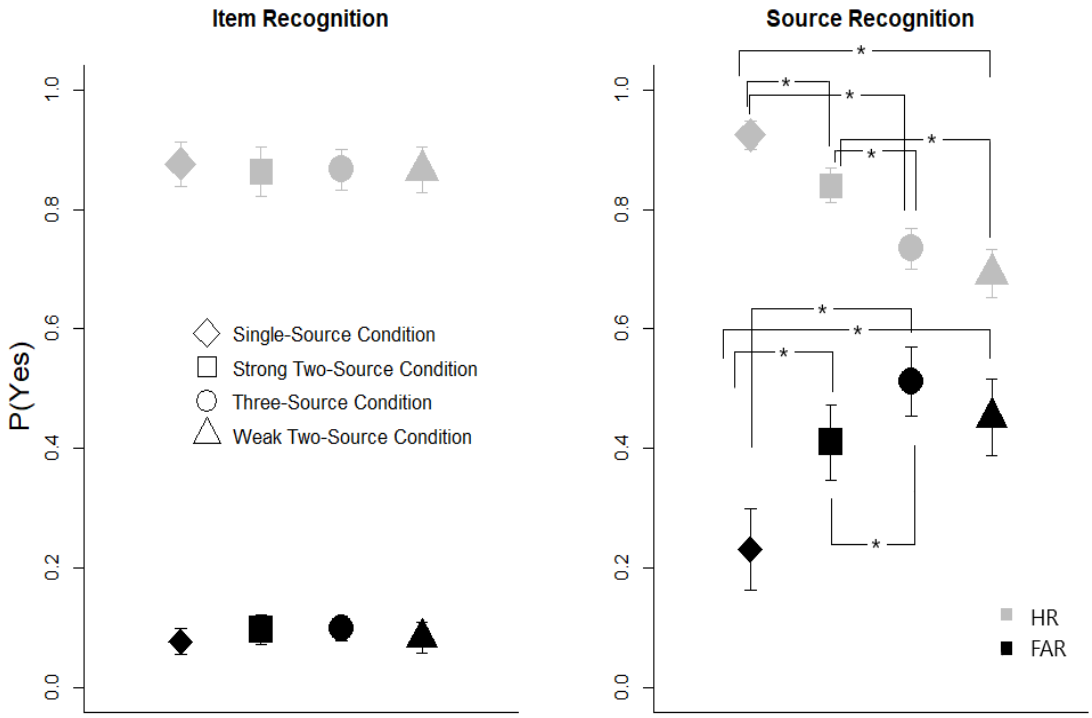

Figure 2.6 The strength-based mirror effect in source recognition memory

2.2.1.2 Distance between the Means of Target and Foil Distributions

Distance between the means of the distributions of the correct and incorrect endorsements (d') was further calculated in item recognition. In order to avoid an infinite d', HR and FAR values which exactly equal to 1 and 0 were converted into 1-1/(2N) and 1/(2N), respectively, where N is the number of trials on which the proportion is based (Macmillan & Creelman, 2005). After the correction, d' was computed for all conditions.

2.2.1.2.1 Normality Assumption

Results of Shapiro-Wilk test demonstrated that item recognition d' was normally distributed in the strong *2SR* [W = 0.983, p = 0.703, Skewness = -0.28, Kurtosis = 0.087], in the *3SR* [W = 0.981, p = 0.606, Skewness = 0.332, Kurtosis = -0.279] and in the weak *2SR* [W = 0.973, p = 0.305, Skewness = -0.316, Kurtosis = -0.061] but not in the *SSR*, [W = 0.952, p = 0.043, Skewness = -0.842, Kurtosis = 1.236] (see Figure 2.7).

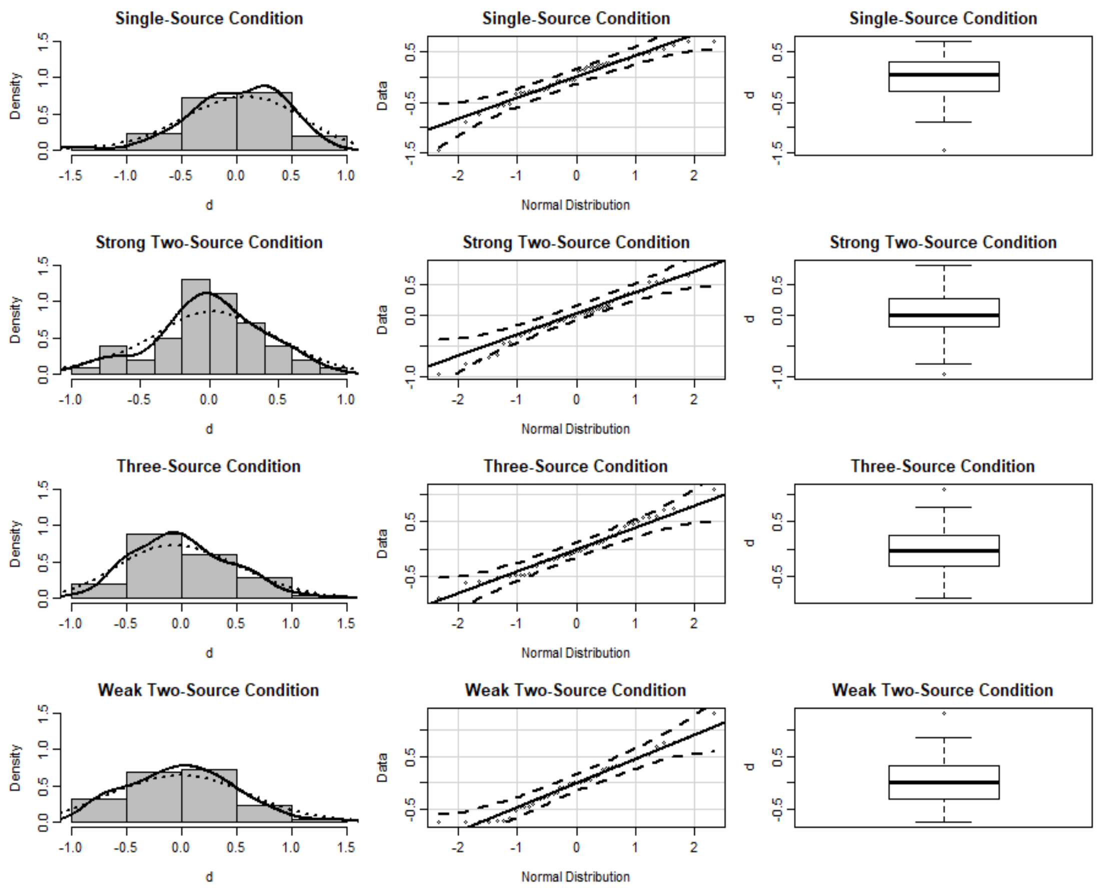

Figure 2.7 Normality analysis for d' in item recognition

2.2.1.2.2 Friedman Rank Sum Test

Item recognition discriminability between targets and foils was not statistically different between conditions in which items were strengthened at an equal level but either at the same or different sources, $\chi 2$ (3) = 5.54, p = 0.136.

2.2.1.2.3 One-way Repeated-Measures Analysis of Variance

Mauchly's Test for Sphericity indicated that the assumption of sphericity has been violated for d' [χ^2 (3) = 0.779, p = 0.036]. Therefore, degrees of freedom were corrected using Huynh-Feldt Corrections (ε = 0.92). One-way repeated-measures ANOVA was assessed to reveal whether discriminability in item recognition across conditions were equal or not. ANOVA results also replicated that there was not a significant difference in discriminability between targets and foils in item recognition across conditions, [F (2.76, 135.24) = 2.348, p = 0.081] (see the left column of Figure 2.8).

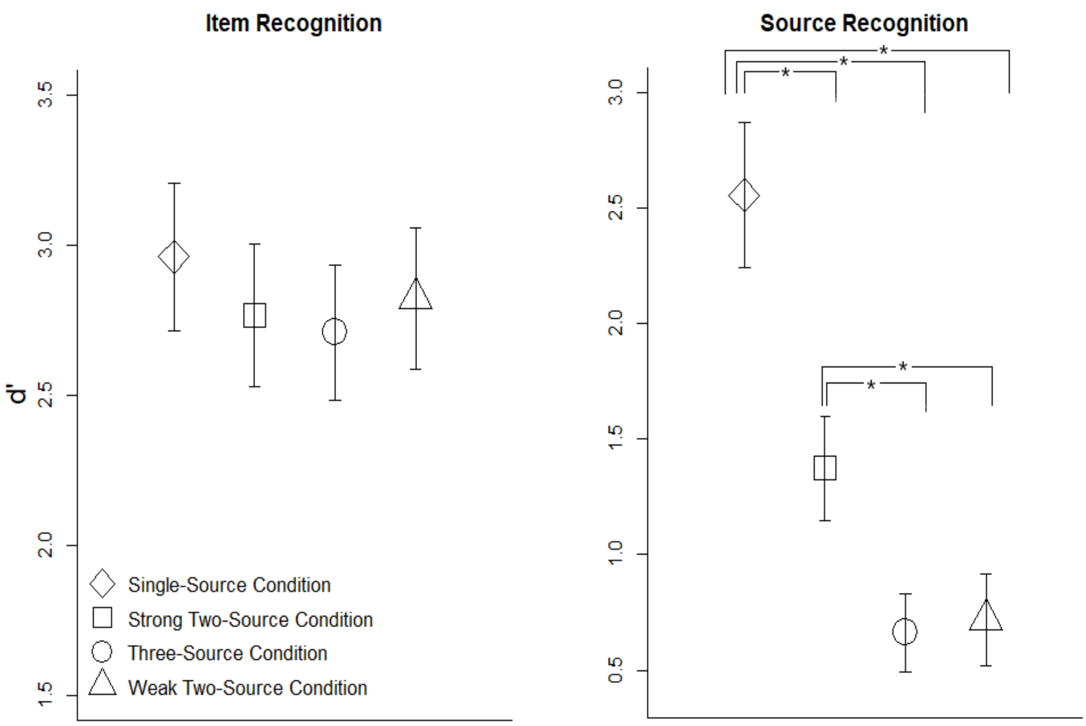

Figure 2.8 The strength effect in d' when pure study lists

2.2.2 Source Recognition

2.2.2.1 Hit Rates and False Alarm Rates

Source recognition task was employed for each item recognized as old in item recognition task regardless of whether the item was target or foil. In the analysis; however, source memory performance was explored for only the target items. Like in the item recognition analysis, HRs and FARs were calculated for all conditions. HRs were defined as the correct endorsements to the items presented in their matched context and FARs as the incorrect endorsements to the items presented in the mismatched context from the studied context/s.

2.2.2.1.1 Normality Assumption

Residuals of source recognition HRs were normally distributed in each condition as Shapiro-Wilk test revealed; in the *SSR*, [W = 0.98, p = 0.575, Skewness = -0.318, Kurtosis = -0.124], in the strong *2SR* [W = 0.969, p = 0.206, Skewness = -0.068, Kurtosis = -0.007], in the *3SR* [W = 0.99, p = 0.945, Skewness = 0.086, Kurtosis = -0.17] and in the weak *2SR* [W = 0.977, p = 0.445, Skewness = -0.041, Kurtosis = -0.594] (see Figure 2.9).

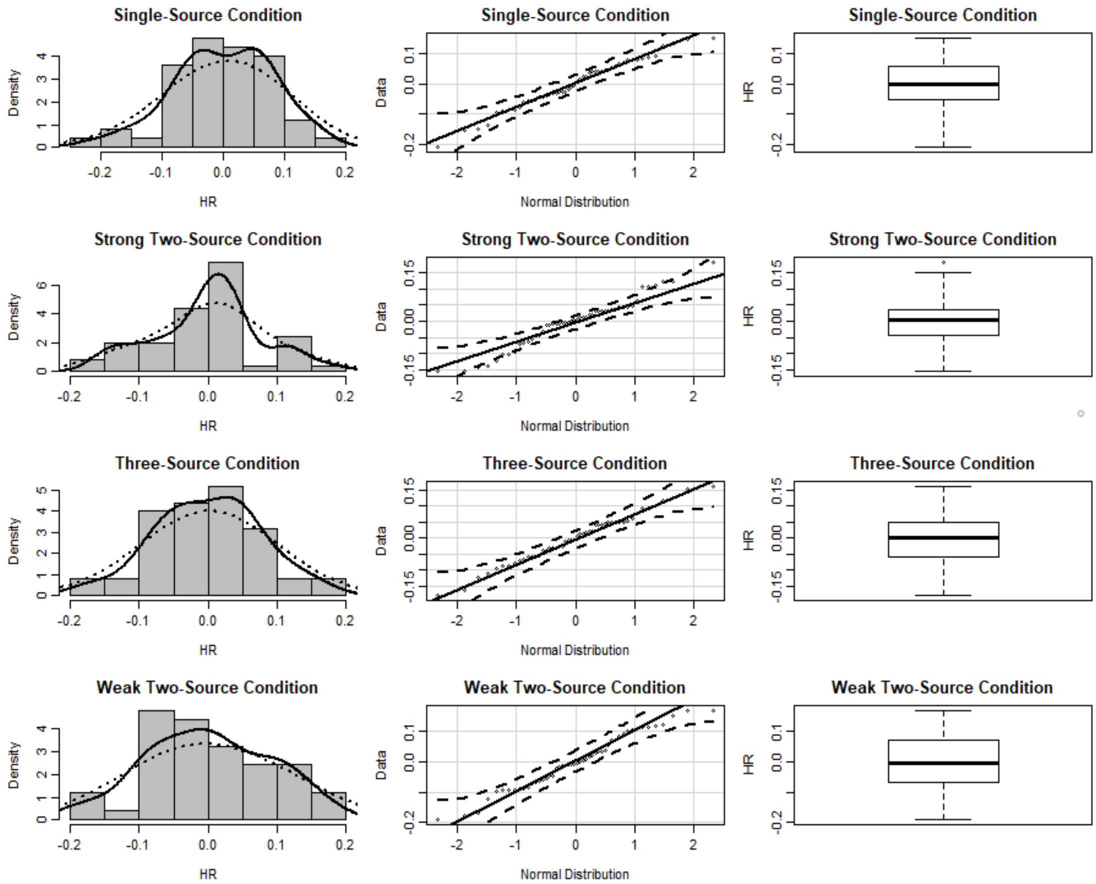

Figure 2.9 Normality analysis for hit rates in source recognition

Normality of residuals was also assumed for source recognition FARs in the *SSR*, [W = 0.981, p = 0.605, Skewness = 0.371, Kurtosis = -0.231], in the strong *2SR* [W = 0.972, p = 0.278, Skewness = 0.178, Kurtosis = -0.773], in the *3SR* [W = 0.988, p = 0.883, Skewness = -0.309, Kurtosis = 0.093] and in the weak *2SR* [W = 0.988, p = 0.886, Skewness = 0.1, Kurtosis = -0.04] (see Figure 2.10).

