

INVESTIGATING THE ASYMMETRIC NATURE OF THE CONTIGUITY  
EFFECT VIA PROBED RECALL TASK

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CONTIGUITY EFFECT VIA PROBES RECALL TASK**

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## **ABSTRACT**

### **INVESTIGATING THE ASYMMETRIC NATURE OF THE CONTIGUITY EFFECT VIA PROBED RECALL TASK**

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In free recall, there is a tendency to generate a word that either follows or precedes the just recalled word in the study list, which is known as the contiguity effect. This effect has been explained by two main accounts: causal models and non-causal models. Causal models claim that the contiguity effect occurs due to the utilization of the just recalled item as a cue to recall the next item, whereas according to non-causal models, items are not used as cues, but instead the similarity between the mental state during the study and test phases results in the contiguity effect. Probed recall task is designed to test these two models to explain the mechanisms underlying the effect. However, the forward asymmetry that is usually observed in the contiguity effect was not observed in the probed recall task. It was suggested that the overall low performance could be the reason behind the symmetrical contiguity effect. Therefore, in this study, the probed recall task has been attempted to be optimized and facilitated. To that aim, 2 Experiments (and 2 Pilot Experiments) have been conducted. The results of the experiments have shown that the contiguity effect has been observed in both within-list and between-list conditions. Moreover, forward asymmetry has been observed in the between-list (long-term) contiguity effect, but not in the within-

list contiguity effect. With the findings of contiguity effects and asymmetry in long-term contiguity effect, this study supports the claims of causal models.

**Keywords:** Contiguity Effect, Probed Recall, Forward Asymmetry, Context

## ÖZ

### YAKINLIK ETKİSİNİN ASİMETRİK DOĞASININ YOKLAYICILI HATIRLAMA GÖREVİ İLE İNCELENMESİ

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Serbest hatırlama görevinde, genellikle hatırlanan bir maddeden sonra hatırlanan madde ilk maddeye pozisyon olarak yakındır. Buna yakınlık etkisi denir ve bu etki hem kısa süreli hem uzun süreli olarak gözlenebilir. Yakınlık etkisinin nedeni konusunda bir fikir birliği bulunmasa da açıklamalar iki ana başlık altında toplanabilir: nedensel modeller ve nedensel olmayan modeller. Nedensel modeller, hatırlanan maddenin hatırlanacak bir sonraki madde için ipucu olarak kullanılmasından ötürü yakınlık etkisinin olduğunu öne sürerler. Öte yandan nedensel olmayan modeller yakınlık etkisine çalışma ve test aşamaları esnasındaki zihinsel durumun benzerliğinin neden olduğunu söylerler. Yoklayıcı hatırlama, bu iki modeli test etmek için etkili bir görevdir. Fakat, yakınlık etkisinde sıklıkla gözlenen ileriye dönük asimetri, yoklayıcı hatırlama görevinde gözlenememiştir ve bunun nedeninin katılımcıların düşün performansının olabileceği öne sürülmüştür. Bu nedenle, bu çalışmada yoklayıcı hatırlama görevi kolaylaştırılmaya ve en uygun hale getirilmeye çalışılmıştır. Bu hedef doğrultusunda 2 deney (ve 2 pilot deney) yapıldı. Deneylerin sonucunda yakınlık etkisi hem liste içerisinde hem de listeler arasında (uzun süreli yakınlık etkisi) gözlemlendi. Bunun yanı sıra, ileriye dönük asimetri listeler arası yakınlık etkisinde

gözlendi ama liste içi yakınlık etkisinde gözlenemedi. Bu çalışma, yakınlık etkisine ve listeler arası yakınlık etkisindeki ileriye dönük asimetriye dair bulgularıyla nedensel modellerin varsayımlarını destekliyor.

**Anahtar Kelimeler:** Yakınlık Etkisi, Yoklayıcı Hatırlama Görevi, İleriye Dönük Asimetri, Bağlam

*For all the girls who dream to become a scientist*

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## **CHAPTER 1**

### **INTRODUCTION**

Episodic memory has been studied since Ebbinghaus (1885); however, it was described in detail and compared with semantic memory for the first time by Tulving (1972). Semantic memory does not include any contextual information as it is generated information from present memories; on the other hand, episodic memory is about one's own experiences and it is more sensitive to interference than semantic memory (Tulving, 1972). An example of semantic memory would be remembering that Paris is the capital of France, usually, there is no information about when and where one has learned this information. On the other hand, an example of episodic memory would be remembering the last office meeting or watching an opera last year, specific time and place information is known in these memories, and they are usually related to personal experiences. In other words, episodic memory is a specific kind of memory that includes both the remembered information regarding the content and the contextual information of that memory (Clayton & Dickinson, 1998; Nyberg et al., 1996; Tulving, 1985, 2002).

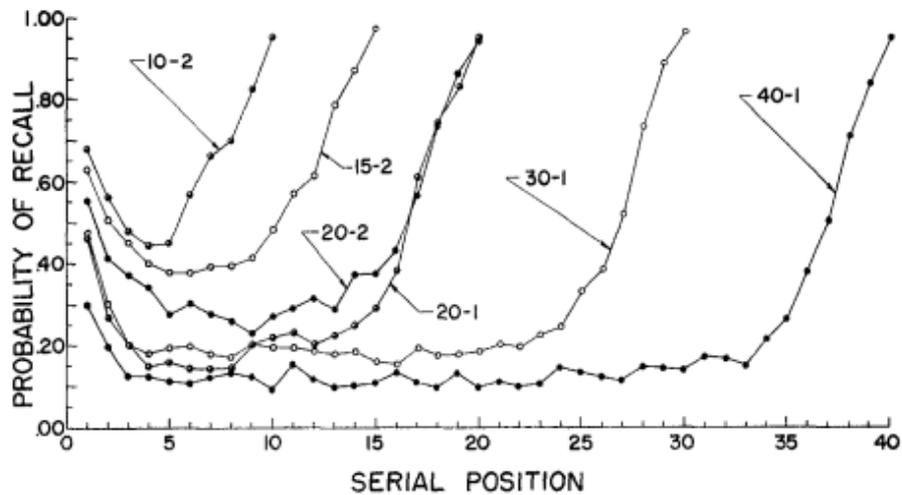
Episodic memory is usually measured in the lab with two main tasks: recognition and recall. In recognition, participants are presented with a list (or multiple lists) of items and in the test phase, they are asked if they have presented with the test item or not. In recall, participants are again presented with a list (or multiple lists) of items and then they are asked to recall what they remember. Free recall is one of the most basic paradigms used in the laboratory to understand the underlying mechanisms of episodic memory. In this paradigm, participants are presented with words and later, they are asked to report them in the order that comes to mind. Free recall is important for understanding how words are generated in the absence of cues. When cues are not provided as in the free recall

task, participants use the context in which the words are presented. Here, context can be defined as the experimental context in a broader sense or the list context in a more specific sense. Another recall type is cued recall, in which word pairs are given and one word from the pair is given as a cue to recall the other one.

In free recall, participants usually recall items in a similar order, as presented in Figure 1.1, which is called the serial position curve (Murdock, 1962). Figure 1.1 plots the recall probability of an item as a function of its position in the list. As can be seen, items at the beginning and at the end of the lists have a higher chance to be recalled. The high probability of recalling items at the beginning of the lists is called the *primacy* effect. The primacy effect is thought to result from the rehearsal advantage of the first items, and it is observed to have vanished when rehearsal is controlled (Atkinson & Shiffrin, 1968; Fischler et al., 1970; Marshall & Werder, 1972). A higher probability of recalling items at the end of the list is called the *recency* effect, as can be observed from Figure 1, the recency effect is stronger than the primacy effect. However, this robust effect of recency is also fragile. When there is a delay between the study phase and the test phase, the recency effect is no longer observed (Glanzer & Cunitz, 1966; Howard & Kahana, 1999).

In the first attempt to explain these effects conjointly, a human memory system with three components was proposed (Atkinson & Shiffrin, 1968; Shiffrin & Atkinson, 1969). The first component is the sensory register, which processes the incoming sensory information initially, and the processed information later enters the short-term store, which works like a limited capacity buffer. Once an item (a stimulus such as a word or a picture) enters the buffer, the first slot is filled in with the item. Then, the next items fill in the second slot and so forth until the buffer capacity is reached. Once the buffer is full, every new coming item forces out the first item that was already in the buffer, and the last empty slot is filled in with the new coming item. Finally, the items processed in the short-term store (buffer) enter the long-term store with some probability, and the

long-term store has an unlimited capacity. According to this model, episodic memory is stored in the long-term store and is subject to interference.

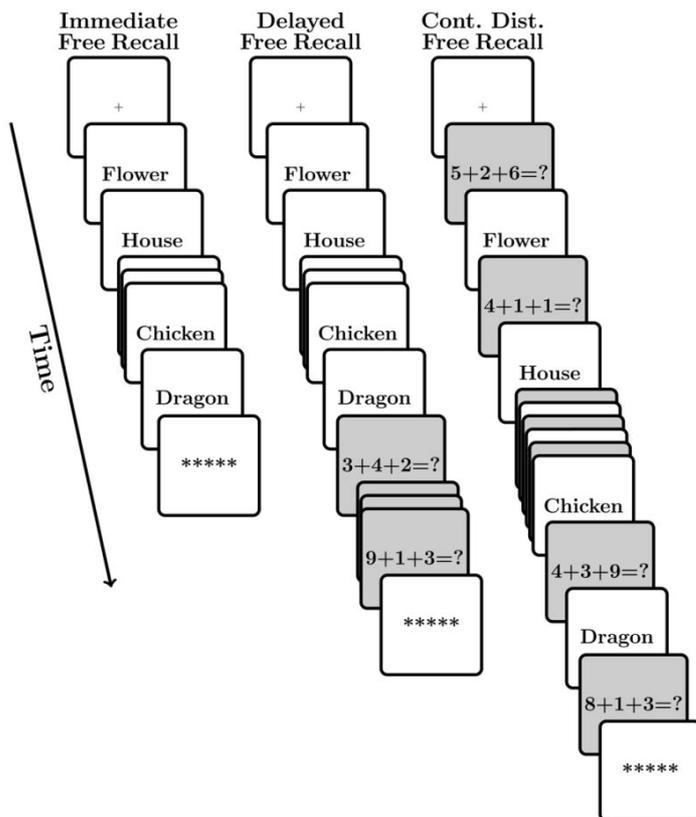


*Figure 1.1.* The Serial Position Curve. This figure plots the serial position curve of lists of 10, 15, 20, 30, and 40 items. The second number next to the list length demonstrates whether the words were presented for 1 second or two. Regardless of list length and presentation time, primacy and recency effects are observed. Adopted from Murdock (1962).

The recency effect is traditionally thought to be resulting of the short-term store because it attenuates with a distractor task that is adequate to fill the buffer (Atkinson & Shiffrin, 1968; Waugh & Norman, 1965), and recency items are usually the first to be retrieved in a free recall task (Bjork & Whitten, 1974). Based on this finding, it is thought that participants first empty their buffer, then switch to the long-term store to continue retrieving.

Another paradigm in the free recall is the continuous-distractor free recall (Figure 1.2), in which each item is followed by a distractor during the study phase. According to dual-store models (Search for Associations in Memory [SAM], Raaijmaker & Shiffrin, 1980, 1981), which simplify the original human memory model by removing the sensory registrar, there should not have been a recency effect observed in this task since the distractor will fill the buffer;

therefore, this effect was thought to be resulting from long term store and named as the long-term recency effect (Koppelaar & Glanzer, 1990). Another opinion on this matter is that long-term and short-term recency effects are the same phenomena, which can be explained by single-store models.



*Figure 1. 2. Different Types of Free Recall.* This figure explains different types of free recall tasks. In immediate free recall, participants study different words. In delayed free recall, the word study phase is the same as the immediate free recall; however, participants have a distractor task (or delay) at the end, which is exemplified as a summation task here. In the continuous-distractor free recall task, there is a distractor task in between each word. The distractors are typically not as long as the one that is at the end of the delayed free recall task. The figure is adapted from Sederberg, et. al. (2008).

As a single store model, TCM (temporal context model) is able to explain the recency effect that is observed in the continuous-distractor free recall task in

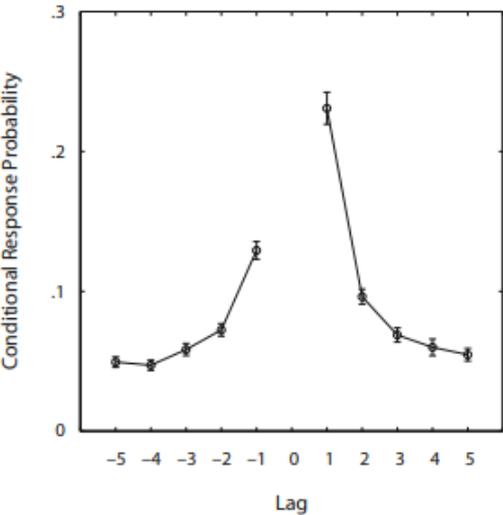
addition to the robust short-term recency effect in free recall (Howard & Kahana, 2002). According to the single store models, the main component in human memory is the drifting context over the course of the experiment (Howard & Kahana, 2002; Howard et al., 2015; Polyn et al., 2009; Sederberg et al., 2008). During the study phase, items are linked to the context and also cause a change in the context, which is then linked in the same way with subsequently presented items. Thus, a drift in context occurs based on being encountered with new items in the study. Later at retrieval, a current context is used as a cue, and once an item is retrieved, the retrieved item is again linked to the current context. That is, the context drifts as a result of retrieved items and as new items are retrieved, the context keeps on drifting until the recall is terminated. In short, the context drifts because of incoming items, which are either new words presented during the study phase or words retrieved during the test phase. Thus, in single-store models, an ongoing change in context can explain the ubiquitous recency effect.

According to TCM, putting a distractor lowers the strength of end list items relative to immediate free recall in both delayed free recall and continuous-distractor free recall. In delayed free recall, the recency effect disappears because the current context is not a useful cue anymore. However, because of the distractors in-between each item in the continuous-distractor free recall task, the strength of other items will also be lower compared to that in immediate free recall. During retrieval, all the items compete with each other to be recalled based on their strength. During this competition, more recent items will still have a higher chance to be generated in continuous-distractor-free recall (Howard & Kahana, 1999). Thus, despite being lower in magnitude, the recency effect is still observed in the continuous distractor-free recall task.

### **1.1. The Contiguity Effect**

In a free recall task, when participants recall an item from the list, the next item they are likely to recall is studied at a nearby position to the just recalled item; this is called *the contiguity effect* (Kahana, 1996; Kahana et al., 2008). Figure 1.3

demonstrates the usual graphical shape of the contiguity effect. As can be seen, the words which are positionally closer have a higher chance to be recalled when compared to the ones that were studied in a farther position including a forward asymmetry for the next recalled word. For example, if the words ABSENCE, HOLLOW, PUPIL, RIVER, DARLING are studied, there is a tendency to retrieve the words in the order such as PUPIL, RIVER, DARLING. That is, the words retrieved come from nearby study positions (RIVER) of the just recalled item (PUPIL), also in a forward direction, rather than a backward direction.



*Figure 1. 3.* The Usual Graphical Shape of the Contiguity Effect. The figure shows the probability of response as a function of the lag between words. Adopted from Sederberg, et. al. (2010).

The contiguity effect can also be observed on long-time scales. Similar to the recency effect, it can be observed in continuous-distractor-free recall tasks (Bjork & Whitten, 1974; Howard & Kahana, 1999) or it can be observed across lists; for example, in an experiment that Howard and colleagues have conducted (2008), the contiguity effect was observed through 48 lists that were shown to the participants. In other words, not only positionally closer words were being recalled sequentially within a list, but also words from closer lists were being recalled back-to-back. The contiguity effect can also be observed in longer time scales than in an experimental setting; in an experiment, participants were shown

a word each hour from their phone as they continued their daily activities for a day and the contiguity effect was observed in the recall phase (Mack et al., 2017). In another experiment, participants were asked to recall memories from their past within weeks, months, and years, and the contiguity effect was observed here too (Moreton & Ward, 2010).

Despite its importance in the literature, the mechanisms underlying the contiguity effect are still not clear. In their review, Healey, and colleagues (2019) claimed 6 basic mechanisms behind the contiguity effect: associative chaining, short-term memory, positional coding, chunking, control processes, and contextual dynamics. However, in more general terms, it can be said that there are two main accounts to explain the contiguity effect: causal models and non-causal models (Kılıç et al., 2013). Causal models claim that words that are recalled are used as cues to recall additional words and that is the reason why we observe the contiguity effect. SAM (search of associative memory) is a more recent version of Atkinson and Shiffrin's (1968) model, which aims to explain a mechanism for episodic memory, and is one example of causal models (Raaijmakers & Shiffrin, 1981). According to SAM, items that are positionally close to each other spend more time in the short-term store (buffer) together and get associated. Because of the strong association between the words, in the time of recall, they will serve as cues for each other. However, in its current form, SAM cannot explain the long-term contiguity effect. Lehman and Malmberg, on the other hand, developed another model similar to and partially built on SAM (2013). The model includes a buffer and a long-term store like SAM; however, the buffer takes a more active role compared to the earlier dual-store models; it can manipulate information according to the current strategy that is developed for the task. Moreover, unlike SAM, there is a vector in which contextual information for each item, similar to the contextual information of previous items, is encoded. Therefore, during retrieval similar items are more likely to be recalled subsequently, since they carry similar contextual features. With the addition of contextual features, Lehman and Malmberg's model can account for the contiguity effect as well as the asymmetry (2013).

Another example of causal models is TCM (Howard & Kahana, 2002). Context-item and item-context relations are highly emphasized in TCM. According to the model, context does not change randomly, rather items actively change the context (item-context relation) and when an item is recalled, its context is activated, and the activated context is used as a cue to retrieve the next word throughout the context-item association. Items that are presented in near positions will have a more similar context and this is the reason why a positionally close word will succeed the just recalled word. TCM is the first model that has explained a dynamically drifting context with the received input as explained above. It can be interpreted that taking the contextual information into account helps to explain the contiguity effect better.

Non-causal models, on the other hand, claim that the similarity between the mental state during the study phase and the test phase results in the contiguity effect. Davealar and colleagues' model is an example of a non-causal model (Davelaar et al., 2005). According to the model, context changes randomly and independent of the list presented in an experiment; and when the participants start to recall, the context will also be recalled as in the study phase and the mental state will also be similar; however, the context will not be affected by the retrieved words, but rather they drift in a random-walk fashion.

To investigate the underlying mechanisms of the contiguity effect, Kılıç, and colleagues (2013) developed the probed recall task. In this task, participants are presented with multiple lists of words to study; and in the test phase, they are given a random word from one of the random lists. They are first asked to rate how sure they are of seeing the probe word before from 1 to 9, and next they are asked to generate another word from the list that the probe word was presented in. Since the mental state of the test phase will be a lot different than the mental state of the study phase, if the non-causal mechanisms are the sole reason for the contiguity effect, we would not expect to observe this effect in this task. However, in the experiment, they observed both within-list and between-list

contiguity effects (Kılıç et al., 2013). This suggests that causal mechanisms should be involved; however, this does not mean that non-causal mechanisms do not play a role in the contiguity effect observed in a standard free recall task. Probed recall task is also important because it merges two, seemingly distinct from each other tasks to measure episodic memory: recognition and recall. Therefore, the probed recall task can help to advance literature with the aim to develop a more comprehensive model of episodic memory in the future.

## **1.2. Asymmetry in Contiguity Effect**

In associative memory, which is tested by showing participants word pairs in the study phase and giving one of the pairs and asking the other one or giving both of the pairs asking if the association is true in the test phase, there are two hypotheses on how the association works: independent association hypothesis (IAH), and associative symmetry hypothesis (ASH). IAH claims that when an association is given there is a forward and a backward direction and they are not dependent on each other, which means that they can enhance or worsen independent from each other (Wolford, 1971). This hypothesis provides a space for forward-direction advantage. On the other hand, ASH argues that the link between the pairs is bidirectional and symmetric, it cannot be evaluated independently from each other (Asch & Ebenholtz, 1962). Kahana's review on the topic (2002) indicated that forward asymmetry has been observed more prevalently when compared to findings that support the symmetric association.

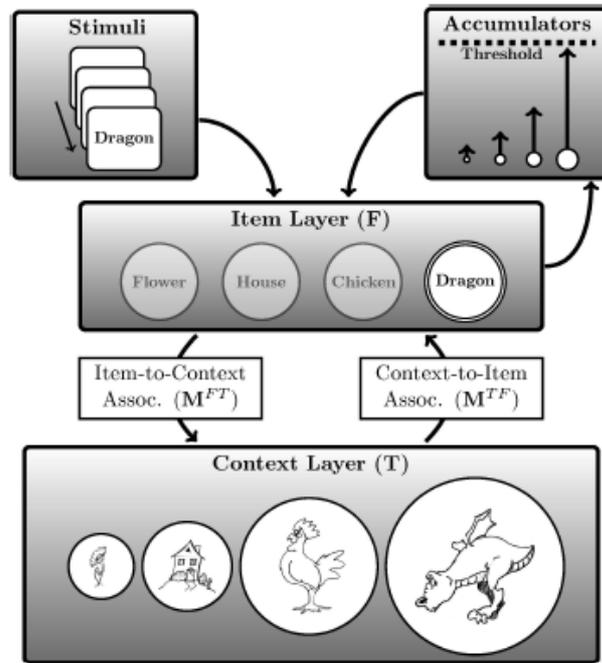
When participants are asked to freely recall the studied items, they usually do it in a similar pattern and this is thought to reflect how memory works. In a free recall task, forward asymmetry is mostly observed, especially for the items that are at the beginning of the list. Furthermore, response times are longer when recalling the preceding word when compared to recalling the subsequent word (Kahana, 1996). Kahana and Caplan have presented participants with word triplets and in the test phase, gave them one or two of the words and asked them to recall the other one or two words (2002). In a triple of ABC, when participants

are given AB, they recalled C faster and more accurately compared to when they are given BC and asked to recall A. Forward asymmetry can also be observed in recognition (Vaughn & Rawson, 2014; Yang et al., 2013). In fact, remember-know decision tasks in recognition seem to be having the same mechanisms with contiguity effect including the forward asymmetry (Sadeh et al., 2015). These findings show us that the contiguity effect and the forward asymmetry can be observed outside the recall tasks too.

