# RECOGNITION MEMORY FOR EMOTIONAL WORDS UNDER INCIDENTAL ENCODING: EFFECTS OF VALENCE, AROUSAL AND AGE

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**RECOGNITION MEMORY FOR EMOTIONAL WORDS UNDER INCIDENTAL ENCODING: EFFECTS OF VALENCE, AROUSAL AND AGE**

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**ABSTRACT**

RECOGNITION MEMORY FOR EMOTIONAL WORDS
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EFFECTS OF VALENCE, AROUSAL AND AGE

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Emotional information is commonly assumed to be recognized more accurately than neutral information. While emotionality enhances recognition accuracy, it also induces a more liberal response bias. In this study, the effects of arousal and valence axes of emotion on recognition memory accuracy and liberal bias were examined in young and older adults, for emotional words. For this purpose, memory was assessed with a surprise old/new recognition task, based on Signal Detection Theory. There are also some factors regarding words that influence visual word recognition. One is the dissociation between consonants and vowels; consonants and vowels are processed differently. In the study session, the participants were instructed to

count vowels within a word under incidental encoding. Since vowels constrain lexical selection less tightly than consonants, deciding how many vowels each word contained is compatible with the idea that the vowels should be processed faster. The results of the recognition session showed that young adults recognized more accurately as compared to older adults, replicating the age effect. Valence differences of words also showed a significant effect on memory performance, that is positive words were recognized better in both groups. On the other hand, it was observed that there was a significant bias to respond as 'old' only to positive words in older group; whereas young adults showed a liberal bias to negative words. This age-related difference suggested that older adults regulated their emotion in favour of maintaining well-being, even incidentally. Considering individual differences and mood state in emotional word processing is essential so personality traits and current mood states were assessed by commonly used Five Factor Personality Inventory and Positive and Negative Affect Schedule respectively. Except 'openness to experience', other personality dimensions did not predict recognition memory performance for emotional words.

Keywords: Recognition memory under incidental encoding, liberal bias, aging, mood, personality

# ÖZ

KAZARA KODLANAN DUYGU İÇERİKLİ KELİMELER İÇİN TANIMA BELLEĞİ:
DUYGUSAL OLUMLULUK, HEYECAN DÜZEYLERİ VE YAŞIN ETKİSİ

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Duygusal içerikli bilginin nötr bilgiye göre, daha iyi tanındığı bilinmektedir. Duygusal içerikli bilgi, bir taraftan bellek performansı üzerinde olumlu etkiye sahipken, diğer yandan liberal yanlılığa da sebep olmaktadır. Bu çalışmada, duygusal içerikli kelimelerin duygusal olumluluk ve heyecan düzeylerinin yaşlı ve genç yetişkinlerde tanıma belleği ve liberal yanlılık üzerindeki etkisi incelenmektedir. Bu amaçla, Sinyal Tespit Teorisi temel alınarak sürpriz bir eski/yeni tanıma göreviyle bellek performansı ölçüldü. Görsel kelime tanımayı etkileyen faktörlerden göz önüne alındığında, sesli ve sessiz harflerin sistem tarafından farklı biçimde işlendiği bilinmektedir.

Çalışma aşamasında, katılımcılar gördükleri kelimelerin kaç sesli harften oluştuğunu belirtmişlerdir. Bu süreç, sesli harflerin sessiz harflere göre kelime tanıma sürecindeki farklı rolleri düşünüldüğünde, uyumludur. Tanıma testi oturumunun sonuçlarına göre, genç katılımcılar yaşlılara göre daha iyi hatırladılar; bu, yaşın tanıma belleği üzerindeki etkisini göstermiştir. Ayrıca, kelimelerin olumluluk düzeylerinin bellek performansı üzerindeki etkisi de anlamlı bulunmuştur. Diğer bir deyişle, pozitif içerikli kelimeler iki yaş grubunda daha iyi tanınmıştır. Ancak yaşlı katılımcıların özellikle pozitif içerikli kelimelere karşı bir liberal yanlılık içinde oldukları gözlemlenmiştir. Diğer taraftan, genç katılımcılar negatif içerikli kelimeler için liberal yanlılık göstermiştir. Yaşla birlikte ortaya çıkan bu farklılık, katılımcılar kelimeleri doğrudan çaba olmadan, kazara kodladıklarında bile, yaşlıların iyi olma hallerini korumak adına duygularını düzenlediklerini göstermiştir. Duygusal içerikli kelimeleri tanımayı gerektiren bellek performansının, bireysel farklılıklardan ve duygudurumundan etkilendiği bilinir. Bu anlamda, 5-Faktör Kişilik Envanteri ve Pozitif ve Negatif Duygu Ölçeği uygulanmıştır. 'Yeniliğe açıklık' altboyutu haricinde, diğer kişilik altboyutları duygu içerikli kelimeler için tanıma belleği performansını yordamamıştır.

Anahtar Sözcükler: kazara kodlanan tanıma belleği, liberal yanlılık, yaşlanma, duygudurum, kişilik

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# CHAPTER 1

## INTRODUCTION

Human memory, the most important component of cognitive information processing is defined as the system in which information is encoded, stored, and retrieved when needed. Memory labels a diverse set of cognitive capacities so it has crucial roles in the understanding of cognitive science.

Memory is not a single unitary process but there are different types of memory. Specifically, recognition memory is defined as the ability to distinguish previously learned, old items from new items. This process is affected by various parameters such as type of encoding, type of stimuli, and aging. One open question concerns whether incidental and intentional encoding affects recognition memory performance differently, especially when emotional manipulations are involved. One factor which could be responsible for this is that in an intentional task, conscious attempts to focus on memorizing the stimuli can cause elimination of the emotional aspect of the stimuli. Additionally, during incidental encoding, the affective information of a stimulus is expected to be processed better compared to intentional encoding. The reason behind this is that under incidental encoding, only the evolutionarily meaningful, that is, affective aspects, can be expected to pop up; on the other hand, "cognitive" aspects are attenuated.

There is broad consensus on the fact that recognition memory is highly related to emotional stimuli:

> "An experience may be so exciting emotionally as almost to leave a scar on the cerebral tissues." James, 1890, Vol. 1, pp. 670.

Interestingly, emotion is not characterized through a single variable. Emotions have three orthogonal dimensions: valence, arousal, dominance. Valence is the dimension ranging from pleasant to unpleasant. Arousal is the dimension referring to the intensity of emotional experience and it ranges from calming to exciting. The last one, dominance ranges from feelings of strong to weak (Bradley and Lang, 1999).

The recent researches (Charles, Mather and Carstensen, 2003; Dougal and Rotello, 2007; Estes and Verges, 2008; Kapucu, Rotello, Ready and Seidl, 2008; Kensinger, Garoff-Eaton and Schacter, 2007) have demonstrated that negative stimulus have a tendency to be better remembered, overall. On the other hand, regarding the emotional stimuli, older participants perform better in the positive stimuli, as opposed to younger participants who are good at remembering the negative ones. This is not surprising because recognition memory performance is affected by age related changes in the individuals: As the age increases, the recognition memory performance decreases. However, memory is often suffused with emotion, hence, the interaction between emotion and aging can result in differential effects in memory enhancement for emotional stimuli.

While measuring memory enhancement, discriminability is derived from recognition memory tasks based on old/new paradigm. Participants go through a study session in which items are presented. Then after a break, participants' memory is tested. During the test, twice as many items are presented and the participant is required to answer whether the presented item is 'old' (seen in the study session) or 'new' (not seen in the study session). 'Old' responses given to studied stimuli are called **hits** while 'old' responses given to unstudied stimuli are called **false alarms**. Based on signal detection theory, in order to measure discriminability, the false alarms are subtracted from the hits and so called d' scores are obtained.

Although d' is a reliable measure to evaluate memory accuracy, it is not sufficient. Another measure useful in understanding the cognitive system is **liberal bias**, which is the tendency to favor 'yes' (or 'old') responses. It is important to note that underlying mechanism of memory enhancement for emotionally evocative words might be because of liberal bias. As an indicator, Thapar and Rouder (2009) stated that emotionally charged words affect a response bias locus, rather than a discriminability one, and this pattern holds for young and older participants differently. Although both groups have a tendency to choose emotionally evocative words over neutral ones, they differ in their bias toward positive and negative words. A further question, whether nature of bias differs in age groups under incidental encoding has not been addressed in the literature yet.

It was shown that people are more likely to retrieve materials that were affectively consistent with their moods (Bower, 2003; Josephon, Singer and Salovey, 1996; Rusting, 1998). This phenomenon is so called "mood-congruent memory". In order to examine this kind of mood effect, the participants should have asked to rate affect items from the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988; Gençöz, 2000)

described as a measure of their "last week" state. An important question regarding mood is that whether the participants' current mood predict memory performances for valenced words.