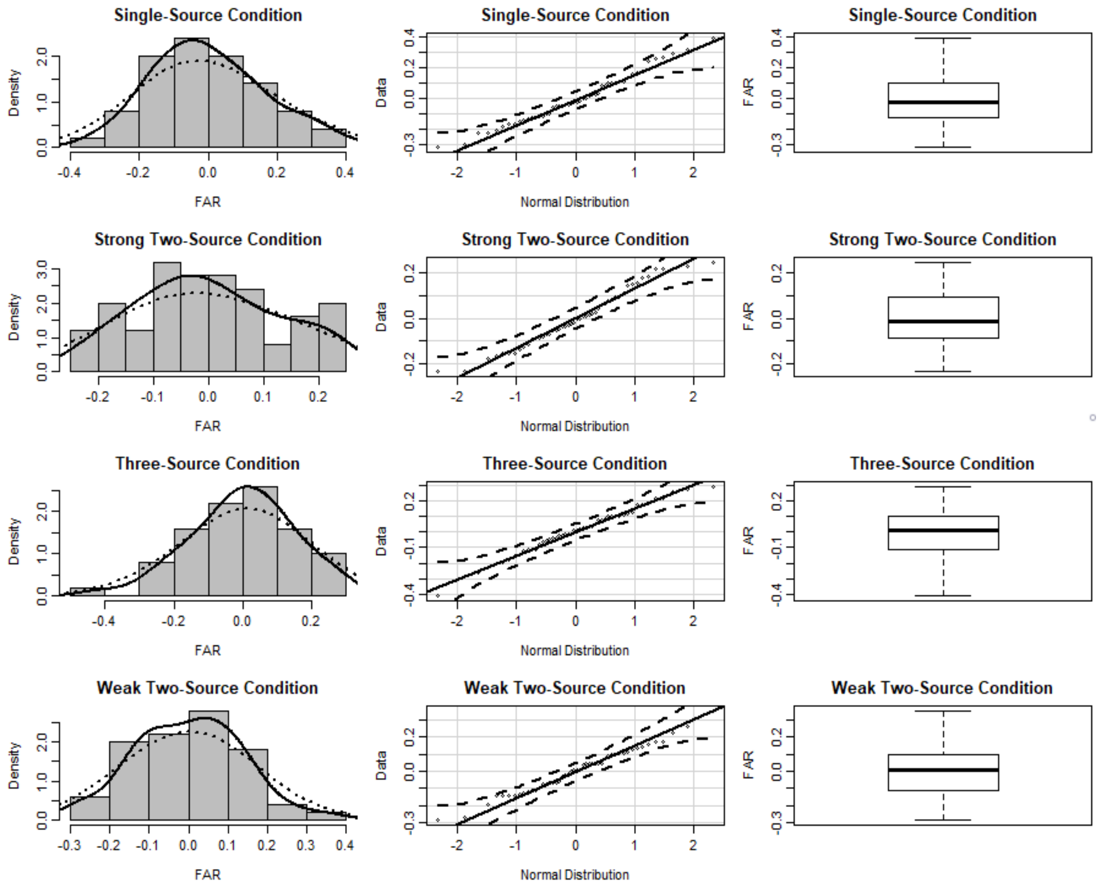

Figure 2.10 Normality analysis for false alarm rates in source recognition

2.2.2.1.2 One-way Repeated-Measures Analysis of Variance

Mauchly's Test for Sphericity indicated that the assumption of sphericity has not been violated for HRs [χ^2 (3) = 0.902, p = 0.426]. One-way repeated-measures ANOVA results showed that there was at least one significant difference between the conditions for source recognition HRs, [F (3,147) = 62.15, p < 0.001, η^2= 0.559]. Post-hoc comparisons using the t-test with Bonferroni correction indicated that contexts strengthened three times in the *SSR* (M = 0.924, SD = 0.085, *95% CI* = [0.901, 0.948]) had higher HR compared to the context strengthened twice in the *2SR* (M = 0.840, SD = 0.104, *95% CI* = [0.811, 0.869]), (Cohen's d = 0.714, BF_{10} = 1179.649). The *SSR* had also higher HR than the contexts presented only once in the *2SR* (M = 0.692, SD = 0.146, *95% CI* = [0.652, 0.732]), (Cohen's d = 1.54, BF_{10} = 2634E+8) and in the *3SR* (M = 0.735, SD = 0.123, *95% CI* = [0.701, 0.769]), (Cohen's d = 1.499, BF_{10} = 1074E+8). HR was also higher for the contexts repeated two times in the *2SR* than both weak contexts presented once in the *2SR* (Cohen's d = 1.063, BF_{10} = 4371E+3) and the *3SR* (Cohen's d = 0.805, BF_{10} = 9616.388). However, there was no significant HR difference between the weak contexts of the *2SR* and the *3SR* (BF_{01} = 1.362) (see right column of Figure 2.6).

Mauchly's Test for Sphericity indicated that the assumption of sphericity has not been violated for FARs [χ^2 (3) = 0.847, p = 0.16]. One-way repeated-measures ANOVA also revealed that FARs were significantly differ across conditions, [F (3,147) = 25.64, $p < 0.001$, $\eta^2 = 0.344$]. Post-hoc comparisons using the t-test with Bonferroni correction indicated that FAR was lower for three-times strengthened context in the *SSR* (M = 0.232, SD = 0.244, *95% CI* = [0.164, 0.299]) when compared to the strong *2SR* (M = 0.411, SD = 0.227, *95% CI* = [0.348, 0.474]), (Cohen's d = -0.744, BF_{10} = 2333.598), the weak *2SR* (M = 0.452, SD = 0.23, *95% CI* = [0.388, 0.516]), (Cohen's d = -0.947, BF_{10} = 277118.851), and weak context in the *3SR* (M = 0.512, SD = 0.207, *95% CI* = [0.455, 0.57]), (Cohen's d = -0.99, BF_{10} = 773092.533). In addition, the strong *2SR* had lower FAR than the *3SR* (Cohen's d = -0.486, BF_{10} = 10.015). There was no other significant difference in FARs between the weak *2SR* and the strong *2SR* (BF_{01} = 7.303) and between the weak *2SR* and the *3SR* (BF_{01} = 3.253) (see right column of Figure 2.6).

2.2.2.2 Distance between the Means of Target and Foil Distributions

2.2.2.2.1 Normality Assumption

Shapiro-Wilk test revealed that source recognition d' was normally distributed in the *SSR*, [W = 0.962, p = 0.107, Skewness = -0.605, Kurtosis = 0.101], in the strong *SSR* [W = 0.987, p = 0.871, Skewness = 0.024, Kurtosis = 0.374], in the *3SR* [W =

0.988, p = 0.889, Skewness = 0.218, Kurtosis = -0.146] and in the weak *2SR* [W = 0.961, p = 0.101, Skewness = -0.242, Kurtosis = 1.876] (see Figure 2.11).

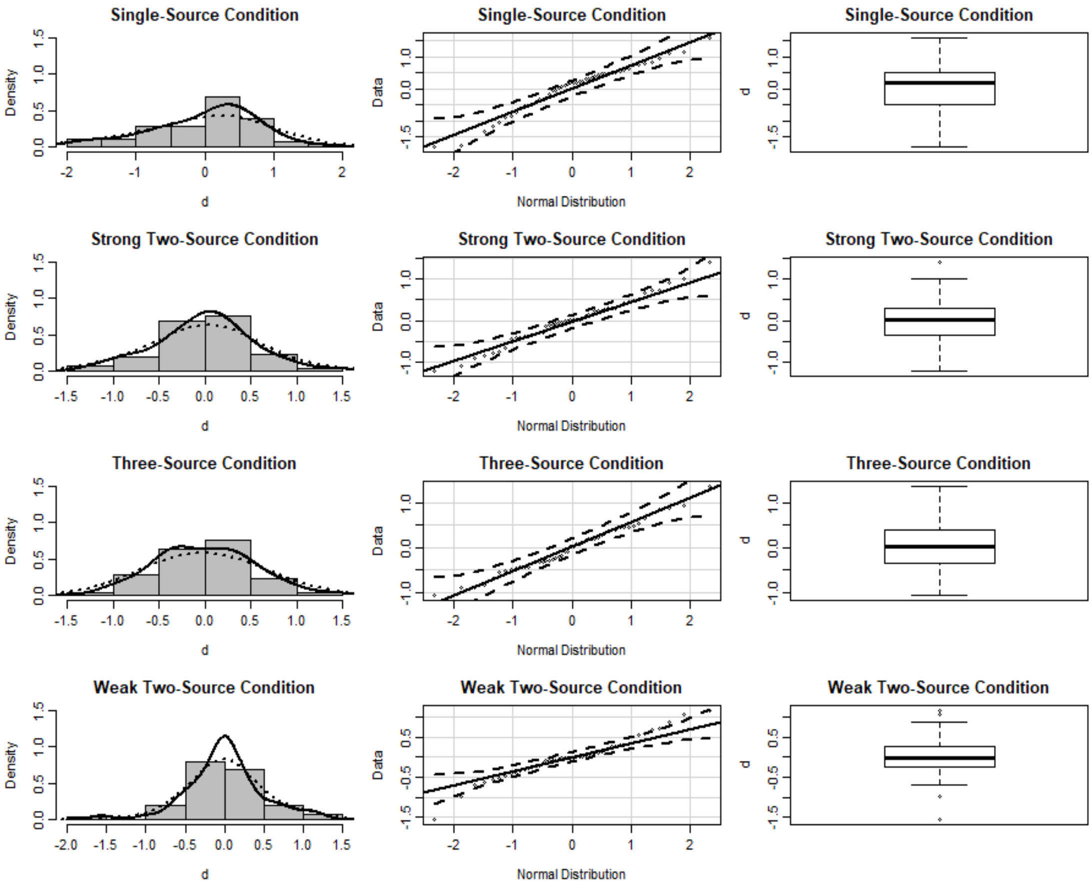

Figure 2.11 Normality analysis for d' in source recognition

2.2.2.2.2 One-way Repeated-Measures Analysis of Variance

Mauchly's Test for Sphericity indicated that the assumption of sphericity has been violated for d' [χ^2 (3) = 0.674, p = 0.002]. Therefore, degrees of freedom were corrected using Huynh-Feldt Corrections (ε = 0.826). One-way repeated-measures ANOVA was performed to measure the discriminability in source recognition across conditions. There was significantly different source recognition discriminability across conditions, [F (2.478, 121.422) = 83.83, p < 0.001, η^2=

0.631]. Post-hoc comparisons using the t-test with Bonferroni correction detected that contexts strengthened three times in the *SSR* (*M* = 2.554, *SD* = 1.138, *95% CI* = [2.239, 2.87]) had higher discriminability values than the context strengthened twice in the *2SR* (*M* = 1.373, *SD* = 0.809, *95% CI* = [1.149, 1.598]), (Cohen's *d* = 1.053, BF_{10} = 3442E+3) and the contexts presented only once in the *2SR* (*M* = 0.717, *SD* = 0.718, *95% CI* = [0.518, 0.916]), (Cohen's *d* = 1.752, BF_{10} = 2398E+10) and in the *3SR* (*M* = 0.662, *SD* = 0.608, *95% CI* = [0.493, 0.830]), (Cohen's *d* = 1.616, BF_{10} = 1372E+9). In addition, the contexts repeated two times in the *2SR* had higher discrimination than both weak contexts presented once in the *2SR* (Cohen's *d* = 0.786, BF_{10} = 6160.65) and the *3SR* (Cohen's *d* = 0.942, BF_{10} = 242093.905). However, there was no significant difference in d' between the weak contexts of the *2SR* and the *3SR* (BF_{01} = 13.722) (see right column of Figure 2.8).

2.2.3 When FARs for The Weak *2SR* and The Strong *2SR* Are Unified

Although the weak *2SR* and the strong *2SR* conditions were the pure test lists including either weak or strong source targets at test, respectively, the study list was the same for both conditions - half of the studied sources was strong and the other half was weak. Results above revealed no difference between these two conditions when the test cue was an item and a source foil and supported the assumption of the REM model (Shiffrin & Steyvers, 1997): the test cue is compared with all the contents in memory to make a decision. Therefore, recognition memory performance of the weak *2SR* and of the strong *3SR* were analyzed together when a foil was displayed at test.

2.2.3.1 Item Recognition

Mauchly's Test for Sphericity indicated that the assumption of sphericity has not been violated for the conditions when the FARs of the weak *2SR* and the strong *2SR* conditions were unified [χ^2 (2) = 0.906, *p* = 0.092]. One-way repeated-measures ANOVA indicated no significant difference between groups, [F (2, 98) = 1.736, p = 0.182].

2.2.3.2 Source Recognition

Mauchly's Test for Sphericity indicated that the assumption of sphericity has been violated for the source recognition FARs across conditions [χ^2 (2) = 0.72, p < 0.001]; therefore, degrees of freedom were corrected using Huynh-Feldt Corrections (ε = 0.802). One-way repeated-measures ANOVA revealed that at least one group differed from each other significantly, [F (1.604, 78.596) = 39.55, p < 0.001, η^2 = 0.447]. Post-hoc comparisons using the t-test with Bonferroni correction indicated that FAR were lower for the *SSR* (M = 0.232, SD = 0.244, *95% CI* = [0.164, 0.299]) when compared to the unified *2SR* (M = 0.431, SD = 0.198, *95% CI* = [0.377, 0.486]), (Cohen's d = -0.965, BF_{10} = 593485.136) and the *3SR* (M = 0.512, SD = 0.207, *95% CI* = [0.455, 0.57]), (Cohen's d = -0.99, BF_{10} = 1096E+3). There was also significant difference in the FARs between the unified *2SR* and the *3SR* (Cohen's d = -0.432, BF_{10} = 5.278).

2.3. Discussion

Experiment 1 was designed to test how additional learning of information in the same source affects source memory performance compared to learning from different sources. Item information were strengthened three times but either in the same source or in different sources. Thereby, item strength level was kept equal across source strength levels in order to eliminate possible effects of item strengthening on source information and to observe the clear effect of additional learning in the same source on source memory. Unlike item information, context information was strengthened either three times by presenting the items three times in that context, or two times by presenting the items two times in that context – and once in other context –, or only once by presenting the items only once in that context – and one time in other two contexts. Hence, context strength level varied between one and three for the particular strong items. Analysis was done for both item recognition and source recognition.

Results revealed very high acceptance of studied items as old and very low acceptance of foils as old for item recognition regardless of in which source items were strengthened; either same or different. That is, item recognition performance was the same for all conditions. These results were also compatible with the results from the research by Starns and Ksander (2016).

Source memory results basically showed that recognition of source targets and rejection of new sources in which items were presented for the first time at test differed with respect to source repetition times. Information learned three times in only one source in the *SSR* revealed the highest recognition of source information and the lowest acceptance of source foils compared to all the other conditions. When information learned two times in one source and once in another source in the *2SR,* source recognition had the second highest hits and the second lowest false alarms. Strong sources in the *2SR* had increased hits than weak sources in the *2SR* and those in the *3SR*. In addition, strong sources in the *2SR* also had decreased recognition of source foils than the *3SR.* In short, source recognition performances revealed that increasing the number of occurrences in a list of contexts improved performance on these contexts. These findings can also be labeled as the SBME in source recognition memory like in item recognition memory.

As the REM.4 model (Shiffrin & Steyvers, 1997) proposes that context information is stored in memory with its features, this study might demonstrate that repetition of source information might also result in storing more information about the particular source. Consequently, more accurate and complete source representation might be formed in memory and this results in getting much more similar to its target and dissimilar to the new ones.

Endorsements of studied sources and sources in which the information never studied were statistically comparable for the weak source in the *2SR* and the weak source in the *3SR*. In addition, when the information was presented in a new source at test as a source foil, testing those source foils with two-times strengthened sources or weak sources from the *2SR* did not change the probability of acceptance of those source foils. One can easily recognize that the *2SR* was a mixed list design in its nature. The study list contained both the weak and two-times strengthened strong sources. Source memory performance on incorrectly endorsing of source foils was compatible for the weak and strong sources when the study list was a mixed list (the *2SR*) because the list activated for making a recognition decision was the same. This result is well predicted by the differentiation account.

Since the study list was the same for the weak and strong *2SR*s and their source FARs were also compatible as the results revealed, these two conditions were unified and further analyzed to compare FARs in both item recognition and source recognition. Item recognition results demonstrated no difference in FARs across three conditions. Source recognition results again revealed the same results with the previous one: the probability of identifying source foils as studied decreased in the *SSR* compared to the performance in the unified *2SR* and the *3SR*. In addition, the unified *2SR* had lower endorsement of sources in which the information was never studied relative to the *3SR.*

Finally, when information was acquired three times in the same source, this strengthened source was discriminated from the never-studied sources much more compared to the conditions in which an information was repeated in different sources. Additionally, when source recognition was assessed with two-times strengthened sources and foils, again, discriminability of those strong sources from the foils was higher than the weak sources in the *2SR* and the *3SR.* However, source recognition performance was not different between the weak sources in the *2SR* which also includes strong sources and the weak sources in the *3SR.*

The research conducted on the list-strength effect in item recognition has revealed that strengthening some items in a list while keeping the others weak does not reduce memory performance for the weak items in item recognition when compared them with the weak items from the pure weak lists (*null list-strength effect*) (Ratcliff et al., 1990; Shiffrin et al., 1990; Yonelinas et al., 1992). The current study further demonstrated that strengthening of some sources by repetition of information in the same source while keeping the other sources weak by presenting information only once in it did not harm weak source recognition. Precisely, no difference in source memory performance for the weak sources in the *3SR* (the pure weak list) and the weak sources in the *2SR* (the mixed weak list) was revealed in this experiment. This was very similar result with the mixed-list strength results in item recognition revealed previously in the literature.

CHAPTER 3

EXPERIMENT 2

Experiment 1 revealed an interesting finding in source memory. When source memory performance in the pure weak list (the *3SR*) was compared with that in the mixed weak list (the weak *2SR*), the results revealed a null LSE in source memory. To further investigate the effect of additional learning from the same source in a list including the information repeated in multiple sources on source memory, Experiment 2 was conducted with mixed study lists.

3.1 Method

3.1.1 Participants

50 undergraduate students (*M* age= 20.98, *SD* age = 1.62) from METU participated to the study in exchange for partial course credit. There were 40 females and 10 males, and 44 right-handed and 6 left-handed people. All participants were native Turkish speakers with normal color-vision and normal or corrected-to-normal visual acuity.

3.1.2 Materials

The same word pool as in Experiment 1 was used.

In the current experiment, the study phase was divided into eight blocks each including 24 words. Half of the words were displayed three times in the same source and the other half three times in three different sources in the same list. The test phase contained 15 words including three item foils along with the targets belonging to either strong sources or weak sources. In total, 216 words were randomly sampled for each experimental session from the Turkish Word Norms (Tekcan & Göz, 2005) after removing color words and the words less than 4- or more than 7- letters.

3.1.3 Design and Procedure

The procedure was almost the same with Experiment 1 but there were vital differences. The study lists in Experiment 2 were mixed in strength such that weak sources and strong sources were displayed in the same list. The experiment followed a two factor (single-source, three-source) within subject design, where only the *SSR* condition and the *3SR* condition were used in this experiment (see Table 2.1 in the Chapter 2). Half of the items in a study list was strengthened three times in the same source (the *SSR*) and the other half was strengthened in three different sources (the *3SR*). In this way, sources in which items were strengthened three times were also strengthened three times for that particular items. Sources in which items were presented only once remained as weak sources. Thereby, the mixed-list design for source memory was created (see Figure 3.1).