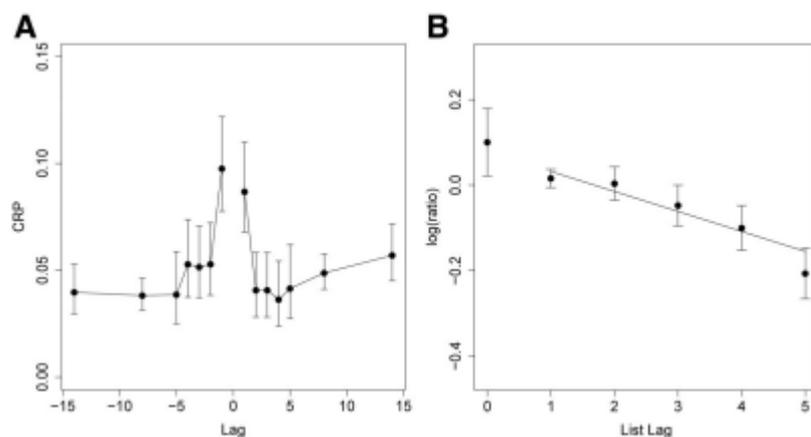
As mentioned above, there is usually a forward asymmetry in the contiguity effect. According to TCM, when an item is presented, its pre-experimental context is retrieved, becoming a part of the experimental context, and actively changing it with the information it brings in (Figure 4). In the test phase, when an item is recalled, its pre-experimental context is used as a cue to recall the succeeding item presented in the list. As mentioned above, in the study phase after the presentation of an item, its pre-experimental context becomes part of the experimental context, which is then linked to the next item presented via association matrices as presented in Figure 1.4 (Sederberg et al., 2008). That is, an item's pre-experimental context has the most similarity with the following item's experimental context and this causes the forward asymmetry (Sederberg et al., 2008). According to Davelaar et al. (2005), there is a forward asymmetry because simply, the context is changing again in a similar random-walk fashion as in the study, and this results in a similar drift.

In the probed recall task that Kılıç and colleagues (2013) have conducted, there was a contiguity effect; however, there was no asymmetry (Figure 1.5). In the paper, they suggested two possible reasons for the absence of asymmetry. The first one is that since the non-causal mechanisms are eliminated in the probed recall task and if the asymmetry is a result of non-causal mechanisms, then a lack of asymmetry would be expected when the only reason for the contiguity effect is causal mechanisms. The second possibility is the dropped overall recall probability. It is claimed in another study that people who had lower performances in the recall task showed no asymmetry in the contiguity effect

(Spillers & Unsworth, 2011). The performance of the participants was lower than the usual in the paper, so this can be the reason for the failure to observe asymmetry.



*Figure 1. 4.* The Representation of TCM. This figure represents how TCM works (the accumulator layer is added to the figure in an extended version of the model, which is called TCM-A). The sizes of the circles in the context layer represent how much space they have in the layer. In the test phase context is used to recall the words, which are likely to be the last words since the context will be most similar. Then, recalled words' context will also be recalled and again will be used as a cue. The figure is adapted from Sederberg et al. (2008).



*Figure 1. 5.* The Results from Kılıç et al. (2013). The figure shows the contiguity effect in probed recall task (Kılıç et al., 2013). It can be seen that there is no asymmetry.

This thesis aims to advance the probed recall task to increase the average performance to the benchmark observed in free recall. By optimizing the task, it will be possible to understand the mechanisms underlying the contiguity effect better. It is hypothesized that if the performance increases, asymmetry will be observed as the causal models propose, otherwise an adaptation would be required for the causal models.

### 1.3. Importance of Context

The importance of context has been known for a while in episodic memory research, as it is contextual information that is required to define episodic memory. One of the most known studies in this area is Godden and Baddeley's experiment (1975), in which participants were given lists either underwater or on land, and at the recall phase participants remembered the words better when they were in the same context where they learned those words. There are other examples in the literature about the effects of context on memory (Smith & Vela, 2001; Smith, 1985; Tulving & Thomson, 1973; Herz, 1997). However, it is also needed to note here that there is also a replication study of Goddel and Baddeley's experiment (1975), which could not find the same effect (Murre,

2021). This could be implying that the importance of the contextual information is not as major as it has been thought.

There has been a great number of findings that show the importance of the hippocampus for episodic memory (Eichenbaum & Cohen, 2001; Moscovitch & Winocur, 1992; Scoville & Milner, 1957; Squire & Zola-Morgan, 1991; Tulving & Markowitsch, 1998). It has been mentioned that the episodic memory has to include the context information, which is mainly the answer to the questions “when” and “where”. When an episodic memory is remembered, the context of that memory is also retrieved (Folkerts, 2018). Hippocampus has been shown to make those temporal and spatial associations with memories through *time cells* and *place cells* (Burgess et al., 2002; Howard & Eichenbaum, 2015; Kraus et al., 2015; MacDonald et al., 2011; O'Keefe & Nadel, 1978; Westmacott & Moscovitch, 2001). The memories are temporally encoded and claimed to be scale-invariant in time (Chater & Brown, 2008; Howard, 2017; Howard & Eichenbaum, 2015; Nielson et al., 2015; Shankar & Howard, 2012; Shankar & Howard, 2013) which can be thought of as a support for single-store and temporal context-driven memory and can be used to explain long-term contiguity and recency effects.

There are different theories about how context influences memory. According to TCM, items are encoded with their contextual information, and items actively change the context; also, context is used as a cue to recall items (Howard & Kahana, 2002). According to SAM, during retrieval, the short-term buffer is emptied at first, being followed by further retrieval in which both context and the retrieved words are used as cues (Raaijmakers & Shiffrin, 1981). However, retrieved words do not influence context as in TCM. According to Davelaar and their colleagues' model (2005), both a short-term buffer and context are all connected in a matrix. With each item presented, context changes via random walk; however, items are not causing any change in the context, thus, different from TCM, the context drifts in a random fashion (Davelaar et al., 2005).

Since this thesis aims to facilitate and optimize the probed recall task, making context stronger for the lists could lead to better performance. It is hypothesized that the contiguity effect for within-list items will be enhanced with stronger contextual information. However, how it is going to affect the contiguity effect between list items is not clear. It is expected that since the performance will probably increase, the likelihood of participants' retrieving words from wrong lists will be reduced, but still, if they retrieve from a wrong list, it is expected to be a list that is positionally close to the actual list.

The within- and across-list contiguity effects observed in the probed recall have not been replicated yet, and this paradigm hasn't been used in another experiment. Tasks that will merge recall and retrieval are necessary for a more comprehensive model of episodic memory. Thus, developing the probed recall task would be an important step to understanding the mechanisms of the contiguity effect as it is emphasized above; with a more stable probed recall task, it can be possible to examine other important effects in episodic memory and have a better understanding in general. That is why, this thesis aims to improve the method of the probed recall task, especially by making it easier for the participants. It is hypothesized that the within-list and the between-list contiguity effects will be observed in the experiments as predicted by the causal models. As mentioned, the probed recall task has a recognition part that include confidence interval ratings, and a recall part. It is also hypothesized that there will be a relationship between confidence interval rating and the recall rate.

## CHAPTER 2

### PILOT EXPERIMENTS AND EXPERIMENT 1

#### 2.1 Pilot Experiment 1

##### 2.1.1. Method

The probed recall task is a novel task, and it has not been replicated before. Due to that, before doing the actual experiments, two pilot experiments have been done to observe the general dynamics. Then, an additional preliminary study has been conducted to select the proper word lists. These studies are explained in detail in this section.

##### 2.1.1.1. Participants

15 participants took part in the experiment. Participants were native Turkish speakers with normal or corrected vision. 8 of the participants (53.33%) were identifying themselves as a man and 7 of them as a woman (46.67%). They were aged between 22-28 ( $M= 24.53$ ,  $SD=1.46$ ). 13 of the participants (86.67%) were right-handed and 2 of the participants (13.33%) were left-handed.

##### 2.1.1.2. Materials

Word lists were taken from Kılıç and colleagues' experiment (2013) and translated into Turkish by me. I have written a code in MATLAB using Psychtoolbox for this experiment.

##### 2.1.1.3. Procedure

The ethical approval that has been taken for the main experiments has been used in this study. Participants came to the lab at the arranged time. First, they signed written consent, then they were escorted to the sound-proof lab in which they were going to be doing the experiment. They were instructed every part of the experiment detailly by the experimenter first, then they read the instructions themselves and if they do not have any questions, the experimenter left the room, and the experiment has begun.

The experiment had 3 phases: study, arithmetic, and test. In the study phase, participants have seen 7 lists and 10 words in each list. Lists were selected randomly for each participant from the 32 lists that were prepared. They were instructed to learn each word, and meanwhile, they had to rate each word for whether it is abstract (press z) or concrete (press m) for them. After each list, there was an arithmetic task that lasted 60 seconds. During the 60 seconds, a random number between 1-9 appeared on the screen. Participants had to sum this number up with the number that came before. In the test phase, participants were given 28 probe words, they have seen 21 of them in the lists and they have not seen 7 of them at all. 3 words were selected from each list. 1<sup>st</sup>, 2<sup>nd</sup>, 9<sup>th</sup>, and 10<sup>th</sup> words of the lists were not used to eliminate the primacy and recency effects. Either the 3<sup>rd</sup>, 5<sup>th</sup>, and 7<sup>th</sup> words or the 4<sup>th</sup>, 6<sup>th</sup>, and 8<sup>th</sup> words of a list were selected randomly as probe words. 7 new words were chosen randomly between 30 potential words. All 28 words were shuffled before being shown to the participant. Participants were first asked “Did you see this word?” for each word, and they answered this question with a number from 1 to 9. After, they were asked to write another word from the list that they saw this probe word. Throughout the experiment the background was black, and the writing was white. All the data was collected using a keyboard.

Even though everything about the experimental procedures was explained to the participants in detail and without hiding anything, there was also a debriefing form if participants were curious about the experiment more when they are finished. This study used a within-subject design.

### **2.1.2. Results**

There were 21 true probe words (3 words from each list) in the test phase. The mean ratio of participants' going back to the right list and recalling another word is 1.2/21 (5.71%). R is used to conduct all the analysis and draw all the figures in this thesis (R Core Team, 2021).

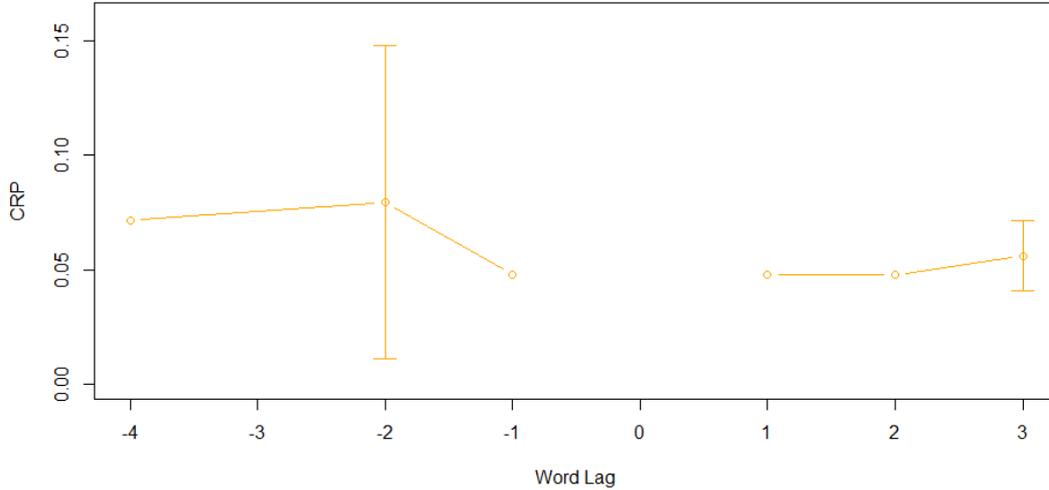
#### **2.1.2.1. Data Organization**

Another MATLAB code has been written for data organization. First, the list and the study position in the list for each recalled word have been determined. After that, the word lags (WL) and the list lags (LL) have been calculated for each response. Finally, frequencies for specific WLs and LLs were calculated for each participant. For example, to look for the in-list-contiguity effect, WL 1, WL 2, and WL 3 responses of a participant were grouped and compared with WL 5, WL 6, and WL 7 responses of a participant. If they recalled a word that is 2 positions away from the probe word (WL 2) for 3 times and a word that is 3 times away (WL 3) 2 times, the first group would have the frequency of 5 for this particular participant.

#### **2.1.2.2. Within-List Contiguity Effect**

Participants rarely could go back to the right list and recall other words, so the analysis has been conducted for very few data points; therefore, the results are far away from reliable. Nonetheless, the analyses were performed. WLs 1,2,3 and 5,6,7 were compared to see whether there is any within-list contiguity effect (Figure 2.1). A paired sample t-test analysis was performed, and the results demonstrated that the words in closer position ( $M=.73$ ,  $SD=1.1$ ), which are WLs 1, 2, 3, were not recalled more than words that are in a distant position ( $M=.27$ ,  $SD=0.46$ ), which are WLs 5,6,7,  $t(14)= 1.52$ ,  $p= .15$ ,  $d = .39$ , with the mean

difference of .47 with 95% lower end of -.19 points (Table 2.1). Therefore, no within-list contiguity effect was observed.



*Figure 2. 1. Lag CRP plot for the within-list contiguity effect in Pilot Experiment 1. CRP is word lag frequency divided by word lag possibilities. For example, let us say that a participant gives word lag 5 responses 2 times. How many word probe words have word lag 5 is checked, for example, if the probe word is in the 11th, 12th, or 13th position in the study list it does not have lag 5, let us say in this case 12 probes have lag 5. The CRP for this condition is 2/15.*

*Table 2. 1. Within-List Contiguity Effect Paired Samples T-Test for Pilot Experiment 1*

	Student's t	df	p	Mean Difference	SE Difference	95% CI	Cohen's d
WL 1,2,3- WL 5,6,7	1.52	14.0	0.15	0.47	0.31	[-0.19, 1.12]	0.39
WL+1,2,3- WL -1,2,3	0.27	14.0	0.79	0.07	0.25	[-0.47, 0.6]	0.07

### 2.1.2.3. Between-List Contiguity Effect

Similar to the within-list contiguity effect, the between-list contiguity effect was calculated by comparing LL 1,2,3 and LL 4,5,6 (Figure 2.2). A paired sample t-test analysis was performed, and the results indicated that the words in a closer list to the correct list ( $M=4.53$ ,  $SD=2.33$ ), which are LLs 1, 2, and 3 were

recalled significantly more than words that are in a distant list ( $M=2.47$ ,  $SD=1.64$ ), which are LLs 4, 5, 6,  $t(14)= 3.11$   $p= .008$ ,  $d = 0.8$ , with the mean difference of 2.07 with 95% lower end of 0.64 points (Table 2.2). The Q-Q plot distribution and the Shapiro-Wilk test ( $W = 0.96$ ,  $p= 0.62$ ) indicated no violence to normality.

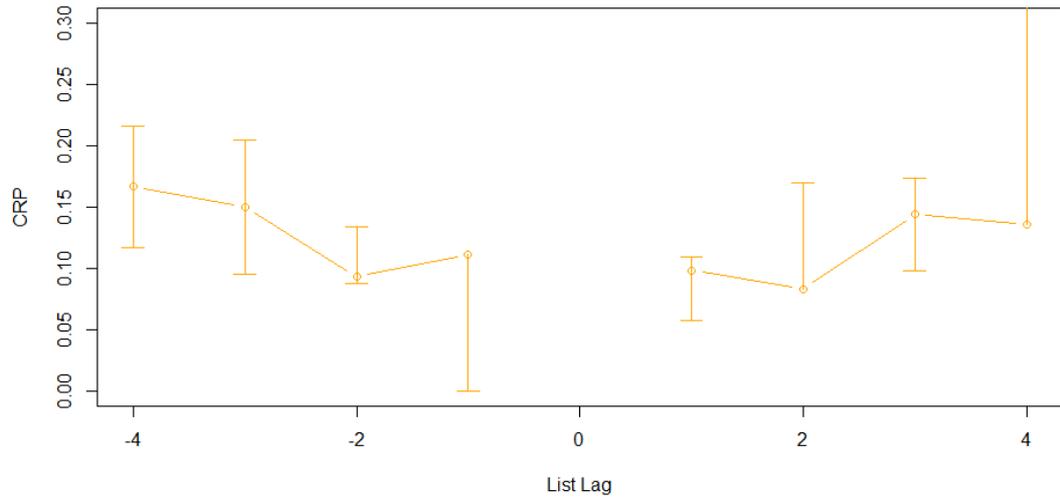


Figure 2. 2. Lag CRP plot for the between-list contiguity effect in Pilot Experiment 1

Table 2. 2. *Between-List Contiguity Effect Paired Sample T-Test for Pilot Experiment 1*

	Student's t	df	p	Mean Difference	SE Difference	95% CI	Cohen's d
LL 1,2,3-LL 4,5,6	3.11	14.0	0.008	2.07	0.67	[0.64, 3.49]	0.80

#### 2.1.2.4. Confidence Interval and Recall

Before making a recall, participants have rated each probe word from 1 to 9 to indicate whether they have seen this probe word in the study lists or not, 1 being “I definitely have not seen this word”, and 9 being “I definitely have seen this word.”. The mean rates for turning back to the correct list for each confidence interval are given in the table (Table 2.3) and the figure below (Figure 2.3). A

one-way ANOVA has been conducted to see whether there is a difference in making a recall from the correct list according to the confidence interval rating (Table 2.4). The results did not yield a significant result ( $F(8, 411) = 1.07$ ,  $MSE = .04$ ,  $p = .382$ ).

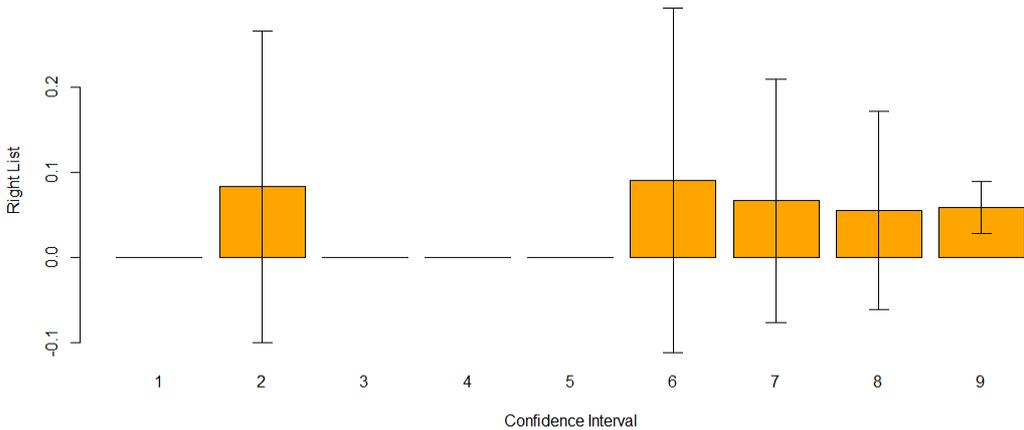


Figure 2. 3. The mean of returning to the correct list according to each confidence interval rating in Pilot Experiment 1

Table 2. 3. The mean of returning to the correct list according to the confidence interval rating for Pilot Experiment 1

Confidence Interval	Right List
1	0.00
2	0.08
3	0.00
4	0.00
5	0.00
6	0.09
7	0.07
8	0.06
9	0.06

Note: Returning to the right list has coded with 1 and every other situation has been coded with 0. Here is the mean for returning to the right list for all the conditions in the experiment (meaning response to the 20 probe words for every 76 participants) grouped by the confidence interval rating that the probe word has taken.

Table 2. 4. *One-way ANOVA Table for returning to the right list based on Confidence Intervals in Pilot Experiment 1*

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	$\eta^2$
CI	8	0.35	0.04	1.07	0.38	0.20
Residuals	411	16.88	0.04			

## 2.2 Pilot Experiment 2

### 2.2.1. Method

A second pilot experiment is done with some changes aiming to make the task easier. This pilot was in a time when the pandemic started and there was no vaccination. Therefore, it had to be done online and for that purpose, the code of the experiment was written this time in Pavlovia.

#### 2.2.1.1. Participants

31 participants from Middle East Technical University participated in the experiment in exchange for course credit. One participant has been excluded from the study for not complying with the age limits, which are 18-35, which left the study with 30 participants. Participants were native Turkish speakers with normal or corrected vision. 25 of the participants (83.33%) were identifying themselves as a woman and 5 of them as a man (16.67%). They were aged between 20-27 ( $M= 22.2$ ,  $SD=1.67$ ). 24 of the participants (80%) were right-handed and 6 of the participants (20%) were left-handed.

#### 2.2.1.2. Materials

Word lists were taken from Kılıç and colleagues' experiment (2013) and translated into Turkish by me. I have written a code using both Python (Psychopy) and JavaScript to run the code in the online platform Pavlovia.

### 2.2.1.3. Procedure

The ethical approval that has been taken for the main experiments has been used in this study. Participants signed up for a slot and joined a Zoom meeting at the arranged time. In that Zoom meeting their verbal approval was taken (later an approval will be taken again at the beginning of the experiment). They were asked questions like “Are you alone in the room?”, “Can you ensure that you will not be disturbed for the next 20 minutes?”. Lastly, their demographic information was taken verbally; then they started the experiment and both the experimenter, and the participant left the Zoom.

Different than the first pilot experiment, this time participants have seen 5 lists and 15 words in each list. Lists were selected randomly for each participant from the 40 lists that I had. They were instructed to learn each word, and meanwhile, they had to rate each word for whether it is pleasant (press z) or not pleasant (press m) for them. This change from rating abstractness/concreteness to pleasantness was to increase the strength of each item to make the task eventually easier; also, both of the ratings were functional to make participants think of the word in front of them, not the words before. Therefore, the rehearsal for the previous words has been prevented. The Distractor task was shortened from 60 seconds to 30 seconds. For the first 15 seconds of the distractor task, random summing calculations appeared on the screen, some of them were correct and some of them were not. Participants have pressed “z” if they thought the calculation was correct. After 15 seconds has passed, they waited for 15 more seconds with “Please wait” written on the screen. In the test phase, participants were given 20 probe words, they have seen 15 of them in the lists and they have not seen 5 of them at all. 3 words were selected from each list. 1<sup>st</sup>, 2<sup>nd</sup>, 14<sup>th</sup>, and 15<sup>th</sup> words of the lists were not used to eliminate the primacy and recency effects. 1<sup>st</sup> word of the 3 words that were taken from a list has been chosen randomly between the 3<sup>rd</sup>, 4<sup>th</sup>, or 5<sup>th</sup> word that has been shown, 2<sup>nd</sup> probe word has been chosen randomly between the 7<sup>th</sup>, 8<sup>th</sup>, or 9<sup>th</sup> words and the last

probe word has been chosen randomly between the 11<sup>th</sup>, 12<sup>th</sup>, or 13<sup>th</sup> words. The reason for the 6<sup>th</sup> and 10<sup>th</sup> words not to be used was to avoid showing preceding words during the test phase. 5 new words were chosen randomly among 20 potential words. All the 20 words were shuffled before being shown to the participant. Participants were first asked “Did you see this word?” for each word, and they answered this question with a number from 1 to 9. After, they were asked to write another word from the list that they saw this probe word. Throughout the experiment the background was grey, and the writing was white. All the data was collected using the keyboard.