There is a tradition for relating positive versus negative affectivity to personality dimensions, especially extraversion and neuroticism (Gilboa and Revelle, 1994). Namely, personality is another factor for the explanation of positive-negative emotion retrieval. According to relevant studies (Ruiz-Cabellero and Bermudez, 2001; Rusting, 1999), neuroticism is related to a memory bias for negative material; that is, neuroticism was associated positively with the processing of unpleasant information. On the other hand, people who have higher scores on extraversion are usually affectionate, talkative, fun, loving, active and passionate (McCrae and Costa, 1987); while low scorers on this trait are usually, passive, lonely and lack the ability to express their feelings. In line with such reasoning, how well extraversion dimension predict memory performance of positively valenced words is an important topic.

To sum up, this research focuses on understanding the cognitive mechanisms involved in the effects of emotion on recognition memory under incidental encoding. Confounding factors such as liberal bias and current mood state and personality are addressed in the study as well. All of these investigations are performed on two age groups, young and old, to observe if age-related interactions exist.

### 1.1 Problem statement

This study investigates the following research questions:

- How does aging affect recognition memory for emotionally charged words under incidental encoding?
- How do the prominent dimensions of emotion (i.e. valence and arousal) affect recognition memory performance under incidental encoding and are there differences regarding age?
- Under incidental encoding, is there a response bias shift in response to emotional stimuli with increasing age and what is the nature of it?
- Do current mood state and personality traits predict incidentally encoded memory performance of emotionally valenced words in young and older adults?

The present study is based on mainly two dimensions of emotions: valence and arousal. The type of stimuli selected for an emotion-cognition interaction study could be pictures, faces, words. All of them are core components of daily social interactions, however they signal emotions on very different levels of visual representation. Facial expressions are biologically significant cues, whereas words represent emotions on a symbolic level (Frühholz, Jellinghaus and Herrmann, 2011). Thus, there may be differences in the time course of processing due to differing levels of emotional representation in different domains. We used verbal stimuli in our experiments. Regarding valence, positive and negative words were chosen and regarding arousal highly and medium arousing words were chosen. Neutral nonarousing words were used for the purpose of control.

The solution to the first problem requires recruiting young and older adults similar in years of education, nondemented and medication free. For the third question, bias shift for emotional words can be calculated as described by Signal Detection Theory. Lastly, to consider individual differences in emotional word processing which might be due to personality traits or mood states, commonly used Five Factor Personality Inventory (Costa and McRae, 1992; Somer, Korkmaz and Tatar, 2004) and Positive and Negative Affect Schedule (Watson et al., 1988; Gençöz, 2000) are administered respectively.

### 1.2 Significance of the Study

Recognition memory for emotional words has drawn attention recently. In emotional memory literature, intentional learning of stimuli is often preferred. However, intentional learning may interfere with the experience of emotions; voluntary attention to stimuli may differ among participants and this may lead to confusion to interpret the memory effects (Dolcos, LaBar and Cabeza, 2004; Nielen, et al., 2009; Mickley-Steinmetz, Addis and Kensinger; 2010; Thomas and Hasher, 2006).

In the present study, memory performance was measured under incidental encoding. The subjects had not known that their memory performance would have been measured after half an hour retention interval. During the study session, incidental encoding is initiated by asking the young and older participants to just firstly read the presented words silently and then count the number of vowels. Consonants and vowels are different components of words contributing differently to lexical access. Recent literature (Carreiras, Gillon-Dowens, Vergara, and Perea, 2009; Cutler, Sebastian-Galles, Soler-Vilageliu and van Ooijen, 2000; Sharp, Scott, Cutler and Wise, 2005) has supported the idea that vowels, rather than consonants are more frequent

causing faster processing. Instructing the participants to count vowels within a word is compatible with the idea that the vowels are processed faster. In brief, we believe that our study is significant because it studies the process of incidental encoding of emotional verbal stimuli across age groups and across personality traits.

Memory accuracy is a valid measure in order to evaluate memory performances however it may be contaminated by response bias. Unless it is taken into account, drawing a conclusion about memory performance for emotional words across ages is not reliable and it does not give any proper data to interpret the cognitive system of young and older adults. In this respect, especially under an incidental encoding task, the nature of bias in response to emotionally manipulated verbal stimuli is one of the important motivations of this study. Furthermore, addressing this issue regarding bias shift for emotional words with respect to aging is another significant contribution of our study.

Finally, the present study has investigated the possible roles of current mood and personality characteristics on recognition memory and has analyzed them according to aging. Retrieval is a cognitive process; and so it is not independent of individuals' expectations, experiences, and knowledge obtained throughout their lives. With the additional focus on current mood states and personality traits as separate constructs, we examined the relations between mood state-memory performance and personality-memory performance for emotional words. We hypothesized that the internal mood and personality characteristics had a role in the incidental encoding of the presented emotional verbal stimuli.

### 1.3 Organization of the Dissertation

The aims of the study have been introduced and the questions addressed by the study have been stated in the present chapter.

In the second chapter, the literature on recognition memory, the effect of emotional dimensions on memory, age related changes in recognition memory and emotion processing, the effect of emotion on liberal bias are presented in detail. Finally, mood-memory interaction and personality-memory interaction are explained in line with the way they are employed in this study.

In the third chapter, the methodology of our study, the design of the experiment conducted for the purposes of this study and the materials used in the experiment are given.

In the fourth chapter, detailed analyses of the data and the results in terms of the effects of age, valence and arousal dimensions of emotional words on recognition memory performances and bias are presented. In addition, results regarding mood-recognition memory relationship and personality traits-recognition memory relationship are provided.

In the last, the fifth chapter, the results are discussed with possible explanations in the light of the previous researches. Finally, a conclusion of the study, as well as limitations and suggestions for further researches are provided.

# CHAPTER 2

# LITERATURE REVIEW

This chapter aims to present the studies on recognition memory for emotional stimuli with healthy aging. Recognition memory, signal detection theory, and theoretical approaches to explain recognition memory are explained with respect to the aging and emotional stimuli. Afterwards, bias effect and its link to memory accuracy are reported. Subsequently, findings of mood effect on the retrieval of emotional words are provided. Finally, the construct of personality and its association with memory performance to emotional words are explained.

## 2.1 Recognition Memory

Memory is an important research topic in cognitive science. Memory can be briefly defined as the individual's mental ability to store, retain and recall information. There are many distinct kinds of memory (see Figure 2.1, Leritz, Grande and Bauer, 2006, page 2) divided into two main systems; declarative and non-declarative memory. Distinctions in declarative memory can be named as episodic and semantic memory. While episodic memory is memory of personal facts and events, semantic memory consists of general knowledge about the world. These distinct memory

systems are represented in the brain differently. While the hippocampus, entorhinal cortex are involved in episodic memory, the medial temporal lobe and the surrounding structures play an important role in semantic memory.

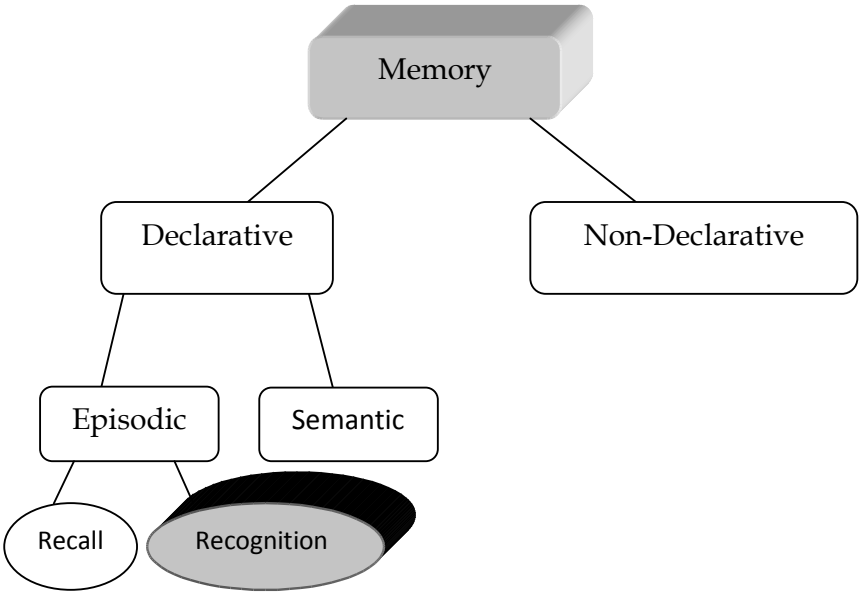


**Figure 2.1.** Classification of memory categories. Adapted from Leritz, Grande and Bauer, 2006, page 2.

Episodic memory provides re-experience of personal events by mentally traveling back in time (Wheeler, Stuss and Tulving, 1997). Episodic memories include not only item information but also temporal, contextual and perceptual information about events (Tulving, 1983). Episodic memory is divided into two types: recall memory and recognition memory. As one of the types of episodic memory, recognition memory is the ability to distinguish previously learned items from new items. A typical recognition memory task consists of three sessions: study, distraction, and test. In standard recognition tests, participants are shown a list of stimuli in the study session. The distraction session is kind of retention interval. In this session, participants are occupied with a task not related to the study and test

sessions. After the interval, namely, in test session, participants are again shown a list of stimuli. However, this new list contains both studied items and new items. The participants are asked to decide whether the item has been seen previously. The two possible responses are YES (also known as OLD) and NO (also known as NEW).