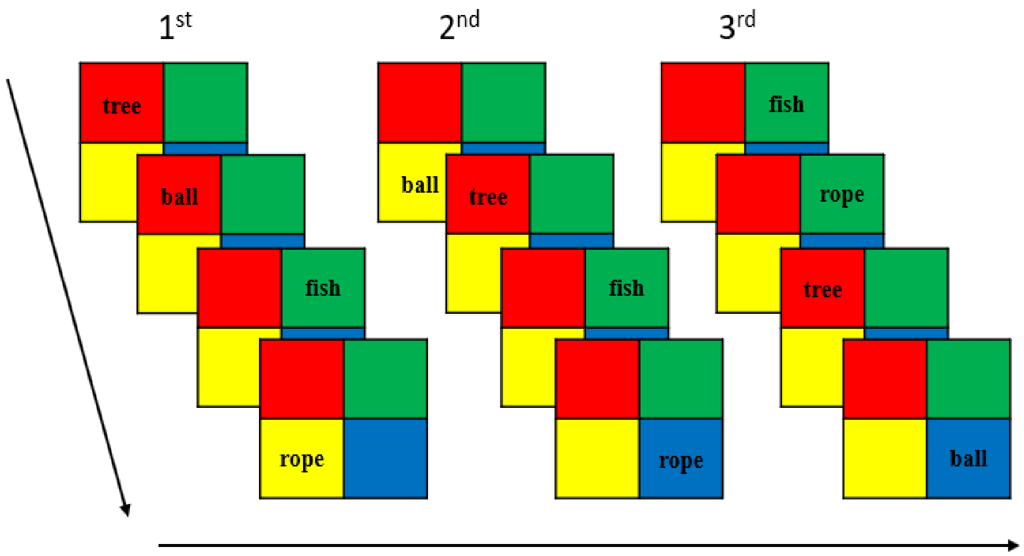

Figure 3.1 An illustration of study phase with mixed-list design

In one block, 12 items were studied in the *SSR* condition and another group of 12 items were studied in the *3SR* condition. Thereby, 24 words were studied in total which was the same as the total number of words studied across conditions in the first experiment. Each source information was strengthened equally in and across each condition (see Table 3.1). To be able to do that; however, the number of distinct words presented in each context was different across conditions (see Table 3.2).

Table 3.1

Number of Presentations in Each Location for Each Condition in Experiment 2

Condition/Location	Location A	Location B	Location C	Location D
Single-Source Repetition	9	9	9	9
Three-Source Repetition	9	9	9	9

Table 3.2

Number of Distinct Words Presented in Each Location for Each Condition in Experiment 2

Condition/Location	Location A	Location B	Location C	Location D
Single-Source Repetition	3	3	3	3
Three-Source Repetition	9	9	9	9

The test phase again consisted of two stages. In the first stage of the test, item recognition task was performed and for the items recognized as old, participants performed a conditionalized source recognition task (see Figure 2.2 in the Chapter 2). Each test block included half of the targets of the study block - either the *SSR* or the *3SR* targets - and additional three new items. That is, the studied items from either the *SSR* condition or the *3SR* condition were chosen to create a pure test list. In addition, half of the test blocks was a pure strong test list and the other half was a pure weak test list. In the conditionalized source recognition task in which participants made a source recognition for the items recognized as old, nine trials were tested with source targets and three trials with source foils.

3.2 Results

3.2.1 Item Recognition

3.2.1.1 Normality Assumption

Normality assumption stating that the difference between two groups are normally distributed or not was checked before conducting a paired-sample t-test. The graphs including histogram, Q-Q plot and box plot were drawn for visualization of data, Shapiro-Wilk test was performed to statistically test the normality, and additionally skewness and kurtosis values were calculated in order to understand if there was any violation of normality.

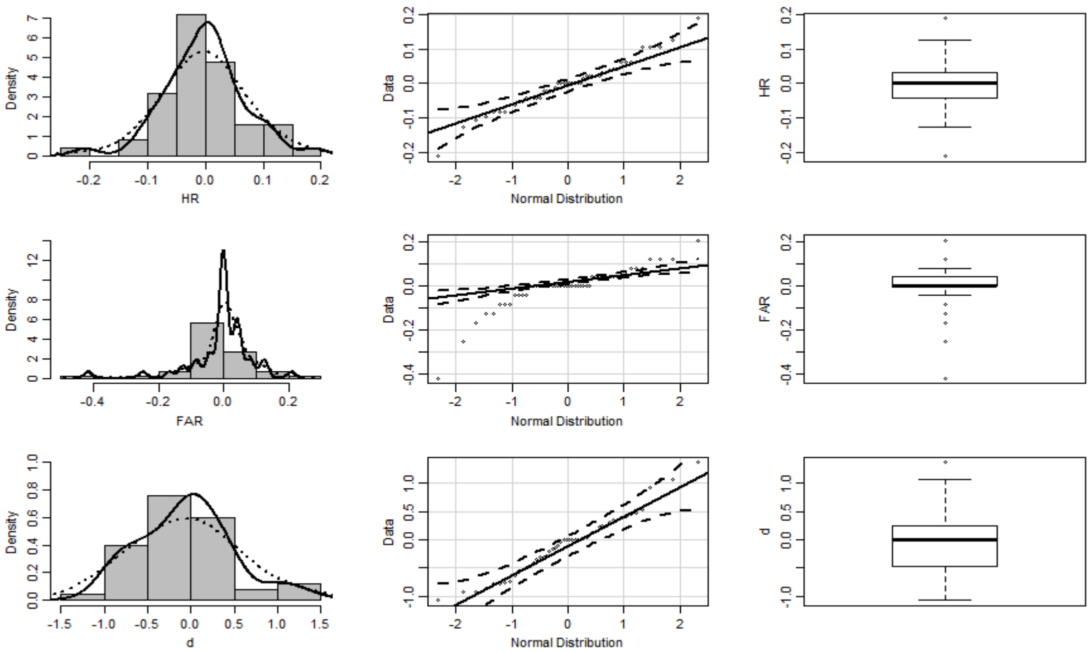

Figure 3.2 Normality analysis for item recognition: Experiment 2

Shapiro-Wilk test was used to test for the normality assumption on the dependent variables. Difference between item recognition HR in the *SSR* condition and item recognition HR in the *3SR* condition was normally distributed, [W = 0.978, p = 0.491, Skewness = -0.048, Kurtosis = 1.29] but not the difference between item recognition FARs between the groups, [W = 0.821, p < 0.001, Skewness = -1.794, Kurtosis = 6.806]. Shapiro-Wilk test also revealed that the data for d' difference between the *SSR* condition and the *3SR* condition was normally distributed, [W = 0.971, p = 0.267, Skewness = 0.38, Kurtosis = 0.17] (see Figure 3.2).

3.2.1.2 Wilcoxon Signed Rank Test

To test whether non-normally distributed data for FAR in the *SSR* condition and FAR in the *3SR* condition were different or not, a nonparametric test A Wilcoxon Signed Rank Test was further implemented. A Wilcoxon Singed Rank test indicated that FAR of the *SSR* condition (*Mdn* = 0.083) and FAR of the *3SR* condition (*Mdn* = 0.042) were not statistically different from each other, V = 228.5, p = 0.818.

3.2.1.3 A Paired-sample T-test

A paired-sample t-test was conducted to compare the *SSR* condition and the *3SR* condition in terms of evaluation of both HRs and FARs in item recognition. The paired-sample t-test analysis revealed that there was no statistically significant difference in HRs between the *SSR* condition and the *3SR* condition, t (49) = -0.234, p = 0.816, BF_{01} = 6.334. Additionally, FAR for the *SSR* condition and FAR for the *3SR* condition also were not different from each other, t (49) = -0.352, p = 0.726, BF_{01} = 6.129 (see left side of Figure 3.3).

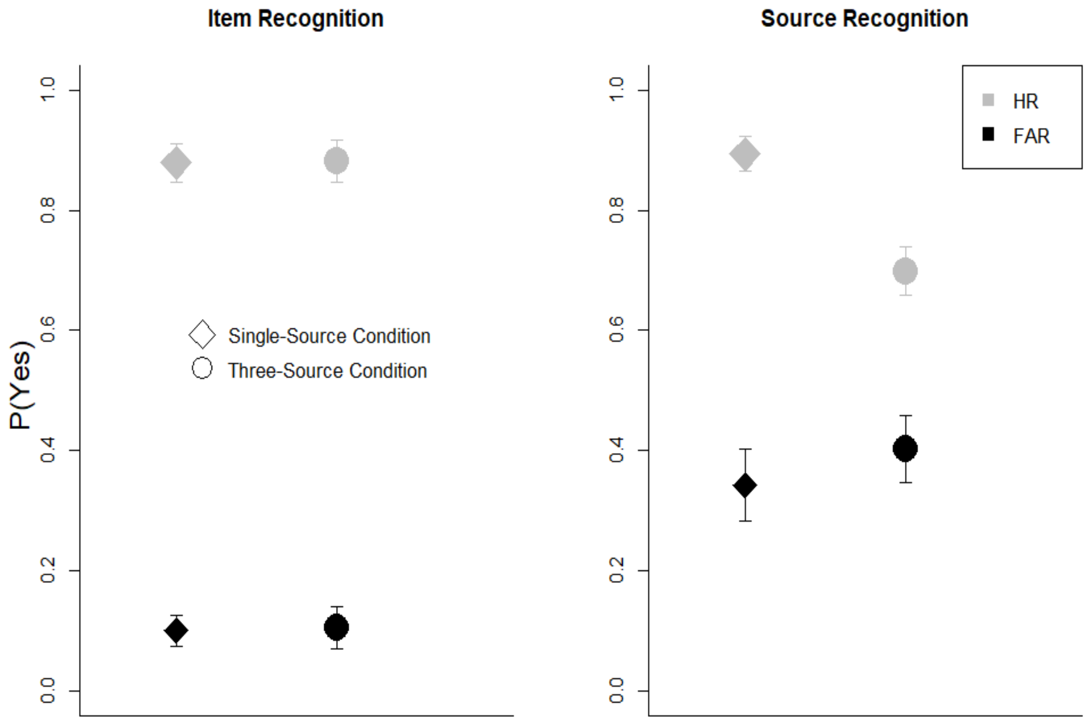

Figure 3.3 The strength-based mirror effect in source recognition memory when mixed study lists

Further, a paired-sample t-test was again assessed to compare whether the discriminability values between the *SSR* condition and the *3SR* condition were different or not in item recognition. The t-test results demonstrated that there was no statistically significant difference between the *SSR* condition and the *3SR* condition in terms of the discriminability of targets from foils, t (49) = -0.767, p = 0.447, BF_{01} = 4.92 (see left side of Figure 3.4).

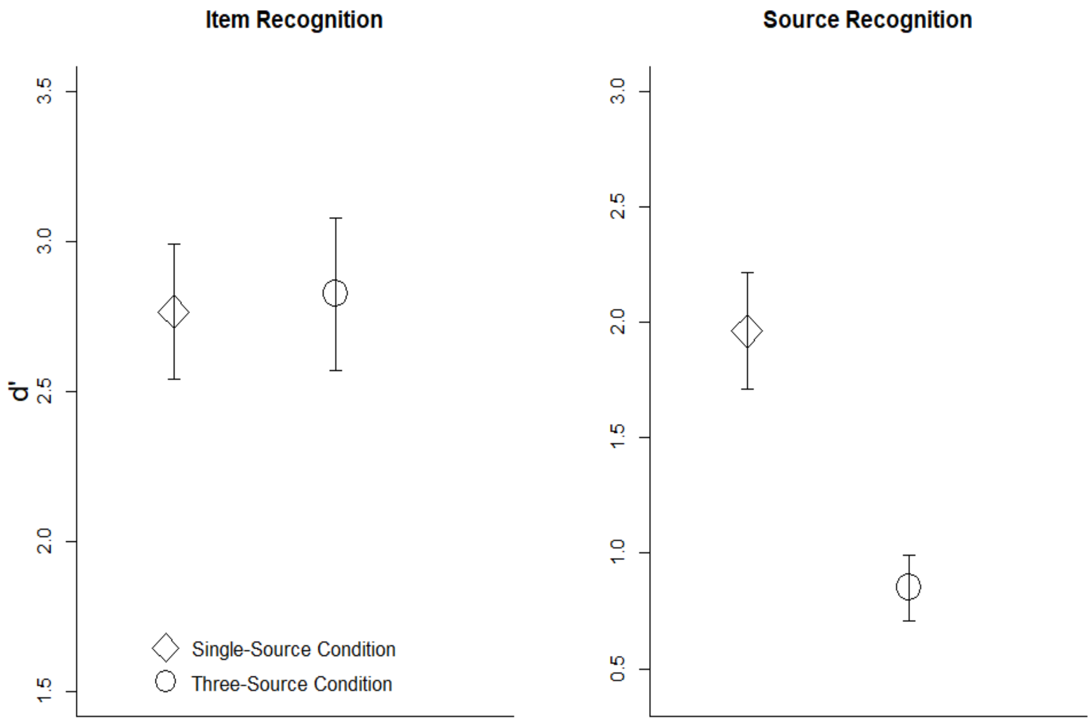

Figure 3.4 The strength effect in d' when mixed study lists

3.2.2 Source Recognition

3.2.2.1 Normality Assumption

Shapiro-Wilk test was used to test for normality on the dependent variables. Difference between the *SSR* and the *3SR* in source recognition HR was not normally distributed, [W = 0.932, p = 0.002, Skewness = 0.492, Kurtosis = 4.809]. On the other hand, normality was assumed for FAR [W = 0.97, p = 0.228, Skewness = -0.05, Kurtosis = -0.103] and d' differences between these two conditions, [W = 0.964, p = 0.127, Skewness = -0.109, Kurtosis = -0.878] (see Figure 3.5).

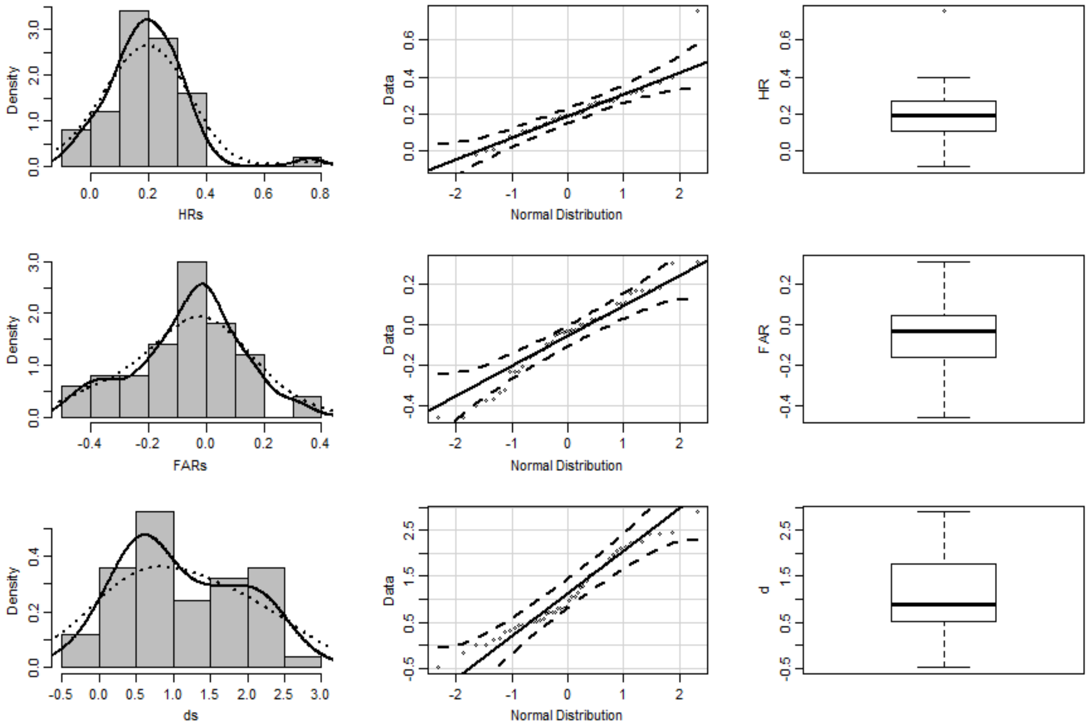

Figure 3.5 Normality analysis for source recognition: Experiment 2

3.2.2.2 Wilcoxon Signed Rank Test

For the data non-normally distributed, a nonparametric test A Wilcoxon Signed Rank Test was implemented. A Wilcoxon Singed Rank test indicated that HR of the *SSR* condition (*Mdn* = 0.94) were significantly higher than HR of the *3SR* condition (*Mdn* = 0.714), $V = 1212$, $p < 0.001$, $r = 0.901$.

3.2.2.3 A Paired-sample T-test

A paired-sample t-test was conducted to compare HRs and FARs in source recognition in the *SSR* and the *3SR*. There was a significant difference in HRs for the *SSR* (*M* = 0.894, *SD* = 0.107, *95% CI* = [0.864, 0.923]) and the *3SR* (*M* = 0.699, *SD* = 0.144, *95% CI* = [0.659, 0.739]), t (49) = 10.115, *95% CI* = [0.156, 0.234], $p < 0.001$, d = 1.43, BF_{10} = 5621E+7. In addition, FAR was significantly lower for the *SSR* (*M* = 0.342, *SD* = 0.215, *95% CI* = [0.282, 0.402]) than the *3SR* (*M* =

0.403, *SD* = 0.199, *95% CI* = [0.348, 0.458]), *t* (49) = -2.377, *95% CI* = [-0.113, -0.009], *p* = 0.021, *d* = -0.336, BF_{10} = 1.969 (see right side of Figure 3.3).