Even though everything about the experimental procedures was explained to the participants in detail and without hiding anything, there was also a debriefing form that appeared on the screen if participants were curious about the experiment more when they are finished. When their data was on the system, they were given course credit for participation. This study used a within-subject design.

### **2.2.2. Results**

There were 15 true probe words (3 words from each list) in the test phase. The mean ratio of participants’ going back to the right list and recalling another word is 3.47/15 (23.13%).

#### **2.2.2.1. Data Organization**

The Data organization procedures were the same as in Pilot Experiment 1.

#### **2.2.2.2. Within-List Contiguity Effect**

WLs 1,2,3 and 5,6,7 were compared to see whether there is any within-list contiguity effect (Figure 2.4). A paired sample t-test analysis was performed, and the results demonstrated that the words in closer position ( $M=1.67$ ,  $SD=2.2$ ), which are WLs 1, 2, 3, were recalled significantly more than words that are in a

distant position ( $M=.67$ ,  $SD=.92$ ), which are WLS 5,6,7,  $t(29)= 2.55$ ,  $p= .016$ ,  $d = .465$ , with the mean difference of 1 with 95% lower end of .2 points. However, the Shapiro-Wilk test ( $W = .85$ ,  $p <.001$ ) and Q-Q plot distribution pointed out a violation of normality. Because of this situation, the Wilcoxon rank test was also conducted and it also resulted in a significant difference between the groups  $W(29)= 202^a$ ,  $p= .013$ ,  $r_{rb} = 0.6$ , with the mean difference of 1.5 with 95% upper-end of 2 points.

To test whether there is an asymmetry, WLS +1,+2,+3, and WLS -1,-2,-3 were compared. A paired sample t-test analysis was performed, and the results indicated no significant difference between subsequent ( $M=.6$ ,  $SD=.93$ ), which are WL +1,+2,+3, and preceding words ( $M=1.07$ ,  $SD=1.6$ ), which are WL -1,-2,-3,  $t(29)= -1.82$ ,  $p = .08$ ,  $d = -.33$ . The Shapiro-Wilk test ( $W = .84$ ,  $p <.001$ ) and Q-Q plot distribution pointed out a violation of normality. Wilcoxon W test also yielded no significant results,  $W(29)= 21^a$ ,  $p= .09$ ,  $r_{rb} = -.54$ , with the mean difference of -1 with 95% lower-end of -2.5 points (Table 2.5).

To conclude, within list contiguity effect, but not forward-asymmetry was significantly observed. In other words, participants tend to recall the words that are positionally closer to the given probe word significantly more with a small-to-medium effect size. However, the words that come after the probe word has found to not have an advantage over the words that come before.

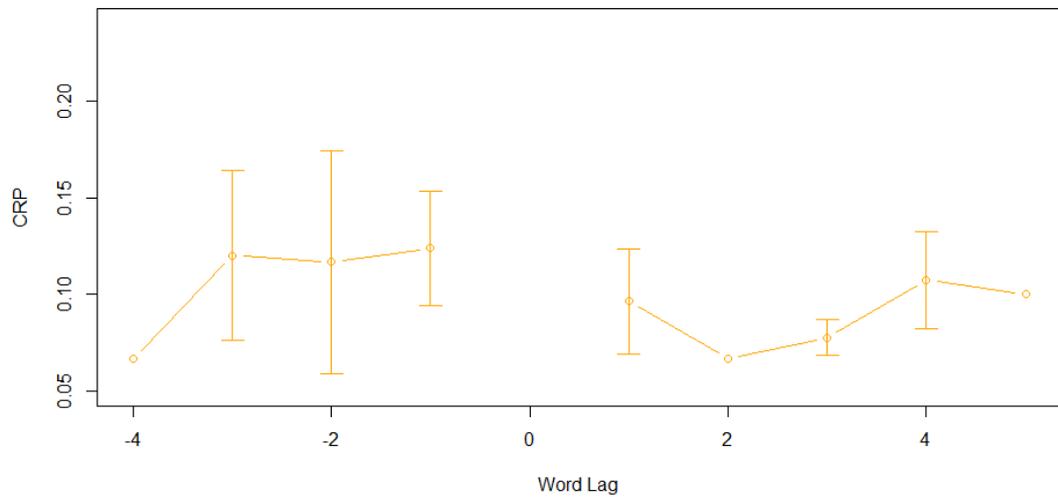


Figure 2. 4. Lag CRP plot for the within-list contiguity effect in Pilot Experiment 2

Table 2. 5. Within-List Contiguity Effect Paired Samples T-Test for Pilot Experiment 2

		Statistic	df	P	Mean Difference	SE Difference	95% CI		Effect Size
WL 1,2,3- WL 5,6,7	Student's t	2.55	29.0	0.02	1.00	0.39	[0.2, 1.8]	Cohen's d	0.47
	Wilcoxon W	202.0		0.01	1.50	0.39	[4.46e-5, 2.00]	Rank biserial correlation	0.6
WL+1,2,3- WL -1,2,3	Student's t	-1.82	29.0	0.08	-0.47	0.26	[-0.99, 0.06]	Cohen's d	-0.33
	Wilcoxon W	21.0		0.09	-1.00	0.26	[-2.50, 2.36e-5]	Rank biserial correlation	-0.54

### 2.2.2.3. Between-List Contiguity Effect

Similar to the within-list contiguity effect, the between-list contiguity effect was calculated by comparing LL 1,2 and LL 3,4 (Figure 2.5). A paired sample t-test analysis was performed, and the results indicated that the words in a closer list to

the correct list ( $M=5.9$ ,  $SD=2.38$ ), which are LLs 1, 2, were recalled significantly more than words that are in a distant list ( $M=1.93$ ,  $SD=1.34$ ), which are LLs 3,4,  $t(29)= 9.11$   $p < .001$ ,  $d = 1.04$ , with the mean difference of 3.97 with 95% lower end of 3.08 points. The Q-Q plot distribution and the Shapiro-Wilk test ( $W = .97$ ,  $p= .44$ ) indicated no violence to normality.

Although it has not been hypothesized, I wondered whether there is a forward-asymmetry in the between-list contiguity effect and conducted an analysis between LLs +1, +2, and LLs -1, -2. Another paired sample t-test analysis was performed, and the results indicated no difference between the recall of subsequent lists ( $M=3.43$ ,  $SD=2.06$ ), which are LLs +1, +2, and preceding lists ( $M=2.47$ ,  $SD=1.74$ ), which are LLs -1, -2,  $t(29)= 1.78$ ,  $p= .086$ ,  $d = .33$ , with the mean difference of .97 with 95% lower end of -.15 points (Table 2.6).

In summary, when participants made an error and recalled a word from a wrong list, that list is prone to be a positionally close list to the right list significantly more with a large effect size; however, no directional advantage in position has been observed. Therefore, it can be concluded that the between-list contiguity effect is observed in this experiment.

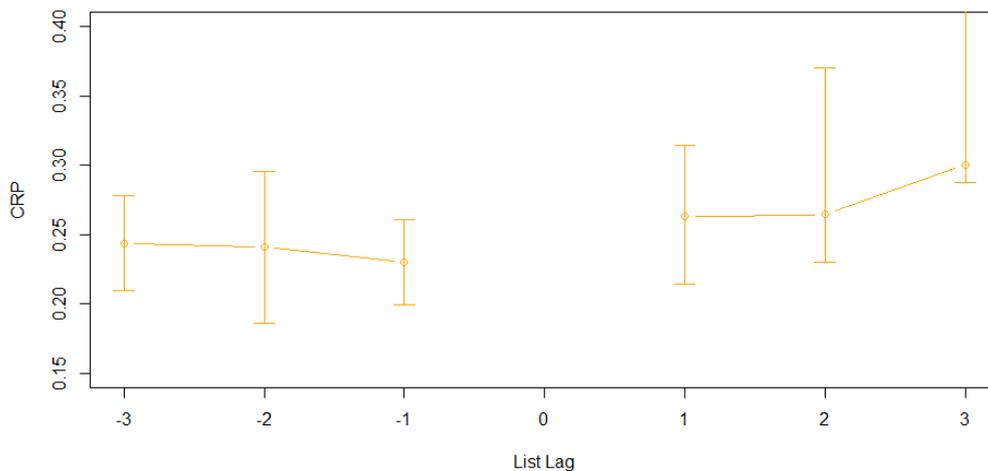


Figure 2. 5. Lag CRP plot for the between-list contiguity effect in Pilot Experiment 2

Table 2. 6. *Between-List Contiguity Effect Paired Samples T-Test for Pilot Experiment 2*

		Statistic	df	P	Mean Difference	SE Difference	95% CI		Effect Size
LL 1,2-LL 3,4	Student's t	9.11	29.0	< .001	3.97	0.44	[3.08, 4.86]	Cohen's d	1.66
	Wilcoxon W	378		< .001	4.50	0.44	[3.50, 5.00]	Rank biserial correlation	1.00
LL+1, 2-LL -1,2	Student's t	1.78	29.0	0.086	0.97	0.54	[-0.15, 2.08]	Cohen's d	0.33
	Wilcoxon W	273		0.110	1.00	0.54	[-1.31e-5, 2.50]	Rank biserial correlation	0.35

#### 2.2.2.4. Confidence Interval and Recall

Before making a recall, participants have rated each probe word from 1 to 9 to indicate whether they have seen this probe word in the study lists or not, with 1 being “I definitely have not seen this word”, and 9 being “I definitely have seen this word.”. The mean rates for turning back to the correct list for each confidence interval are given in the table (Table 2.7) and the figure below (Figure 2.6). A one-way ANOVA has been conducted to see whether there is a difference in making a recall from the correct list according to the confidence interval rating (Figure 6). The results yielded a significant result ( $F(8, 591) = 7.47, MSE = .13, p < .001$ ), meaning at least one of the ratings predicted a recall from the correct list significantly more than the other ratings. A Tukey's HSD has been further conducted to see the significant comparisons. The ratings 8 and 1 ( $p = .03, 95\% \text{ C.I.} = [.01, .55]$ ), 9 and 1 ( $p < .001, 95\% \text{ C.I.} = [.13, .36]$ ), the ratings 9 and 2 ( $p = .003, 95\% \text{ C.I.} = [.05, .45]$ ) have been found significantly different from each other, the other comparisons were not significant (Table 2.8). To sum up, it can be concluded that the ratings of 8 and 9, which is the highest rating meaning that the participant is totally confident that they have seen this word before, led to more correct recalls in some cases.

Table 2. 7. The mean of returning to the correct list according to the confidence interval rating for Pilot Experiment 2

Confidence Interval	Right List
1	0.01
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.07
8	0.29
9	0.25

Note: Returning to the right list has coded with 1 and every other situation has been coded with 0. Here is the mean for returning to the right list for all the conditions in the experiment (meaning response to the 20 probe words for every 76 participants) grouped by the confidence interval rating that the probe word has taken.

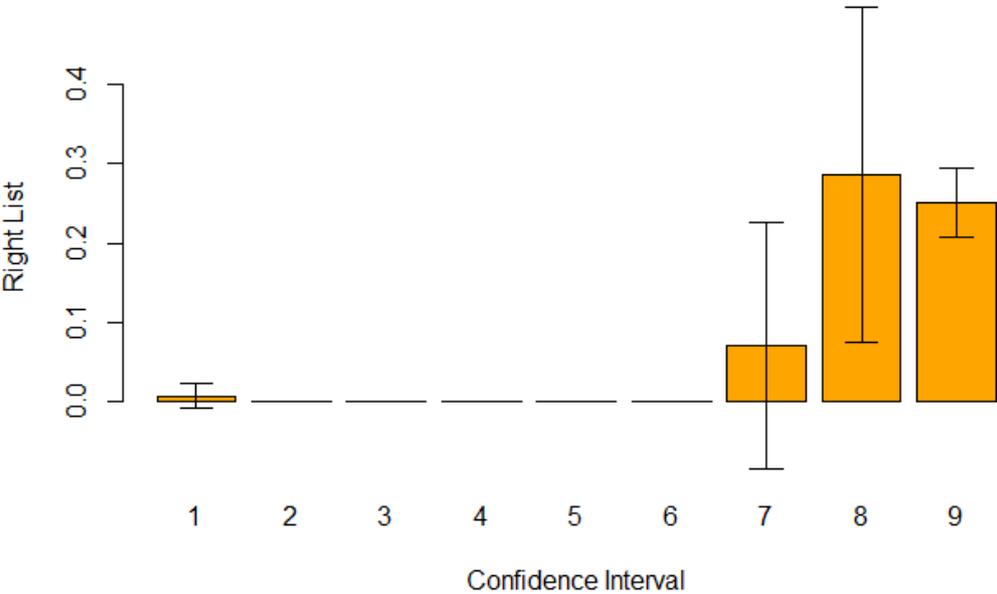


Figure 2. 6. The mean of returning to the correct list according to each confidence interval rating in Pilot Experiment 2

Table 2. 8. *One-way ANOVA Table for returning to the right list based on Confidence Intervals in Pilot Experiment 2*

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	$\eta^2$
CI	8	7.89	0.99	7.47	< .001	0.09
Residuals	591	78.08	0.13			

## **2.3 Preliminary Study**

### **2.3.1. Method**

In order to choose the words that will be used in the experiments, a preliminary experiment was necessary. Since I am looking at episodic relations here, semantic relations are needed to be controlled; therefore, there should not be any related words in a list. Kılıç and her colleagues (2013) have arranged this in their own experiment using the SEMMOD package (Stone, Dennis, & Kwantes, 2008) which used the Latent Semantic Analysis model (Landauer, & Dumais, 1997) to evaluate the semantic relatedness among words in a list. Their words were in English, and due to the several difficulties and lack of resources in Turkish, doing the same calculations was not possible. For this reason, I have translated these words into Turkish and did this preliminary study to make sure there are not any semantically related words in the lists.

#### **2.3.1.1. Participants**

Data from 109 participants were collected with the snowball sampling method. Participants were native Turkish speakers and they were aged between 18-35. 2 participants were excluded from the study because they have written single words instead of word pairs; therefore, I could not use their data. That left the study with 107 participants in total.

#### **2.3.1.2. Materials**

Qualtrics program was used to collect the data. Participants have shown 33 lists in total with 17 words in each list.

### **2.3.1.3. Procedure**

The ethical approval that has been taken for the main experiments has been used in this study. The Qualtrics link has been sent to the potential participants through social networks and social media. First, the participants have given consent by clicking a button prior to the study. Then they were instructed to write word pairs that they consider to be related to each other in each list. They have evaluated all 33 lists for semantic similarity.

### **2.3.2. Results**

A cutoff point to eliminate a word was determined relatively. Each list had 2 extra words since in the experiment lists were going to have 15 words. 2 of the words from the word pairs that have been selected as related the most, have been eliminated from the list. Which word to exclude from the selected word pair has been chosen randomly. When I looked at the frequencies, that meant if more than 15 people out of 107 people thought that there are two words related in a list, one of those words was removed from the list. For example, the words madalya and ödül (medal and award) have been found to be related by 58 people (this word pair has the highest rating for being related), and the words baharat and ülser (spice and ulcer) have been rated as being related by 25 people; therefore, one word from these two-word pairs (ödül and baharat in this case) has been randomly chosen to be removed from the lists. Moreover, to illustrate the words that were not removed, the words sonbahar and bitki (autumn and plant) were rated as being related by 10 people; and, the words kültür and bilmece (culture and puzzle) have been found to be related by 5 people; therefore, they were not excluded from the study. After the related words have been cut off from the study, I have calculated the frequency of current word pairs from each

list the most people have been voted as semantically related. The mean of the most related word pairs in each list is 7.97 out of 107 people.

## **2.4 Experiment 1**

### **2.4.1. Method**

#### **2.4.1.1. Participants**

A calculation using G Power has been conducted to decide on the sample size. The statistical test is chosen as matched paired T-test, and for the experiment to have 0.99 power with two-tailed, 0.5 DZ effect size, and .05 alpha; the estimated sample size was 76 (Faul et al., 2019).

In total, 78 participants from Middle East Technical University participated in the experiment in exchange for course credit. Participants were native Turkish speakers with normal or corrected vision. Two of the participants had to be excluded from the data for technical problems: One participant could not get into the test phase because of an error in the computer and the other participant's data was not saved for an unknown reason. One participant was excluded from the experiment because even though instructed not to leave the room during the experiment, they left the room several times to ask random questions to the experimenter, and therefore, the experimental context was disrupted. After excluding the three participants described above, 75 participants in total were included in the analysis. 55 of them were identified themselves as a woman (73.33%) and 20 them as a man (26.67%), their ages were between 18-28 ( $M=21.65$ ,  $SD=2.01$ ), and 70 of them were right-handed (93.33%), 5 of them were left-handed (6.67%).

#### **2.4.1.2. Materials**

Word lists were taken from Kılıç and colleagues' experiment (2013). They were in English and prior to the experiment, they were controlled for semantic similarity using the SEMMOD package (Stone, Dennis, & Kwantes, 2008) which used the Latent Semantic Analysis model (Landauer, & Dumais, 1997) to assess semantic similarity across words in the list. The words have been translated into Turkish by me, and to prevent any meaning to be lost or gained in translation, all the lists have been evaluated by 109 participants for semantic similarities (details are explained in the previous section). A MATLAB code using Psychtoolbox has been written by me for this experiment.

#### **2.4.1.3. Design and Procedure**

First, ethical approval has been taken from the METU Ethical Committee. Participants have come to the lab at the arranged time and signed a written consent to participate in the experiment. Then, they were taken to the sound-proof room with the experimenter. The experimenter first explained the procedure verbally in detail, then participants read the instructions if they did not have any questions, the experimenter left the room and the study has begun.

The experiment had three phases: study, arithmetic, and test. In the study phase, participants have seen 5 lists with 15 words in each list (black background, white words). 5 lists are selected randomly by MATLAB from 33 lists in total. Participants were instructed to learn each word while they were also rating each word for its pleasantness (pressed “z” if it is pleasant for them and “m” if it is not). This is to make sure they are thinking about the word on the screen, not the previous words. Between each list, there was an arithmetic part that lasted 15 seconds and after each arithmetic part, there was a 15-second waiting period with only “Please wait” written on the screen (in total there was a 30-second lasting distractor task). During the arithmetic phase, a random number from 1-9 appeared on the screen and participants summed the new number with the number that has appeared before until the time has ended. When all the 5 lists were finished, there were two distractor tasks (two arithmetic tasks, and two

waiting periods) to separate the study phase from the test phase. In the test phase, participants were given 20 probe words, they have seen 15 of them in the lists and they have not seen 5 of them at all. 3 words were selected from each list. 1<sup>st</sup>, 2<sup>nd</sup>, 14<sup>th</sup>, and 15<sup>th</sup> words of the lists were not used to eliminate the primacy and recency effects. 1<sup>st</sup> word of the 3 words that were taken from a list has been chosen randomly between the 3<sup>rd</sup>, 4<sup>th</sup>, or 5<sup>th</sup> word that has been shown, 2<sup>nd</sup> probe word has been chosen randomly between the 7<sup>th</sup>, 8<sup>th</sup>, or 9<sup>th</sup> words and the last probe word has been chosen randomly between the 11<sup>th</sup>, 12<sup>th</sup>, or 13<sup>th</sup> words. The reason for the 6<sup>th</sup> and 10<sup>th</sup> words not to be used was to avoid showing preceding words during the test phase. 5 new words were chosen randomly among 20 potential words. All the 20 words were shuffled before being shown to the participant. Participants were first asked “Did you see this word?” for each word, and they answered this question with a number from 1 to 9. After, they were asked to write another word from the list that they saw this probe word. All the data was collected using the keyboard.

Even though everything about the experimental procedures was explained to the participants in detail and without hiding anything, there was also a debriefing form if participants were curious about the experiment more when they are finished. They were offered to read the debriefing after the experiment and then they left the lab. After that, they were given their course credit. This experiment used a within-subject design.

## **2.4.2. Results**

There were 15 true probe words (3 words from each list) in the test phase. The mean ratio of participants’ going back to the right list and recalling another word is 3.59/15 (23.93%).

### **2.4.2.1. Data Organization**

The data organization procedures were the same with pilot experiments.

#### 2.4.2.2. Within-List Contiguity Effect

WLs 1,2,3 and 5,6,7 were compared to see whether there is any within-list contiguity effect (Figure 2.7). A paired sample t-test analysis was performed, and the results demonstrated that the words in a closer position ( $M=2.03$ ,  $SD=2.69$ ), which are WLs 1, 2, 3, were recalled significantly more than words that are in a distant position ( $M=.65$ ,  $SD=.76$ ), which are WLs 5,6,7,  $t(74)= 4.17$ ,  $p < .001$ ,  $d = .481$ , with the mean difference of 1.37 with 95% lower end of 2.03 points. However, the Shapiro-Wilk test ( $W = .75$ ,  $p < .01$ ) and Q-Q plot distribution pointed out a violation of normality. Possibly this is because of the low amount of data points because due to the high difficulty of the task, participants had difficulty going into the right list. Because of this situation, the Wilcoxon rank test was also conducted and it also resulted in a significant difference between the groups  $W(74)= 1323^a$ ,  $p < .001$ ,  $r_{rb} = 0.66$ , with the increased mean difference of 1.5 with a 95% lower end of 2 points.

To test whether there is an asymmetry, WLs +1,+2,+3, and WLs -1,-2,-3 were compared. A paired sample t-test analysis was performed, and the results indicated no significant difference between subsequent ( $M=1$ ,  $SD=1.39$ ), which are WL +1,+2,+3, and preceding words ( $M=1.03$ ,  $SD=1.61$ ), which are WL +1,+2,+3,  $t(74)= .17$ ,  $p = .87$ ,  $d = .02$ . Similar to the previous analysis, the Shapiro-Wilk test ( $W = 0.91$ ,  $p < 0.01$ ) and Q-Q plot distribution pointed out a violation of normality. Therefore, the Wilcoxon rank test was also conducted and yielded similar results  $W(74)= 481^a$ ,  $p= .87$ ,  $r_{rb} = -.3$  (Table 2.9).

A priori power analysis has yielded .99 power. Post hoc power analyses have resulted in .99 power for lag comparisons of 1,2, 3, and 5, 6, 7; and, 0.05 power for the comparison of lags +1, +2, and +3, and lags -1, -2, and -3. To summarize, the results indicated that participants recalled words that are positionally closer to the probe word more than the words that are positionally distant with a medium effect size; therefore, a within-list contiguity effect was observed.

However, subsequent words did not have an advantage over preceding words in the recall; in other words, contrary to what was expected, no forward asymmetry was observed.