## 2.2 Theoretical Approaches

There are two theoretical approaches explaining the recognition memory. These are 'Dual Process Theory' and 'Signal Detection Theory'. According to the '**Dual Process Theory**', there are two processes that recognition memory is based on: recollection and familiarity (Jacoby, 1991 and Tulving, 1983). Recollection refers to remembering consciously previously studied items and recollecting them in a detailed manner. On the other hand, familiarity refers to remembering previously studied items but not consciously and not in a detailed manner. In this respect, the proportion of 'remember' responses of the participants is considered to provide a measure for 'recollection', while the proportion of 'know' responses of the participants is considered to provide a measure for 'familiarity' (Yonelinas and Jacoby, 1995). As another approach regarding the recognition memory, '**Signal Detection Theory**' stating that recognition memory processes rely on a single process is based on old / new paradigm (Yonelinas, 1994). This theory is a standard tool for analyzing performance in many domains such as psychophysics, memory and perception. Based on this theory, there are two equal variance Gaussian distributions: One represents old items and one represents new items. Items can be placed on a familiarity continuum such that old items (namely studied items) fall on the high end of the continuum and new items (namely unstudied items) fall on the low end of the continuum (Yonelinas et al., 2006). In order to do this, level of familiarity as a response criterion is set and

the items that exceed this criterion are accepted as old; otherwise the items are accepted as new (see Figure 2.2).

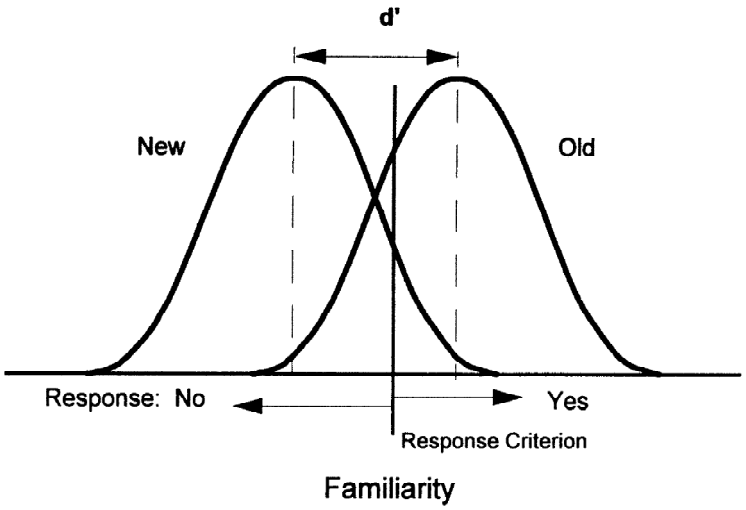


**Figure 2.2.** Familiarity distributions for signal detection theory (Yonelinas et al., 2006).

Signal detection theory assumes that items are represented on this familiarity continuum. For instance, old items are represented on the higher end of the continuum, while new items are represented on the lower end of the continuum. So as to distinguish old and new items from each other, a response criterion should be selected. The items that exceed this criterion are considered as 'hit rate' which refers to the participants' old responses which are given to studied items. On the contrary, the participants' old responses which are given to non-studied items refer to 'false alarm'. After calculating hits and false alarm rates, recognition accuracy, d ', can be computed. d' is the distance between the means of studied items and non-studied items. In this sense, as d ' value increases, it can be considered that old and new items are distinguished well by participants. d', the discriminability index, refers to the

ability to distinguish old words from new ones and is widely considered to be the best measure of recognition memory accuracy.

### 2.3 Emotion and Recognition Memory

Emotional stimuli may be characterized by two factors: valence (either positive or negative) and arousal (either exciting or calming) (Bradley and Lang, 1994). On a scale of 9, valence dimension ranges from highly negative to highly positive. On the other hand, arousal dimension ranges from calming to exciting on a scale of 9 (Figure 2.3.). In other words, valence refers to the affective value of an emotional stimulus on a continuum that varies from negative to positive with neutral in the middle, whereas arousal refers to a continuum that varies from calm to excitement. Thus, stimuli can be highly positive and exciting (e.g. miracle); highly positive and calming (e.g. relaxed); low negative and exciting (e.g. slaughter); low negative and calming (e.g. fatigued). As both factors influence memory performance mainly and they also seem to affect via distinct mechanisms.

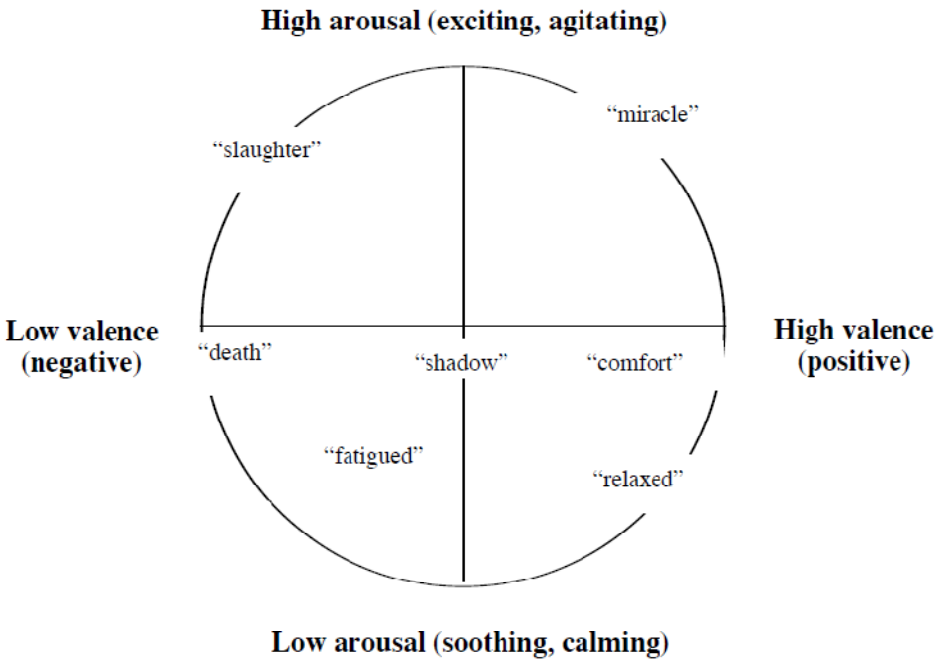


**Figure 2.3.** Two dimensions of emotional experience (Kensinger, 2004). Adapted from Russell, 1980.

Emotional words are better recognized than their neutral equivalents (Kensinger and Corkin, 2004; LaBar and Phelps, 1998). Although the phenomenon of enhanced emotional memory is so robust, its mechanisms have not been fully described yet. Whether an item is remembered or not is more likely to be influenced by its valence and arousal.

### 2.3.1 Visual Word Recognition

There are some factors regarding words that influence visual word recognition. One of these factors is the dissociation between consonants and vowels: consonants and vowels are processed differently. In the recent literature, it is stated that consonants and vowels contribute differently to lexical access (Carreiras, Gillon-Dowens, Vergara and Perea, 2009; Carreiras

and Price, 2008; Lee, Rayner and Pollatsek, 2001). It seems that vowels constrain lexical selection less tightly than consonants. In order to explain differences in consonant and vowel processing, Nespor, Pena and Mehler (2003) proposed that consonants are essential to the detection of words; whereas vowels are essential to identify pitch and intensity, which are responsible for prosody. In accordance with this fact, lexico-semantic processing is more dependent on consonants than vowels; while prosodic processing is more dependent on vowels than consonants (Nespor, Pena and Mehler, 2003).

Cutler, Sebastian-Galles, Soler-Vilageliu and van Ooijen's (2000) study showed that when the participants were asked to change one phoneme to make a word from a nonword, they were more likely to alter a vowel than a consonant. For instance, when the participants were presented a nonword such as 'zobra', they more often altered a vowel and reported 'zebra', rather than altering a consonant to report 'cobra'. This finding indicated that a vowel substitution is easier than a consonant substitution. In the similar line with this explanation, in the study of Sharp, Scott, Cutler and Wise (2005), the participants were instructed to generate real words from heard pseudowords. These pseudowords were generated by the substitution of either a consonant or a vowel. It was observed that when a consonant was substituted, participants had a difficulty to generate real words. On the other hand, the substitution of a vowel did not result into a difficulty of word generation. Hence, these studies have provided support for the notion that consonant and vowels are not processed in the same way during the processing of written words.

A research conducted by Carreiras, Gillon-Dowens, Vergara, and Perea (2009) investigated the response times in a lexical decision task. In one condition, two nonadjacent internal consonants were delayed (e.g. CHO O ATE-CHOCOLATE) and then the whole word appeared on the screen. The participants were asked to press a button to indicate whether the letter string was a legitimate word or not. In the other condition, two nonadjacent internal vowels were delayed and then again the whole word appeared on the screen (e.g. CHOC L TE-CHOCOLATE). The participants performed the same lexical decision task: was it a legitimate word or not? Reaction time analyses indicated that words with delayed consonants were responded more slowly than words with delayed vowels. So, delaying two internal consonants for 50 msec slows down word identification. The researchers concluded that the delay of vowels were less detrimental for the visual word recognition system than the delay of consonants (Carreiras, Gillon-Dowens, Vergara, and Perea, 2009).