A paired-sample t-test was again assessed to compare the discriminability in source recognition. There was a significant difference between the *SSR* (*M* = 1.961, *SD* = 0.907, *95% CI* = [1.71, 2.213]) and the *3SR* (*M* = 0.85, *SD* = 0.515, *95% CI* = [0.707, 0.992]) in discriminability in source recognition, *t* (49) = 9.636, *95% CI* = [0.880, 1.343], *p* < 0.001, *d* = 1.363, BF_{10} = 1209E+7 (see right side of Figure 3.4).

3.2.3 The List-Strength Effect

2 (Pure List (Experiment 1) vs Mixed List (Experiment 2)) x 2 (Strong vs Weak Sources) Mixed-Subject ANOVA with repeated measures for the latter variable was run to examine the LSE in source memory. No significant interaction effect was revealed for HRs, *F* (1,98) = 0.037, *p* = 0.847. On the other hand, FARs difference between strong and weak sources in the mixed list significantly decreased when compared to the difference in the pure list, *F* (1,98) = 51.5, *p* < 0.001, η^2= 0.124 (see left column of Figure 3.6). Further, simple main effect analysis showed that FARs for strengthened sources in the mixed list increased compared to those in the pure list, *F* (1,98) = 5.741, *p* = 0.018, and FARs for weak sources in the mixed list decreased compared to FARs for weak sources in the pure list, *F* (1,98) = 7.172, *p* = 0.009.

Difference in d' between the mixed-list strong sources and the mixed-list weak sources significantly decreased relative to the d' difference in the pure list, *F* (1,98) = 14.98, *p* < 0.001, η^2= 0.045 (see right column of Figure 3.6). A measure used by Ratcliff et al. (1990) to represent the magnitude of the list strength effect was the ratio of ratios: The ratio of strong to weak sources in the mixed list divided by the ratio of strong to weak sources in the pure list. Values greater than 1 represents a (positive) LSE and lower than 1 represents a negative LSE, and values equal to 1 represents a null LSE. The ratio of ratios was calculated as 0.598 which represents a *negative LSE*. d' decreased for the mixed-list strong sources and increased for the mixed-list weak sources when compared with their corresponding in the pure list. However, simple main effect analysis only revealed a significant difference for the strong sources between the lists, F (1,98) = 8.306, p = 0.005 but not for the weak sources, F (1,98) = 2.794, p = 0.098.

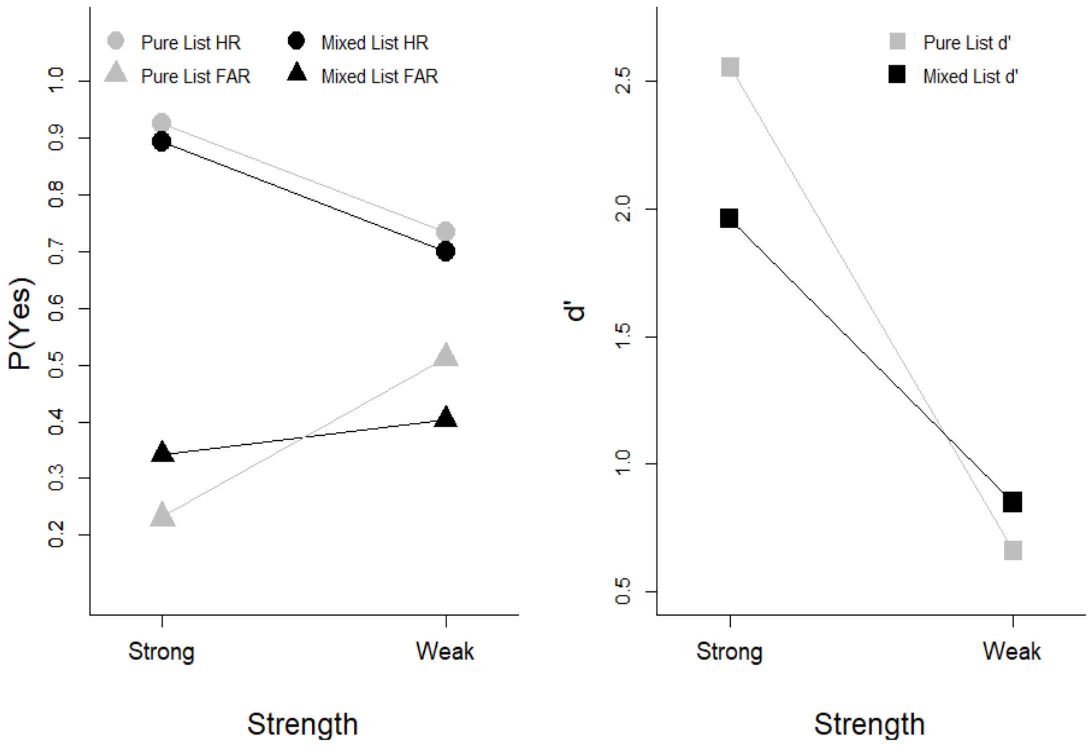

Figure 3.6 Slightly negative list-strength effect in source recognition memory

3.3 Discussion

Experiment 2 was conducted to further observe source memory performance of strong sources, which were the only source information learned repeatedly in, and weak sources, which were one of the sources information presented in, when these sources that have different strength levels were studied in the same (mixed) list. Specifically, the lists included three-times strengthened sources where items repeated three times and weak sources where items presented only once – but repeated twice in two other contexts. Item recognition results revealed that repetition of item information whether in the same source or in multiple sources increased memory strength of that information at the same level (see Experiment 1; Starns & Ksander, 2016). Source recognition results, on the other hand, revealed different source memory performances. That is, when item information was obtained from the same source three times, the probability of acceptance of those sources as old got increased compared to the sources in which item information was obtained only once but two more times from different sources. As expected, repetition of item information in the same source increased memory strength of those sources. In addition to that, source foils were less likely recognized as studied when tested with strong sources than weak sources, but the difference between these two groups was small as both the Bayes Factor (BF_{10} = 1.969) and the effect size (Cohen's *d* = .34) revealed.

There was no significant difference between the probability of saying "old" to source foils when tested with the strong sources in which information was repeated two-times, and once in another (the strong *2SR*) and when tested with the weak sources in which items were presented once, and twice in another source (the weak *2SR*) in the first experiment. In Experiment 1, an item was repeated two times in one context and the same item was repeated once in another context. That is, items were the same for strong contexts and weak contexts in the mixed list. On the other hand, in the second experiment, different items were used for different strength levels of contexts. A group of items strengthened three times in the same context and another group of items strengthened three times in three different contexts. Thereby, some subjects could understand the test content as soon as the item was presented in the second experiment even though they were not given any additional information whereas, in Experiment 1, subjects could not be aware of the test content because the same item was presented in both strong source and weak source. As a result, source FAR might differ in Experiment 2 because of an adjustment of the decision criterion.

Furthermore, when looking at source memory performance of weak and strong sources from the pure lists and the mixed lists, the results suggested a slightly negative LSE which means that the difference between strong and weak sources from the mixed list was lower compared to the difference in the pure list. This is because of a decreased performance for strong sources in the mixed list - compared to the strong sources from the pure list - due to the increase in false alarms in the mixed list. This result can be explained by both the differentiation and the criterion shift accounts. The mixed list FAR when tested with only the weak sources was lower than the pure weak list. Similarly, the FAR for the mixed study list when tested with only the strong sources was higher than the pure strong list. The differentiation account explains this result by stating that the mixed list contains half of the weak source information instead of the full list containing strong information which eventually results in a less differentiation in the mixed list compared to the pure strong list. Therefore, the probability of saying old to the source foils increased in the mixed. This rationale is also the same for the increased FARs when tested with the mixed list compared to the pure weak list. However, the differentiation account has a difficulty explaining the small difference in FARs between the test lists containing only the strong sources or weak sources even though they have the same study list (the mixed list). Criterion shift account explains this difference by assuming that individuals may adjust a new criterion based on the test list containing weak or strong sources rather than the study list.

CHAPTER 4

EXPERIMENT 3

Because Experiment 2 revealed a small FAR difference between strong sources and weak sources when the mixed list design was used, Experiment 3 was conducted to manipulate the decision criterion according to the test content. According to the criterion shift account, participants adjust a stricter criterion when being tested with strong sources; as a result, incorrect acceptance of foils as old decreases. In other scenario, when testing with weak sources, a more liberal criterion is defined and incorrect endorsement of foils as old increases (Cary & Reder, 2003; Starns, Ratcliff, & White, 2012; Stretch & Wixted, 1998; Verde & Rotello, 2007). Thus, in the current experiment, subjective familiarity criterion was manipulated by informing participants about the nature of the test list.

4.1 Method

4.1.1 Participants

54 undergraduate students from METU participated to the study in exchange of partial course credit. Four participants were excluded from the analysis since they could not follow the instructions: Data from two participants were removed since they did not give any source recognition response and data from two participants were removed because they always pressed the same particular button throughout the source recognition task. Finally, data from 50 individuals (*M* age= 21.98, *SD* age = 2.18) were analyzed. There were 28 females and 44 right-handed people. All participants were native Turkish speakers with normal color-vision and normal or corrected-to-normal visual acuity.

4.1.2 Materials

The materials were identical to Experiment 2.

4.1.3 Design and Procedure

The procedure was the same with Experiment 2 except that participants were informed about the nature of the test phase. That is, they were given information about whether the test block contains only the items strengthened three times in a single context or the items strengthened three times in three different contexts. For the pure strong test list, participants were informed specifically by stating that "*The words going to be tested in the upcoming test will be the words repeated in the 'same' location of the computer screen. Press '3' to start the test.*". For the pure weak test list, they were informed by specifically stating that "*The words going to be tested in the upcoming test will be the words repeated in 'different' locations of the computer screen. Press '1' to start the test.*". The information given before each test block was always true which means that it was stated the real nature of the test content. Further, participants were asked to press a specific key on the keyboard, either "3" or "1" based on the strength of the source information, to be able to start the test. The rest of the experiment was exactly the same with the second experiment.

4.2 Results

4.2.1 Item Recognition

4.2.1.1 Normality Assumption

Normality assumption whether the difference between the groups was normally distributed was checked before conducting a paired-sample t-test. Visual graphs including histogram, Q-Q plot and box plot were drawn, Shapiro-Wilk test was performed, and additionally skewness and kurtosis values were calculated in order to understand if there was any violation of normality.

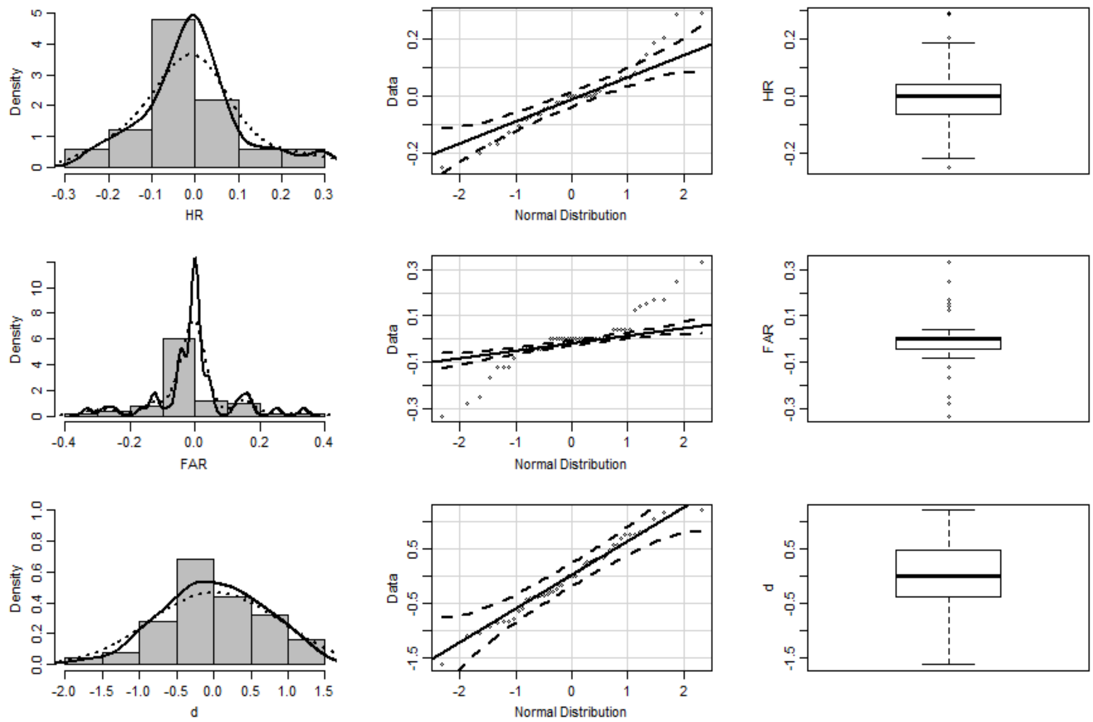

Figure 4.1 Normality analysis for item recognition: Experiment 3

Shapiro-Wilk test was used to test for normality on the dependent variables. Difference between the *SSR* and the *3SR* conditions in item recognition HR was normally distributed, [W (50) = 0.955, p = 0.056, Skewness = 0.492, Kurtosis = 1.085] but not in item recognition FAR, [W (50) = 0.882, p < 0.001, Skewness = -0.05, Kurtosis = 2.516]. Shapiro-Wilk test also revealed normally distributed data for d' difference between two groups, [W (50) = 0.984, p = 0.739, Skewness = -0.109, Kurtosis = -0.416] (see Figure 4.1).

4.2.1.2 Wilcoxon Signed Rank Test

A Wilcoxon Singed Rank test indicated that the FAR of the *SSR* (*Mdn* = 0.042) and the FAR of the *3SR* (*Mdn* = 0.083) were equal, [$V = 208.5$, $p = 0.626$].

4.2.1.3 A Paired-sample T-test

A paired-sample t-test was conducted to test the null hypothesis that HRs, FARs and the discriminability values of the *SSR* and the *3SR* conditions for item recognition are equal or not. The t-test analysis revealed that these two conditions did not differ from each other in all three. There were no statistically significantly differences in HRs, [t (49) = -0.533, $p = 0.596$, $BF_{01} = 5.681$], and in FARs, [t (49) = -0.397, $p = 0.693$, $BF_{01} = 6.031$] (see the left side of Figure 4.2).

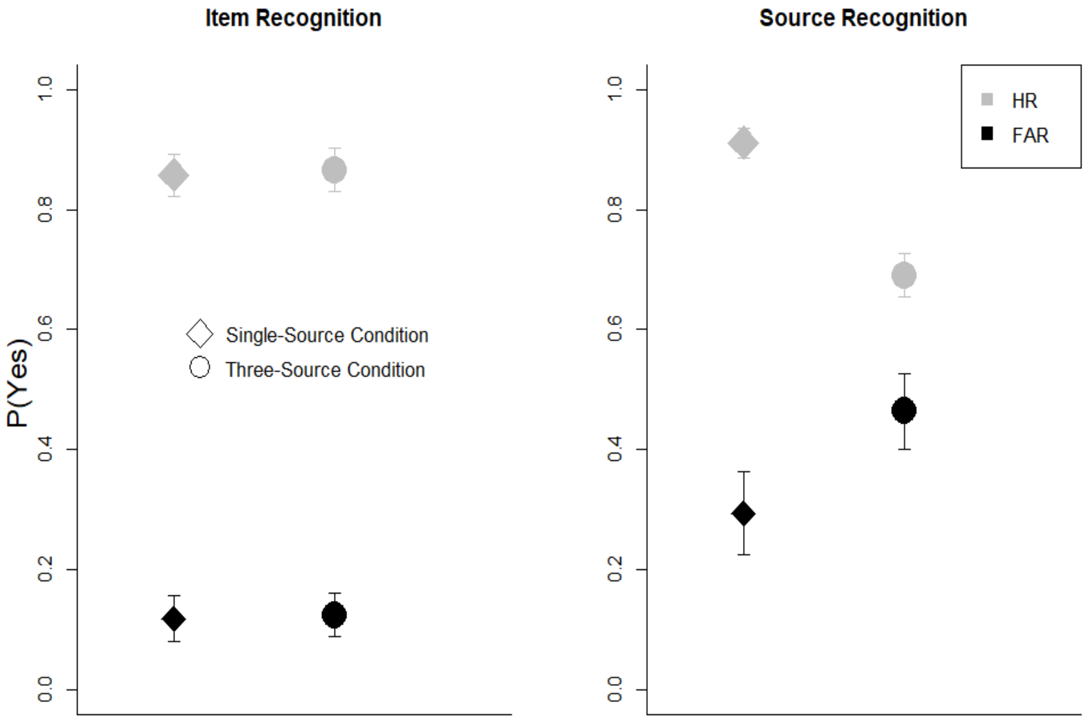

Figure 4.2 The strength-based mirror effect in source recognition memory when mixed study lists and information about test content given

As well as in d', [t (49) = 0.105, p = 0.917, BF_{01} = 6.466] between the *SSR* and the *3SR* conditions in item recognition was not different (see left side of Figure 4.3).