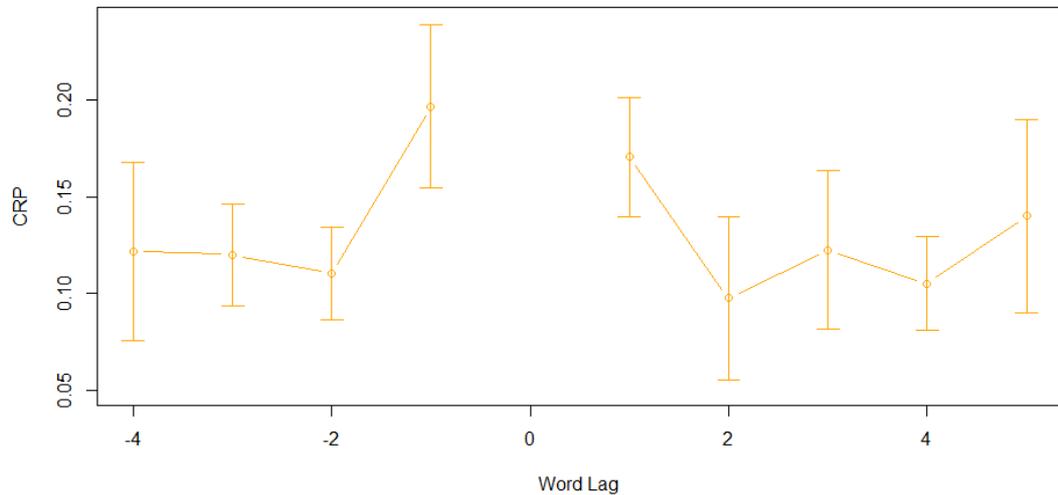


Figure 2. 7. Lag CRP plot for the within-list contiguity effect in Experiment 1

Table 2. 9. *Within-List Contiguity Effect Paired Samples T-Test for Experiment 1*

		Statistic	df	P	Mean Difference	SE Difference	95% CI		Effect Size
WL 1,2,3-WL 5,6,7	Student's t	4.17	74.0	< .001	1.37	0.33	[0.72, 2.03]	Cohen's d	0.49
	Wilcoxon W	1323		< .001	1.50	0.33	[1.00, 2.00]	Rank biserial correlation	0.66
WL+1,2, 3- WL - 1,2,3	Student's t	-0.17	74.0	0.866	-0.03	0.16	[-0.34, 0.29]	Cohen's d	-0.02
	Wilcoxon W	510		0.866	2.48e-5	0.16	[-0.50, 0.50]	Rank biserial correlation	0.03

### 2.4.2.3. Between-List Contiguity Effect

Similar to the within-list contiguity effect, the between-list contiguity effect was calculated by comparing LL 1,2 and LL 3,4 (Figure 2.8). A paired sample t-test analysis was performed, and the results indicated that the words in a closer list to the correct list ( $M=5.52$ ,  $SD=3.08$ ), which are LLs 1, 2, were recalled significantly more than words that are in a distant list ( $M=2$ ,  $SD=1.76$ ), which are LLs 3,4,  $t(74)= 9.02$ ,  $p < .001$ ,  $d = 1.04$ , with the mean difference of 3.52 with 95% lower end of 3 points. Violence to normality was again implied by the Q-Q plot distribution (Figure 3) and the Shapiro-Wilk test ( $W = .96$ ,  $p= .02$ ). Hence, the Wilcoxon rank test was also conducted and it also resulted in a significant difference between the groups  $W(74)= 2195^a$ ,  $p < .001$ ,  $r_{tb} = .93$ , with the mean difference of 4 with a 95% lower end of 3 points.

Although it has not been hypothesized, I wondered whether there is a forward-asymmetry in the between-list contiguity effect and conducted an analysis between LLs +1, +2, and LLs -1, -2. Another paired sample t-test analysis was performed using, and the results indicated that subsequent lists ( $M=3.24$ ,  $SD=2.18$ ), which are LLs +1, +2, had a recall advantage over preceding lists ( $M=2.27$ ,  $SD=1.74$ ), which are LLs -1, -2,  $t(74)= 3.42$ ,  $p= .001$ ,  $d = .4$ , with the mean difference of 0.97 with 95% lower end of .41 points. The Q-Q plot distribution and the Shapiro-Wilk test ( $W = .97$ ,  $p= .06$ ) yielded no violation of normality (Table 2.10).

A priori power analysis has yielded .99 power. Post hoc power analyses have resulted in 1 power for lag comparisons of 1,2, and 3,4; and, .92 power for the comparison of lags +1, and +2, and lags -1, and -2. To summarize, the results indicated that when participants cannot go to the right list, they go to a near list (LL 1,2) significantly more than a further list (LL 3,4) with a big effect size; therefore, it can be concluded that between-list contiguity effect was observed. Moreover, when people go to the near lists, they go to subsequent lists (LL +1, +2) significantly more than the preceding lists (LL -1, -2), with a small-to-medium effect size, which means that even though an asymmetry could not be

observed in within-list contiguity effect, it could be observed in the between-list contiguity effect.

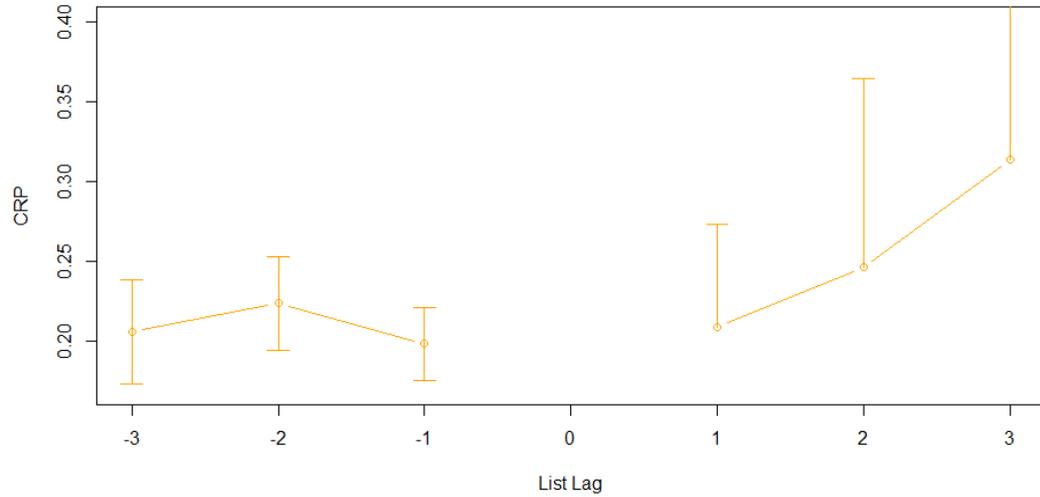


Figure 2. 8. Lag CRP plot for the between-list contiguity effect in Experiment 1

Table 2. 10. *Between-List Contiguity Effect Paired Samples T-Test for Experiment 1*

		Statistic	Df	P	Mean Difference	SE Difference	95% CI		Effect Size
LL 1,2-LL 3,4	Student's t	9.02	74.0	< .001	3.52	0.39	[2.74, 4.30]	Cohen's d	1.04
	Wilcoxon W	2195		< .001	4.00	0.39	[3.00, 4.50]	Rank biserial correlation	0.93
LL+1,2-LL -1,2	Student's t	3.42	74.0	0.001	0.97	0.29	[0.41, 1.54]	Cohen's d	0.4
	Wilcoxon W	1510		0.001	1.00	0.29	[0.50, 2.00]	Rank biserial correlation	0.45

#### 2.4.2.4. Confidence Interval and Recall

Before making a recall, participants have rated each probe word from 1 to 9 to indicate whether they have seen this probe word in the study lists or not, with 1

being “I definitely have not seen this word”, and 9 being “I definitely have seen this word.”. The mean rates for turning back to the correct list for each confidence interval are given in the table (Table 2.11) and the figure below (Figure 2.9). A one-way ANOVA has been conducted to see whether there is a difference in making a recall from the correct list according to the confidence interval rating. The results yielded a significant result ( $F(8, 1491) = 19.77, MSE = .13, p < .001$ ), meaning at least one of the ratings predicted a recall from the correct list significantly more than the other ratings. A Tukey’s HSD has been further conducted to see the significant comparisons. The ratings 9 and 1 ( $p < .001, 95\% \text{ C.I.} = [.19, .33]$ ), the ratings 9 and 2 ( $p < .001, 95\% \text{ C.I.} = [.07, .46]$ ), the ratings 9 and 3 ( $p = .001, 95\% \text{ C.I.} = [.06, .46]$ ), and the ratings 9 and 5 ( $p = .004, 95\% \text{ C.I.} = [.52, .47]$ ) have been found significantly different from each other, the other comparisons were not significant (Table 2.12). To sum up, it can be concluded that the rating of 9, which is the highest rating meaning that the participant is totally confident that they have seen this word before, usually led to more correct recalls.

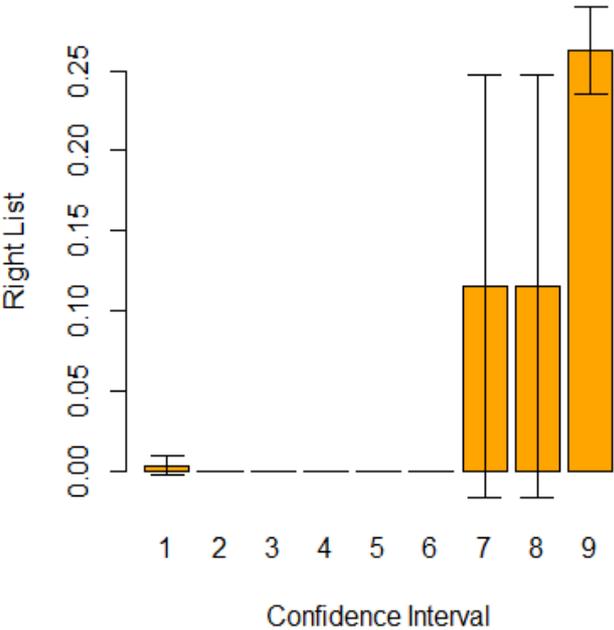


Figure 2. 9. The mean of returning to the correct list according to each confidence interval rating in Experiment 1

Table 2. 11. *The mean of returning to the correct list according to the confidence interval rating for Experiment 1*

Confidence Interval	Right List
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.12
8	0.12
9	0.26

*Note:* Returning to the right list has coded with 1 and every other situation has been coded with 0. Here is the mean for returning to the right list for all the conditions in the experiment (meaning response to the 20 probe words for every 76 participants) grouped by the confidence interval rating that the probe word has taken.

Table 2. 12. *One-way ANOVA Table for returning to the right list based on Confidence Intervals in Experiment 1*

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	$\eta^2$
CI	8	21.17	2.65	19.77	< .001	0.1
Residuals	1491	199.59	0.13			

### 2.5.1. Discussion

In this chapter two pilot experiments, one preliminary study, and one experiment have been explained. In the preliminary study, the word lists were rated by the participants to assess whether there is a semantic similarity between the words. In all three other experiments, the between-list contiguity effect has been observed, and in Pilot Experiment 2 and Experiment 1, the within-list contiguity effect has been observed. Moreover, in Experiment 1, forward-asymmetry for the

between-list contiguity effect has been observed; however, the forward asymmetry was never observed in the within-list contiguity effect. When participants give 9 out of 9 ratings that they have seen a probe word in the study list, they have returned to the right list significantly more when compared to some other ratings.

## CHAPTER 3

### EXPERIMENT 2

#### 3.1. Method

Experiment 2 aimed to make the list context stronger and therefore, make it easier to return to the right lists. In that aim, scene pictures were presented at the back of each list.

##### 3.1.1. Participants

A calculation using G Power has been conducted to decide on the sample size. The statistical test is chosen as matched paired T-test, and for the experiment to have 0.99 power with two-tailed, 0.5 DZ effect size, and .05 alpha; the estimated sample size was 76 (Faul et al., 2019).

In total, 77 participants from Middle East Technical University participated in the experiment in exchange for course credit. One participant was eliminated from the data since they did not comply with the age interval, that is 18-35, which left the data with 76 participants in total. Participants were native Turkish speakers with normal or corrected vision. 51 of them were identified themselves as a woman (67.11%) and 25 of them as a man (32.89%), and their ages were between 18-31 ( $M=23.71$ ,  $SD=2.97$ ), and 67 of them were right-handed (88.16%), 9 of them were left-handed (11.84%).

##### 3.1.2. Materials

All the materials were the same with Experiment 1 except for the 5 pictures used in the study phase. The pictures were taken from the free-online platform

Pixabay (<https://pixabay.com>). They were scene pictures, meaning, they can be expressed in a word. The 5 scenes in the pictures were: beach, city, forest, library, and kitchen.

### **3.1.3. Design and Procedure**

The design and the procedure were the same with Experiment 1. The only difference was the scene pictures behind each list. The pictures' order and with which list they were going to be demonstrated were randomized within the experiment using MATLAB. The scene pictures were covering the whole screen in the study phase while the words were coming to the screen except for the black box in the middle of the screen on which the words were shown in white color. The pictures were demonstrated only during the presentation of the word lists.

## **3.2. Results**

There were 15 true probe words (3 words from each list) in the test phase. The mean ratio of participants' going back to the right list and recalling another word is 4.07/15 (27.13%).

### **3.2.1. Data Organization**

The data organization process is exactly the same as in Experiment 1.

### **3.2.2. Within-List Contiguity Effect**

First, the within-list contiguity effect is checked. The positionally closer words to the probe word, meaning lag 1,2, and 3 ( $M=1.84$ ,  $SD=1.77$ ), have been significantly recalled more, when compared to the positionally further words, meaning lag 5,6, and 7 ( $M=.96$ ,  $SD=1.07$ ),  $t(75)= 4.41$ ,  $p < .001$ ,  $d = .51$ , with the mean difference of .9 with 95% lower end of .49 points (Figure 3.1).

Violence to normality was implied by the Q-Q plot distribution and the Shapiro-Wilk test ( $W = .91, p < 0.01$ ). Therefore, the Wilcoxon rank test was also conducted and it also resulted in a significant difference between the groups  $W(75)= 1097^a, p < .001, r_{rb} = .66$ , with the mean difference of 1.5 with a 95% lower end of 1 point.

When it comes to asymmetry, lags +1, +2, and +3 ( $M=.72, SD=.84$ ) was found to be recalled less compared to lags -1, -2, -3 ( $M=1.12, SD=1.4$ ),  $t(75)= -2.31, p= .024, d = -.27$ , with the mean difference of -0.4 with 95% lower end of -.74 points. Violence to normality was implied by the Q-Q plot distribution and the Shapiro-Wilk test ( $W =.89, p < .01$ ). Therefore, the Wilcoxon rank test was also conducted and it also resulted in a significant difference between the groups  $W(75)= 560^a, p= .04, r_{rb} = -.3$ , with the mean difference of -.5 with a 95% lower end of -1 point (Table 3.1).

A priori power analysis has yielded .99 power. Post hoc power analyses have resulted in .99 power for lag comparisons of 1,2, 3, and 5, 6, 7; and, 0.64 power for the comparison of lags +1, +2, and +3, and lags -1, -2, and -3. It can be concluded from the results that when participants recalled a word from the right list, they recalled it from a closer position to the probe word. Moreover, they recalled the words that came before the probe word more than the words that came after.

Table 3. 1. *Within-List Contiguity Effect Paired Samples T-Test for Experiment 2*

		Statistic	df	P	Mean Difference	SE Difference	95% CI		Effect Size
WL 1,2,3-WL 5,6,7	Student's t	10.70	75.0	< .001	3.16	0.3	[2.57, 3.00]	Cohen's d	1.23
	Wilcoxon W	2123		< .001	3.50	0.3	[3.00, 4.00]	Rank biserial correlation	0.98
WL+1,2, 3- WL -1,2,3	Student's t	4.54	75.0	< .001	1.09	0.24	[0.61, 1.57]	Cohen's d	0.52

Table 3.1 (Cont'd)

	Wilcoxon W	1496		<.001	1.50	0.24	[1.00, 2.00]	Rank biserial correlation	0.58
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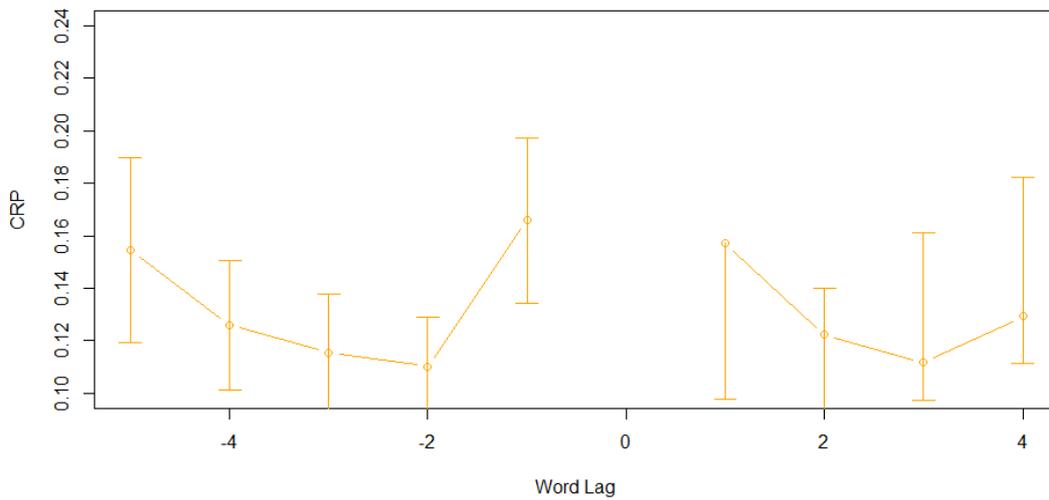


Figure 3. 1. Lag CRP plot for the within-list contiguity effect in Experiment 2. CRP is word lag frequency divided by word lag possibilities. For example, let us say that a participant gives word lag 5 responses 2 times. How many word probe words have word lag 5 is checked, for example, if the probe word is in the 11th, 12th, or 13th position in the study list it does not have lag 5, let us say in this case 12 probes have lag 5. The CRP for this condition is 2/15.

### 3.2.3. Between-List Contiguity Effect

Then, the between-list contiguity effect was checked. A paired sampled t-test analysis has resulted that the words from a closer list, meaning lags 1, and 2 ( $M=4.99$ ,  $SD=2.4$ ), were recalled more than the words from a further list, meaning lags 3, and 4 ( $M=1.83$ ,  $SD=1.47$ ),  $t(75)= 10.07$ ,  $p < .001$ ,  $d = 1.23$ , with the mean difference of 3.16 with 95% lower end of 2.57 points (Figure 3.2). Violence to normality was implied by the Q-Q plot distribution and the Shapiro-Wilk test ( $W = 0.96$ ,  $p= 0.012$ ). Therefore, the Wilcoxon rank test was also conducted and it also resulted in a significant difference between the groups

$W(75)= 2123^a$ ,  $p < .001$ ,  $r_{rb} = 0.98$ , with the mean difference of 3.5 with a 95% lower end of 3 points.

Even though it was not hypothesized, the asymmetry has also been checked for the between-list condition. A paired sampled t-test analysis has yielded that the responses from lags +1, and +2 ( $M=3.04$ ,  $SD=1.6$ ) were significantly higher than lags -1, and -2 ( $M=1.95$ ,  $SD=1.58$ ),  $t(75)= 4.54$ ,  $p < .001$ ,  $d = .52$ , with the mean difference of 1.09 with 95% lower end of .61 points. There was no violation of normality indicated by the Q-Q plot distribution and the Shapiro-Wilk test ( $W = 0.97$ ,  $p= 0.08$ ). However, because of the general non-normality of the data, the Wilcoxon rank test was also conducted to be on the safe side, and it also resulted in a significant difference between the groups  $W(75)= 1496^a$ ,  $p < .001$ ,  $r_{rb} = 0.58$ , with the mean difference of 1.5 with a 95% lower end of 1 point (Table 3.2).

A priori power analysis has yielded .99 power. Post hoc power analyses were also conducted to compare. For the between-list contiguity effect comparison, the power was found to be 1, and for the asymmetry comparison, it is found to be .99. The results demonstrate that when participants failed to turn back and recall a word from a right list, they went to a positionally closer list to complete the recall; also, they turned back to subsequent lists more than the preceding lists.

Table 3. 2. *Between-List Contiguity Effect Paired Samples T-Test for Experiment 2*

		Statistic	Df	P	Mean Difference	SE Difference	95% CI		Effect Size
LL 1,2-LL 3,4	Student's t	10.70	75.0	< .001	3.16	0.3	[2.57, 3.75]	Cohen's d	1.23
	Wilcoxon W	2123		< .001	3.50	0.3	[3.00, 4.00]	Rank biserial correlation	0.98
LL+1,2 - LL -1,2	Student's t	4.54	75.0	< .001	1.09	0.24	[0.61, 1.57]	Cohen's d	0.52
	Wilcoxon W	1496		< .001	1.50	0.24	[1.00, 2.00]	Rank biserial correlation	0.58

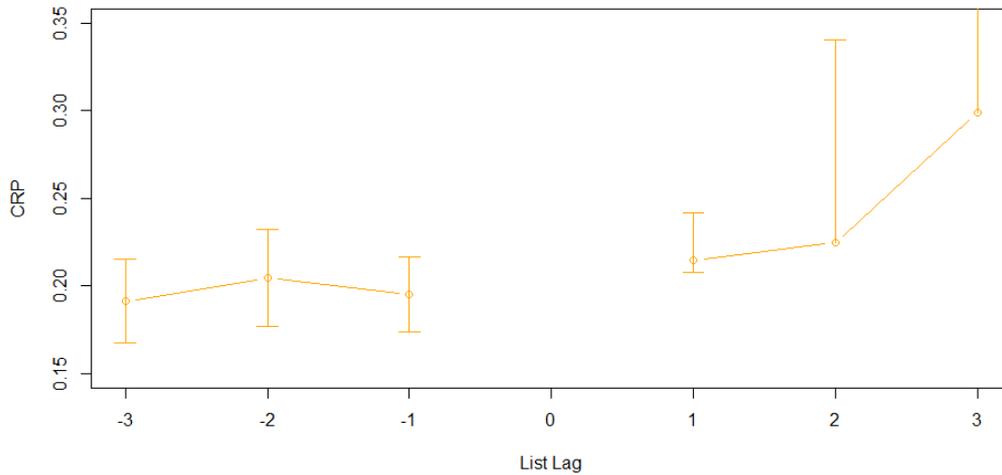


Figure 3. 2. Lag CRP plot for the between-list contiguity effect in Experiment 2

### 3.2.4. Confidence Interval and Recall

Before making a recall, participants have rated each probe word from 1 to 9 to indicate whether they have seen this probe word in the study lists or not, 1 being “I definitely have not seen this word”, and 9 being “I definitely have seen this word.”. The mean rates for turning back to the correct list for each confidence interval are given in the table (Table 3.3) and the figure below. A one-way ANOVA has been conducted to see whether there is a difference in making a recall from the correct list according to the confidence interval rating (Figure 3.3). The results yielded a significant result ( $F(8, 1511) = 19.29$ ,  $MSE = .15$ ,  $p < .001$ ), meaning at least one of the ratings predicted a recall from the correct list significantly more than the other ratings (Table 3.4). A Tukey’s HSD has been further conducted to see the significant comparisons. The ratings 9 and 1 ( $p < .001$ , 95% C.I. = [.19, .36]), the ratings 9 and 2 ( $p < .001$ , 95% C.I. = [.11, .42]), the ratings 9 and 3 ( $p < .001$ , 95% C.I. = [.08, .4]), the ratings 9 and 5 ( $p < .001$ , 95% C.I. = [.08, .46]), and the ratings 9 and 7 ( $p = .02$ , 95% C.I. = [.02, .39]) have been found significantly different from each other, the other comparisons

were not significant. To sum up, it can be concluded that the rating of 9, which is the highest rating meaning that the participant is totally confident that they have seen this word before, usually led to more correct recalls.