Other property of words that influence word recognition is frequency effect. For instance, more commonly encountered words (e.g., world) are recognized faster than less common words (e.g., glitch). This effect is known as the "**word frequency effect**". In the literature on word recognition, this effect is one of the most frequently reported robust effects. The other factor that influences the processing of words is the concreteness. **'Concreteness effect'** within the memory system is defined as the easier recalling of concrete words in larger amounts when compared to abstract words. In other words, concrete words are facilitated. According to the dual-coding theory claimed by Paivio (1971), the concrete words are encoded both verbally and visually, while abstract words are encoded only verbally. Thus, concrete words are more likely to be remembered (Fliessbach et al., 2006).

## 2.4 Aging and Recognition Memory

Most studies in recent years have stated the changes in neurological and neuropsychological status occurring in the aging brain (Denburg, Tranel and Bechara, 2005; Makris et al., 2007; Picq, 2007). There is broad consensus on the fact that performance of most of memory systems are affected by age and memory performance declines with advanced age. Nevertheless, there are contradictory findings on the effect of age on emotional memory performance and/or the relationship between the two. Selected articles regarding the aging effect on recognition memory for the emotional stimuli is presented in the following.

Since there is an age-related decline in recognition memory, it is an open question whether memory performance is influenced by explicit and implicit instruction differently during the encoding session. It is emphasized that, rather than automatic processes, memory tasks requiring effortful performance is influenced by advanced age more. In this respect, most studies argue that performance deteriorates in explicit memory tasks (which require conscious recollection of information) with increasing age, while no effect of age on implicit memory tasks (which are defined as automatic processes) has been observed (Anooshian, 1999; Jelicic, Craik and Moscovitch, 1996; Light and Singh, 1987; Maki, Zonderman and Weingartner, 1999; Mitchell and Bruss, 2003). In addition, emotional memory researches conducted with a brain imaging technique try to reveal the underlying brain mechanism of emotional processing in order to find the effect of emotion on memory. Recognition memory is found to be related to medial temporal lobe (MTL). MTL consists of the hippocampal region and surrounding perirhinal, entorhinal, and parahippocampal cortices. According to the Yassa and Stark's study (2008) conducted by fMRI with the college-aged participants who underwent a yes/no recognition task, it was

found that recognition is a dynamic process that involves multiple signals in the medial temporal lobe. Thus, since older adults often have less activation of MTL and its surrounding regions (Dennis, Kim, and Cabeza, 2007; Gutchess et al., 2005), it is expected in this study that their recognition memory performances are more likely to decrease as compared to young adults. On the other hand, the amygdala is known to have an essential role in emotion since it directly mediates emotional aspects of learning. Importantly, with aging, amygdala associated emotion activity is preserved (Chow and Cummings, 2000). Hamann (2001) also supports the role of the amygdala in memory. It is reported in their study that individuals with amygdala damage appear to be impaired significantly in mechanisms that enhance explicit emotional memory, but show normal reactivity to emotional stimuli.

Van der Veen et al. (2006) also examined the phenomenon of decrement in recognition memory function with age. Under fMRI scan, young and old participants performed two types of word encoding tasks. In one condition, the words were encoded incidentally and the participants were not intentionally instructed to be memorized the words. In other condition, they were encoded intentionally and the participants were instructed to memorize. After the 30 minutes interval, a typical recognition task was performed: the participants were instructed whether they saw the displayed word before or not. According to the behavioral results, in both age groups, the words from the incidental condition were recognized less accurately than words from the intentional condition. Neuroimaging results indicated that activation in the left inferior frontal gyrus, left precentral gyrus and right cerebellum was observed in successful retrieval session for both young and old participants. Moreover, bilateral medial prefrontal gyrus and right parahippocampal gyrus was found to be active in older participants. Hence, medial prefrontal gyrus seems to be responsible for the intentional encoding.

### 2.4.1 Positivity Bias in Older Adults

It is known that recognition memory is influenced by emotional valence of the test items. Similarly, emotional stimulus have more likely to be remembered than neutral stimulus. Older adults, like young adults, are more likely to detect and attend emotional information than they are to detect and attend non-emotional information (Leclerc and Kensinger, 2008). Moreover, some studies have shown that there is a distinct tendency between older and younger adults to remember stimuli with emotional valence. Emotional information is not processed by older adults in the same way by young adults. Older adults seem to exhibit a positivity bias, in other words, they are more likely to remember positive information than negative information (Carstensen and Mikels, 2005; Kennedy, Mather and Carstensen, 2004; Leigland, Schulz and Janowsky, 2004; Mather and Knight, 2005). Furthermore, older adults spend more time looking at positive stimuli than at negative stimuli (Issacowitz, Wadlinger, Goren, and Wilson, 2006; Thomas and Hasher, 2006). However, other studies have found no this kind of mnemonic benefit for positive information for older adults (Comblain, D'Argembeau, Van der Linden, and Aldenhoff, 2004; Gruhn, Smith, and Baltes, 2005; Murphy and Isaacowitz, 2008).

In the literature, there is a theory called **'Socioemotional Selectivity Theory'** which tries to explain the positivity bias of older adults by stating that as older adults realize that they are close to the end of their lives, they begin to view time as limited. As they approach the end of life, goals associated with emotional well-being become more salient. Hence, the focus of their goals may change from exploration and knowledge accumulation toward emotional gratification (Carstensen, Fung and Charles, 2003). This kind of shift in their perspectives may cause the positivity bias, such that they are more likely to remember positive information than negative information.

Since young adults do not view time as limited and finite, they do not need to regulate emotions. Literally, 'emotional regulation' goals of young and older adults seem to be very different and this difference results in differential biases. Older adults are more likely to recognize positive items; younger adults are, on contrary, more likely to recognize negative items (Kennedy, Mather and Carstensen, 2004; Mikels, Larkin, Reuter-Lorenz and Carstensen, 2005; Tapar and Rouder, 2009). Young participants also attend more to negative stimuli than to positive stimuli (Thomas and Hasher, 2006).

Attentional processes may offer an explanation to this finding because some researchers have failed to find a positivity effect in the memories of older adults. In order for older adults to generate the positivity effect, there exists some criteria. According to one, the more the task is constrained by external circumstances, the less room there will be for goal-directed processes to have an impact. That is, positivity effects should be less likely to occur when the focus of attention or thought is constrained during encoding (Mather, 2006, pp.150). For instance, when older adults actively rated the emotional characteristics of positive, negative, and neutral pictures or words during encoding, this kind of mnemonic benefit for positive information for older adults was not found (Comblain, D'Argembeau, Van der Linden, and Aldenhoff, 2004; Denburg, Buchanan, Tranel, and Adolphs, 2003; Kensinger, Brierley, Medford, Growdon, and Corkin, 2002; Leigland, Schulz, and Janowsky, 2004; Murphy and Isaacowitz, 2008).

In the study of Leigland, Schulz, and Janowsky (2004), the age differences in memory for emotional words was examined. Participants rated the valence of 27 negative, positive and neutral words. No age differences were found in the valence of the words recalled on an immediate or 30-minute delayed recall test. In another study, Grühn, Smith, and Baltes (2005) presented younger and older adults with emotionally toned words and found no

evidence of a positivity effect in recall. Thus, these findings lead researchers to suggest that the positivity effect may not generalize to memory of verbal material. Moreover, attentional differences during encoding might result in variable emotional processing. In this context, emotional information can be processed automatically or controlled. Emotion regulation is considered to occur in a more controlled manner and it tends to require attentional resources. Thus, this controlled emotional processing allows older adults to respond flexibly to an emotional stimulus (Kensinger, 2009, pp. 122). It is because 'the attentional effort spent during encoding' is another possible variable that might result in positivity/negativity effect in memory. That is, when older adults devote full attention towards the emotional information, they show positivity bias (Kensinger and Leclerc, 2009). On the other hand, when their attention is divided or cognitive resources are limited during the processing information via experimental task, they do not control their attentional resources towards to positive information and, so positivity bias disappear (Knight et al., 2007; Muraven, Tice and Baumeister, 1998). Thus, it may be concluded that the tendency of shifting attention to positive items in older adults is a controlled and effortful process.

The study of Xing and Isaacowitz (2006) also supported this idea. They observed differences in young and older adults in terms of directing eye gaze to the negative and positive images by using eyetracking methods. The results declared that when young adults were instructed to regulate their emotions as they view images, they gazed less at negative images and more at positive images as older adults did. In contrast, when young adults were given no instructions, they showed no such effects of valence. Hence, young and older adults' attentional processes seem indeed to be similar but what create the behavioral differences are the **'emotional regulation'** goals of two age groups. In other words, older adults' emotional regulation mostly causes their positivity shift: While older adults are more likely to remember positive

items, younger adults are, in contrary, more likely to remember negative items.