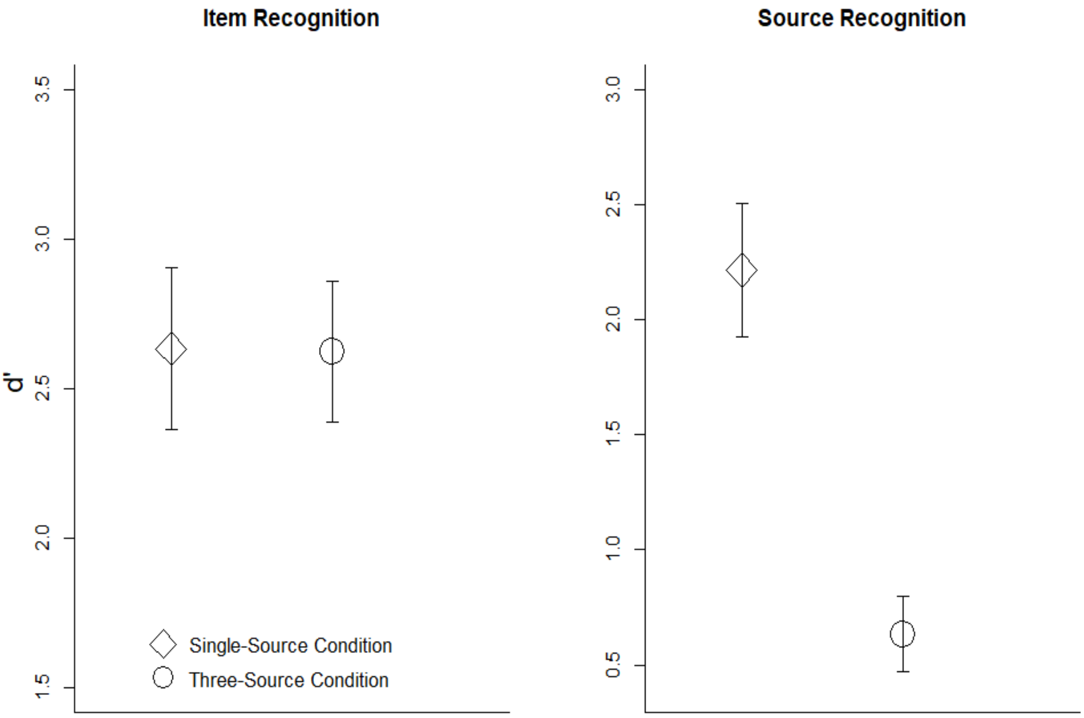

Figure 4.3 The strength effect in d' when mixed study lists and information about test content given

4.2.2 Source Recognition

4.2.2.1 Normality Assumption

Shapiro-Wilk test was used to test for normality on the dependent variables including HR, FAR and d' in source recognition. The HR of the *SSR* and the HR of the *3SR* difference was normally distributed, [W (50) = 0.985, p = 0.7922, Skewness = -0.033, Kurtosis = 0.597] as well as the FAR [W (50) = 0.981, p = 0.5806, Skewness = -0.002, Kurtosis = -0.611]. The test also revealed that d' of the *SSR* and d' of the *3SR* difference also normally distributed, [W (50) = 0.983, p = 0.6828, Skewness = -0.047, Kurtosis = -0.267] (see Figure 4.4).

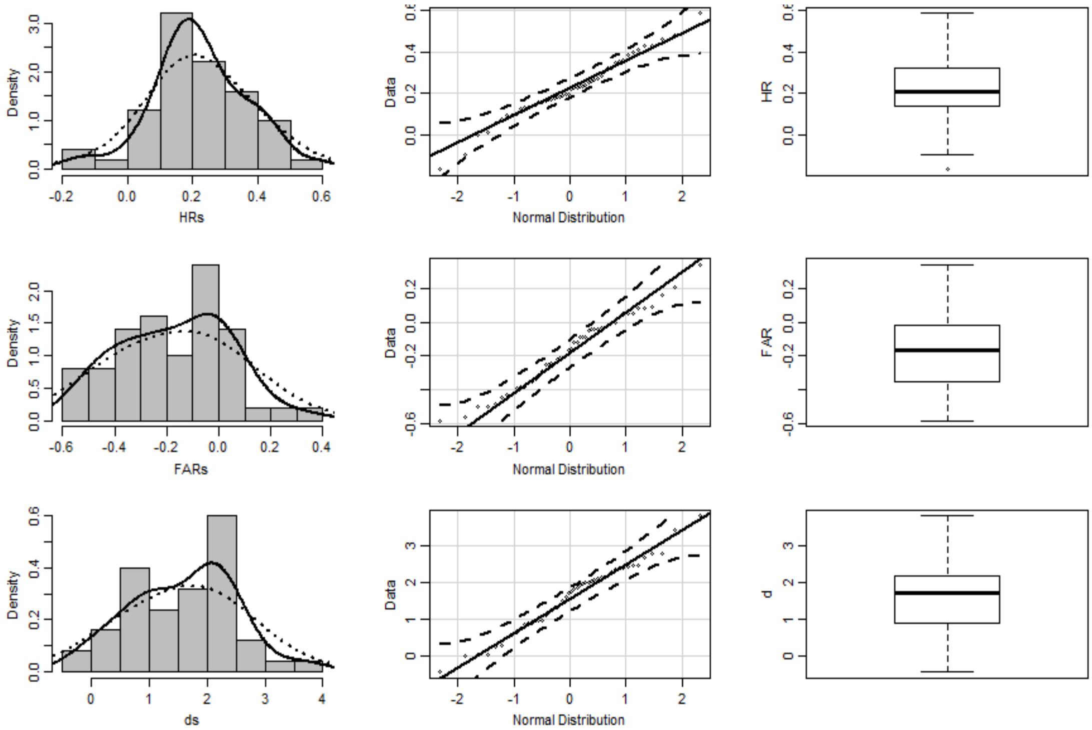

Figure 4.4 Normality analysis for source recognition: Experiment 3

4.2.2.2 A Paired-sample T-test

To compare the HRs and the FARs in source recognition between the *SSR* condition and the *3SR* condition, a paired-sample t-test was again conducted. Source recognition HR was significantly higher for the *SSR* condition (*M* = 0.911, *SD* = 0.089, *95% CI* = [0.886, 0.936]) than the *3SR* condition (*M* = 0.69, *SD* = 0.131, *95% CI* = [0.654, 0.726]) as the analysis revealed, *t* (49) = 10.732, *95% CI* = [0.180, 0.262], $p < 0.001$, *d* = 1.518, BF_{10} = 3923E+7. Source recognition FAR was significantly lower for the *SSR* condition (*M* = 0.294, *SD* = 0.252, *95% CI* = [0.225, 0.364]) than the *3SR* condition (*M* = 0.464, *SD* = 0.228, *95% CI* = [0.401, 0.527]), *t* (49) = -5.56, *95% CI* = [-0.231, -0.108], $p < 0.001$, *d* = -0.786, BF_{10} = 14898 (see right side of Figure 4.2).

A paired-sample t-test also revealed that the *SSR* condition (*M* = 2.214, *SD* = 1.043, *95% CI* = [1.925, 2.504]) and the *3SR* condition (*M* = 0.633, *SD* = 0.589, *95% CI* =

[0.469, 0.796]) were significantly different in terms of discriminability of source targets from source foils, t (49) = 12.151, *95% CI* = [1.320, 1.843], $p < 0.001$, d = 1.718, BF_{10} = 2898E+7 (see right side of Figure 4.3).

4.2.3 The List-Strength Effect

2 (Pure List (Experiment 1) vs. Mixed List (Experiment 3)) x 2 (Strong vs. Weak Sources) Mixed-Subject ANOVA with repeated measures for the latter variable revealed no significant interaction effect for the HRs, F (1,98) = 1.306, p = 0.256 but a significant interaction effect for the FARs, F (1,98) = 4.847, p = 0.03, η^2= 0.027. FAR difference between strong and weak sources in the mixed list decreased compared to the difference in the pure list (see the left column of Figure 4.5). FAR for the mixed strong sources increased compared to the pure strong sources whereas FAR for the mixed weak sources decreased compared to the pure weak sources. Simple main effect analysis however neither showed a significant change in the FARs for the mixed-list and the pure-list strong sources, F (1,98) = 1.595, p = 0.210, nor a change in the FARs for the mixed-list and the pure-list weak sources, F (1,98) = 1.219, p = 0.272. In addition, no significant interaction effect for d' was observed, F (1,98) = 2.177, p = 0.143 (see right column of Figure 4.5). The ratio of ratios was 0.907 which represents slightly negative but *null list-strength effect.*

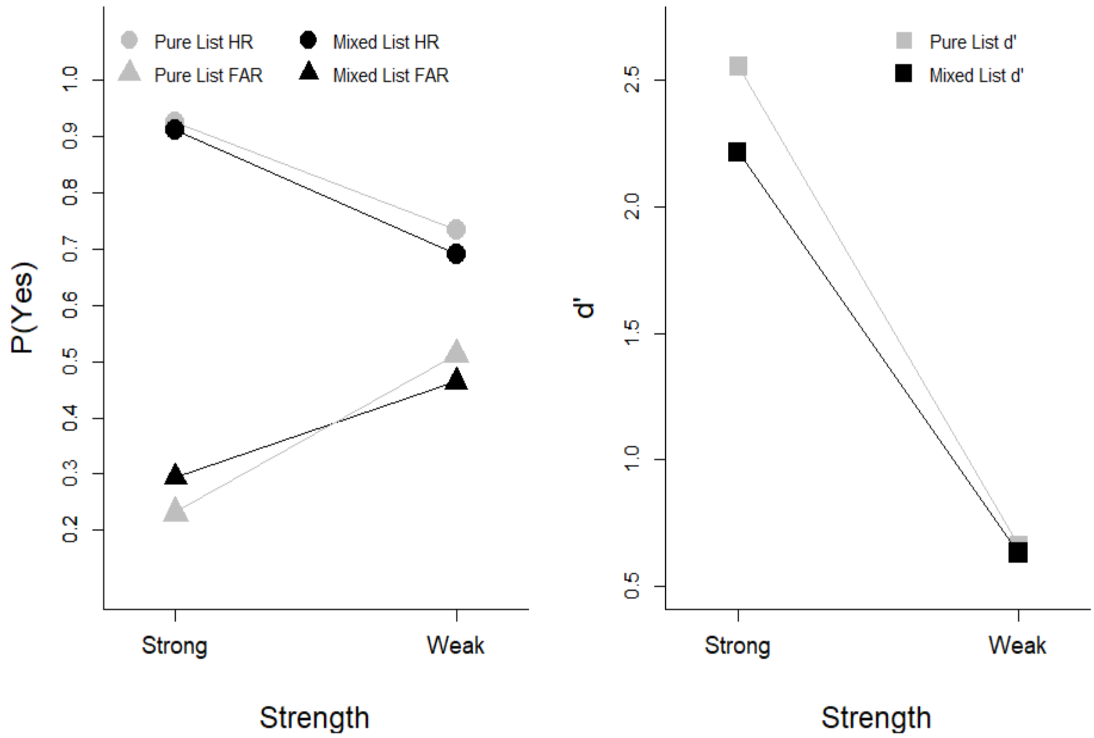

Figure 4.5 The null list-strength effect

4.3 Discussion

The present experiment revealed similar results with Experiment 2 with small but important differences. Repetition of an item information either in the same source or in different sources resulted in the same amount of updating of a single memory trace for that item (see Experiment 1 & 2; Starns & Ksander, 2016). Source recognition results revealed that when item information was learned repeatedly in the same source, this results in the increase in recognition of strong sources as well as the decrease in the acceptance of source foils as old compared to the test in which weak source information was tested. The most important result from this study was that the test list containing only strong sources had lower FAR than the test list containing only weak sources. When looking at the results, one can easily notice that the effect size (Cohen's d = .79) demonstrating the FAR difference was more than twice as big from the second experiment (Cohen's d = .34). This shows that the FAR difference between the strong and weak sources doubled when information about the nature of the test list was given in order to change subjects' decision criterion. Additionally, Bayes factor (BF_{10} = 14898) suggested that the alternative hypothesis, which states that the probability of acceptance of source foils when tested with strong sources was different from the probability of acceptance of source foils when tested with weak sources, was 14898 times more likely than the null hypothesis. Since the subjects knew that they were going to be tested with only the strong sources at test, they might have chosen more stringent criterion to decide whether the test probe was studied or not in that context. Similarly, when participants were going to be tested with only the weak sources at test, they might have chosen more lenient criterion to perform the required task. The criterion shift account explains this result very well with a shift in the criterion after additional encoding of source information by repetition.

On the other hand, the differentiation account has a difficulty in explaining this result as it does not assume any criterion change. The differentiation account does not expect any difference in FARs between strong and weak test lists because the study list is the same for both test lists - a mixed study list in which half of sources is strengthened, and the other half is remained as weak. When an item is presented in a source foil at test, the test probe is compared with the whole study list. Hence, testing with weak or strong contexts does not reveal any difference when the item is tested in a new source. However, there can be a different process when explicitly informing participants about the test content. REM.4 (Shiffrin & Steyvers, 1997) suggested a two-step recognition memory model. All items in the specific list context are activated first, and then the test probe is compared with each information in the activated set. Although strength level is not likely to create different source information, when information about the test content is given to the participants, only the items and their contexts related to the test content might be activated during test. As a result, recognition decision might be performed by comparing the test probe with the set activated based on the information given by the experimenter. That is, when information about the test content which includes only strong contexts was given, only strong contexts and items learned in that strong contexts might be activated, and comparison might occur only with pure strong study list. Similarly, when the experimenter explicitly gave an information stating that the list would contain only the weak sources, this might cause an activation of the items learned in different sources repeatedly. Thus, test probes might be compared with only the weak sources and their items like in the pure weak lists. This can explain the SBME after studying a mixed list without the criterion shift assumption. A comparison between the effect sizes of strength obtained from the second and third experiments might further demonstrate that when participants consciously adapted a more stringent criterion for strongly encoded sources, both differentiation and criterion shift played a role in the source SBME.

CHAPTER 5

GENERAL DISCUSSION

5.1 Discussion

The vast majority of recognition memory experiments on the list-strength paradigm has focused on item recognition. Item recognition experiments have revealed that pure list strength manipulation increases the probability of strong target endorsement and decreases the probability of acceptance of foils as "studied" when compared with pure weak lists (Cary & Reder, 2003; Criss, 2006; 2009; 2010; Criss, Aue, & Kılıç, 2014; Glanzer & Adams, 1985; Kılıç, Criss, Malmberg, & Shiffrin, 2017; Shiffrin & Stevyers, 1997; Starns, Ratcliff, & White, 2012; Starns, White, & Ratcliff, 2010; Stretch & Wixted, 1998).

There are two main accounts making a clear explanation on the SBME in item recognition memory: the differentiation account and the criterion shift account. The differentiation account assumes that the more an item is strengthened through repetition, longer presentation or deeper encoding, the more information is stored in its memory trace. Thus, the more the target probe becomes similar to its corresponding memory trace and likewise the foil probe becomes evenly dissimilar to the traces in memory. On the other hand, the criterion shift account explains the SBME with a shift in decision criterion after an increase in item strength.

The experiments exploring the SBME in source memory are limited in the literature (e.g. Starns & Ksander, 2016). Starns and Ksander (2016) conducted a series of experiments to observe the outcomes of strengthening item information in the same or different sources, and their research revealed many important findings. First, their results suggested that repetition of an item information whether in the same source or in different sources resulted in the same amount of updating of a single memory trace for that item. The current thesis brought out the same result in all three experiments. Second, the results from Starns and Ksander (2016)'s study demonstrated that repetition of an item in the same source increases source strength while repetition in different sources increases interference and eventually reduces source memory performance relative to the condition in which an item is demonstrated only once in one source. In the first experiment of this thesis, the SBME in source recognition was examined in three different strength levels. That is, source information was strengthened three times, two times or none – presented only once. The results of the first experiment indicated that strength of source information, as well as source memory performance with an increase in HR and a decrease in FAR, increased directly proportional to the number of repetitions. This indicated an SBME in source recognition memory. In addition to that, there was also no difference between the weak sources from the *2SR* and the *3SR* conditions. This demonstrated that repetition of a context twice does not cause an interference for the accompanying weak context, also known as the null LSE.

In addition to the SBME, when mixed list strength is implemented; that is, some items in the list are strengthened while keeping the others weak, memory performance of weak items is not impaired by strengthened items in the list and strong items do not benefit from that half of the list contains weak items (Ratcliff et al., 1990; Murnane & Shiffrin, 1991; Yonelinas, Hockley, & Murdock, 1992; Hirshman, 1995). The null LSE in item recognition was first presented by Ratcliff et al. (1990) showing that unlike in free call or cued recall, strengthening a group of items in a list does not harm performance of the remaining weak items in an item recognition task. Shiffrin et al. (1990) introduced the differentiation mechanism, which explains how multiple presentations of items are encoded as a single trace in memory and further becomes more distinct than weak items, rather than being encoded as separate traces. This theory of differentiation was further developed in later models (e.g., Shiffrin & Steyvers, 1997; Cox & Shiffrin, 2017). The results from the first experiment suggests that the differentiation mechanism can be generalized to source memory.