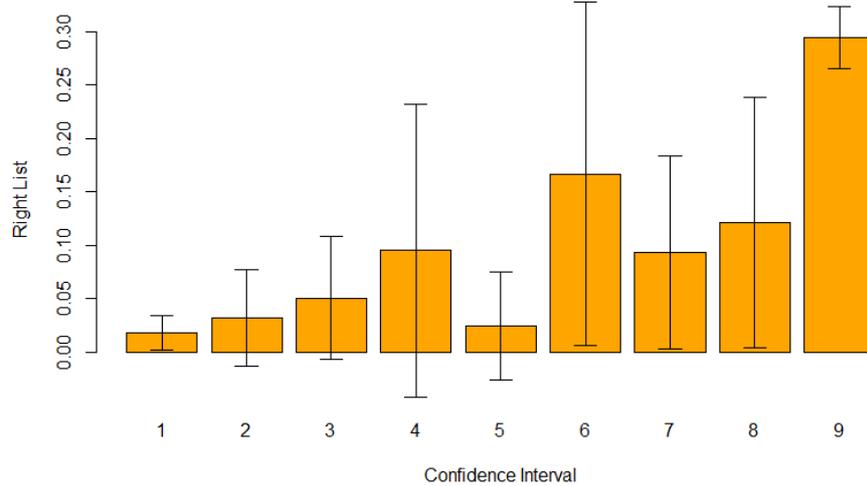


Figure 3. 3. The mean of returning to the correct list according to each confidence interval rating in Experiment 2

Table 3. 3. The mean of returning to the correct list according to the confidence interval rating for Experiment 2

Confidence Interval	Right List
1	0.09
2	0.03
3	0.05
4	0.10
5	0.03
6	0.17
7	0.09
8	0.12
9	0.29

Note: Returning to the right list has coded with 1 and every other situation has been coded with 0. Here is the mean for returning to the right list for all the conditions in the experiment (meaning response to the 20 probe words for every 76 participants) grouped by the confidence interval rating that the probe word has taken.

Table 3. 4. *One-way ANOVA Table for returning to the right list based on Confidence Intervals in Experiment 2*

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	$\eta^2$
CI	8	22.81	2.85	19.29	< .001	0.09
Residuals	1511	223.37	0.15			

### 3.2.5. Exploratory Analyses

To further examine whether the two experiments differed significantly, a one-way ANOVA has been conducted. In this analysis, the two experiments were combined as one experiment, and the conditions were having a scene picture in the back or not, since this is the only difference between the two experiments (Table 3.5). The analysis has shown that there were no significant differences between the two experiments in terms of returning to the correct list ( $F(1, 149) = .98, MSE = 8.23, p = 0.323$ ), within-list contiguity ( $F(1, 149) = 1.54, MSE = 5.63, p = 0.217$ ), between-list contiguity ( $F(1, 149) = 0.55, MSE = 9, p = 0.46$ ), within-list asymmetry ( $F(1, 149) = 2.51, MSE = 2.04, p = 0.12$ ), or between-list asymmetry ( $F(1, 149) = 0.1, MSE = 5.24, p = 0.75$ ). To summarize, adding scene pictures behind the lists did not have a meaningful effect on returning to the right list, the contiguity effect, the within-list, and the between-list asymmetries in the recall.

Table 3. 5. *ANOVA Table to compare Experiment 1 with Experiment 2*

	Df1	Df2	MSE	F value	Pr(>F)	$\eta^2$
Returning the Right List	1	149	8.83	0.98	0.32	0.01
Within-list contiguity	1	149	5.63	1.54	0.22	0.01
Between-list contiguity	1	149	9.00	0.55	0.46	0.00

Table 3.5 (Cont'd)

Within-list asymmetry	1	149	2.04	2.51	0.12	0.02
Between-list asymmetry	1	149	5.24	0.10	0.75	0.00

### 3.3. Discussion

A second experiment was conducted with the aim of making the list context more powerful, which would hypothetically cause an easier task compared to the task in Experiment 1. However, the comparisons across two experiments showed that there was no difference between going back to the right list, within and between list contiguity effects, or the asymmetries. A within-list contiguity effect, as well as a between-list contiguity effect, was observed in this experiment. There was a forward asymmetry in the between-list contiguity effect; however, within-list contiguity effect there was a backward asymmetry.

## CHAPTER 4

### GENERAL DISCUSSION

In the scope of this thesis, 4 experiments (2 of them were pilots) have been conducted. The within-list contiguity effect has been observed in all of the experiments except Pilot Experiment 1, and the between-list contiguity effect has been observed in all of the experiments. The forward asymmetry in between list contiguity effect has been observed in, Experiments 1 and 2; however, the forward asymmetry in the within-list contiguity effect could not be observed in any of the experiments; in fact, in the last experiment, a backward asymmetry was observed. In terms of returning to the correct list, the performance was the lowest in Pilot Experiment 1 (1.2/21), the other experiments were closer to each other with 3.47/15 in Pilot Experiment 2, 3.59/15 in Experiment 1, and 4.07/15 in Experiment 2. The first pilot has not been found to be successful, since the aim was to facilitate the probed recall task, the probability of returning to the correct list was still low. Therefore, some of the features of the experiment were changed to make the task easier in Pilot Experiment 2. Experiment 1 was exactly the same as Pilot Experiment 2, and the only difference in Experiment 2 was that it had scene pictures behind each list. The resemblance between the last three experiments' performances can be expected because of their methodological similarity. Moreover, it has been found that when participants are 100% sure that they have seen the probe word, they went back to the correct list more often than when they rated their recognition level between 1- 8.

In these experiments both short-term and long-term contiguities are observed. Short-term contiguity effect means observing contiguity effect within a shorter scale, usually within a list in which there is no distractor task, and long-term contiguity means the contiguity effect for the longer scales, usually between lists and across distractors or delays. In the beginning, it was mentioned that the

mechanisms behind the contiguity effect are not clear in the literature; however, the claims can be combined in two main headlines: non-causal and causal models. Non-causal models claim that the contiguity effect in free recall tasks is a result of the similarity between the study and test phases as Davelaar and his colleagues modeled (2005). The probed recall task is a very strict task that does not allow a mental similarity or a similar contextual drift as Davelaar et al. (2005) suggested to be occurring between the lists. On the other hand, causal models assert that items are being used as a cue to recall each other in free recall and that results in the contiguity effect. SAM claims that when items stay together in the short-term store, they form an association that will later be used as a cue to recall one other (Raaijmakers & Shiffrin, 1981). However, SAM, like most the dual-store models, cannot account for the long-term contiguity effect since it explains the contiguity effect with the short-term store. Furthermore, SAM cannot explicate the forward asymmetry in the long-term contiguity effect with its explanation. TCM is another causal model, and it claims that when a word is recalled, its contextual information is also recalled, which in fact cues the context of a nearby item, and that context is finally used to recall the item (Howard & Kahana, 2002). Since there is not a short-term store, and the emphasis is on the active item-context relationship, it can account for both short-term and long-term contiguity effects. Also, the model can explain the asymmetry with the contextual information of the next item being closer to the current item when compared to the previous item.

Therefore, when this study is combined with the previous probed recall task where the contiguity effect was also observed (Kılıç et. al., 2013), it can account for a supporting finding for the causal models. This study can be thought of as a follow-up study for Kılıç et. al. (2013). Firstly, the results from the previous experiment (the within and between list contiguity effects) have been replicated. Secondly, the aim was to optimize the task and enhance the performance, and it can be said that the results were clearer in this study. Lastly, another aim was to observe the forward-asymmetry, which is a benchmark finding in the contiguity effect in free recall. One of the most important findings of the current

experiments is the forward asymmetry observed in the between-list contiguity condition. The forward-asymmetry was the only feature that was missing from the experiment of Kılıç et al. (2013) which was the missing feature of the contiguity effect. Now with these new findings, the causal models are supported more and it can be concluded that the non-causal models are not the sole reason behind the contiguity effect.

Even when the performance of returning to the correct list was the highest (4.07 times out of 15 times) in Experiment 2, the performance was still low compared to the performance levels of the other tasks utilized in memory studies. A g-power analysis was conducted prior to the study to decide on the sample size, and the study had a really high power of .99 (Faul et al., 2009). However, what power analysis does not take into account when planning on sample size is how many data points it is going to be collected from each participant. If I would have got full data points from each participant, in total there would be 1140 data points for within-list responses; however, now there are 309. That means I should have approximately 280 participants to get the result that I desired with 76 participants. When post-power analyses were made, it was found that in the first experiment the power was .99 for the between-list contiguity and .92 for the asymmetry in between-list contiguity, and it was .99 for the within-list contiguity effect, .05 for the asymmetry in within-list contiguity (which was not significant). In Experiment 2, the power for between-list contiguity was 1 and the asymmetry in between-list contiguity was .99. For the within-list contiguity, it was again .99; and lastly, for the within-list asymmetry, it was .64. It can be seen that all the significant conditions actually have a high power like it was predicted by a priori analysis, except for the backward asymmetry finding in the last experiment. To my knowledge, there is no theory that predicts backward asymmetry in recall or any data that shows it. Therefore, I believe that this finding was due to chance.

Confidence intervals were found to be correlated with recalling a word from the right list. The rating 9 was significantly different than most of the other ratings

(and the rating 8 was significantly different from rating 1 for once in Pilot Experiment 2). This finding carries an importance in terms of showing the relation between recognition and recall. This recall success of the rating 9 over the other ratings can stand as a support as the distinction between remember and know judgements in recognition. Remember judgement means the contextual information as well as the item information is recalled; whereas know judgements mean that there is no contextual information (Dunn, 2004; Gardiner, 1988, 2001; Jacoby et al., 1997; Rajaram, 1996; Tulving, 1985). This result might be showing that with the rating 9 there is contextual information being recalled since the return to the right list is more common.

The aim of doing the second experiment was to strengthen the contextual information and make it easier to return to the right list. However, the analyses have shown that there was no significant increase in returning to the right list, within-list contiguity effect, between-list contiguity effect, or the asymmetries. The reason why this manipulation did not work could be the difficulty of the probed recall task.

#### **4.1. Limitations**

The biggest limitation of this study is to have very few data points within a list. Despite all the efforts, the recall was still hard for the participants and that resulted in them not being able to do what is asked and go to the right list. However, this also helped us to see from where they are having wrong recalls, and the wrong answers were mostly from nearby lists, which might be the reason for a strong a between-list contiguity effect observed throughout the experiments.

The second limitation was that the words were not actually controlled with the Latent Semantic Analysis model as it was intended. As mentioned above, the actual aim was to control the semantic relation using the Latent Semantic Analysis model (Landauer, & Dumais, 1997) and the SEMMOD package (Stone

et al., 2008) like the original experiment (Kılıç et al., 2013). However, it was not possible for this study due to the limited resources in Turkish, as well as the limited time course to finish the thesis, and the limited linguistics knowledge of the researcher.

The last limitation was that there were drastic changes between Pilot Experiment 1 and Pilot Experiment 2. The performance has increased with the second pilot; however, since there were several changes it is not clear which change resulted in this increase. A more ideal way would have been trying each change with a new pilot experiment.

#### **4.2. Future Research**

This study paves the way for several different directions in future research. First, as mentioned above, collecting very few data points from the participants actually decreases the power in a great sense and threatens the reliability of within-list findings. One way to overcome this obstacle could be increasing the sample size by regarding the fact that from each participant there will be approximately 75% of the data points will be lost. That means, if we want the experiment to have 76 participants, in fact, 280 participants in the best-case scenario should be collected to have full data points that 76 participants would have. Another way to go could be to make the task very easy. It has been shown that decreasing the list length enhances the contiguity effect (Cortis Mack et al., 2018; Healey et al., 2019.). The list length can be really shortened, like 5 or 6 words per list, and only 1 word from each list can be chosen as a probe. That way, if the chances of returning to the right list are maximized, we can actually see whether the forward-asymmetry in the within-list contiguity effect can be observed or not.

Second, the words can actually be controlled for semantic similarity using LSA (Landauer, & Dumais, 1997), or newer methods by a linguist. LSA is not a perfect method and it also gets criticized (Evangelopoulos et al., 2012;

Evangelopoulos, 2013; Hoenkamp, 2011). However, it is wildly used in the literature; therefore, if it is possible to use in Turkish, I think it would be useful to conduct the experiments once more using the words selected using the LSA.

Third, the findings can be used to make additions to the current models described to make the models more comprehensive. The data sometimes supports a model, which is considered to be a good sign for models; yet, sometimes it does not. When there is new conflicting information available, the models have to improve their parameters and general predictions in order to explain and account for the data. Since this study carries important information regarding the underlying reasons for the contiguity effect, it would be useful for the models to explain and simulate the results.

Lastly, as mentioned before, episodic memory is measured in the lab with two main tasks: recognition and recall. In recognition, in the test phase some of the items from the study phase are demonstrated to participants and asked “Did you see this item?”; however, in the recall, participants are asked to write/say the items that they remember. The episodic memory models usually only explain either recognition or recall. To illustrate, TCM (Howard & Kahana, 2002) and SAM (Raaijmakers & Shiffrin, 1981) explain the dynamics of recall; whereas, REM (Shiffrin & Steyvers, 1997), and BCDMEM (Dennis & Humphreys, 2001) accounts for the mechanisms behind recognition. Although these two tasks have very different dynamics from each other and it is understandable that they are studied separately, they actually claim to measure the same type of memory. The beauty of the probed recall task is that it includes both a recognition and a recall task. In the experiments, it has been observed that when participants recognize the word without a doubt (rating 9 out of 9), they do more correct recalls, this indicates a relation between two tasks, which is of course predictable. I believe, the probed recall task can be used for purposes other than the contiguity effect; for example, effects that act differently in these two tasks (e.g. the mirror effect) can be tested in a probed recall task. The aim of having lots of different specific episodic memory models is to be able to combine the specific features one day to

combine what we have learned in this long run in one single model of episodic memory that can account for all observed effects. By combining the recognition and recall tasks, the probed recall task carries great importance in that aim. I believe, that exploring this task better and including it in the models will carry us further on this path.

### **4.3. Conclusion**

It was hypothesized that the within-list and between-list contiguity effects were going to be observed, forward asymmetry would be found in the within-list contiguity effect, and if the confidence intervals were high, a higher chance of going back to the right list was expected. The within-list contiguity effect is observed in Pilot Experiment 2, Experiment 1, and Experiment 2, and the between-list contiguity effect was observed in all of the experiments. When it comes to forward asymmetry, it could not be observed in within-list contiguity; however, it was observed in between-list contiguity. Moreover, when the confidence interval is 9, in general participants also returned to the right list better. It can be concluded that these results when put on top of the results of Kılıç et al. (2013) stand as a support for causal models. Now, with the asymmetry finding, which was absent in the previous experiment, it is safer to say that the contiguity effect does not only have non-casual mechanisms behind it and probably includes plenty of causal mechanisms. The fact that the asymmetry was not there in the within-list contiguity effect was thought to be the result of having very few data points in that condition, and ways to overcome it were proposed in the future research section. Lastly, the probed recall task can also be important outside the contiguity effect, since it merges recognition and recall tasks, which are usually approached separately in the literature, and brings us one step closer to having one episodic memory model that can account for everything.

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## APPENDICES

### A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

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Sayı: 28620816 /

13 KASIM 2020

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Aslı Kılıç ÖZHAN

Danışmanlığını yaptığınız Hazal ARPACI'nın "*Yakınlık Etkisinin Asimetrik Doğasının Yoklayıcı Hatırlama Görevi ile İncelenmesi*" araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve 333-ODTU-2020 protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

  
Prof. Dr. Mine MISIRLISOY  
İAEK Başkanı

## B. THE INFORMED CONSENT FORM

### ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu çalışma ODTÜ Psikoloji Bölümü öğretim üyelerinden Dr. Aslı Kılıç Özhan danışmanlığında, Hazal Arpacı'nın 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 Bilişsel Psikoloji Laboratuvarı'nda yapılacaktır. Üniversite öğrencileri katılımcı olarak davet edilecek, katılmak isteyenler yaklaşık yarım saatlik bir laboratuvar seansına katılacaklardır. Çalışmada size kelimeler gösterilecektir ve daha sonra bu kelimeleri hatırlamanız istenecektir..

#### 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 [hazal.arpaci@metu.edu.tr](mailto:hazal.arpaci@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

--/---/----

## C. THE DEBRIEFING FORM

Öncelikle çalışmamıza katıldığınız için teşekkür ederiz.

Daha önce de belirtildiği gibi, bu çalışma Hazal Arpacı'nın yüksek lisans tezi kapsamında, bellek süreçlerinin nasıl işlediğini daha iyi anlamak amacı ile yürütülmektedir. Çalışma kapsamında yaptığımız göreve *yoklayıcı hatırlama* denir ve bu görevde test aşamasında karşınıza çıkan kelimeyi çalışma aşamasında gördüğünüz listeden başka bir kelime hatırlamanız istenir. Literatüre göre, bir kelimeyi hatırladıktan sonra hatırlayacağınız bir sonraki kelime, ilk kelimeye pozisyon olarak yakın olacaktır. Buna yakınlık etkisi denir. Yakınlık etkisinin temel olarak iki olası açıklaması bulunmaktadır. Bunlardan ilki olan nedensel modeller, yakınlık etkisinin hatırlanan bir kelimenin hatırlanacak bir sonraki kelime için ipucu olarak kullanılması sonucu gözlemlendiğini öne sürer. Nedensel olmayan modellerse çalışma ve test aşamalarındaki zihinsel durum benzerliğinin yakınlık etkisine yol açtığını öne sürer. Yoklayıcı hatırlama görevi ise çalışma ve test aşamalarındaki zihinsel durum benzerliğini bozduğu için bu iki açıklama arasında bir ayrıştırma yapmamıza olanak sağlaması amacı ile bu deneyde kullanılmıştır.

Bu çalışmadan elde edilen bilgiler sadece bilimsel amaçlarla kullanılacaktır. Çalışmamıza objektif bir şekilde devam edebilmemiz için çalışmanın konusunu diğer insanlarla paylaşmamanızı rica ederiz.

Araştırma ile ilgili sorularınızı [hazal.arpaci@metu.edu.tr](mailto:hazal.arpaci@metu.edu.tr) adresine e-mail aracılığı ile iletebilirsiniz.

## D. EXPERIMENT INSTRUCTIONS

Çalışmamıza hoş geldiniz. Deneyin sorunsuzca ilerlemesi için yönergeyi dikkatlice okumanız gerekmektedir. Deney üç aşamadan oluşmaktadır: Çalışma, aritmetik ve test.

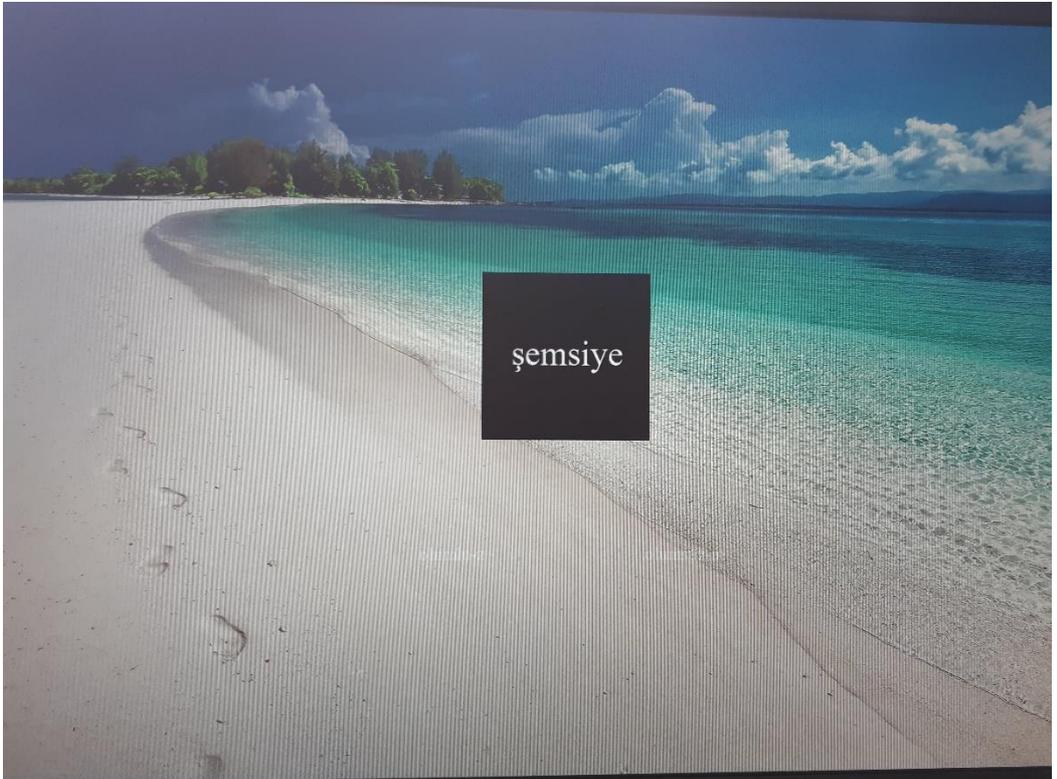
Çalışma aşamasında 15 kelimedenden oluşan toplam 5 liste göreceksiniz. Bu kelimeleri mümkün olduğunca öğrenmeye çalışmanız beklenmektedir. Aynı zamanda çıkan her kelimenin size göre olumlu mu olumsuz mu bir anlama sahip olduğunu oylamanız gerekmektedir. Kelimenin olumlu olduğunu düşünüyorsanız "z" tuşuna, olumsuz olduğunu düşünüyorsanız "m" tuşuna basmalısınız.