Age differences in emotional memory emerged during encoding of positive items: Older adults showed more activity in medial prefrontal cortex and along the cingulate gyrus which are associated with 'self-referential' processing. Thus, the results propose that older adults' biased attention at the time of encoding for positive items may result from an increased tendency to process these items in relation to themselves (Kensinger and Schacter, 2008). Similarly, older adults think about how positive items relate to themselves and how their internal feeling state is altered by positive items. So, this change may be a contributor to the positivity effect (Kensinger and Leclerc, 2009). Moreover, a theory called 'emotional regulation' sheds light on the underlying process leading to positivity effect. 'Emotional regulation' is defined as a person's ability to control which emotions they have, in what context, for how long and how intensely experience them (Gross, 1998). Older adults regulate their emotions consciously and effortfully (Williams et al., 2006). While trying to avoid negative information, older adults try to approach towards positive information deliberately. Hence, this intentionality may be the cause of older adults' 'controlled emotional regulation' process towards positive items.

Neuroimaging studies provide support for 'controlled emotion processing' as well. When older adults were presented emotional information, it was observed that activation of prefrontal cortex increased, while activation of amygdala decreased (Gunning-Dixon et al., 2003; Tessitore et al., 2005; Williams et al., 2006). Another interesting neuroimaging result is that older adults showed greater medial prefrontal activity while responding to the negative emotional images when compared to the young adults. Since medial prefrontal activity often is associated with emotion regulation; it can

be concluded that older adults tried to control their responses to negative items consciously and effortfully (Williams et al., 2006). This kind of control mechanism in the brain was absent in young adults (Ochsner et al., 2004). Moreover, a recent study conducted by Addis, Leclerc, Muscatell and Kensinger (2010) revealed that while older adults were encoding positive stimuli, ventromedial prefrontal cortex and amygdala together affected hippocampal activity. On the other hand, only thalamus had an influence on hippocampal activity while young adults were encoding these stimuli. This may be reason that why young adults are less likely to remember positive stimuli in comparison to negative stimuli. It is also crucial to state that in terms of brain regions' connectivity, during the encoding of negative stimuli no age-related differences are detected. Thus, positivity bias of the older adults may be because of the different brain regions' strong and positive influences on hippocampal activity.

On another front, it has been suggested that the positivity effect in older adults may be limited to nonverbal material (Grühn, Smith and Baltes, 2005), as the most consistent memory evidence is in favor of the effect examined for faces or scenes (Charles, Mather and Carstensen, 2003; Mather and Carstensen, 2003; Mikels, Larkin, Reuter-Lorenz and Carstensen, 2005) rather than verbal material (Grühn, Smith and Baltes, 2005). Thus, the type of studied stimuli (word, picture, face, scene etc.) might be another important factor that reveals positivity effect. Although it is clearly known that when older adults reminisce about their own lives, they preferentially recall positive events (Carstensen, 1995); it seems that this effect is faint when other types of stimuli are considered. Consequently, in the light of these different manifestations of positivity effect, it seems that there are some limitations due to the attentional and stimulus-based processes.

### 2.4.2 Negativity Bias in Young Adults

Whether stimuli are positive or negative, these emotional stimuli are recognized better compared to neutral stimuli. Even positive or negative items that do not elicit arousal can be recognized better than items that evoke neither valence nor arousal (Ochsner, 2000). Effects of positive and negative valence on memory are also different. It is stated that when memory for verbal stimuli was particularly tested, the emotional enhancement is greater for negative stimuli than positive ones (Charles, Mather and Carstensen, 2003; Kensinger, Garoff-Eaton and Schacter, 2007; Mickley and Kensinger, 2008; Ortony, Turner and Antos, 1983). The phenomenon that negative information is more attended to is called "negativity bias". 'Negativity bias hypothesis' is supported by various studies (Algom, Chajut and Lev, 2004; Delplanque, Silvert, Hot, Rigoulot and Sequeira, 2006; Estes and Verges, 2008). The idea behind negativity bias hypothesis is that participants respond more rapidly and saliently to negative items compared to equally arousing positive items (Ito and Cacioppo, 2005). For the purposes of semantic characteristics, negative items convey more information relevant for survival. For instance, stimuli about death, injury, threat or mutilation are highly arousing negative stimuli that have greater relevance for immediate survival, hence motivationally remembered better as compared to highly arousing positive stimuli such as words/pictures of sport, adventure and erotica (Briggs and Martin, 2009). It probably has an evolutionary basis since it is more important not to miss negative than to miss positive information (Grossmann et al. 2005).

There are also claims that negative information is less likely to be missed because negative information is processed in a detail-oriented and analytical fashion, whereas positive information is processed in a more heuristic and schematic fashion (Gasper and Clore, 2002; Ochsner, 2000). Hence, negative

information is recognized more vividly and accurately. Mickley and Kensinger (2008) examined the neural processes of the emotional stimuli (words selected from the Affective Norms for English Words and pictures taken from the International Affective Picture System database) so as to understand why negative stimuli are vividly remembered. Positive, negative and neutral stimuli were shown to the young participants at encoding session under an fMRI scan. About 30 minutes later, participants underwent a surprise recognition test outside of the scanner and they were to indicate whether each item was among the ones that they had seen in the scanner. If they indicated that an item had been seen, they were also asked to decide whether the stimulus was remembered vividly or just known. According to the fMRI results, negative items recruited temporo-occipital regions associated with sensory processing more than positive or neutral items. Hence, this shows that during encoding of the negative items, there is an increment in sensory processing, and this leads to negative items to be vividly remembered.

### 2.4.3 Arousal-Based Memory

In memory literature on explicit recognition, arousal dimension of emotion is stated to be critical for observing emotional memory enhancement effect. Amygdala is a key brain region such that its activity during encoding is related to successful retrieval of arousing items rather than nonarousing items (Dolcos, LaBar and Cabeza, 2004). Specifically, amygdala plays an indispensible role in modulating memory for arousing information, whereas non-amygdalar networks might be instrumental in enhancing memory for nonarousing positive or negative information (Kensinger, 2004). According to "memory modulation hypothesis", as long as the emotionally valenced (either positive or negative) information are highly arousing, amygdala-

hippocampal interactions guide successful encoding. Since both amygdala and hippocampus are involved, encoding and consolidation of emotional stimuli become stronger (McGaugh, 2004). Although McGaugh's "memory modulation hypothesis" concerns consolidation mechanisms, instead of retrieval of emotional memory; there are several studies that postulate the crucial role of amygdala during retrieval as well (Dolcos, LaBar, and Cabeza, 2005; Greenberg et al., 2005; Smith, Henson, Dolan and Rugg, 2004).

Even though studies indicate the importance of arousal for better memory performance, studies emphasizing the effect of valence that includes arousal are also worth mentioning within the emotional memory network (Garavan, Pendergrass, Ross, Stein and Risinger 2001; Kensinger and Corkin, 2004; Mickley-Steinmetz, Addis and Kensinger; 2010). For less-arousing emotional stimuli, frontal lobe regions interacting with hippocampus are found to enhance memory performance (Kensinger and Corkin, 2004).

When it comes to age differences, young and older adults do not differ in arousal-based memory enhancement for highly arousing stimuli (Charles, Mather and Carstensen, 2003; Denburg, Buchanan, Tranel, and Adolphs, 2003; Mather and Knight, 2005) since some regions of the brain are not affected by aging. For instance; aging has relatively little impact on amygdala, which is responsible for enhancing memory for emotionally arousing items.

On the other hand, memory enhancement for arousing information may occur relatively automatically. Thus, older adults show very little decline in automatic processes of arousal-based memory. Despite the effect of valence dimension of emotion, the arousal level of the stimuli is a potentially important factor.

Arousal is also essential for 'positivity effect' that is seen in older adults. As it is declared before, this age-related positivity effect does not always occur and arousal level of the stimuli influences the strength of the effect (Kensinger, 2008). It is discussed earlier that positivity effect results from the engagement of controlled processing. Similarly, the memory enhancement for nonarousing information may result from the engagement of more controlled processing strategies. Then, it can be derived that the positivity effect might be manifest more strongly in memory for nonarousing stimuli (Kensinger, 2004).

It can be expected that positivity effect disappears while arousing information are presented to older adults. In order to test this hypothesis, Kensinger (2008) conducted behavioral experiments in which recognition performances of younger adults and older adults were compared for negative arousing, negative nonarousing, positive arousing, and positive nonarousing words. Participants saw each word for 3 seconds and decided whether each word was abstract or concrete. No mention was made of a subsequent memory task. After a 10-minute retention interval, they did the surprise recognition task. The findings from the study states that, for the arousing words, there was no effect of valence; both age groups recognized negative arousing words as well as they remembered positive arousing words. Hence, there was no evidence of an age-related positivity effect for the arousing words. On the contrary, valence had an influence on memory for the nonarousing words: Young adults recognized negative nonarousing words better than they did positive nonarousing words. Older adults showed the opposite effect of valence: They remembered positive nonarousing words better than they did negative nonarousing words. So, there was a positivity effect for the nonarousing items. This research is very important due to its implications that there is a critical impact of valence upon the types of nonarousing information remembered by young and older

adults; whereas there is no effect of valence upon the types of arousing items remembered by the two age groups (Kensinger, 2008). Hence, in the light of these findings, positivity effect might not occur for arousing words in the arousal memory task under incidental encoding.