Osth, Fox, McKague, Heathcote, and Dennis (2018) recently published a study on the LSE in source memory to answer the question whether strengthening some sources in the list would cause a decrease in memory performance of the remaining weak sources. In Osth et al. (2018) experiments, pure weak lists and mixed lists were implemented in which weak sources were presented one time and strong sources three more. After that, item recognition test and/or source judgment test in which subjects discriminate the source for the recognized/presented item were performed. Osth et al. (2018) found a null LSE in source memory except their first experiment where source memory was directly tested without item recognition first. They explained this unexpected positive LSE revealed in the first experiment as due to the unrecognized items for which there cannot be a source information at all (Hautus, Macmillan, & Rotello, 2008). Osth et al. (2018) ultimately concluded that source memory reveals a null LSE. In the second and the third experiments of the present thesis, the mixed list strength design was implemented to explore the LSE in source memory. Specifically, sources were strengthened with repetitions of items thrice or remained weak with presentations of items only once in these particular sources. Unlike the study of Osth et al. (2018), item strength was kept equal across varying source strength in this thesis. Keeping item strength equal was important to be able to clearly test the context strength. A source recognition task was implemented with the presentation of items either in the source they had already studied or in a new source they had never studied before. Therefore, both item and context information were tested at the same time in source recognition task as REM.4 (Shiffrin & Steyvers, 1997) assumes the concatenation of an item and its context information to each other. The results from this thesis similarly suggested a null LSE in source memory with an opportunity of further testing the LSE in source memory while keeping item strength level equal across differing context strength levels.

After observing a null effect in source memory, Osth et al. (2018) have extended their memory model (Osth & Dennis, 2015) to explain source memory as well. In their model, source memory is a global matching process in which familiarity value is calculated by matching the test cue against all traces in memory. One of the important points in their model is that source and context information are represented by different vectors. Context is defined as an episode in which the information is learned in a specific list, and source is the information including but not limited to color, location or modality in which an item is learned. Therefore, there are three dimensions including item, episodic context and source context in the model and all three information is assumed to be stored as a tensor in memory. Source information is then retrieved by combining an item and episodic context with each possible source and matching the combination against all memory traces. Then, the difference between these different levels of memory strength is used to decide which source information is more likely.

In their model, Osth et al. (2018) assumes that there are three different noises: other items learned in the same context with the test cue (item noise), other contexts in which the test cue has been previously encountered (context noise) and background noise due to all the other items, different than the cue and the other items in the list, in all the other contexts, different than the experimental context and the contexts in which the cue has been learned before. The Osth et al. (2018) model explains very well a null LSE in both item recognition and source memory because it assumes that the context noise and the item noise interference are very small and most of the interference is coming from the background noises.

Beyond the studies conducted on the list-strength paradigm in source memory (Starns & Ksander, 2016; Osth et al., 2018), this thesis further tested the differentiation and the criterion shift accounts in terms of how likely they are able to explain the SBME in source memory. Therefore, the third experiment conducted with the mixed study lists but specifically subjects were given the exact information prior to each test block about the test content. The aim of this experiment was to allow subjects to change their decision criterion based on the test list. The SBME in source memory came into light with the third experiment especially with a decrease in FAR when strong sources were tested. The criterion shift account explains this result very well with a shift in the decision criterion based on the strength of the test list. The differentiation account may explain this result too with an additional implementation of the two-step recognition memory model proposed by REM.4 (Shiffrin & Steyvers, 1997). Subjects were warned about the test content by specifically stating that either the test content contained only the items repeating in the same context or the items repeating in different contexts. Thereby, the given information might activate only the list of items studied in one context or the list of items studied in multiple contexts and comparison may have been made with the activated list of contexts. Further research is needed to specifically test the plausibility of this explanation.

Ultimately, the current thesis suggested that source memory reveals an SBME when implemented a pure list strength manipulation and tested with a source recognition task. After that, a null LSE in source memory was revealed with this thesis for almost the first time. Sources remained weak in the list was not affected negatively from the sources strengthened in the same list. Finally, the given information about test content prior to each test block again proposed the SBME even the study list was mixed.

5.2 Limitations

Previously, source memory was tested with a recognition task only in Starns and Hicks' (2008) study. In their study, items were studied in separate color and location combinations to be able to explore whether the contexts are bound together or not. At test in the first experiment, items were tested either in their studied color/location or in an unstudied source in order to observe item-context binding. The second experiment was designed to directly test the context binding. Thereby, items were tested either in their studied color and location combination (intact pair) or in a rearranged source combination. Their results demonstrated that item information is bounded to each context information but there is no binding between contexts. For Starns and Hicks' (2008) study, a recognition task was necessary to be able to directly test the association between the contexts in which the information is learned.

In this thesis, employment of a source recognition task to measure source memory performance was also necessary for a number of reasons. First reason was related to how source information was strengthened in this research. For example, items were studied once in each three different sources in the *3SR* condition. For this condition, specifying the context at test was important due to the existence of other two contexts in which the item was studied besides the one presented at test. In addition, in the *2SR* condition, items were repeated in two different contexts by strengthening the one context while keeping the other one weak. For these items, both weak and strong sources were intentionally tested to be able to observe memory performance for both. Second reason to employ a source recognition task was that item and context information were aimed to be tested with each other as REM.4 assumes that two vectors representing this two information are concatenated to each other and stored in memory like that (Shiffrin & Steyvers, 1997). Therefore, item and source information could be tested together similar to their representations in memory. Finally, the current thesis had only four different color and location combinations as source information in which all the information was acquired. Thus, a recognition task allowed to test source memory performance for the particular strong items by eliminating source similarity. That is, re-presenting an item in one of the sources at source memory test eliminated the comparison of the item information against all the source information but ensured testing of the concatenated item-context information against all memory traces.

However, testing source memory with a recognition task may still be a limitation because source information may not be kind of an information people recognize in real life. That is, although people encounter with item information in real life repeatedly and do a recognition judgment to decide whether they have the information or run up against it for the first time, source information is usually the information people use additionally to the item retrieval process. For example, imagine that you see somebody in the university cafeteria, and you are sure that you met this person before but do not know from where you know this person. There are several possibilities where you may know this person from such as the dormitory, the library, or the department. You mentally put that person in each possible source and decide where you can know this person by comparing the likelihood of item information in that particular place with the criterion. Finally, you decide that the library is the place where you met this person before. In that case, you encounter in real life with the person, which is an item information recognized in laboratory studies, but possible sources are not presented to you in real life. Instead, you mentally evaluate these possible sources. For this reason, re-presenting the item information in its possible sources at test may not be representing the real-life situations but still a beneficial task for laboratory studies to be able to perform controlled source memory tasks.

5.3 Future Research

The LSE reveals completely different results in item memory depending on with which task memory is tested. Strengthening some items while keeping the others weak in the list causes a decrease in memory performance of weak items while an increase in memory performance of strong items in free recall. However, recognition memory testing does reveal completely ineffective LSE. In this thesis, source recognition test was employed, and a null LSE was revealed as in item recognition memory. Since different tests bring out different results, the LSE in source memory might be tested in free recall. Free recall task is not typically used to test source memory in the literature but employing a free recall task for source memory would extend the theoretical understanding of the LSE.

In addition, the second experiment showed a FAR difference between the strong test list and the weak test list although the study list was the same for both. However, the mixed list from the first experiment did not reveal such a difference. The reason behind these two different results might be that the test content was not obvious in the first experiment since the items were displayed in both sources, but in the second experiment, the situation was the opposite: items learned in the strong sources were different from the items learned in the weak sources. This might have caused a change in the decision criterion based on the test content for some subjects although no information was given. To be able to test this reasoning, a further study might be conducted. In that, items might be strengthened three times in the same source and the same items might also be displayed only once in a different source. Therefore, source memory performance would be tested in a condition in which it is not likely to change the criterion to make a recognition decision because items do not reveal whether strong or weak sources are going to be tested.

Finally, the mixed list design might be developed by using different strength levels including once, twice or thrice strengthened sources like in the first experiment. Thus, memory performance can be observed for sources with different strength levels studied in the same list.

5.4 Conclusion

To conclude, this study reveals two important results which broaden our knowledge on source memory. While additional study of information in the same source increases source recognition, it also decreases the likelihood of acceptance of source foils as old compared to weak sources, defined as an SBME in source memory. Further, a null LSE in source memory is highlighted which demonstrates that strengthening some sources while remaining another group of sources weak in the same list does not change recognition performance of strong and weak sources relative to pure lists. These results indicate that source information might be representing similar to item information in memory as REM.4 suggests. They also obviously state that additional learning of sources has the same effect in source memory as in item memory which may further help us to develop source memory models.

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APPENDICES

A. APPROVAL OF METU HUMAN SUBJECTS ETHICS COMMITTEE

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Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Yrd.Doç.Dr. Aslı KILIÇ ÖZHAN ;

Danışmanlığını yaptığınız yüksek lisans öğrencisi Sinem AYTAÇ'ın **"Tanıma Belleğinde Bağlam Bilgisinin Güçlendirilmesi"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2017-SOS-172** protokol numarası ile **17.11.2017 – 30.09.2018** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

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Sayın Dr.Öğretim Üyesi Aslı Kılıç ÖZHAN

Danışmanlığını yaptığınız yüksek lisans öğrencisi Sinem AYTAÇ'ın "**Tanıma Belleğinde Bağlam Bilgisinin Güçlendirilmesi** " başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2017-SOS-172** protokol numarası ile **01.10.2018 - 31.12.2019** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

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B. INSTRUCTION FOR THE EXPERIMENTS

Çalışmamıza hoş geldiniz. Deneyi düzgün ilerletebilmeniz ve deney sırasında herhangi bir aksaklık yaşamamanız için yönergeyi dikkatli bir şekilde okumanız gerekiyor. Yönergeyi ilerletebilmek için yukarı-aşağı ok tuşlarını kullanabilirsiniz.

Çalışmamız yaklaşık 45 dakika sürecek ve 8 bölümden oluşacak. Her bölüm: çalışma, aritmetik toplama ve test aşamalarından oluşmaktadır.

1)Her bölümün ilk aşaması, çalışma aşaması olacak. Bu aşamada bilgisayar ekranında arka arkaya kelimeler göreceksiniz. Bilgisayar ekranı dörde bölünmüş ve farklı renklerle renklendirilmiştir. Her kelime dörde bölünmüş ekranın belirli bir alanında sunulacak ve bütün kelimeler mutlaka 3'er defa tekrarlanacak. Fakat, kelimeler aynı alanda veya farklı alanlarda tekrarlanabilir. Daha sonra test aşamasında kelimeleri ve gösterildikleri alanları hatırlamanız beklenecektir.

2)Çalışma listesinin ardından toplama aşaması gelecek. Toplama aşamasında, ekranda sırayla rakamlar göreceksiniz. Bu bölümde göreviniz rakamları geldiği sırayla toplamak. Mesela ilk rakam gösterildiğinde, cevap olarak gösterilen rakamı yazacaksınız (ör, 5). Ardından gelen ikinci rakamı bir önceki cevabınıza ekleyeceksiniz. Bu durumda cevabınız ilk iki rakamın toplamı olacak. Bir sonraki rakamı tekrar bir önceki cevabınıza ekleyeceksiniz ve cevabınız ilk üç rakamın toplamı olacak. Bu şekilde bölüm bitene kadar devam edeceksiniz. Bu aşamada klavyenin üst kısmındaki rakamları kullanın. Her seferinde cevabınızı kaydetmek için "enter" tuşuna basın.

3)Toplama işlemi bittiğinde test aşamasına geçeceksiniz. Test aşamasında, aynı bölümdeki çalışma aşamasında gösterilen kelimeler ve bunlara ek olarak çalışılmamış yeni kelimeler de göreceksiniz. Sizden ilk önce, sunulan bu kelimeleri daha önce çalışıp çalışmadığınızı hatırlamanız beklenecek. Kelimeyi daha önce çalıştığınızı düşünüyorsanız, "evet" cevabını vermek için "c" tuşuna basın. Kelimenin yeni bir kelime olduğu düşünüyorsanız, "hayır" cevabını vermek için "m" tuşuna basın.

Kelimenin daha önce çalışıldığına karar verdiyseniz, sizden bu sefer kelimenin gösterildiği alan hakkında tanıma gerçekleştirmeniz beklenecek. Kelimeler çalışılan alanda veya çalışılmadıkları farklı alanda gösterilebilir. Mesela 3 defa aynı alanda tekrarlanan bir kelime için tekrarlandığı alanda veya diğer alanlarda gösterilebilir. Veya farklı alanlarda tekrarlanan kelime için tekrarlandığı herhangi bir alanda veya hiç tekrarlanmadığı yeni bir alanda gösterilebilir. Sizin göreviniz, kelimenin çalışıldığı herhangi bir alanda gösterildiğini düşünüyorsanız, "evet" cevabınız için "c" tuşuna basmanız. Eğer kelimenin hiç gösterilmediği farklı bir alanda gösterildiğini düşünüyorsanız, "hayır" cevabınız için "m" tuşuna basmanız gerekiyor.

Test boyunca, sol işaret parmağınızı "c" tuşunun, sağ işaret parmağınızı ise "m" tuşunun üzerinde tutmalısınız.

Vereceğiniz cevaplar bizim için önemli. Bu nedenle hem çalışma aşamasında kelimeleri ve gösterildikleri alanları dikkatli bir şekilde takip etmeniz, hem de test aşamasında cevabınızı verirken özenli bir şekilde vermenizi bekliyoruz.

Deneye başlamadan önce alıştırma aşaması olacaktır. Alıştırma aşamasına başlamak için boşluk tuşuna basabilirsiniz.

C. INFORMED CONSENT FORM

ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu çalışma ODTÜ Psikoloji Bölümü Yüksek Lisans öğrencisi Sinem Aytaç tarafından Dr. Öğr. Üyesi Aslı Kılıç Özhan danışmanlığındaki yüksek lisans tezi kapsamında yürütülmektedir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Bu çalışma yeni bilgiler öğrenirken belleğimize bu bilgileri nasıl kaydettiğimizi ve daha sonra nasıl hatırladığımızı araştırmaktadır.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırma, Psikoloji Bölümü Araştırma Laboratuvarı/Dikkat ve Bellek Laboratuvarında yapılacaktır. Üniversite öğrencileri katılımcı olarak davet edilecek, katılmak isteyenler yaklaşık 1 saatlik bir laboratuvar seansına katılacaklardır. Çalışmada size kelimeler/harfler/resimler gösterilecektir. Daha sonra bu kelimeleri/harfleri/resimleri hatırlayıp hatırlamadığınız sorulacaktır.

Katılımınızla ilgili bilmeniz gerekenler:

Bu çalışmaya katılmak tamamen gönüllülük esasına dayalıdır. Herhangi bir yaptırıma veya cezaya maruz kalmadan çalışmaya katılmayı reddedebilir veya çalışmayı bırakabilirsiniz. Araştırma esnasında cevap vermek istemediğiniz sorular olursa boş bırakabilirsiniz.

Araştırmaya katılanlardan toplanan veriler tamamen gizli tutulacak, veriler ve kimlik bilgileri herhangi bir şekilde eşleştirilmeyecektir. Katılımcıların isimleri bağımsız bir listede toplanacaktır. Ayrıca toplanan verilere sadece araştırmacılar ulaşabilecektir. Bu araştırmanın sonuçları bilimsel ve profesyonel yayınlarda veya eğitim amaçlı kullanılabilir, fakat katılımcıların kimliği gizli tutulacaktır.

Çalışmaya katılanlar bu duyurunun yapıldığı ders için puan alacaklardır. Alınacak puan dersin öğretim üyesi tarafından belirlenecektir.

Riskler:

Çalışma ile ilgili bilinen bir risk yoktur.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Çalışmayla ilgili soru ve yorumlarınızı araştırmacıya aytac.sinem@metu.edu.tr adresinden iletebilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.
(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad Tarih İmza

D. TURKISH SUMMARY / TÜRKÇE ÖZET

BÖLÜM 1

GİRİŞ

1.1 Tanıma Belleği

Olaysal bellek ilk kez Tulving (1983) tarafından belli bir zamanda ve mekânda edinilen olayın hatırası olarak tanımlanmıştır. Olaysal belleği ölçmek için kullanılan laboratuvar testlerinden bir tanesi tanıma belleği testidir. Tanıma belleği testi, önce bir grup bilginin (örneğin; kelimeler, resimler gibi) çalışılması ve ardından bu çalışılan listeye yeni bilgiler eklenerek katılımcıların test edilmesinden oluşur. Bu test sırasında katılımcılardan çalıştıkları bilgiyi çalışılmamış yeni bilgiden ayırt etmeleri istenir.