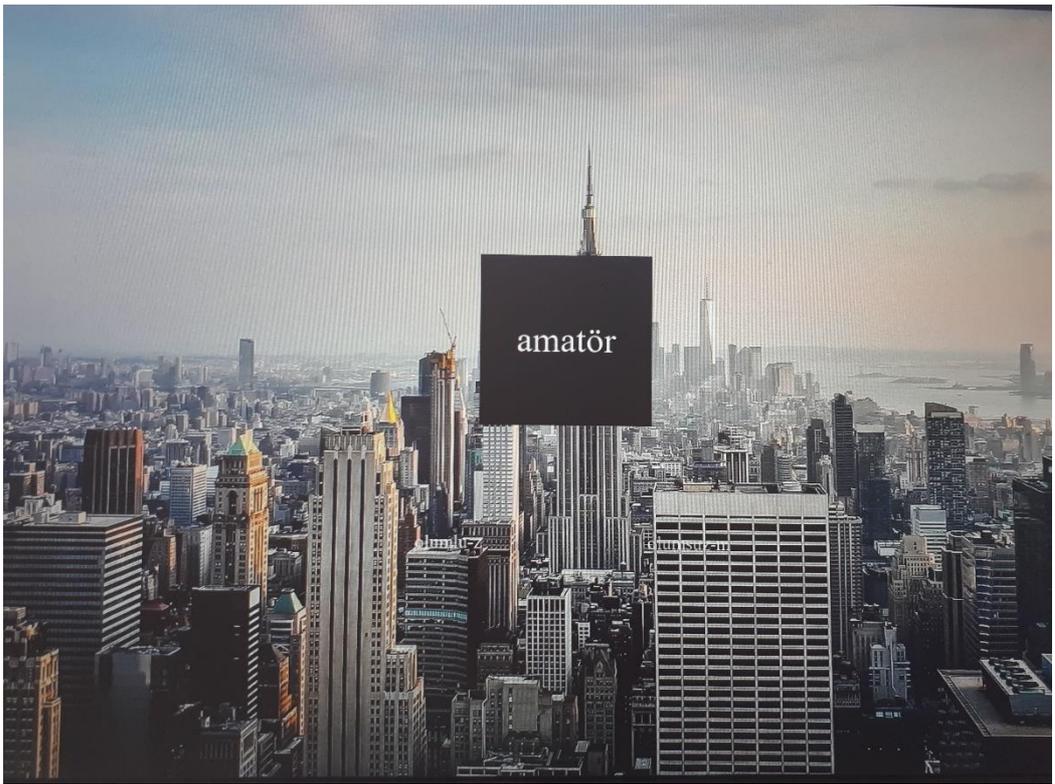
Aritmetik aşamasında ekranın ortasında bir sayı göreceksiniz. Klavyenin üstündeki sayı tuşlarını kullanarak öncelikle gördüğünüz sayıyı girip sonra "enter" tuşuna basmalısınız. Sonra, gelen bir sonraki sayı ile gördüğünüz bir önceki sayıyı toplayarak bu sefer onu ekrana yazıp, yine "enter" tuşuna basarak aşama sona erene kadar bu şekilde devam etmelisiniz. Her aritmetik aşamasının ardından 15 saniye bekleyeceksiniz.

Test aşamasında ise size gördüğünüz listelerin birinden rastgele bir kelime verilecek. Öncelikle bu kelimeyi gördüğünüze 1'den 9'a ne kadar emin olduğunuzu tuşlamalısınız. Ardından o kelimeyi gördüğünüz listeden başka bir kelimeyi ekrana yazmalısınız.

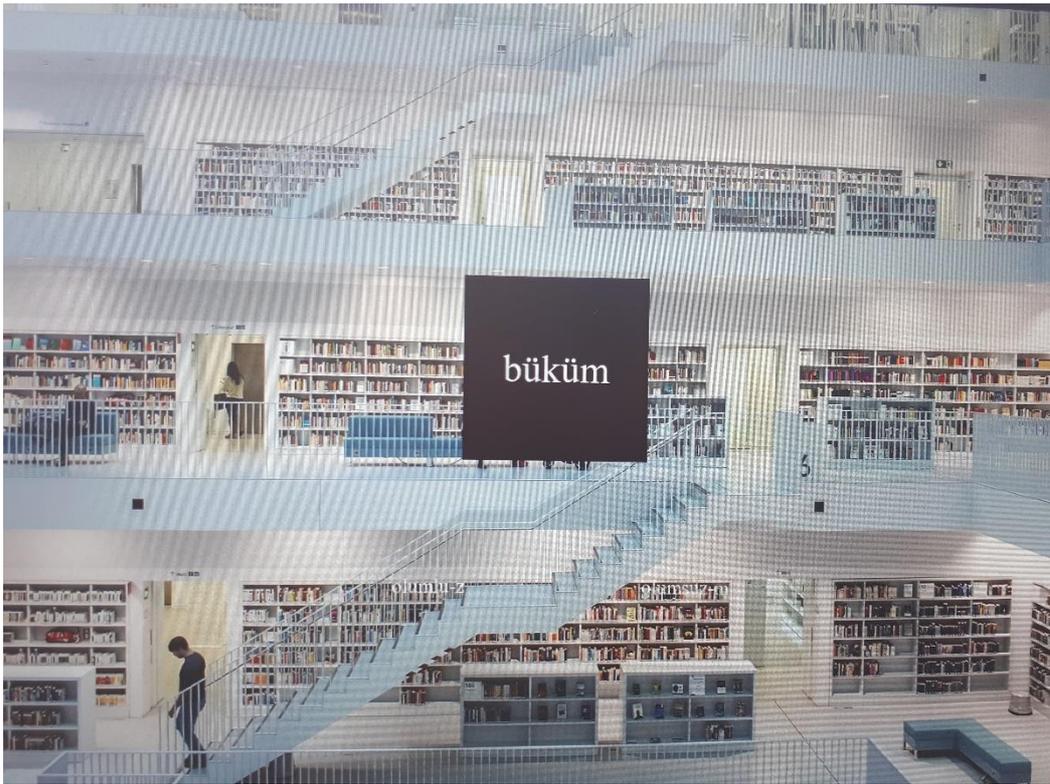
Herhangi bir sorunuz varsa deneye başlamadan yürütücüye sorabilirsiniz, yoksa boşluk tuşuna basarak ilerleyebilirsiniz. Kolaylıklar dileriz.

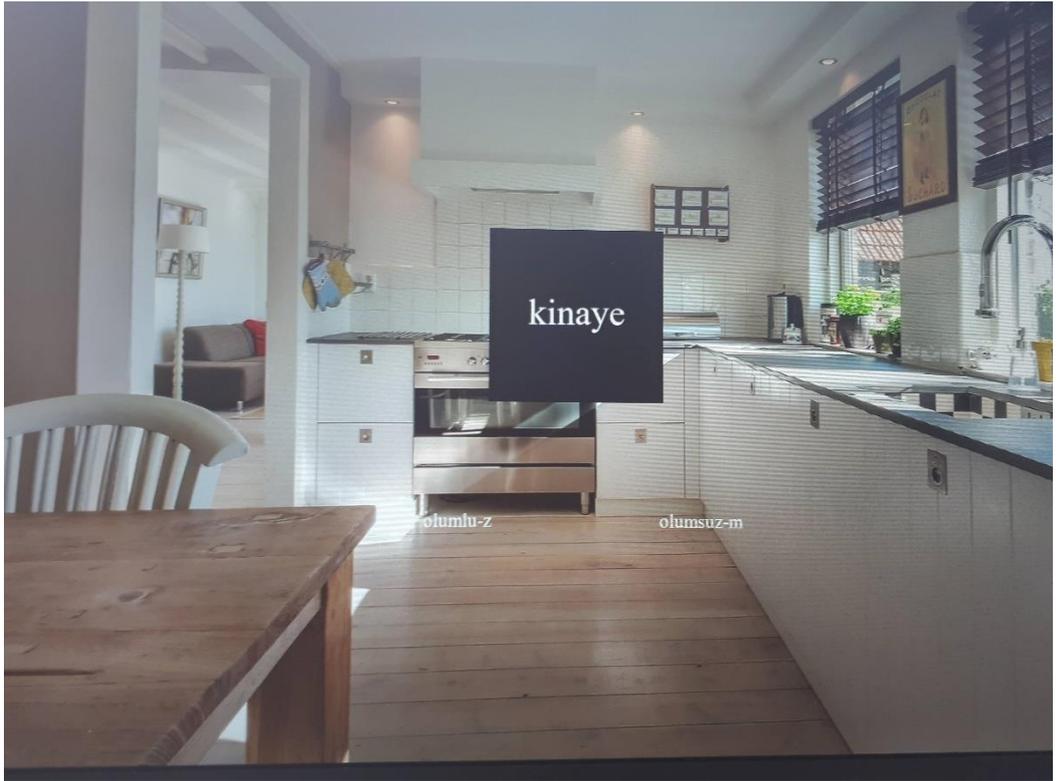
## E. SCENE PICTURES











## F. THE RESULTS OF THE PRELIMINARY STUDY

List	WordPair	Frequency
1	araştırma-anket	45
1	araştırma-takım	26
1	araştırma-emek	18
1	araştırma-taslak	19
1	köpek-geyik	14
1	gözlük-mağaza	10
1	araştırma-alan	9
1	baba-emek	8
1	takım-emek	5
1	sarma-hardal	4
1	sarma-emek	3
1	geyik-omurga	4
1	anket-takım	3
1	alan-araştırma	3
1	keman-emek	3
1	omurga-köpek	4
1	alan-anket	2
1	anket-taslak	2
1	gözlük-emek	2
1	alan-köpek	2
1	ceza-alan	2
1	takım-omurga	1
1	araştırma-omurga	1
1	mağaza-keman	1
1	baba-ceza	1
1	emek-köpek	1
1	takım-alan	1
1	anket-emek	1
1	taslak-emek	1
1	takım-baba	1
1	araştırma-gözlük	1
1	geyik-kereste	1
1	omurga-baba	1
1	alan-mağaza	1
1	baba-gözlük	1
1	kereste-keman	1
1	omurga-keman	1

1	emek-alan	1
1	baba-köpek	1
2	bilim-beyin	44
2	ciğer-beyin	30
2	ciğer-biftek	28
2	savaş-roket	20
2	okuma-bilim	19
2	okuma-konuşmacı	17
2	beyin-unutma	15
2	bakan-maaş	13
2	savaş-bakan	12
2	beyin-okuma	10
2	roket-bilim	9
2	sonbahar-bitki	9
2	bakan-konuşmacı	9
2	konuşmacı-bilim	6
2	unutma-okuma	6
2	ekşi-bitki	5
2	unutma-konuşmacı	4
2	bitki-bilim	3
2	biftek-ekşi	2
2	maaş-ortak	2
2	biftek-maaş	2
2	melodi-plaj	2
2	konuşmacı-ortak	2
2	plaj-maaş	2
2	ortak-plaj	1
2	sonbahar-melodi	1
2	bitki-okuma	1
2	bilim-ortak	1
2	bilim-litre	1
2	bilim-maaş	1
2	bakan-bilim	1
2	sonbahar-unutma	1
2	plaj-okuma	1
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19	ödeme-belge	8
19	tarih-kilise	8
19	amaç-ideal	7
19	dürüstlük-doktor	5

19	fabrika-ödeme	3
19	ideal-doktor	3
19	ideal-dürüstlük	3
19	tarih-portre	3
19	pembe-rahim	3
19	ödeme-dürüstlük	2
19	amaç-fabrika	2
19	ödeme-portre	2
19	yılan-doktor	1
19	amaç-klarnet	1
19	dürüstlük-portre	1
19	kilise-belge	1
19	tenis-ödeme	1
19	portre-klarnet	1
19	doktor-ödeme	1
19	ödeme-tarih	1
19	pembe-porselen	1
19	kilise-ödeme	1
19	tarih-ideal	1
19	dürüstlük-kilise	1
19	ideal-portre	1
19	dürüstlük-yılan	1
19	amaç-dürüstlük	1
19	porselen-tarih	1
19	tarih-dürüstlük	1
19	dürüstlük-porselen	1
19	pembe-tarih	1
19	sodyum-amaç	1
19	pembe-tenis	1
19	pembe-yılan	1
19	sodyum-porselen	1
19	tarih-fabrika	1
19	amaç-tarih	1
19	ideal-tarih	1
19	lağım-yılan	1
20	rahatsızlık-sivrisinek	36
20	kiraz-elma	26
20	şafak-başlangıç	8
20	sivrisinek-damar	7
20	rahatsızlık-tepki	7
20	rahatsızlık-rapor	6
20	rahatsızlık-damar	5

20	silah-şafak	5
20	ekip-silah	4
20	manşet-radyo	4
20	manşet-tepki	4
20	rahatsızlık-fitul	4
20	ekip-rapor	4
20	rapor-damar	3
20	rapor-kalıntı	3
20	silah-fitul	3
20	sivrisinek-tepki	2
20	çıkıntı-damar	2
20	kalıntı-çıkıntı	2
20	başlangıç-manşet	2
20	fitil-damar	2
20	manşet-silah	2
20	silah-rahatsızlık	2
20	radyo-tepki	2
20	silah-tepki	2
20	başlangıç-radyo	2
20	çıkıntı-rahatsızlık	2
20	silah-rapor	2
20	çıkıntı-rapor	1
20	damar-ekip	1
20	ekip-radyo	1
20	radyo-sivrisinek	1
20	çekmece-rapor	1
20	kiraz-damar	1
20	ekip-manşet	1
20	çekmece-silah	1
20	sivrisinek-çıkıntı	1
20	şafak-radyo	1
20	yüksük-tepki	1
20	elma-başlangıç	1
20	kiraz-çıkıntı	1
20	başlangıç-rahatsızlık	1
20	rapor-tepki	1
20	fitil-ekip	1
20	yüksük-çekmece	1
20	rapor-radyo	1
20	çıkıntı-çekmece	1
20	kalıntı-elma	1
21	eşya-cüzdán	19

21	kent-medeniyet	19
21	medeniyet-kütüphane	19
21	kent-kütüphane	9
21	rakip-kütüphane	7
21	çaydanlık-eşya	7
21	göbek-fantezi	4
21	fantezi-tütsü	4
21	eşya-kürek	4
21	joker-rakip	3
21	rozet-eşya	3
21	balon-göbek	3
21	göbek-atom	3
21	tütsü-çaydanlık	3
21	vekil-rozet	3
21	fantezi-eşya	2
21	kent-vekil	2
21	musibet-rakip	2
21	musibet-tütsü	2
21	cüzdan-rozet	2
21	cüzdan-çaydanlık	1
21	vekil-cüzdan	1
21	fantezi-kütüphane	1
21	göbek-kent	1
21	rakip-medeniyet	1
21	musibet-atom	1
21	fantezi-cüzdan	1
21	cüzdan-joker	1
21	atom-kürek	1
21	rozet-kent	1
21	çaydanlık-atom	1
21	fantezi-medeniyet	1
21	rakip-kürek	1
21	musibet-kürek	1
21	medeniyet-vekil	1
21	joker-fantezi	1
22	kaya-mağara	20
22	melez-prens	19
22	kaya-karbon	9
22	içerik-bilgisayar	8
22	prens-mücevher	7
22	kafes-mağara	6
22	karbon-mücevher	5

22	kaya-mücevher	5
22	mücevher-pazarlık	5
22	gelgit-mürettebat	5
22	prens-serenat	5
22	yurt-kafes	5
22	içerik-faktör	5
22	mağara-yurt	3
22	mağara-karbon	3
22	içerik-mürettebat	2
22	gelgit-kaya	2
22	mücevher-mağaza	1
22	ilmik-jöle	1
22	içerik-jöle	1
22	gelgit-faktör	1
22	pazarlık-gelgit	1
22	prens-jöle	1
22	karbon-faktör	1
22	karbon-içerik	1
22	prens-yurt	1
22	kafes-prens	1
22	bilgisayar-kafes	1
22	ilmik-mağara	1
22	gelgit-kafes	1
22	melez-pazarlık	1
22	içerik-melez	1
22	ilmik-kaya	1
23	dostluk-birlik	30
23	özne-isim	22
23	fragman-bölüm	12
23	isim-mezar	7
23	ikametgah-sicil	6
23	cinsiyet-isim	5
23	bölüm-derece	4
23	balta-mezar	3
23	gelir-cinsiyet	3
23	boğaz-gelir	3
23	boğaz-kaşık	3
23	sicil-isim	2
23	dostluk-bölüm	2
23	derece-dostluk	2
23	ikametgah-gelir	2
23	derece-sicil	2

23	ikametgah-mezar	2
23	derece-birlik	1
23	balta-boğaz	1
23	gelir-cinsiyet	1
23	cinsiyet-dostluk	1
23	özne-sicil	1
23	derece-kaşık	1
23	ikametgah-birlik	1
23	sicil-birlik	1
23	boğaz-mezar	1
23	stadyum-bölüm	1
23	deve-gelir	1
23	stadyum-dostluk	1
23	stadyum-cinsiyet	1
23	deve-ikametgah	1
23	cinsiyet-kaşık	1
23	eskiz-derece	1
23	balta-kaşık	1
23	dostluk-mezar	1
23	derece-isim	1
23	bölüm-eskiz	1
23	özne-mezar	1
23	boğaz-stadyum	1
23	derece-gelir	1
23	sicil-gelir	1
23	birlik-bölüm	1
23	ikametgah-özne	1
24	cehennem-kötülük	40
24	kahraman-hikaye	20
24	fasulye-biber	16
24	kriz-nöbet	6
24	zambak-böcek	5
24	malikane-vals	4
24	hikaye-malikane	4
24	kötülük-kahraman	4
24	özel-malikane	4
24	kötülük-kriz	4
24	yumruk-kötülük	3
24	kriz-cehennem	3
24	hikaye-hece	2
24	kriz-yumruk	2
24	alabalık-yelek	2

24	özel-kahraman	2
24	nöbet-kahraman	2
24	teori-hikaye	2
24	kriz-teori	2
24	yelek-kahraman	2
24	böcek-cehennem	2
24	nöbet-cehennem	1
24	kahraman-yumruk	1
24	cehennem-teori	1
24	fasulye-böcek	1
24	zambak-hikaye	1
24	yelek-hikaye	1
24	yelek-fasulye	1
24	alabalık-teori	1
24	böcek-nöbet	1
24	kriz-kahraman	1
24	kriz-hikaye	1
24	alabalık-biber	1
24	vals-zambak	1
24	böcek-alabalık	1
24	teori-hece	1
24	zambak-malikane	1
24	örümcek-kötülük	1
24	kahraman-fasulye	1
25	kale-kılıç	20
25	namaz-tunik	9
25	çoğunluk-namaz	7
25	sanayi-donanım	5
25	besteci-efsane	5
25	kale-efsane	4
25	kılıç-efsane	4
25	donanım-örnek	3
25	ayna-tepsi	3
25	daire-havuz	3
25	yerçekimi-ağaç	2
25	efsane-örnek	2
25	donanım-besteci	2
25	havuz-ayna	2
25	daire-kale	2
25	ağaç-havuz	2
25	sanayi-çoğunluk	2
25	ayna-efsane	1

25	donanım-havuz	1
25	yerçekimi-efsane	1
25	efsane-donanım	1
25	boğum-ağaç	1
25	kale-donanım	1
25	yerçekimi-daire	1
25	yerçekimi-tepsi	1
25	ağaç-ayna	1
25	boğum-daire	1
25	ayna-yerçekimi	1
25	donanım-kale	1
25	namaz-örnek	1
25	çoğunluk-efsane	1
25	sanayi-ağaç	1
25	daire-tepsi	1
26	çaba-özveri	27
26	yılbaşı-konser	20
26	torpido-tampon	14
26	gövde-kalp	14
26	yöntem-pişirme	8
26	kabuk-gövde	6
26	özveri-değer	6
26	kabuk-kılçık	6
26	kılçık-pişirme	4
26	bölünme-krallık	3
26	yılbaşı-pişirme	3
26	bölünme-yöntem	3
26	torpido-gövde	3
26	bölünme-tiftik	2
26	kabuk-bölünme	2
26	kılçık-gövde	2
26	krallık-değer	2
26	değer-çaba	2
26	koridor-bölünme	1
26	kabuk-çaba	1
26	tampon-kalp	1
26	tiftik-kılçık	1
26	yılbaşı-özveri	1
26	eksen-koridor	1
26	krallık-konsej	1
26	gövde-eksen	1
26	tiftik-pişirme	1

26	kalp-özveri	1
26	kabuk-değer	1
26	kalp-bölünme	1
26	konser-koridor	1
26	kılçık-değer	1
26	eksen-çaba	1
26	yöntem-kabuk	1
26	kalp-değer	1
26	yılbaşı-krallık	1
26	pişirme-özveri	1
27	ofis-güvenlik	15
27	protokol-güvenlik	14
27	evlilik-cesaret	12
27	evlilik-protokol	12
27	bayram-evlilik	7
27	cesaret-heves	6
27	evlilik-heves	5
27	kanca-büküm	3
27	servet-evlilik	3
27	güvenlik-cesaret	3
27	bayram-protokol	3
27	ofis-servet	3
27	evlilik-kanca	3
27	kenar-oyuk	2
27	tabak-nişasta	2
27	servet-güvenlik	2
27	bayram-heves	2
27	cesaret-servet	2
27	ofis-protokol	2
27	oyuk-parça	2
27	bayram-tabak	1
27	oyuk-kanca	1
27	depozito-servet	1
27	ofis-depozito	1
27	kenar-nişasta	1
27	kenar-tabak	1
27	kenar-parça	1
27	büküm-oyuk	1
27	heves-hızlı	1
27	tabak-parça	1
27	evlilik-parça	1
27	kanca-depozito	1

27	gezegen-tabak	1
27	tabak-oyuk	1
27	ofis-parça	1
27	evlilik-güvenlik	1
27	depozito-güvenlik	1
28	kanun-denetim	22
28	denetim-kurum	19
28	koni-üçgen	18
28	tost-içecek	17
28	tosbağa-örümcek	13
28	kurum-kanun	10
28	tosbağa-sabır	7
28	üçgen-uzunluk	5
28	kasaba-denetim	5
28	uzunluk-bayrak	4
28	koni-uzunluk	3
28	bayrak-kanun	3
28	kanun-kasaba	3
28	kasaba-folklor	2
28	sabır-uzunluk	2
28	folklor-kanun	1
28	folklor-bayrak	1
28	örümcek-denetim	1
28	mors-merkür	1
28	kanun-sabır	1
28	kurum-mors	1
28	tost-üçgen	1
28	kanun-uzunluk	1
28	örümcek-mors	1
28	örümcek-conta	1
28	bayrak-kurum	1
28	kanun-merkür	1
28	conta-asbest	1
28	örümcek-merkür	1
28	kanun-üçgen	1
28	asbest-denetim	1
28	mors-uzunluk	1
29	şiiir - hayalperest	15
29	makine - araç	12
29	lokomotif - makine	11
29	lokomotif - araç	10
29	hapis - trajedi	9