High arousing words seem to boost memory since the process is automatic. High arousing words do not need elaborative, attention-demanding encoding process in order to be recognized. For instance threatening items tend to pop out and get noticed automatically and they are tend to be recognized vividly. It is concluded that high arousing words benefit from automatic focus via amygdala-hippocampal interactions (Kensinger and Corkin, 2004). On the other hand, nonarousing items are more likely to benefit from organized and elaborative encoding strategies via prefrontal-hippocampal interactions (Kensinger and Corkin, 2004).

**2.5 Liberal Bias**

Till now, it has been mentioned that emotionally evocative words result in better performance on recognition memory tasks. However, instead of a pure measure of accuracy (discriminability), d' might reflect biases favoring emotional words. Besides discriminability, performance on a recognition memory task is also influenced by bias, which is the tendency to favor "yes" or "no" responses. Particularly, people may have different bias/criterion. Some people may have a tendency to favor "yes" responses. Others may choose to be more conservative and favor "no". In terms of old/new recognition memory tasks, a person who always says "yes" is guaranteed all hits. On the other hand, s/he also says "yes" to new words, therefore false alarm rates would hit the ceiling. As a consequence, overall memory accuracy would decrease, reflecting its score on d' calculated based on SDT.

This kind of a participant who tends to give the response "yes" is called liberal (see the top panel at Figure 2.4). As the second kind of bias, a person who always says "no" is guaranteed all correct rejections. In this instance, s/he never misses to say "no" to new words and false alarm rates would hit the floor. On the other hand, s/he also says "no" to old words and hit rate would be zero. As a consequence, overall memory accuracy would decrease. This kind of a participant who tends to give the response "no" is called conservative (see the bottom panel at Figure 2.4, Heeger, 1998). d' scores reflecting memory accuracy, that is sensitivity, should be separated from bias effects applying SDT. Hence, in addition to the primary memory accuracy, d', bias should be measured to identify liberal or conservative effects on memory recognition rates.


**Figure 2.4.** Different criterion shifts (Heeger, 1998)

For an unspecified memory test, Thapar and Rouder (2009) stated that the reason behind emotional enhancement effect in both young and older adults was because of a more liberal response bias for emotional words. For older adults, liberal bias was greatest for positive words; while for young adults liberal bias was greatest for negative words (Thapar and Rouder, 2009). Consistent with this conclusion, Dougal and Rotello (2007) also found a

liberal bias effect favoring negatively valenced words. They conducted the study with undergraduates using 144 words (48 neutral nonarousing, 48 negative arousing and 48 positive arousing) as stimuli set. The participants were asked to study all words for the immediate recognition task. In Dougal and Rotello's (2007) study, it was concluded that the proportion of 'old' judgments (YES) was higher for negative words than for neutral and positive words, regardless of whether the words had been studied. So, although recognition memory for negatively valenced words is often thought to be better than recognition of neutral words, it has been shown that the effect is due to liberal bias, not accuracy (Dougal and Rotello, 2007; Kapucu, Rotello, Ready and Seidl, 2008). This liberal bias for negative stimuli is consistently observed in the literature. In the study of Kapucu, Rotello, Ready and Seidl (2008), they investigated recognition memory for 192 emotional words (96 neutral nonarousing, 48 negative arousing, and 48 positive arousing) in younger and older adults. All participants were instructed to study the words shown one at a time for 3 seconds. They concluded that although younger and older adults did not differ in their memory accuracy, they differ in their liberal bias: The negative words yielded more liberal responses than the neutral stimuli for both young and older participants. However, positive stimuli yielded more liberal responses than the neutral stimuli, only for the older participants (Kapucu, Rotello, Ready and Seidl, 2008).

### 2.6 Current Mood and Recognition Memory

Inconsistencies in the literature indicate the importance of determining conditions carefully. One possible variable that has a great potential for giving rise to positivity/negativity effect in memory is 'mood'. People may possibly retrieve material from memory that is congruent with their current mood state. "**Mood-congruent memory**" hypothesis postulates that

participants in positive mood retrieve more positive memories; on the contrary participants in negative mood retrieve more negative memories (Rusting, 1998). One model of the interaction between mood and cognitive processes is presented in the 'semantic network approach' (Bower, 2003). This model suggests that emotion-specific memory nodes connect many related aspects of an emotion, such as autonomic responses, expressive behaviors, and description of situations that might evoke the emotion. At the theoretical level, excitation of any of these connections propagates to the rest of the associated network (Lewis and Critchley, 2003). Therefore, emotional material is remembered more reliably in moods that match the emotional content of the information. Bower (1983) also found a close correlation between the recognition performance and the corresponding emotional states.

On the other hand, people have a subjective sense of their own satisfaction. This subjective evaluation of satisfaction increases across the life span. In a study including participants from 18 to 94 years old, positive affect appears to remain mostly constant (Carstensen, Pasupathi, Mayr and Nesselroade, 2000) or increase (Mroczek, 2001) across the life span. On the contrary, the frequency and duration of negative emotions experienced in daily life decreased with age (Carstensen, Pasupathi, Mayr and Nesselroade, 2000). Thus, young adults are more likely to be in a negative mood while older adults would respond that they experience fewer negative emotions than younger adults. Developmental depression literature also states similar findings that young adults are at higher risk for depression rather than older adults (Lawton, Kleban and Dean, 1993).

In the literature, mood effect on memory has been studied experimentally. As an example, Josephon, Singer and Salovey (1996) studied mood factor by inducing happy mood (e.g., winning the lottery) or sad mood (e.g., a close

friend is terminally ill) firstly. After the mood induction, participants were asked to recall two memories related to themselves. Their depression scores were also measured. The results revealed that individuals with low depression scores, but in the sad mood condition, recalled positive memories; whereas individuals with high depression scores, in the sad mood condition, recalled negative memories. So, it might be concluded that, not mood but the depression level of participants is the determining factor while recalling positive/negative memories. Hence, mood is not an exclusive factor influencing memory; mood might interact with other variables.

### 2.7 Personality Characteristics and Recognition Memory

> "Personality is an abstraction used to explain consistency and coherency in an individual's pattern of Affects, Cognitions, Desires and Behaviors. What one feels, thinks, wants and does changes from moment to moment and from situation to situation but shows a patterning across situations and over time that may be used to recognize, describe and even to understand a person. The task of the personality researcher is to identify the consistencies and differences within and between individuals (what one feels, thinks, wants and does) and eventually to try to explain them in terms of a set of testable hypotheses (why one feels, thinks, wants and does)" (Revelle, 2007).

Emotional dimensions are not obviously the only factor to influence performance on the memory task. Personality is also an essential factor and process that shows individual characteristics patterns of thoughts, feelings and behaviors. Hence, since personality variables might be related to the way in which information is encoded/processed and subsequently recognized; participants' personality traits should also be assessed.

Some studies suggest a relationship between personality and positive-negative emotion retrieval. For instance, individuals who score high on extraversion are more likely to retrieve positive memories. On the contrary, individuals who score high in neuroticism are more likely to retrieve negative memories (MacLeod, Andersen and Davies, 1994; Seidlitz and Diener, 1993). Canli et al. (2001) found overlapping results when they studied personality effects on brain reactivity to emotional stimuli. That is, highly extraverted people might be more biased to respond to positive pictures; whereas highly neurotic people might be more biased to respond to negative pictures. Their study provides direct evidence that personality associated brain reactivity to emotional stimuli is localized: Higher scores of extraversion are associated with greater activity in the left middle frontal gyrus, the right temporal cortex and the right amygdala; higher scores of neuroticism are associated with greater activity in left middle frontal gyrus and the left temporal cortical regions (Canli et al., 2001). This result identifies common and distinct brain regions where such modulation takes place. A recent study by Rasmussen and Berntsen (2010) found a positive relationship between Openness to Experience and overall usage of autobiographical memory. Since people who score high on Openness to Experience tend to use their memories more for problem solving and behavior guidance, they experience their memories with a stronger sense of life story relevance (Rasmussen and Berntsen, 2010).

It is intriguing to think about how aging affects personality. Studies find that there exists age related changes in five dimensions of personality. For instance, openness to experience declines with aging (Terracciano, McCrae, Brant and Costa, 2005). It may be because as people age, they prefer to spend their time with close relatives, friends. They seem to be closed to novelty. On the other hand, young adults are open to meet new people, see new places, and learn new information. Some studies find supporting results about this

shift in goals. For example, when participants were given a hypothetical choice to spend time with a family member or meet someone new such as a famous author (Fung, Carstensen and Lutz, 1999; Fung, Lai and Ng, 2001), their choices were not surprising: Older adults are more likely to select the emotionally close social partner, whereas younger adults are more likely to select the social partner who may provide new information. Due to the absence of work-related social interactions, older adults experience less social stimulation, which has an effect on their extraversion scores. On the other hand, neuroticism declines with aging (Matthews and Deary, 1998). Older adults' avoidance from negative information is associated with their decreased tendency to experience states of anxiety, anger, guilt.