Bir ölçüm modeli olan Sinyal Tespit Teorisi (Green & Swets, 1966) insan belleğine uyarlandığında bellek izleri tespit edilmesi gereken sinyal olarak tanımlanırken yeni bilgi reddedilmesi gereken gürültü olarak tanımlanır. Hedef ve çeldirici bilgilerin normal bir dağılımdan geldiği varsayılarak bu dağılımlardan hedef bilgiler daha önce çalışıldığı için daha büyük bir ortalamaya sahiptir. Karar vermek için katılımcı tarafından bir kriter belirlenir ve test sırasında sunulan uyaran bu kriteri geçerse bilgi çalışılmış, geçmezse çalışılmamış kabul edilir. Test sırasında sunulan hedef bilginin çalışılmış kabul edilmesi isabet, yeni bilginin çalışılmış kabul edilmesi ise yanlış alarm olarak tanımlanır. Tanıma belleği başarısı da isabet ve yanlış alarm oranlarına bağlıdır.

1.2 Güce Dayalı Ayna Etkisi

Ayna etkisi, hedef bilgilerin kabul edilmesinde artışla birlikte yeni bilginin yanlışlıkla kabul edilmesinde düşüş görülmesidir (Glanzer & Adams, 1985). Ayna etkisi güçlendirme manipülasyonunda da sıklıkla gözlemlenmiştir (Cary & Reder, 2003; Criss, 2006; 2009; 2010; Criss, Aue, & Kılıç, 2014; Kılıç, Criss, Malmberg, & Shiffrin, 2017). Bilginin tekrarı, uzun süre gösterimi veya derin kodlama yöntemleriyle öğrenilmesi bilginin bellekte güçlü bir şekilde saklanmasını sağlar. Güçlendirme aynı liste içerisinde (karışık liste) veya listeler arasında (saf liste) yapılabilir. Bir listede çalışılan bütün bilgilerin güçlendirilmesi sonucunda saf güçlü liste, bütün bilgilerin zayıf bırakılması sonucunda saf zayıf liste oluşturulur. Saf güçlü listedeki bilgilerin isabet oranları saf zayıf bilgilere kıyasla artarken, yanlış alarm oranları da azalır. Buna güce dayalı ayna etkisi denir.

1.3 Liste Güçlendirme Etkisi

Bir listede çalışılan bilgilerin yarısı güçlendirilir yarısı zayıf bırakılarsa karışık liste elde edilmiş olur. Güçlendirme karışık listede yapıldığında güçlü bilgiyle birlikte öğrenilen zayıf bilginin bellek başarısında değişim olup olmayacağı merak edilen konulardan biri olmuştur. Hatırlama testlerinde, karışık listede sunulan zayıf bilginin saf zayıf listeye kıyasla hatırlama oranında düşüş gözlenmiştir. Aynı şekilde, güçlü bilgilerin bir grup zayıf bilgiyle öğrenilmesi hatırlama performanslarını saf güçlü listeye kıyasla arttırmıştır (Tulving & Hastie, 1972). Bu etkiye liste güçlendirme etkisi denir. Ratcliff, Clark ve Shiffrin (1990) liste güçlendirme etkisini hatırlama belleğinin yanı sıra tanıma belleğinde de incelemişlerdir. Yaptıkları deneylerin sonucu tanıma belleğinde liste güçlendirme etkisinin olmadığını göstermiştir. Yani, güçlü bilgilerin aynı liste içerisinde zayıf bilgilerle öğrenilmiş olması tanıma başarısını arttırmamış, zayıf bilgilerin aynı liste içerisinde güçlü bilgilerle öğrenilmesi ise tanıma başarını zayıflatmamıştır.

1.4 Güce Dayalı Ayna Etkisi için İki Açıklama

Listenin tamamının güçlendirilmesi sonucu, güçlü bilgilerin bellek başarısının artması çok da şaşırtıcı değildir çünkü bellek izleri güçlü kodlamayla birlikte artmıştır. Fakat, yeni bilginin yanlışlıkla çalışılmış olarak tanımlanmasındaki düşüş araştırmacıların ilgisini çekmiştir. Kodlama sırasında yapılan güçlendirme manipülasyonun neden test sırasında ilk defa gösterilen yeni bilginin reddedilme olasılığını arttırdığını araştırmacılar iki farklı şekilde açıklamaya çalışmışlardır. İlki kriter değişimi açıklamasıdır. Bu açıklamaya göre, güçlü listeyle çalışılması sonucunda katılımcılar daha muhafazakâr bir kriter belirler ve böylece yeni bilgilerin bu kriteri geçme olasılığı düşer. Bunun sonucunda da yanlış alarm oranında düşüş gözlemlenir (Cary & Reder, 2003; Starns, Ratcliff, & White, 2012; Verde & Rotello, 2007). Diğer açıklama ise ayrıştırma açıklamasıdır. Ayrıştırma açıklamasına göre, bilginin güçlendirilmesi sonucu o bilgiyi temsil eden bellek izi daha doğru ve tamamlanmış bir şekilde bellekte saklanır. Bunun sonucunda, o bilgiyle test sırasında karşılaşıldığında bilginin çalışılmış kabul edilme olasılığı artar. Aynı şekilde, daha önce çalışılmamış yeni bir bilgi test sırasında sunulduğunda yeni bilginin bellekteki güçlü izlerle eşleşme olasılığı düşer ve yeni bilgi ayrışmış olur. Nihayetinde, yanlış alarm oranında düşüş meydana gelir (Shiffrin, Ratcliff, & Clark, 1991; Criss, Wheeler, & McClelland, 2013; Koop, Criss, & Pardini, 2019).

1.5 Bellekten Etkin Gerigetirme Modeli

Ayrıştırma açıklamasına dayanarak geliştirilen Bellekten Etkin Gerigetirme (BEG; Shiffrin & Steyvers, 1997) modeline göre, bellek her biri farklı bir izi temsil eden imgelerden oluşmaktadır. Bu imgeler özellik değerleri içerir ve bu özellik değerleri bilginin anlamsal, fiziksel ve işitsel özelliklerini taşır. Çalışma sırasında, her bir bilgi belleğe bir iz olarak kaydedilir ve bu iz bilginin hataya açık ve tamamlanmamış kopyasıdır. Bilginin güçlendirilmesi sonucunda bu iz giderek tamamlanır ve bilgiye daha çok benzer. Test sırasında, sunulan test uyaranı bellekte bulunan tüm izlerle karşılaştırılır. Bu karşılaştırma sonucunda elde edilen aşinalık değeri eğer katılımcının belirlediği kriteri geçerse uyaran çalışılmış, eğer geçmezse yeni olarak kabul edilir.

BEG modelinin alternatif bir versiyonunda (BEG.4; Shiffrin & Steyvers, 1997), bilginin edinildiği bağlam tıpkı bilginin kendisi gibi imgelerle temsil edilir. Bu bağlam imgesi, bilginin kendisini temsil eden imgenin yanına bitiştirilerek belli bir bağlamda öğrenilen bilgi belleğe kaydedilmiş olur. Tanıma ise iki aşamadan oluşur. Buna göre, ilk aşamada yalnızca bağlam bilgisine dayanarak belirli bir bağlamda edinilmiş bilgiler etkinleştirilir. Ardından, yalnızca bilginin kendisine dayanarak BEG'in saf versiyonunda olduğu gibi karşılaştırma yapılır ve bir karara varılır.

1.6 Kaynak Belleği

Kaynak belleği, bilginin hangi bağlamda öğrenildiğini belirleyebilme yetisidir. Kaynak belleği birçok şeye tekabül edebilir; örneğin, zamansal, mekânsal veya sosyal bağlam, bilginin kim tarafından verildiği veya nasıl verildiği gibi. Bilginin kaynağını belirleyebilmek önemli bir bellek yetisidir çünkü tanıma testlerinde katılımcılardan çalıştıkları bilgileri yeni olanlardan ayırt etmeleri istenir ve bu yeni bilgiler daha önce başka bağlamlarda karşılaşıldıkları için tanıdık gelebilir. Bu nedenle, istenilen görevi yerine getirebilmek için katılımcıların laboratuvar ortamında öğrendikleri bilgileri daha önce öğrendikleri bilgilerden ayırt edebilmeleri önemlidir.

Kaynak belleği testinde, katılımcılar bir grup bilgiyi A bağlamında (örneğin, bir kadın sesinden) diğer bir grup kelimeyi B bağlamında (örneğin, bir erkek sesinden) çalışır. Test aşamasında, önce standart tanıma testi gerçekleştirilir, ardından tanıma gerçekleştirdikleri her bir bilgi için bilginin edinildiği bağlamı ayırt etmeleri beklenir. Bu durumda bağlam bilgisi bilginin bir kadın mı yoksa bir erkek tarafından mı verildiğidir.

Starns ve Ksander (2016) tarafından yürütülen bir çalışmada bir grup bilgi aynı bağlamda tekrar edilmiş, diğer bir grup bilgi farklı bağlamlarda çalışılmış ve son grup bilgi ise yalnızca bir defa çalışılmıştır. Bunun sonucunda, aynı veya farklı bağlamlarda çalışılmış olması fark etmeksizin bilginin tekrarla güçlendiği ve bellek performansının arttığı gözlemlenmiştir. Aynı zamanda, bilginin aynı bağlamda çalışılması kaynak belleği başarısını arttırırken farklı bağlamlarda çalışılması kaynak belleği başarısını düşürmüştür.

1.7 Mevcut Tezin Hedefleri

Temel olarak bu tezde, öncelikle, bir listedeki tüm bilgilerin aynı bağlamda güçlendirilmesinin, ardından ise, bir listedeki bilgilerin yarısının aynı bağlam içerisinde diğer yarısının farklı bağlamlarda güçlendirilmesinin hem zayıf hem güçlü bağlamların hatırlamasını nasıl etkileyeceği araştırılmıştır. Öncelikle, tanıma belleği testiyle birlikte aynı veya farklı bağlamlarda güçlendirilen bilgilerin bellek performansı incelenmiştir. Ardından kaynak belleği tanıma testi uygulanmıştır. Kaynak belleği testinde, saf listede sunulan bilginin aynı bağlamda tekrar edilmesinin bu güçlü bağlamların tanınmasını arttıracağı ve güçlü bağlamlarla birlikte test edilen çalışılmamış yeni bağlamların ise tanınma olasılığını azaltacağı, saf listede sunulan bilginin farklı bağlamlarda tekrar edilmesine kıyasla, beklenmiştir. Tıpkı madde tanıma testlerinde ortaya çıkan güce dayalı ayna etkisinin kaynak tanıma belleğinde de ortaya çıkacağı öngörülmüştür. Saf listede yapılan güçlendirmenin devamında, bir listedeki bilgilerin yarısı aynı bağlamda tekrar edilirken diğer yarısı farklı bağlamlarda tekrar edilerek karışık listeler oluşturulmuş. Karışık listelerde bilginin kendisiyle birlikte güçlendirilen bağlam bilgisinin kaynak tanıma başarısının saf güçlü listeye kıyasla artması beklenmemiştir. Aynı şekilde, karışık listelerde zayıf bırakılan bağlam bilgisinin kaynak tanıma başarısının ise saf zayıf listeye kıyasla azalması beklenmemiştir. Bu şekilde tıpkı madde tanıma testlerinde olduğu gibi anlamsız liste güçlendirme etkisi beklenmiştir.

BÖLÜM 2

DENEY 1

2.1 Yöntem

2.1.1 Katılımcılar

Anadili Türkçe olan ve Orta Doğu Teknik Üniversitesi (ODTÜ) lisans öğrencisi olan 50 katılımcıdan aldıkları psikoloji dersinde kısmi puan verilmesi karşılığında veri toplanmıştır.

2.1.2 Veri Toplama Araçları ve İşlem

905 kelimelik Türkçe Kelime Normları'ndan (Tekcan & Göz, 2005) 4 ile 7 hece arasında değişen kelimeler seçilmiştir. Buna ek olarak, renk belirten (örneğin; kırmızı, sarı veya yeşil gibi) kelimeler de listeden çıkartılmıştır. Bu kelimeler bilginin kendisini temsil etmesi için kullanılmıştır. Bağlam bilgisi ise bilgisayar ekranı dörde bölünerek ve her bir bölüme farklı bir renk atanarak oluşturulmuştur.

Çalışma aşamasında, tüm kelimeler üçer defa ya aynı bağlamda ya da farklı bağlamlarda tekrar edildi. Tek-bağlam tekrarı koşulunda (TBT), kelimeler üçer defa aynı bağlamda tekrar edildi. İki-bağlam tekrarı koşulunda (2BT) ise kelimeler iki defa aynı bağlamda bir defa ise farklı bağlamda tekrar edildi. Son olarak üç-bağlam tekrarı koşulunda (3BT) ise kelimeler üç defa fakat üç farklı bağlamda tekrar edildi. Bu şekilde listeler arasında bilginin kendisi aynı güce sahip olan fakat farklı güçlerde bağlam bilgileri oluşturuldu. Kelimeler 2000 milisaniye herhangi bir bağlamda sunulurken uyaranlar arası süre 250 milisaniye tutuldu.

Test aşamasına geçilmeden önce 45 saniye süren dağıtıcı bir görev verildi. Ardından gelen test aşamasında, katılımcılar ilk önce madde tanıma testine ardından kaynak tanıma testine tabii tutuldu. Madde tanıma testinde, çalışılan kelimelere ek olarak yeni kelimelerden de oluşan listeden rastgele seçilen kelimeler ekranın tam ortasında herhangi bir bağlam bilgisi olmaksızın katılımcılara sunuldu. Eğer katılımcı sunulan kelime için çalışıldı cevabı verdiyse bu sefer kaynak tanıma testi sunuldu. Kaynak tanıma testinde kelimeler ya çalışıldıkları renkli konumda (hedef bağlam) veya çalışılmadıkları renkli konumda (çeldirici bağlam) sunuldu. Böylece katılımcıdan bu sefer bağlam bilgisi için tanıma gerçekleştirmesi istendi.

2.2 Bulgular

2.2.1 Madde Tanıma Bulguları

Tek-yönlü varyans analizi sonuçları madde tanıma belleğinde isabet oranı (İO) ve yanlış alarm oranı (YAO) için gruplar arasında anlamlı bir fark göstermemiştir. Hedef ve çeldirici bilgilerin ortalama bellek izleri arasındaki farkı ölçmek için kullanılan standardize değer d' de aynı şekilde madde tanıma belleğinde gruplar arasında anlamlı bir farklılık göstermemiştir.

2.2.2 Kaynak Tanıma Bulguları

Tek-yönlü varyans analizi sonuçlarına göre kaynak tanıma belleğinde İO’da gruplar arasında anlamlı bir fark vardır. Bu anlamlı farkın ardından hangi grupların birbirinden farklılaştığını görmek için Bonferroni düzeltmesiyle birlikte post-hoc t-testi yapılmıştır. Buna göre, üç defa güçlendirilen TBT koşulu diğer tüm koşullardan kaynak tanıma testinde daha yüksek İO’ya sahiptir. Aynı şekilde, 2BT koşulunda iki defa güçlendirilen bağlam diğer zayıf bağlamlardan daha yüksek İO’ya sahiptir. Fakat, zayıf bağlamlar arasında İO’da herhangi bir fark yoktur.

Aynı şekilde, tek-yönlü varyans analizi kaynak tanıma belleğinde YAO'da gruplar arasında anlamlı fark ortaya koymuştur. Bonferroni düzeltmesiyle birlikte yapılan post-hoc t-testi sonuçları göstermiştir ki üç defa tekrarlanan bağlam diğer gruplardan anlamlı olarak daha düşük YAO'ya sahiptir. Ek olarak, 2BT koşulunda iki defa güçlendirilen bağlam 3BT koşulundan anlamlı olarak daha az YAO'ya sahiptir. Fakat, başka herhangi bir anlamlı fark çıkmamıştır.

Son olarak, kaynak tanıma belleğinde hedef ve çeldirici bağlamların ortalama bellek izleri arasındaki farkı ölçmek için standardize d' değeri hesaplanmış ve tek-yönlü varyans analizi yapılmıştır. Analiz sonuçları en az iki grup arasında anlamlı bir fark olduğunu göstermiştir. Bonferroni düzeltmesiyle birlikte yapılan post-hoc t-testi ise TBT koşulunun diğer koşullara kıyasla en yüksek ayırt edilebilirlik skoruna sahip olduğunu göstermiştir. Ek olarak, 2BT koşulundaki güçlü bağlam, 2BT koşulundaki zayıf bağlamdan ve 3BT koşulundaki zayıf bağlamdan anlamlı olarak daha yüksek ayırt edilebilirlik skoruna sahiptir. Fakat, zayıf bağlamlar arasında anlamlı bir fark yoktur.

2.3 Tartışma

Deney 1'in sonuçlarını madde tanıma belleği ve bağlam tanıma belleği olarak incelediğimizde madde tanıma belleğinde bilginin aynı veya farklı bağlamlarda güçlendirilmesi fark etmeksizin bilginin gücünün benzer oranda arttığı bir kez daha ortaya konmuştur (Starns & Ksander, 2016). Bağlam tanıma belleği sonuçlarını incelediğimizde ise güce dayalı ayna etkisinin bağlam bilgisinde de geçerli olduğu ortaya konmuştur. Tekrar sayısıyla doğru orantılı olarak bağlam bilgisinin gücü ve kaynak belleği başarısı artmıştır. Benzer şekilde, bağlam bilgisi güçlendikçe İO'da bir artış olurken YAO'da bir azalma olmuştur. Diğer taraftan, ayrıştırma açıklaması tarafından da öngörüldüğü gibi aynı listede çalışılan güçlü ve zayıf bağlamların YAO'ları arasında anlamlı bir fark çıkmamıştır.