29	ıspanak - armut	7
29	şiiir - trajedi	7
29	yular - saman	7
29	şiiir - saygı	6
29	hapis - müttefik	4
29	hayalperest - trajedi	4
29	şiiir - jargon	4
29	yular - hapis	2
29	hapis - ipucu	2
29	şiiir - hapis	2
29	saman - gölet	1
29	armut - küre	1
29	saman - ıspanak	1
29	hapis - jargon	1
29	müttefik - araç	1
29	ipucu - müttefik	1
29	ipucu - damga	1
29	gölet - şiiir	1
29	müttefik - lokomotif	1
29	hayalperest - sabır	1
29	müttefik - damga	1
29	saygı - kanun	1
29	hapis - saygı	1
29	küre - araç	1
29	damga - yular	1
29	yular - gölet	1
29	jargon - saygı	1
29	hayalperest - hapis	1
29	hapis - damga	1
30	tren - posta	7
30	baskın - çıđlık	4
30	palyaço - çıđlık	4
30	bülbül - çıđlık	4
30	oturum - kurs	4
30	ozan - bülbül	3
30	koloni - birey	3
30	ozan - çıđlık	3
30	tren - çıđlık	2
30	birey - organ	2
30	kırpmak - ölçüm	2
30	organ - ölçüm	2
30	bilezik - ölçüm	2

30	birey - kurs	2
30	birey - baskın	2
30	koloni - baskın	1
30	koloni - tren	1
30	şemsiye - palyaço	1
30	organ - oturum	1
30	oturum - posta	1
30	oturum - koloni	1
30	ozan - birey	1
30	palyaço - ozan	1
30	organ - çığlık	1
30	posta - bülbül	1
30	samimi - çığlık	1
30	oturum - baskın	1
30	ozan - bilezik	1
30	palyaço - samimi	1
30	organ - leke	1
30	bülbül - samimi	1
30	posta - samimi	1
30	palyaço - birey	1
30	hapis - damga	1
31	soruşturma - şahit	21
31	orman - ırmak	17
31	makale - denek	14
31	kalıtım - aktarma	8
31	bölge - orman	7
31	ırmak - bölge	6
31	makale - aktarma	5
31	üzüm - açlık	4
31	yabancı - soruşturma	3
31	denek - kapsül	3
31	boru - aktarma	3
31	makale - kalıtım	2
31	kalıtım - hükümdar	2
31	üzüm- orman	2
31	yabancı - bölge	2
31	kalıtım - denek	2
31	makale - tercih	2
31	soruşturma - denek	2
31	orman - kapsül	2
31	şahit - makale	2
31	makale - afiş	2

31	hükümdar - soruşturma	2
31	soruşturma - bölge	1
31	denek - tercih	1
31	hükümdar - bölge	1
31	bölge - açlık	1
31	bölge - tercih	1
31	yabancı - denek	1
31	orman - hükümdar	1
31	hükümdar - aktarma	1
31	ırmak - boru	1
31	tercih - aktarma	1
31	açlık - yabancı	1
31	hükümdar - makale	1
31	hükümdar - yabancı	1
31	makale - soruşturma	1
31	hükümdar - tercih	1
31	hükümdar - afiş	1
32	kağıt - sayfa	37
32	otoyol - geçit	14
32	döngü - sıkıcı	10
32	durum - komedi	9
32	mimik - komedi	9
32	pandemi - sıkıcı	9
32	komedi - anekdot	7
32	sıkıcı - anekdot	5
32	döngü - pandemi	5
32	anekdot - sayfa	4
32	komedi - sıkıcı	4
32	anekdot - durum	3
32	istridye - midilli	3
32	kazak - renk	3
32	durum - hırs	2
32	pandemi - otoyol	2
32	pandemi - durum	2
32	anekdot - kağıt	2
32	kağıt - sıkıcı	1
32	kağıt - ladin	1
32	renk - kağıt	1
32	döngü - durum	1
32	anekdot - ladin	1
32	anekdot - hırs	1
32	döngü - tahmin	1

32	tahmin - kağıt	1
32	pandemi - tahmin	1
32	tahmin - renk	1
32	döngü - geçit	1
32	otoyol - komedi	1
32	komedi - döngü	1
32	renk - mimik	1
32	durum - sıkıcı	1
32	hükümdar - makale	1
32	hükümdar - yabancı	1
32	makale - soruşturma	1
32	hükümdar - tercih	1
32	hükümdar - afiş	1
33	seçmen- dokunulmazlık	24
33	hava - oksijen	23
33	komedi - dram	16
33	fildişi - kolye	9
33	mercan - kolye	6
33	dokunulmazlık - yoldaş	6
33	mercan - fildişi	5
33	komedi - bira	5
33	komedi - makara	4
33	seçmen - yoldaş	4
33	dokunulmazlık - sigorta	2
33	oksijen - alkali	2
33	yoldaş - makara	2
33	bitiş - sigorta	2
33	seçmen - sigorta	2
33	bira - yoldaş	1
33	fildişi - alkali	1
33	bira - alkali	1
33	oksijen - bitiş	1
33	fildişi - dokunulmazlık	1
33	bitiş - dram	1
33	yoldaş - sigorta	1
33	mercan - oksijen	1
33	hava - alkali	1
33	alkali - mercan	1
33	dilbilgisi - dokunulmazlık	1
33	hava - sigara	1
33	yoldaş - fildişi	1
33	kulübe - hava	1

33	kulübe - oksijen	1
33	hava - bira	1
33	yoldaş - dram	1
33	durum - sıkıcı	1
33	hükümdar - makale	1
33	hükümdar - yabancı	1
33	makale - soruşturma	1
33	hükümdar - tercih	1
33	hükümdar - afiş	1

## G. TURKISH SUMMARY/ TÜRKÇE ÖZET

### BÖLÜM 1

#### GİRİŞ

Olaysal bellek hem madde bilgisi hem de bağlam bilgisi içerir. Bir başka deyişle “ne” sorusuna cevap verdiği gibi “nerede” ve “ne zaman” sorularına da cevap verir (Clayton ve Dickinson, 1998; Nyberg ve ark., 1996; Tulving, 1985, 2002). Olaysal bellek laboratuvarında iki ana görevle ölçülür: tanıma ve hatırlama. Tanıma görevinde katılımcılar madde listeleri çalışırlar ve test aşamasında bu maddelerden bazıları onlara tekrar gösterilir ve “Bu maddeyi gördünüz mü?” diye sorulur. Hatırlama görevindeyse madde listeleri çalışıldıktan sonra test aşamasında katılımcıdan ne hatırladığını söylemesi istenir. Serbest hatırlama, sıklıkla kullanılan bir hatırlama görevidir. Serbest hatırlamada katılımcılar hatırlamaya hangi sırayla başlayıp bitirecekleri konusunda tamamen özgürlerdir.

#### 1.1 Yakınlık Etkisi

Serbest hatırlama görevinde katılımcılar bir kelime hatırladıktan sonra, bir sonraki hatırladıkları kelime bu ilk kelimeye genellikle pozisyon olarak yakın olur, buna *yakınlık etkisi* denir. Figür 1.3'te yakınlık etkisinin genel şekli verilmiştir. Örneğin “yokluk”, “boşluk”, “öğrenci”, “nehir” ve “sevgili” kelimelerinin çalışıldığını düşünelim. Bu kelimelerin hatırlanma sırasının çalışma sırasına benzer olması muhtemeldir, mesela “öğrenci”, “nehir” ve “sevgili” şeklinde ilerleyebilir.

Yakınlık etkisi uzun süreli de gözlemlenebilir. Howard ve iş arkadaşları yaptıkları bir deneyde katılımcılara 48 tane liste gösterdiler ve bu listelerin arasında da bir yakınlık etkisi gözlediler (2008). Otobiyografi literatüründen gelen çalışmalar da deney bağlamı dışındaki ve daha uzun süreli hatırlamalarımızda da bir yakınlık etkisine işaret ediyor (Mack ve ark., 2017; Moreton ve Ward, 2010).

Literatürdeki önemine rağmen, yakınlık etkisinin nedenleri konusunda bir fikir birliği bulunmamakta. Bu etkiyi açıklamaya çalışan modeller iki ana başlık altında toplanabilir: nedensel modeller ve nedensel-olmayan modeller. Nedensel modeller hatırlanan kelimelerin hatırlanacak bir sonraki kelimeler için ipucu olarak kullanıldığını öne sürer. TCM ve SAM nedensel modellere örnek olarak verilebilir. TCM'e göre (Temporal Context Model [TCM], Howard ve Kahana, 2002) bir kelime hatırlandığında onun bağlamı da hatırlanır ve bu bağlam bilgisi ona yakın başka bir kelimenin bağlamını hatırlamak için ipucu olarak kullanılır. SAM'e göreyse (Search for Associations in Memory [SAM], Raaijmaker ve Shiffrin, 1980, 1981), kelimeler kısa-süreli hafızada birlikte vakit geçirdiklerinde aralarında bir bağ oluşur ve bu bağ sonrasında ipucu olarak kullanılır. Öte yandan, nedensel-olmayan modeller çalışma ve test aşamalarındaki zihinsel durum benzerliğinin yakınlık etkisine sebebiyet verdiğini öne sürer. Develaar ve arkadaşlarının modeli buna örnek olarak verilebilir (2005). Bu modelde bağlam çalışılan kelimelerden bağımsız ve rastgele bir şekilde akar, test aşamasında da bu bağlam hatırlanır ve söz konusu olan zihinsel benzerliğe sebebiyet verir.

Yoklayıcı hatırlama görevi bu iki modeli ayırtmak için tasarlanmıştır. Yoklayıcı hatırlama görevinde katılımcılara kelime listeleri gösterilir, test aşamasındaysa rastgele bir listeden rastgele bir kelime ekrana gelir ve katılımcıdan bu kelimeyi gördüğü listeden hatırladığı başka bir kelimeyi ekrana yazması istenir. Burada zihinsel benzerlik çok kısıtlandığı için yakınlık etkisi gözlenirse nedensel modellerden kaynaklı gözlemlendiği öne sürülebilir. Kılıç ve iş arkadaşları yoklayıcı hatırlama görevinde hem kısa süreli hem uzun süreli yakınlık etkisi gözleyerek nedensel modelleri desteklediler (2013).

## 1.2 Yakınlık Etkisinde Asimetri

Katılımcılardan gördükleri kelimeleri özgürce hatırlamaları istendiğinde bunu genellikle benzer bir şekilde yaparlar, bu da bize belleğin nasıl çalıştığına yönelik ipuçları verir. Serbest hatırlama görevinde genellikle ileriye dönük bir asimetri gözlenir ve sonraki genel kelimeler daha kısa sürede ve daha büyük bir doğruluk yüzdesiyle hatırlanır (Kahana, 1996; Kahana ve Caplan, 2002). Tanıma görevinde de ileriye dönük asimetri bulunduğu dair bulgular mevcut (Sadeh ve ark., 2015; Vaughn ve Rawson, 2014; Yang ve ark., 2013).

Figür 1.3'te de görüldüğü gibi yakınlık etkisinde de güçlü bir ileriye dönük asimetri vardır, yani bir sonraki kelimeyi hatırlama ihtimali bir önceki kelimeyi hatırlama ihtimalinden fazladır. Kılıç ve iş arkadaşlarının deneyinde yakınlık etkisi gözlenmesine rağmen ileriye dönük asimetri gözlenemedi (2013). Daha önceki bulgulardan biliyoruz ki performans düştüğünde asimetri kaybolabiliyor (Spillers ve Unsworth, 2011) ve bu deneyde de performans bir hatırlama görevine göre düşüktü.

Ben bu tezde yoklayıcı hatırlama görevini kolaylaştırarak performansını artırmayı hedefliyorum. Hem liste-içi hem listeler-arası yakınlık etkisini, ileriye-dönük asimetriyi gözlemleyeceğimi hipotez ediyorum. Ayrıca yoklayıcı hatırlama görevinin başındaki tanıma kısmı ile hatırlama kısmı arasında da bir ilişki olacağını hipotez ediyorum.

## BÖLÜM 2

### PİLOT DENEYLER VE DENEY 1

#### 2.1 Pilot Deney 1

##### 2.1.1 Yöntem

###### 2.1.1.1 Katılımcılar

15 katılımcı (%53.33 erkek, %46.67 kadın) deneye katıldı. Katılımcıların hepsinin ana dili Türkçe'ydi ve görmelerinde bir sorun yoktu.

###### 2.1.1.2 Uyananlar

Kılıç ve iş arkadaşlarının (2013) deneyindeki kelimeler Türkçe'ye çevrilerek kullanıldı. Bu deney için MATLAB'da Psychtoolbox kullanılarak bir kod yazıldı.

###### 2.1.1.3 Prosedür

Çalışma aşamasında katılımcılara 10 kelimedenden oluşan 7 liste gösterildi. Kelimeleri çalışırken aynı zamanda bu kelimelerin soyut mu somut mu bir anlama geldiğini oyladılar. Her liste arasında 60 saniye süren bir toplama işlemi yaptılar. Test aşamasında her listeden üç adet yoklayıcı kelime ve buna ek olarak çalışma aşamasında hiç görmedikleri 7 adet kelime gösterildi. Önce katılımcılara bu kelimeyi görüp görmedikleri soruldu ve bunu 1 ile 9 arasında oylamaları istendi, sonrasında da bu kelimeyi gördükleri listeden hatırladıkları başka bir

kelimeyi ekrana yazmaları istendi. Deney Matlab üzerinden yapıldı ve katılımcılar-ıçi bir desene sahipti.

## **2.1.2 Sonular**

Katılımcıların doęru listeye dönme oranı %5.71'di. Bu alıřmadaki tüm deneyler ve plotlar R kullanarak yapıldı (R Core Team, 2021).

### **2.1.2.1 Data Düzenleme**

Analizden önce liste uzaklıkları ve kelime uzaklıkları hesaplandı. Kelime uzaklıklarını hesaplamak için yoklayıcı kelimenin liste içindeki pozisyonundan, aynı listeden hatırlanan kelimenin kelime içindeki pozisyonu ıkartıldı. Örneęin yoklayıcı kelime 3. Listenin 5. Kelimesi ise, katılımcı da bu kelimeyi kullanarak yaptığı hatırlamada ekrana 3. Listenin 7. Kelimesini yazdıysa, kelime uzaklıęı +2 diyebiliriz. Benzer şekilde, liste uzaklıkları da katılımcı başka bir listeden bir kelime hatırladıęı durumlarda, yoklayıcı kelimenin listesinden hatırlanan kelimenin listesi ıkartılarak bulundu.

### **2.1.2.2 Liste-ıçi Yakınlık Etkisi**

Kelime uzaklıkları 1, 2, 3 ( $M=.73$ ,  $SD=1.1$ ) ve 5, 6, 7 ( $M=.27$ ,  $SD=0.46$ ) baęımlı örneklemler t-testi kullanılarak birbiri ile kıyaslandı ve anlamlı bir deęiřiklik gözlenmedi,  $t(14)= 1.52$ ,  $p= .15$ ,  $d = .39$  (Tablo 2.1). Bu nedenle, liste-ıçi yakınlık etkisi gözlenemedi (Figür 2.1).

### **2.1.2.3 Listeler-arası Yakınlık Etkisi**

Liste-ıçi yakınlık etkisine benzer bir şekilde, listeler-arası yakınlık etkisini bulmak için liste uzaklıkları 1, 2, 3 ( $M=4.53$ ,  $SD=2.33$ ) ve 4, 5, 6 ( $M=2.47$ ,  $SD=1.64$ ) karşılaştırıldı. Baęımlı örneklemler t-testi sonucunda yakın listelerden, uzak listelere kıyasla anlamlı bir şekilde daha ok kelime hatırlandıęı gözlendi,

$t(14) = 3.11$   $p = .008$ ,  $d = 0.8$  (Tablo 2.2). Başka bir deyişle, listeler arasında bir yakınlık etkisi gözlemlendi (Figür 2.2).

#### **2.1.2.4 Güven Aralığı ve Hatırlama**

Bir kelime hatırlamadan önce, katılımcılar kendilerine verilen yoklayıcı kelimeyi daha önce görüp görmediklerini 1 (kesinlikle görmedim) ve 9 (kesinlikle gördüm) arasında oyladılar. Bu oylama değerlerine göre doğru listeye dönme oranları Tablo 2.3 ve Figür 2.3'te görülebilir. Doğru listeye dönüş oranının yoklayıcı kelimeye verilen oy ile bir ilgisi olup olmadığını görmek için tek yönlü ANOVA analizi yapıldı ve anlamlı bir sonuç görülmedi,  $F(8, 411) = 1.07$ ,  $MSE = .04$ ,  $p = .382$  (Tablo 2.4).

### **2.2 Pilot Deney 2**

#### **2.2.1 Yöntem**

Bazı değişiklikler yaparak deneyi daha kolay hale getirmek amacıyla ikinci bir pilot deney yapıldı. Bu pilot zamanın şartları dolayısıyla online yapıldı ve bu amaçla Pavlovia'da deney için yeni bir kod yazıldı.

##### **2.2.1.1 Katılımcılar**

31 katılımcı ders puanı karşılığında deneye katıldı. Bu katılımcılardan bir tanesi katılımcıların hedeflenen yaş aralığının (18-35) dışında kaldığı için analize dahil edilmedi, sonuç olarak analize 30 katılımcı (%83.33 kadın, %16.67 erkek) dahil edilmiş oldu.

##### **2.2.1.2 Uyanlar**

Kelime listeleri Kılıç ve iş arkadaşlarının deneyinden alındı (2013) ve benim tarafımdan Türkçe'ye çevrildi. Python ve JavaScript kullanılarak Pavlovia'da bu deney için bir kod yazıldı.

### **2.2.1.3 Prosedür**

Katılımcılara bir Zoom linki iletildi ve anlaşılan zamanda bu linki açtılar. Katılımcıya deney yürütücüsü tarafından “Bulduğunuz odada yalnız mısınız?”, “Bu 20 dakika içerisinde rahatsız edilmeyeceğinize emin misiniz?” gibi sorular sorulduktan sonra katılımcıya Pavlovia linki gönderildi ve hem katılımcı hem yürütücü Zoom'u kapattılar.

İlk pilot deneyden farklı olarak, bu deneyde katılımcılara her birinde 15 kelime bulunan 5 kelime listesi gösterildi. Bu kelimeleri öğrenirken aynı zamanda bu kelimelerin onlar için olumlu mu olumsuz mu bir anlama geldiğini oyladılar. Soyut/somut oylamasından olumlu/olumsuz oylamasına geçişin sebebi kelimeleri daha güçlü hale getirmektir. Çeldirici görevin süresi 60 saniyeden 30 saniyeye düşürüldü. Bu 30 saniyenin ilk 15 saniyesinde toplama işlemi yaptırıldı, sonraki 15 saniyesinde ise sadece beklenildi. Test aşamasında her listeden 3 tane, ve 5 tane yeni olmak üzere 20 tane yoklayıcı kelime gösterildi. Katılımcılar önce bu kelimeyi görüp görmediklerini 1 ve 9 arasında değerlendirdiler, ardından da bu kelimeyi gördükleri listeden hatırladıkları başka bir kelimeyi ekrana yazdılar. Deney katılımcılar-İçi desene sahipti.

### **2.2.2 Sonuçlar**

Katılımcıların doğru listeye dönme oranı %23.13'tü.

#### **2.2.2.1 Data Düzenleme**

Data düzenleme süreci Pilot 1 ile tamamen aynıydı.

### 2.2.2.2 Liste-içi Yakınlık Etkisi

Liste-içi yakınlık etkisine bakmak için kelime uzaklıkları 1, 2, 3 ve 5, 6, 7 karşılaştırıldı (Figür 2.4). Bağımlı örneklem t-testi sonucunda yakın kelimeler, yani kelime uzaklıkları 1, 2, 3 ( $M=1.67$ ,  $SD=2.2$ ), uzak kelimelerden, yani kelime uzaklıkları 5, 6, 7 ( $M=.67$ ,  $SD=.92$ ), anlamlı ölçüde daha çok hatırlandı,  $t(29)= 2.55$ ,  $p= .016$ ,  $d = .465$ . Shapiro-Wilk test, ( $W = .85$ ,  $p <.001$ ) ve Q-Q plot dağılımı, normalliğin ihlal edildiğini gösterdi. Bundan ötürü, Wilcoxon W testi de uygulandı ve o da anlamlı bir sonuca işaret etti,  $W(29)= 202^a$ ,  $p= .013$ ,  $r_{rb} = 0.6$  (Tablo 2.5).

Asimetriye bakmak için kelime uzaklıkları +1, +2, +3 ( $M=.6$ ,  $SD=.93$ ) ile -1, -2, -3 ( $M=1.07$ ,  $SD=1.6$ ) kıyaslandı (Figür 2.4). Bağımlı örneklem t-testi sonucunda anlamlı bir fark bulunamadı  $t(29)= -1.82$ ,  $p = .08$ ,  $d = -.33$ . Shapiro-Wilk test, ( $W = .84$ ,  $p <.001$ ) ve Q-Q plot dağılımı, normalliğin ihlal edildiğini gösterdi. Wilcoxon W testi sonucunda da iki grup arasında anlamlı bir farka rastlanamadı,  $W(29)= 21^a$ ,  $p= .09$ ,  $r_{rb} = -.54$  (Tablo 2.5).

Özetle, yoklayıcı kelimeye pozisyon olarak yakın kelimeler uzak kelimelere kıyasla anlamlı ölçüde daha çok hatırlandı, yani liste-içi yakınlık etkisi gözlemlendi. Fakat, yoklayıcı kelimedenden sonra gelen kelimelerin önce gelen kelimelere göre bir avantajı bulunamadı.

### 2.2.2.3 Listeler-arası Yakınlık Etkisi

Listeler-arası yakınlık etkisi için liste uzaklıkları 1, 2 ve 3, 4 karşılaştırıldı (Figür 2.5). Bağımlı örneklem t-test analizi sonucunda liste uzunlukları 1 ve 2'nin ( $M=5.9$ ,  $SD=2.38$ ) 3 ve 4'e kıyasla ( $M=1.93$ ,  $SD=1.34$ ) anlamlı bir şekilde daha çok hatırlandığı bulundu,  $t(29)= 9.11$   $p < .001$ ,  $d = 1.04$  (Tablo 2.6). Q-Q plot dağılımı ve Shapiro-Wilk testi ( $W = .97$ ,  $p= .44$ ) normalliğe bir ihlal göstermedi.

Hipotez edilmediği halde, listeler arasında bir asimetri gözlenip gözlenmediğini araştırmak için liste uzaklıkları +1 ve +2, -1 ve -2 ile karşılaştırıldı (Figür 2.5). Bağımlı örneklem t-testi iki grup arasında anlamlı bir fark olmadığını gösterdi,  $t(29) = 1.78$ ,  $p = .086$ ,  $d = .33$  (Tablo 2.6).

Özetle, katılımcılar doğru listeye dönemediklerinde, pozisyon olarak yakın bir listeye dönüp oradan anlamlı ölçüde daha çok kelime hatırladılar (listeler-arası yakınlık etkisi). Fakat, doğru listeden sonra gelen kelimeler, önceki gelen listelere göre daha avantajlı değildi.