Only a few prior studies have focused on the relation between personality factors and memory in old age. Still, the relation between memory and personality was confirmed (Arbuckle et al., 1992; Hultsch, Hertzog, Small and Dixon, 1999; Meier, Perrig-Chiello, Perrig, 2002). In the study of Arbuckle et al. (1992), personality was measured with the Eysenck Personality Inventory and episodic memory was measured with a story recognition task, words list free and cued recall tests. Although its focus was on episodic memory performance, the results are essential to demonstrate reliable relationship between personality and memory. They declared that in old age, there was a positive correlation between memory performance and extraversion scores. By contrast, memory performance was negatively correlated with neuroticism. As consistent with the expectation, Hultsch, Hertzog, Small and Dixon (1999) and Meier, Perrig-Chiello, Perrig (2002) also found a positive correlation between extraversion and word recall. The correlations between neuroticism and the memory measures (those are, word recall and story recall) were consistently negative. Thus, when viewed from personality perspective, it is expected that people who get high scores in Neuroticism seem to better recognize negative words.

The study (Rusting, 1999) which examined the interactive effects of stable personality traits and temporary mood states on emotion-congruent memory found that these effects were not independent from each other and should be considered together. It is because focusing only on mood ignores the stable aspects of personality that may influence emotional experience. On the other hand, focusing only on traits ignores the impact of temporary moods and situational influences on emotional experience (Rusting, 1999). Specifically, higher scores of extraversion and agreeableness render people more likely to experience positive mood states; whereas higher scores of neuroticism render people more likely to experience negative mood states (Suls and Martin, 2005). Hence, it is identified in the light of these studies that mood states and personality traits interact with one another so as to facilitate the retrieval of emotional memories. Studies that are examining the effects of mood states and personality traits mostly focus on emotional autobiographical memories. Researches exploring the possible effect of personality and mood on memory using memory tasks such as a free-recall or a recognition task are limited.

### 2.8. Rationale and Planning of the Current Study

The current study investigates recognition memory (both memory accuracy and liberal bias) under incidental encoding for emotionally charged words in young and older participants. Percentages of correct responses (namely, hit rates) to medium arousing positive and negative words, and to highly arousing positive and negative words; as well as false alarms rates of these words were aimed to be measured and d' scores and criterion values were calculated based on SDT.

Moreover, verbal materials used in this study consist of written concrete words in order to eliminate the effect of word concreteness on recognition memory. Another concern is about word frequency. Based on the Dictionary of The Frequency of Written Turkish Words prepared by Göz (2003), the range of frequency values of words is too wide; it ranges from 1 to 29286. It is important to note that the words used in the study and test sessions have been controlled for word frequency. Thus, in order to eliminate frequency effect, the most commonly used (high in frequency) and the less commonly used (low in frequency) words have been excluded from the word lists.

The effect of instruction type (incidental versus intentional) on recognition memory accuracy (d') and liberal bias remains relatively unexplored. In order to clarify the influence of focusing or not focusing attention on emotionally charged words, the words were encoded incidentally during study session. The words were presented one at a time at the center of a computer screen. In the study session of the study, while the participants were seeing the words one by one on a computer screen, they were instructed to decide how many vowels each word contained by pressing the respective number button (that is, 2 or 3) within 2 seconds. It is important for the study that the processing of vowels is more rapid than that of consonants. In line with the literature, instructing the participants to count vowels within a word is compatible with the idea that the vowels should be processed faster.

In order to clarify the effect of emotionally charged words on memory accuracy and liberal bias, a verbal material list, which consists of medium and highly arousing is used and presented to the participants under incidental encoding. In this respect, the contributions of different dimensions of emotion on cognition can be characterized along the dimensions of valence and arousal. Moreover, considering the contradictory results, an

answer is searched to positivity bias in the current study. Our experimental design does not let the participants to devote full attention to the words. Since they do not know the main aim of the study, they do not have a chance to study the words. In fact, participants' attention is directed to another task (i.e. counting vowels in words) during encoding. Under such an incidental encoding, arousal level of people during the encoding of highly arousing stimuli can affect memory by leading to narrowed attention. Besides, highly arousing words might be interfering with verbal material list which is encoded without attention. In the literature, the interaction between arousal dimension of emotion and recognition memory performance has been investigated with conflicting results. For instance, memory for peripheral and central information can be differentially affected by arousal level (Christianson, 1992). While memory for central information remains intact, memory for peripheral information can be impaired resulting from arousal. Therefore, it can facilitate the implantation of false memory. Therefore, our aim is to determine the role of arousal on recognition memory in young and older participants.

In the current study, mood and retrieval association was examined as a second aim, so in order to assess mood states of participants before the experimental tasks, a most commonly used scale, Positive and Negative Affect Schedule (PANAS) is used (Watson, Clark and Tellegen, 1988; Gençöz, 2000). The PANAS is a reliable, valid and efficient mean for measuring positive and negative dimensions of mood. Hence, it is planned to test the mood-congruent memory hypothesis by assessing participants' current mood and relating it to age of participant as well as valence of recognized words.

In general, considering the contribution of individual differences in personality is a valuable approach for the explanation of inter-individual differences in emotional memory. Thus, the present study aims to examine how well personality dimensions predict memory performance of positively and negatively valenced words. In line with this reasoning, 5-Factor Personality Inventory (5FPI) (Costa and McRae, 1992) developed for Turkish culture (Somer, Korkmaz and Tatar, 2004) is used. It is also so called 'Big Five' and it is the most widely used taxonomy of personality. These five dimensions are extraversion, neuroticism, agreeableness, conscientiousness and openness to experience. The scores for each of the five dimensions are computed according to Somer, Korkmaz ve Tatar (2004). It is especially expected to find a relationship between five dimensions of personality and valence memory task.

Since mood states and personality traits influence memory in an emotion-congruent fashion, participants' mood and personality is assessed by related inventories. Although there is some evidence for the impact of mood states and personality traits on memory, researchers examining these effects included only one of these factors (either moods or traits). It is essential to conduct a study to examine the combined effects of both mood and traits on memory. It must be determined whether the effects on memory are due to mood, personality or some combinations of the two. In this way, strength and independence of each of these factors can be determined and explored. Thus, the present study is conducted to investigate possible interaction effects of mood and personality on recognition memory and analyze it with aging.

**Hypotheses:**

H1. Recognition memory performance for emotionally charged words under incidental encoding is expected to decline with aging.

H2. Positive and negative words are expected to be recognized more accurately than neutral nonarousing words under incidental encoding.

H3. Highly arousing words are expected to be recognized more accurately than medium arousing words under incidental encoding.

H4. Negative words are expected to be recognized more accurately than positive words in young population sample.

H5. Positive words are expected to be recognized more accurately than negative words in older population sample.

H6. Under incidental encoding, a response bias shift in response to emotional stimuli with increasing age is expected. More specifically, older participants are expected to display a liberal bias towards to positive words; while young participants are expected to display a liberal bias towards to negative words.

H7. Positive mood state is expected to predict memory performance of positively valenced words. On the other hand, negative mood state is expected to predict memory performance of negatively valenced words.

H8. In terms of personality traits, Extraversion, Neuroticism and Openness to Experience are specifically expected to be related to valence of the words to be recognized. Specifically, while the participants' higher scores in extraversion and openness to experience are expected to predict better memory performances for positive words, the participants' higher scores in neuroticism are expected to predict better memory performances for negative words.

# CHAPTER 3

# METHOD

## 3.1 Participants

The data have been collected from 113 volunteers; 60 young adults whose ages range between 18 – 24 years and 53 older adults whose ages range between 65 – 91 years. The healthy, young adult participants were selected among university students enrolled in the courses of "General Psychology" and "Understanding Social Behavior" at Middle East Technical University and also students from various state universities in the academic year 2011-2012. The mean age of the young adult participants is 20.77 years. The healthy, older adult participants were chosen among the residents of Istanbul Etiler Emekli Sandığı Genel Müdürlüğü Dinlenme ve Bakımevi (Nursing Home of Social Security Institution for Civil Servants at Istanbul); among the residents of Istanbul Kızılay Huzurevi (Kızılay Nursing Home) and among the residents of Izmir Narlıdere Emekli Sandığı Genel Müdürlüğü Dinlenme ve Bakımevi (Nursing Home of Social Security Institution for Civil Servants at Izmir). Residents who were living longer than 1.5 years at nursing home were not included in the study. The mean age of the older adult participants is 77.13 years. The two age groups were significantly different in age only; there were no other differences in demographic characteristics such as years of education. Particularly, the participants in both groups are individuals

who received education for 11 or more years. All participants filled out the demographic information form (Appendix A). Based on the data obtained from this form, all participants are native Turkish speakers with normal or corrected-to normal vision and with no history of a neuropsychological or psychiatric disorder for the last six months. Likewise, no participant reported taking any medication that affects the central nervous system. Furthermore, the participants did not report any history of alcoholism, or present treatment with centrally acting medication. The demographical information of the participants can be seen in Table 3.1. Informed consent read and signed by the participants (Appendix B) was obtained in a way that had been approved by the METU Ethics Committee (Appendix C).