Bu deneydeki önemli sonuçlardan diğer bir tanesi, 2BT koşulundaki zayıf bağlam ve 3BT koşulundaki zayıf bağlam arasında kaynak belleği başarısında herhangi bir fark gözlemlenmemiş olmasıdır. 2BT koşulu hem güçlü hem zayıf bağlamların aynı liste içerisinde bulunduğu bir karışık listedir. 3BT koşulu ise sadece zayıf bilgiyi barındıran saf zayıf listedir. Bu iki listenin zayıf bağlamlarını birbiriyle kıyasladığımızda anlamsız bir liste güçlendirme etkisi ortaya konmuştur.

BÖLÜM 3

DENEY 2

Deney 1'de ortaya konan kaynak belleğinde anlamsız liste güçlendirme etkisi sonucunu daha ayrıntılı incelemek için bu deney tasarlanmıştır.

3.1 Yöntem

3.1.1 Katılımcılar

ODTÜ'de okuyan 50 lisans öğrencisi aldıkları psikoloji dersi için kısmi ders puanı karşılığında bu deneye gönüllü olarak katılmıştır.

3.1.2 Veri Toplama Araçları ve İşlem

Deney 1'de kullanılan aynı kelime normundan kelimeler rastgele seçilmiştir ve bağlam bilgisi aynı şekilde manipüle edilmiştir.

İşlem yolu Deney 1 ile küçük farklılıklar dışında neredeyse aynıdır. Deney 1'den farklı olarak bu deneyde yalnızca TBT ve 3BT koşulları kullanılmıştır. Yani, yalnızca kelimelerin üç defa aynı bağlamda tekrar edildiği koşul (TBT) ve kelimelerin üç defa fakat üç farklı bağlamda tekrar edildiği koşul (3BT) kullanılmıştır. Diğer önemli fark ise saf liste yerine karışık liste kullanılmıştır.

Diğer bir değişle, bir grup bağlam zayıf bırakılırken aynı liste içerisinde diğer bir grup bağlam güçlendirilmiştir. Test aşaması ise yine iki aşamadan oluşmuştur ve bir test bölümü içerisinde ya yalnızca güçlü bağlamlar ve bu bağlamlarda edinilen bilgiler ya da yalnızca zayıf bağlamlar ve bu bağlamlarda öğrenilen bilgiler test edilmiştir.

3.2 Bulgular

3.2.1 Madde Tanıma Bulguları

Bağımlı örneklem t-testi sonuçlarına göre madde tanıma belleğinde ne İO'da ne YAO'da iki grup arasında anlamlı bir fark çıkmamıştır. Aynı şekilde, madde tanıma belleğinde ayırt edilebilirlik sonuçları kıyaslandığında iki grup arasında anlamlı bir fark yoktur.

3.2.2 Kaynak Tanıma Bulguları

Kaynak tanıma belleği başarısını ölçmek için sırasıyla İO, YAO ve d' için bağımlı örneklem t-testi yapılmıştır. Sonuçlar tüm bağımlı değişkenler için iki grup arasında anlamlı bir fark olduğunu ortaya koymuştur. Ayrıntılı olarak baktığımızda, üç defa tekrarlanan bağlam zayıf bağlamdan anlamlı olarak daha yüksek İO'ya ve daha düşük YAO'ya sahiptir. Fakat, iki koşul arasındaki YAO farkı, etki büyüklüğü değerine baktığımızda çok yüksek değildir. Son olarak, güçlü bağlam bilgisinin ayırt edilebilirliği zayıf bağlam bilgisinden anlamlı olarak daha fazladır.

3.2.3 Liste Güçlendirme Etkisi

Kaynak belleğinde liste güçlendirme etkisini incelemek için Deney 1 ve Deney 2'den elde edilen sonuçlara karışık desenli varyans analizi uygulanmıştır. Ratcliff ve diğerleri (1990) tarafından kullanılan oranların oranı hesabına göre, küçük de olsa negatif liste güçlendirme etkisi ortaya çıkmıştır.

3.3 Tartışma

Deney 2 liste güçlendirme etkisinin kaynak tanıma belleğinde gözlemlemek için yürütülmüştür. Sonuçlar bir kez daha madde bilginin ister aynı bağlamda ister farklı bağlamlarda güçlendirilsin aynı şekilde güçlendiğini ortaya koymuştur (Deney 1; Starns & Ksander, 2016). Kaynak tanıma belleği sonuçları ise güçlü bağlamın bellek başarısının İO'daki artış YAO'daki düşüşle zayıf bağlamdan daha yüksek olduğunu ortaya koymuştur.

Çalışma listesi karışık ve her iki grup için de aynı olmasına rağmen, güçlü ve zayıf bağlam test listeleri arasında YAO'da küçük ama anlamlı bir fark ortaya çıkmıştır. Bu sonuç Deney 1'le örtüşmemektedir. Çelişen bu iki sonucun nedeni, Deney 1'de bilginin kendisi üç defa güçlendirilirken aynı bilginin iki kere aynı bağlamda bir defa da farklı bağlamda gösterilmiş olması olabilir. Diğer taraftan, Deney 2'de güçlü ve zayıf bağlamlarda gösterilen bilgiler farklıdır. Bu durum, Deney 2'de katılımcılara test öncesinde herhangi bir bilgi verilmemesine rağmen test içeriğini ilk aşamada gelen madde bilgisi (kelime) ile anlayıp kriterlerini değiştirmelerine sebep olmuş olabilir.

BÖLÜM 4

DENEY 3

Karışık listede çalışılan güçlü ve zayıf bağlamların YAO'larında fark çıkması sonucu, katılımcıların kriterlerini kasıtlı olarak değiştirmeye yönelik Deney 3 tasarlanmıştır. Bu deneyde katılımcılar her test öncesinde deney yürütücüsü tarafından test listesinin içeriğinin güçlü bağlamlardan mı yoksa zayıf bağlamlardan mı oluşacağı hakkında bilgilendirilmiştir.

4.1 Yöntem

4.1.1 Katılımcılar

ODTÜ lisans öğrencisi 50 katılımcı kayıtlı oldukları psikoloji dersinde alacakları kısmi ders puanı karşılığında araştırmaya katılmıştır.

4.1.2 Veri Toplama Araçları ve İşlem

Kullanılan veri toplama araçları Deney 2 ile tamamen aynıdır.

İşlem yolu Deney 2 ile neredeyse aynıdır. Tek fark, katılımcılara her test öncesinde güçlü veya zayıf bağlamlarla test edilecekleri bilgisi verilmiştir. Yani, eğer katılımcılar güçlü bağlamlarla test edilecekse, teste başlamadan önce ekranda “Birazdan sorulacak kelimelerin hepsi ekranın "aynı" alanında tekrarlanan kelimeler olacak.” uyarısı gelmiş ve yönergeyi okuduklarından emin olmak için test başlamak için “3”e basmaları istenmiştir. Aynı şekilde, eğer katılımcılar zayıf bağlamlarla test edilecekse, bu sefer “Birazdan sorulacak kelimelerin hepsi ekranın "farklı" alanlarında tekrarlanan kelimeler olacak.” uyarısı gelmiştir. Ardından yönergeyi okuduklarından emin olmak için test başlamak için “1”e basmaları istemiştir. Bu şekilde test listesi hakkında katılımcılara bilgi verilmiş ve katılımcıların kriterlerini test listesine göre değiştirmeleri beklenmiştir.

4.2 Bulgular

4.2.1 Madde Tanıma Bulguları

Bağımlı örneklem t-testi analizi sonuçlarına göre, madde tanıma belleğinde İO, YAO ve d' bağımlı değişkenleri için iki grup arasında anlamlı bir fark çıkmamıştır.

4.2.2 Kaynak Tanıma Bulguları

Bağlamlı örneklem t-testi analizi kaynak tanıma belleğinde iki grup arasındaki başarı farkı olup olmadığını ölçmek için kullanılmıştır. Güçlü bağlam İO, zayıf bağlam İO'na kıyasla anlamlı olarak daha yüksektir. Benzer şekilde, güçlü bağlam YAO, zayıf bağlam YAO'na kıyasla anlamlı olarak daha düşük çıkmıştır. Son olarak, güçlü bağlamların kaynak tanıma belleği başarısı zayıf bağlamların bellek başarısından anlamlı olarak daha yüksektir.

4.2.3 Liste Güçlendirme Etkisi

Karışık desenli varyans analizi kaynak belleğinde liste güçlendirme etkisini incelemek için Deney 1 ve Deney 3'ten elde edilen sonuçlara uygulanmıştır. Aynı zamanda, Ratcliff ve diğerleri (1990) tarafından kullanılan oranların oranı hesabına göre karışık ve saf listeler arasında anlamsız liste güçlendirme etkisi çıkmıştır.

4.3 Tartışma

Diğer iki deneyde de olduğu gibi bir kez daha bilginin aynı veya farklı bağlamlarda güçlendirilmesine bakılmaksızın bilginin kendisinin tanıma belleği başarısının arttığı ortaya konmuştur (Deney 1; 2; Starns & Ksander, 2016). Kaynak tanıma belleği sonuçlarına baktığımızda ise, tekrarla doğru orantılı olarak güçlü bağlamın İO'nda artış YAO'nda ise azalma görülmüştür. Deney 2'den farklı olarak güçlü ve zayıf bağlamlar arasındaki YAO farkı bu deneyde iki katına çıkmıştır. Bu da katılımcılara test içeriği hakkında bilgi verildiğinde katılımcıların güçlü bağlam için daha muhafazakâr bir kriter, zayıf bağlam içinse daha liberal bir kriter belirlediğini göstermiştir. Bu sonuç kriter değişimi açıklaması tarafından öngörülen bir sonuçtur. Güce dayalı ayna etkisi kriter değişimiyle de açıklanabilmektedir, fakat ayrıştırma açıklaması da hala geçerliliğini korumaktadır.

BÖLÜM 5

GENEL TARTIŞMA

5.1 Tartışma

Bellek alanyazınında liste güçlendirme paradigması şimdiye kadar çoğunlukla madde tanıma belleğinde incelenmiştir. Madde tanıma testleri, saf listede güçlendirilen bilginin kabul edilme olasılığında artış, güçlü bilgiyle birlikte test edilen yeni bilgisinin ise kabul edilme olasılığında düşüş gözlemlemişlerdir (Cary & Reder, 2003; Criss, 2006; 2009; 2010; Criss, Aue, & Kılıç, 2014; Glanzer & Adams, 1985; Kılıç, Criss, Malmberg, & Shiffrin, 2017; Shiffrin & Stevyers, 1997; Starns, Ratcliff, & White, 2012; Starns, White, & Ratcliff, 2010; Stretch & Wixted, 1998). Bu güce dayalı ayna etkisi olarak tanımlanmış ve bu etkiyi açıklayan iki farklı açıklama ortaya atılmıştır. Bunlardan ilki olan kriter değişimi açıklaması, katılımcıların test listesinin içeriğine göre kriterlerini değiştirme kararı aldıklarını öne sürmektedir. Katılımcılar, güçlü bilgilerle test edileceklerinde daha muhafazakâr bir kriter seçerler. Böylece, yeni bilginin çalışılmış kabul edilme olasılığı düşer çünkü yeni belirlenen bu kriteri geçemez. Diğer bir görüş olan ayrıştırma açıklaması ise, daha fazla çalışma sonucu daha fazla öğrenme gerçekleştiğini savunur. Yani, bellekte bilgiyi temsil eden iz giderek bilginin kendisine daha fazla yaklaşır. Böylece, test sırasında bu bilgi sorulduğunda bellekteki izle eşleşme olasılığı artar ve İO artar. Aynı şekilde, test sırasında yeni bir bilgiyle karşılaşıldığında bu sefer bellekteki izler o kadar ayrışmış olur ki bu bilgiyle eşleşme olasılıkları düşer. Bu da yeni bilginin çalışılmış kabul edilme olasılığını düşürür.

Güce dayalı ayna etkisini kaynak belleğinde inceleyen çalışmalardan bir tanesi Starns ve Ksander (2016) tarafında yürütülen araştırmadır. Bu araştırmanın sonucunda, bilginin aynı bağlamda güçlendirilmesi bağlam bilgisi bellek başarısını arttırırken bilginin farklı bağlamlarda güçlendirilmesi bağlam bilgisi bellek başarısını düşürmüştür. Mevcut tez ise güce dayalı ayna etkisini daha ayrıntılı olarak farklı güç seviyeleriyle incelemiş ve YAO'daki değişimimi gözlemlemek için tanıma testiyle ölçmüştür. Mevcut tezin sonuçları, güce dayalı ayna etkisini ilk defa İO'daki artış ve YAO'daki düşüşle birlikte kaynak belleğinde göstermiştir.

Güce dayalı ayna etkisine ek olarak, karışık listede bir grup bilgi güçlendirilirken bir grup bilginin zayıf bırakılmasının ne güçlü ne de zayıf bilgiler için saf listelerle kıyaslandığında tanıma belleği başarısını değiştirmediği gözlemlenmiştir (Ratcliff et al., 1990; Murnane & Shiffrin, 1991; Yonelinas, Hockley, & Murdock, 1992; Hirshman, 1995). Osth, Fox, McKague, Heathcote ve Dennis (2018) tarafından yakın zamanda yayınlanan araştırma liste güçlendirme etkisini kaynak belleğinde incelemiştir ve yaptıkları birinci deney hariç anlamsız liste güçlendirme etkisi bulmuşlardır. Mevcut tezin ikinci ve üçüncü deneyleri kaynak belleğinde liste güçlendirme etkisini incelemek için yürütülmüştür. Mevcut tezde, Osth ve diğerleri'nin (2018) araştırmasından farklı olarak bilginin kendisinin bellek gücü farklı güce sahip bağlam bilgisi koşullarında sabit tutulmuştur. Ardından kaynak belleğini test etmek içinse tanıma testi uygulanmıştır. Sonuçlar benzer şekilde anlamsız liste güçlendirme etkisini kaynak tanıma belleğinde ortaya koymuştur.

Alanyazındaki mevcut çalışmaların da ötesinde bu tez, güce dayalı ayna etkisini açıklamak için ortaya atılan kriter değişimi ve ayrıştırma açıklamalarının kaynak belleğinde de test edilmesini sağlamıştır. Bu nedenlle üçüncü deney yürütülmüştür. Üçüncü deneyde katılımcılar karışık listelerde güçlü ve zayıf bağlamları birlikte çalışmışlar, ardından ya yalnızca güçlü ya da yalnızca zayıf bağlamlarla test edilmişlerdir. Aynı zamanda, her test öncesinde katılımcıların kriterlerini değiştirmelerini sağlamak amacıyla test listesi hakkında bilgi verilmiştir. Üçüncü deneyin sonucunda yeniden güce dayalı ayna etkisi kaynak belleğinde ortaya çıkmıştır. Bu sonuç şimdilik kriter değişimi açıklamasını daha fazla destelemektedir; fakat ayrıştırma açıklamasının bu sonucu nasıl yorumlayacağı gelecek çalışmalarla test edilebilir.

5.2 Kısıtlamalar

Kaynak belleği daha önce yalnızca Starns ve Hicks (2008) tarafından yürütülen bir çalışmada tanıma testi ile test edilmiştir. Genellikle, araştırmacılar tarafından kaynak belleği kaynak atfı ile test edilir. Bu nedenle kullanılan tanıma testi kaynak belleğini test etmek için bir kısıtlama olabilir.

5.3 Gelecek Çalışmalar

Liste güçlendirme etkisinin nasıl test edildiği farklı sonuçlar ortaya koyabilir. Örneğin, karışık listede çalışılan bir grup zayıf bilgi hatırlama testiyle test edildiğinde saf zayıf listeye kıyasla bellek başarıları düşer. Benzer olarak, karışık listede güçlendirilen bir grup güçlü bilgi aynı liste içerisinde zayıf bilginin bulunmasından dolayı saf güçlü listeyle karşılaştırıldığında daha iyi hatırlanır. Fakat, tanıma testlerinde liste güçlendirme etkisi anlamsız çıkmıştır. Mevcut tez, kaynak belleğinde liste güçlendirme etkisini ölçmek için tanıma testi uygulamıştır; fakat gelecek araştırmalar aynı etkiyi ölçmek için hatırlama testi kullanabilir.

Ek olarak, tıpkı birinci deneyde olduğu gibi karışık listelerde de birden fazla güç seviyesi kullanılabilir. Yani, bağlam bilgisi aynı liste içerisinde bir defa, iki defa ve üç defa çalışılabilir. Böylece, farklı bellek güçlerine sahip bağlam bilgisi performansının test edilme olanağı elde edilmiş olur.

5.4 Sonuç

Sonuç olarak, mevcut tezin sonuçları gösteriyor ki saf listede yapılan güçlendirme güçlü bağlamlar için kaynak belleği başarısını İO'da artış ve YAO'da azalma ile arttırır. Ek olarak, bir grup bağlam içerisinde zayıf bağlamların da bulunduğu listede güçlendirildiğinde kaynak belleği performansı saf güçlü listeye kıyasla artmazken zayıf bağlamların güçlü bağlamlarla birlikte çalışılması saf zayıf listeye kıyasla kaynak belleği performansını zayıflatmaz.

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