#### **2.2.2.4 Güven Aralığı ve Hatırlama**

Katılımcıların güven aralığı oylama değerlerine göre doğru listeye dönme oranları Tablo 2.7 ve Figür 2.6'da görülebilir. Doğru listeye dönüş oranının yoklayıcı kelimeye verilen oy ile bir ilgisi olup olmadığını görmek için tek yönlü ANOVA analizi yapıldı ve anlamlı bir fark gözlemlendi, ( $F(8, 591) = 7.47$ ,  $MSE = .13$ ,  $p < .001$ ) (Tablo 2.8), bu demek oluyor ki en az bir oylama bir diğer oylamaya göre doğru listeye dönüşü yordamak konusunda anlamlı ölçüde farklıydı. Tukey HSD analizi hangi alt gruplar arasında fark olduğunu gözlemlemek amacı ile yapıldı. 8 ve 1 ( $p = .03$ , 95% C.I. = [.01, .55]), 9 ve 1 ( $p < .001$ , 95% C.I. = [.13, .36]) ve 9 ve 2 ( $p = .003$ , 95% C.I. = [.05, .45]) birbirlerinden anlamlı ölçüde fark gösterdiler, diğer karşılaştırmalar anlamlı değildi.

### **2.3 Ön Çalışma**

#### **2.3.1 Yöntem**

Bu deneyde olaysal ilişkiler araştırıldığı için anlamsal ilişkilerin kontrol edilmesi gerekmektedir. Bir önceki yoklayıcı hatırlama deneyinde (Kılıç ve ark, 2013) kelimeler LSA modeli (Landauer, ve Dumais, 1997)kullanan SEMMOD paketi (Stone ve ark., 2008). Bu yöntemler bazı sorunlar ve Türkçe'deki kaynak

yetersizliđi nedeniye bu deneyde kullanılmadı. Bunun yerine bir önceki deneyde kullanılan kelimeler Türkçe'ye çevrildi ve bu çalışma ile katılımcılara listelerdeki kelimelerin anlamsal olarak ilişkili olup olmadığı soruldu.

### **2.3.1.1 Katılımcılar**

109 katılımcı deneye katıldı. 2 katılımcı kelime çiftleri yerine kelime yazarak cevap verdiği için verileri kullanılmadı ve katılımcı sayısı 107'ye düřtü.

### **2.3.1.2 Uyarılar**

Veriyi toplamak için Qualtrics kullanıldı. Katılımcılara 17 kelimedenden oluşan 33 adet liste gösterildi.

### **2.3.1.2 Prosedür**

Katılımcılara Qualtrics linki iletildi. Gördükleri her 33 liste için, o listede bir kelimeyi listedeki başka bir kelime ile anlamsal olarak ilişkili buluyorlarsa bu kelime çiftini yazmaları istendi.

### **2.3.2 Sonuçlar**

Her listede en çok oylanan iki kelime çiftinden bir kelime rastgele bir şekilde deneyden çıkartıldı. Kalan sonuçlara bakıldığında bir listede başka bir kelimeyle anlamsal olarak en çok ilişkili bulunan kelime 107 kişiden 15'i tarafından ilişkili bulunmuştu. Örneğın, “madalya” ve “ödül” kelimeleri 58 kişi tarafından (alınan en yüksek oylama), “baharat” ve “ülser” kelimeleri ise 25 kişi tarafından ilişkili bulundu. 15 kişi sınırını geçtikleri için, bu kelime çiftlerinden rastgerek birer kelime listelerden çıkartıldı.

## **2.4 Deney 1**

## **2.4.1 Yöntem**

### **2.4.1.1 Katılımcılar**

İdeal katılımcı sayısını hesaplamak için Gpower analizi yapıldı (Faul ve ark., 2019). İki yönlü, .5 dz etki büyüklüğü ve .05 alpha değeri ile bağımlı örneklem t-test analizinde .99 güç elde etmek için tahmin edilen katılımcı sayısı 76'ydı.

78 katılımcı ders puanı karşılığında deneye katıldı. 2 katılımcının verisi deney esnasında çıkan teknik aksaklıklar nedeniyle kaybedildi. Bir katılımcı ise deney esnasında odayı defalarca terk ettiği için analize katılmadı. Sonuç olarak, deneyde 75 katılımcı (%73.33 kadın,%26.67 erkek) kalmış oldu.

### **2.4.1.2 Uyaranlar**

Ön deney ile hazırlanan kelime listeleri kullanıldı. MATLAB'da Psychtoolbox kullanılarak bir kod yazıldı.

### **2.4.1.3 Prosedür**

Bu deneyin prosedürü ikinci pilot deneyin prosedürü ile birebir aynıydı.

## **2.4.2 Sonuçlar**

Katılımcıların doğru listeye dönme oranı %23.93'tü.

### **2.4.2.1 Data Düzenleme**

Data düzenleme süreci pilot deneyler ile birebir aynıydı.

### **2.4.2.2 Liste-içi Yakınlık Etkisi**

Bağımlı örneklem t-testi sonucunda kelime uzaklıkları 1, 2, 3'ün ( $M=2.03$ ,  $SD=2.69$ ) 5, 6, 7'ye göre ( $M=.65$ ,  $SD=.76$ ) anlamlı ölçüde daha çok hatırlandığı bulundu (Figür 2.7),  $t(74)= 4.17$ ,  $p < .001$ ,  $d = .481$ . Shapiro-Wilk testi ( $W = .75$ ,  $p < .01$ ) ve Q-Q plot dağılımı normalliğe bir ihlal gösterdi ve bu yüzden Wilcoxon W testi de uygulandı ve o da anlamlı bir fark gösterdi,  $W(74)= 1323^a$ ,  $p < .001$ ,  $r_{rb} = 0.66$  (Tablo 2.9).

Asimetri için kelime uzaklıkları +1, +2, +3 ( $M=1$ ,  $SD=1.39$ ) ve -1, -2, -3 ( $M=1.03$ ,  $SD=1.61$ ) bağımlı örneklem t-test kullanılarak karşılaştırıldı (Figür 2.7) ve iki grup arasında anlamlı bir fark gözlenmedi,  $t(74)= .17$ ,  $p = .87$ ,  $d = .02$ . Benzer şekilde, Shapiro-Wilk testi ( $W = 0.91$ ,  $p < 0.01$ ) ve Q-Q plot dağılımı normalliğe bir ihlal gösterdiği için Wilcoxon W testi de uygulandı ve gruplar arasında yine anlamlı bir fark gözlenemedi,  $W(74)= 481^a$ ,  $p= .87$ ,  $r_{rb} = -.3$  (Tablo 2.9).

Sonuç olarak, yoklayıcı kelimeye pozisyon olarak yakın kelimeler uzak kelimelere göre anlamlı olarak daha fazla hatırlandı (liste-içi yakınlık etkisi), fakat bir asimetri gözlenemedi.

#### **2.4.2.3 Listeler-arası Yakınlık Etkisi**

Liste uzaklıkları 1, 2 ( $M=5.52$ ,  $SD=3.08$ ) ve 3, 4 ( $M=2$ ,  $SD=1.76$ ) bağımlı örneklem t-test kullanılarak karşılaştırıldı (Figür 2.8) ve yakın listelere uzak listelere nazaran anlamlı ölçüde fazla dönüldüğü gözlemlendi,  $t(74)= 9.02$ ,  $p < .001$ ,  $d = 1.04$ . Shapiro-Wilk testi ( $W = .96$ ,  $p= .02$ ) ve Q-Q plot dağılımı normalliğe bir ihlal gösterdiği için Wilcoxon W testi de uygulandı ve yine anlamlı bir sonuç gözlemlendi  $W(74)= 2195^a$ ,  $p < .001$ ,  $r_{rb} = .93$  (Tablo 2.10).

Hipotez edilmemiş olmasına rağmen, listeler arasında ileriye dönük bir asimetri olup olmadığına bakıldı. Bunun için yeniden bir bağımlı örneklem t-test ile liste uzunlukları +1, +2 ( $M=3.24$ ,  $SD=2.18$ ) ve -1, -2 ( $M=2.27$ ,  $SD=1.74$ )

karşılaştırıldı (Figür 2.8). Analiz sonucunda doğru listeden sonra gelen listelere, önce gelen listelere kıyasla anlamlı ölçüde daha fazla dönüldüğü gözlemlendi,  $t(74) = 3.42, p = .001, d = .4$  (Tablo 2.10). Shapiro-Wilk testi ( $W = .97, p = .06$ ) ve Q-Q plot dağılımı normalliğe bir ihlale işaret etmedi.

Özetle, doğru listeye pozisyon olarak daha yakın olan listelerden hatırlanan kelime sayısı, uzak listelerden hatırlanan kelime sayısından anlamlı ölçüde fazlaydı (listeler-arası yakınlık etkisi). Buna ek olarak, doğru listeden sonra gelen listeler, önce gelen listelere göre anlamlı olarak daha çok hatırlandı (ileriye dönük asimetri).

#### 2.4.2.4 Güven Aralığı ve Hatırlama

Katılımcıların güven aralığı oylama değerlerine göre doğru listeye dönme oranları Tablo 2.11 ve Figür 2.9'da görülebilir. Doğru listeye dönüş oranının yoklayıcı kelimeye verilen oy ile bir ilgisi olup olmadığını görmek için tek yönlü ANOVA analizi yapıldı ve anlamlı bir fark gözlemlendi, ( $F(8, 1491) = 19.77, MSE = .13, p < .001$ ) (Tablo 2.12), bu demek oluyor ki en az bir oylama bir diğer oylamaya göre doğru listeye dönüşü yordamak konusunda anlamlı ölçüde farklıydı. Tukey HSD analizi hangi alt gruplar arasında fark olduğunu gözlemek amacı ile yapıldı. 9 ve 1 ( $p < .001, 95\% \text{ C.I.} = [.19, .33]$ ), 9 ve 2 ( $p < .001, 95\% \text{ C.I.} = [.07, .46]$ ), 9 ve 3 ( $p = .001, 95\% \text{ C.I.} = [.06, .46]$ ) ve 9 ve 5 ( $p = .004, 95\% \text{ C.I.} = [.52, .47]$ ) birbirlerinden anlamlı ölçüde fark gösterdiler, diğer karşılaştırmalar anlamlı değildi.

## **BÖLÜM 3**

### **DENEY 2**

#### **3.1 Yöntem**

Görevi daha da kolaylaştırmak amacı ile ikinci bir deney yapıldı. Bu deneyde her listenin arkasına bir sahne fotoğrafı koyuldu.

##### **3.1.1 Katılımcılar**

İdeal katılımcı sayısını hesaplamak için Gpower analizi yapıldı (Faul ve ark., 2019). İki yönlü, .5 dz etki büyüklüğü ve .05 alpha değeri ile bağımlı örneklem t-test analizinde .99 güç elde etmek için tahmin edilen katılımcı sayısı 76'ydı.

77 katılımcı ders puanı karşılığında deneye katıldı. Bir katılımcı deneyin yaş aralığına uymadığı için (18-35) analize dahil edilmedi, sonuç olarak deneyde 76 katılımcı (%67.11 kadın, %32.89 erkek) kalmış oldu.

##### **3.1.2 Uyarılar**

Uyarılar Deney 1 ile aynıydı, tek fark 5 tane sahne fotoğrafıydı. Fotoğraflar ücretsiz ve online bir platform olan Pixabay'dan alındı (<https://pixabay.com>). Sahne fotoğrafı, tek kelime ile özetlenebilen fotoğraflar demektir. Fotoğraflardaki 5 sahne şunlardı: sahil, şehir, mutfak, orman ve kütüphane.

##### **3.1.3 Prosedür**

Prosedür birinci deney ile tıpatıp aynıydı. Tek fark, listelerin arkasında gelen sahne fotoğraflarıydı.

#### **3.2 Sonuçlar**

Katılımcıların doğru listeye dönme oranı %27.13'tü.

### 3.2.1 Data Düzenleme

Data düzenleme süreci pilot deneyler ve deney 1 ile birebir aynıydı.

### 3.2.2 Liste-içi Yakınlık Etkisi

Liste-içi yakınlık etkisini araştırmak için kelime uzaklıkları 1, 2, 3 ( $M=1.84$ ,  $SD=1.77$ ) ile 5, 6, 7 ( $M=.96$ ,  $SD=1.07$ ) karşılaştırıldı (Figür 3.1). Bağımlı örneklem t-test sonucuna göre yakın kelimelerin (kelime uzaklıkları 1, 2, 3) uzak kelimelerden (kelime uzaklıkları 5, 6, 7) anlamlı olarak daha fazla hatırlandığı bulundu,  $t(75)= 4.41$ ,  $p < .001$ ,  $d = .51$ . Shapiro-Wilk testi ( $W = .91$ ,  $p < 0.01$ ) ve Q-Q plot dağılımı normalliğe ihlal gösterdikleri için Wilcoxon W testi de yapıldı ve benzer sonuçlara ulaşıldı,  $W(75)= 1097^a$ ,  $p < .001$ ,  $r_{rb} = .66$  (Tablo 3.1)

Asimetriye bakmak içinse kelime uzaklıkları +1, +2, +3 ( $M=.72$ ,  $SD=.84$ ) ile -1, -2, -3 ( $M=1.12$ ,  $SD=1.4$ ) karşılaştırıldı (Figür 3.1). Hipotez edilenin aksine, bağımlı örneklem t-test sonucu önceki kelimelerin (kelime uzaklıkları -1, -2, -3) sonraki kelimelerden (kelime uzaklıkları +1, +2, +3) anlamlı olarak daha fazla hatırlandığı bulundu,  $t(75)= -2.31$ ,  $p= .024$ ,  $d = -.27$ . Shapiro-Wilk testi ( $W =.89$ ,  $p < .01$ ) ve Q-Q plot dağılımı normalliğe ihlal gösterdikleri için Wilcoxon W testi de yapıldı ve benzer sonuçlara ulaşıldı,  $W(75)= 560^a$ ,  $p= .04$ ,  $r_{rb} = -.3$  (Tablo 3.1)

Özetlemek gerekirse, yoklayıcı kelimeye pozisyon olarak yakın kelimeler, uzak kelimelere kıyasla daha çok hatırlandı (liste-içi yakınlık etkisi) ve yoklayıcı kelimedenden önce gelen kelimelerin sonra gelen kelimelere göre bir avantajı olduğu gözlemlendi (geriye dönük asimetri).

### 3.2.3 Listeler-arası Yakınlık Etkisi

Listeler arası yakınlık etkisi için liste uzaklıkları 1, 2 ( $M=4.99$ ,  $SD=2.4$ ) ve 3, 4 ( $M=1.83$ ,  $SD=1.47$ ) karşılaştırıldı (Figür 3.2). Bağımlı örneklem t-testi liste uzaklıkları 1 ve 2'den 3 ve 4'e kıyasla anlamlı ölçüde fazla kelime hatırlandığını gösterdi,  $t(75)= 10.07$ ,  $p < .001$ ,  $d = 1.23$ . Shapiro-Wilk testi ( $W = 0.96$ ,  $p= 0.012$ ) ve Q-Q plot dağılımı normalliğe ihlal gösterdikleri için Wilcoxon W testi de yapıldı ve benzer sonuçlara ulaşıldı,  $W(75)= 2123^a$ ,  $p < .001$ ,  $r_{rb} = 0.98$  (Tablo 3.2).

Hipotez edilmemiş olmasına rağmen listeler arasında bir asimetri olup olmadığı araştırıldı (Figür 3.2). Bağımlı örneklem t-testine göre liste uzaklıkları +1 ve +2'den 2 ( $M=3.04$ ,  $SD=1.6$ ), -1 ve -2'ye ( $M=1.95$ ,  $SD=1.58$ ) kıyaslanla anlamlı ölçüde daha fazla kelime hatırlandı,  $t(75)= 4.54$ ,  $p < .001$ ,  $d = .52$ . Shapiro-Wilk testi ( $W = 0.97$ ,  $p= 0.08$ ) ve Q-Q plot dağılımı bu kez normalliğe ihlal göstermedi ama verinin genel anormalitesi sebebiyle Wilcoxon W testi de yapıldı ve benzer sonuçlara ulaşıldı,  $W(75)= 1496^a$ ,  $p < .001$ ,  $r_{rb} = 0.58$  (Tablo 3.2).

Özetle, doğru listeye dönülemediğinde bu listeye pozisyon olarak yakın bir listeye dönme ihtimali, uzak bir listeye göre anlamlı ölçüde daha fazla (listeler arası yakınlık etkisi), aynı zamanda doğru listeden sonra gelen listelerin önce gelen listelere göre bir avantajı bulunmakta (ileriye dönük asimetri).

### 3.2.4 Güven Aralığı ve Hatırlama

Katılımcıların güven aralığı oylama değerlerine göre doğru listeye dönme oranları Tablo 3.3 ve Figür 3.3'te görülebilir. Doğru listeye dönüş oranının yoklayıcı kelimeye verilen oy ile bir ilgisi olup olmadığını görmek için tek yönlü ANOVA analizi yapıldı ve anlamlı bir fark gözlemlendi, ( $F(8, 1511) = 19.29$ ,  $MSE = .15$ ,  $p < .001$ ) (Tablo 3.4), bu demek oluyor ki en az bir oylama bir diğer oylamaya göre doğru listeye dönüşü yordamak konusunda anlamlı ölçüde farklıydı. Tukey HSD analizi hangi alt gruplar arasında fark olduğunu

gözlemlemek amacı ile yapıldı. 9 ve 1 ( $p < .001$ , 95% C.I. = [.19, .36]), 9 ve 2 ( $p < .001$ , 95% C.I. = [.11, .42]), 9 ve 3 ( $p < .001$ , 95% C.I. = [.08, .4]), 9 ve 5 ( $p < .001$ , 95% C.I. = [.08, .46]) ve 9 ve 7 7 ( $p = .02$ , 95% C.I. = [.02, .39]) birbirlerinden anlamlı ölçüde fark gösterdiler, diğer karşılaştırmalar anlamlı değildi.

### 3.2.5 Keşifçi Analiz

Arkaya fotoğraf koymanın anlamlı bir etki yaratıp yaratmadığını görmek için iki deney birleştirildi. Tek yönlü ANOVA sonucu doğru listeye dönüş oranı ( $F(1, 149) = .98$ ,  $MSE = 8.23$ ,  $p = 0.323$ ), liste-içi yakınlık etkisi ( $F(1, 149) = 1.54$ ,  $MSE = 5.63$ ,  $p = 0.217$ ), listeler-arası yakınlık etkisi ( $F(1, 149) = 0.55$ ,  $MSE = 9$ ,  $p = 0.46$ ), liste-içi asimetri ( $F(1, 149) = 2.51$ ,  $MSE = 2.04$ ,  $p = 0.12$ ) ve listeler-arası asimetri ( $F(1, 149) = 0.1$ ,  $MSE = 5.24$ ,  $p = 0.75$ ) etkilerinin hiçbirisinde anlamlı bir fark gözlenemedi. Özetle, arkaya fotoğraf koymak, anlamlı bir etki yaratmadı.

## BÖLÜM 4

### GENEL TARTIŞMA

Katılımcı sayısına karar vermek için bir güç analizi yapıldı (Faul ve ark., 2019) ve bu analiz, alınan katılımcı sayısında oldukça yüksek bir güç vaadetti (.99). Fakat, güç analizi bir katılımcıdan kaç tane veri noktası toplanacağını hesaba katmıyor. Eğer ben her katılımcıdan bütün veri noktalarını toplayabilseydim liste-içi cevapları için totalde 1140 veri noktam olması gerekirdi, ama Deney 2 için sadece 309 veri noktası var. Bu da demek oluyor ki 76 katılımcının etkisini görmek için aslında 280 katılımcı almam gerekiyordu. Deney sonrası güç analizi yaptığımda sonuçlar Deney 1 için şu şekildeydi: listeler-arası yakınlık etkisi için 1, listeler-arası asimetri için .99, liste-içi yakınlık etkisi için .99, liste-içi asimetri için .05 (sonuç anlamlı değildi). Deney 2 için de şu şekildeydi: listeler-arası yakınlık etkisi için 1, listeler-arası asimetri için .99, liste-içi yakınlık etkisi için .99, liste-içi asimetri için .64. Görüldüğü üzere geriye dönük asimetri dışındaki güç bulguları beklenenin aynısıyken geriye dönük asimetrinin gücü beklenenin çok altında. Bunun yanı sıra, benim bildiğim kadarıyla, literatürde geriye dönük asimetri yordayan bir teori, ya da bunu gösteren bir veri yok. Bütün bunlar birleştirildiğinde, bu bulgunun tesadüfen ortaya çıkmış olduğu düşünülmektedir.

#### 4.1 Sınırlamalar

Çalışmanın en büyük sınırlaması çok az veri noktası elde edebilmiş olmaktı. Yapılan denemelere rağmen, görev hala çok zordu ve katılımcılar doğru listeye

dönmede çok zorlandılar. Ama bu aynı zamanda listeler-arası bulguları bu kadar büyük etki büyüklükleri ile elde etmiş olmamızı sağlamış olabilir.

## **4.2 Gelecek Çalışmalar**

Bu çalışmanın ardından araştırmalar birçok farklı yola gidebilir. Öncelikle, güç sorununu aşmak için katılımcı sayısı artırılabilir. Ya da, deney çok kolaylaştırılabilir (her listede 5 kelime göstermek gibi), böylece hatırlama ihtimali çok artırılıp bu durumda liste-içi yakınlık etkisi gözlenecek mi gözlenemeyecek mi bakılabilir. Bir diğer yapılabilecek şey, kelimelerin anlamsal benzerliklerini LSA, ya da benzer bir yöntem kullanarak kontrol edip deneyleri tekrarlamak olabilir. Bunlara ek olarak, bu deneyden elde edilen bulgular modelleri geliştirmek için kullanılabilir. Bu deneylerin nedensel modelleri desteklediği söylenebilir, bu nedenle de deneysel olmayan modeller veriye uygun bir şekilde modellerini geliştirebilirler. Son olarak, olaysal bellekteki diğer etkiler yoklayıcı hatırlama görevi kullanılarak incelenebilir.

## **4.3 Sonuç**

Bu çalışma kapsamında yapılan deneylerde liste-içi ve listeler-arası yakınlık etkilerinin gözleneceği, liste-içi yakınlık etkisinde ileriye dönük bir asimetri bulunacağı, ve tanıma ve hatırlama arasında bir ilişki olacağı hipotez edilmişti. Liste-içi ve listeler-arası yakınlık etkileri yapılan iki deneyde de gözlendi. İleriye dönük asimetri liste-içinde hiç gözlenemedi ama iki deneyde de listeler-arasında gözlendi. Son olarak da katılımcılar tanıma görevinde bir kelimeyi gördüklerine tamamen emin olurlarsa, doğru listeden hatırlama yapma ihtimallerinin arttığı gözlendi.

Bu çalışma Kılıç ve çalışma arkadaşlarının çalışmasının bir uzantısı olarak görülebilir (2013) ve bu iki çalışma birleştiğinde daha de emin bir şekilde nedensel mekanizmaların yakınlık etkisinde önemli bir yer oynadığını

söyleyebiliriz. Bir önceki deneyde eksik olan tek şey ileriye dönük asimetri bulgusuydu ve bu deneyde o da elde edildi.

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