The participants in the healthy, older adult group were selected among those who fulfill "the criteria for healthy elderly". In order to determine whether the participants fulfill the criteria in question, screening tests and/or scales were employed, namely with the Standardized Mini Mental State Examination (SMMSE) (Folstein et al., 1975; Güngen et al., 2002) (Appendix D), Geriatric Depression Scale (GDS) (Scheikh and Yesavage, 1986; Ertan and Eker, 2000) (Appendix E) and Functional Activities Questionnaire (FAQ) (Pfeffer et al., 1982; Selekler, Cangöz and Karakoç, 2004) (Appendix F). On the other hand, for screening purposes, the participants in the young adult group were administered the Beck Depression Inventory (BDI) (Beck, 1978; Hisli, 1988) (Appendix G). The cut-off scores of the screening tests and/or scales to be accepted as 'healthy' older and young adults can be seen in Table 3.2. The mean and standard deviations of the scores that participants' got from screening tests can be seen in Table 3.2. again. Moreover, in order to assess the participants' mood at the time of test and to obtain a measure of their initial emotional state, they were asked to complete the Positive and Negative Affect Schedule (PANAS) (Watson, Clark and Tellegen, 1988; Gençöz, 2000) (Appendix H). Personality traits were assessed by the Five-

Factor Personality Inventory (5FPI) (Costa and McRae, 1992; Somer, Korkmaz and Tatar, 2004) (Appendix I).

**Table 3.1.** Demographic information of the participants

| | | | |
|---|---|---|---|
| Age | Young | M= 20.77<br>SD= 1.54 | |
| | Older | M= 77.13<br>SD= 7.01 | |
| Education Years | Young | M= 13.27<br>SD= 1.04 | |
| | Older | M= 12.96<br>SD= 2.06 | |
| Gender | Young | Female= 30<br>Male= 30 | (%50)<br>(%50) |
| | Older | Female= 33<br>Male= 20 | (%62)<br>(%38) |
| Marital Status | Young | Married= 0<br>Single= 60<br>Widowed/Divorced= 0 | <br>(%100) |
| | Older | Married= 13<br>Single= 6<br>Widowed/Divorced= 34 | (%25)<br>(%11)<br>(%64) |
| Occupation | Young | State= 0<br>Private= 0<br>Self-employed= 0<br>Nonworking/Student= 60 | <br><br><br>(%100) |
| | Older | State= 2<br>Private= 4<br>Self-employed = 1<br>Nonworking/Retired= 46 | (%4)<br>(%8)<br>(%1)<br>(%87) |

Note. M represents mean, SD represents standard deviation.

## 3.2 Materials

### 3.2.1 Scale-Based Materials

Six different scale-based materials are used: Standardized Mini Mental State Examination (SMMSE), Geriatric Depression Scale (GDS), Functional Activities Questionnaire (FAQ), Beck Depression Inventory (BDI), Positive and Negative Affect Schedule (PANAS) and 5-Factor Personality Inventory (5FPI). Different age groups received different sets as summarized in Table 3.2 below.

**Table 3.2.** Summary of general procedure

| | SMMSE | GDS | FAQ | BDI | PANAS | 5FPI |
|---|---|---|---|---|---|---|
| Young Adults | | | | √ | √ | √ |
| Older Adults | √ | √ | √ | | √ | √ |

For the selection of the older participants who fulfill the criteria for "healthy older", three screening tests were used. These are:

*Standardized Mini Mental State Examination (SMMSE)*

The Standardized Mini Mental State Examination (SMMSE) was firstly developed by Folstein et al. (1975) as a cognitive assessment tool to examine the elderly who especially suffer from delirium and/or dementia. The test is commonly used in clinical trials to evaluate cognitive impairment in older adults. The test has also gained wide acceptance since it is very short and can be completed in almost 10 minutes. While administrating the test, raters

firstly give short information to participants about the procedure and then they ask some questions and give some problems to solve to the participants. The test consists of 19 items designed to assess 5 main areas of cognitive function: orientation to time and place, registration, attention and calculation, recall and language. Participants are evaluated out of 30 points. Reliability and validity studies of the SMMSE in differentiating mild dementia from normal controls in Turkish population were conducted by Güngen et al. (2002). The results of this study showed that the Turkish version of the SMMSE has high reliability and validity for the diagnosis of mild dementia in the Turkish population. In the present study, older adults who got at least 25 points from the test were accepted as "healthy" so they were included in the study (Table 3.3.). Answer sheet of the test can be found in the Appendix D.

*Geriatric Depression Scale (GDS)*

The Geriatric Depression Scale (GDS) developed by Scheikh and Yesavage (1986) is a 30-item self-report assessment used to identify depression in older people. As a basic screening measure for depression, the scale consists of 30 question sentences. Some of the sentences are like: "Are you basically satisfied with your life?", "Have you dropped many of your activities and interests?", "Do you often get bored?", "Are you afraid that something bad is going to happen to you?", "Do you enjoy getting up in the morning?", "Do you prefer to stay at home, rather than going out and doing new things?". The GDS questions are answered "yes" or "no". One point is assigned to each answer in favor of depression. Otherwise, zero point is assigned for a non-depression answer. In this sense, the lowest score is 0 and the highest score is 30. Older adults who got 11 points and over from the test were not included in the study (Table 3.3.). Reliability and validity studies of the GDS in the Turkish population were conducted by Ertan and Eker (2000). The statistical

analysis revealed that the scale's internal consistency reliability is .91 and test-retest reliability is .74. The answer sheet of the scale can be found in Appendix E.

*Functional Activities Questionnaire (FAQ)*

The Functional Activities Questionnaire (FAQ) serves as a screening tool for evaluating physical functions in elderly since the questionnaire is sensitive for distinguishing between normal and demented individuals. It was developed by Pfeffer et al. (1982) to assess independence in 10 daily activities (i.e. paying bills-balancing checkbook, shopping alone, preparing a balanced meal, keeping track of current events, paying attention to, understanding, discussing TV, book, magazine, remembering appointments, family occasions, holidays, medications, traveling out of neighborhood, driving, arranging to take buses, playing a game of skill-working on a hobby, heating water-making a cup of coffee-turning off stove after use) designed for community studies of normal aging and mild senile dementia. The FAQ can be self-administered but verified by a lay informant such as the spouse, a relative or a close friend. Approximately 10 minutes is required for completion. For each item of the questionnaire, four levels ranging from independence (scored 0) to dependence (scored 3) are specified. In this sense, the lowest score is 0 and the highest score is 30. Thus, higher scores reflect greater dependency. The normative values for the FAQ of the Turkish adult sample were determined by Selekler, Cangöz and Karakoç (2004). At ages between 60 and 69, getting at least 15 points from 2 or more activities is a sign for a failure on functional activities. For ages 70 and over, getting at least 9 points from 3 or more activities is a sign for a failure on functional activities and reflects greater dependency to others (see Table 3.3.). The answer sheet of the questionnaire can be found in Appendix F.

*Beck Depression Inventory*

In order to choose the 'healthy' young adults, the Beck Depression Inventory (BDI) was used. The inventory was developed by Dr. Aaron T. Beck in 1961. It is a 21-question multiple-choice self-report inventory used to measure the severity of depression. It is composed of items relating to symptoms of depression. These symptoms are hopelessness and irritability, physical symptoms such as fatigue, weight loss, and lack of interest in sex, as well as cognitions such as feelings of being punished. For each item of the inventory, four levels ranging from non-severe (scored 0) to severe (scored 3) are specified. In this sense, the lowest score is 0 and the highest score is 63. Thus, higher scores reflect more severe depressive symptoms. Reliability and validity studies of the BDI in the Turkish population were conducted by Hisli (1988); Şahin and Şahin (1992). The results of the statistical analysis, using as reliability coefficient the split-half technique, was r=.74 and the concurrent validity was 0.74 and .63, respectively. Participants who got 17 or lower points were accepted as 'normal' and included in the study (see Table 3.3.). The answer sheet of the inventory can be found in Appendix G.

**Table 3.3.** Means and standard deviations of the scores that participants' got from screening tests and/or scales and the cut-off points for 'healthy' young and older adults

| | | |
|---|---|---|
| SMMSE (Older) | M= 27.68<br>SD= 1.68 | Cut-off point ≥25 |
| GDS (Older) | M= 4.28<br>SD= 2.86 | Cut-off point ≤11 |
| FAQ (Older) | M= .23<br>SD= .82 | 60–69 years old= 2 or more activities ≤ 5 points<br>70 years old and above= 2 or more activities ≤9 points |
| BDI (Young) | M= 7.62<br>SD= 3.84 | Cut-off point ≤17 |

Note. M represents mean, SD represents standard deviation.

*Positive and Negative Affect Schedule (PANAS)*

To assess their mood at the time of test and to obtain a measure of their initial emotional state, participants were asked to complete the Positive and Negative Affect Schedule (PANAS) (Gençöz, 2000) before the experimental tasks. The PANAS is the most commonly used scale to assess mood states. Positive and negative affects emerge as two independent dimensions, both in the United States and in a number of other countries. Positive affect reflects the extent to which a person feels enthusiastic, alert and active; in contrast, negative affect reflects the extent to which a person feels contempt, disgust, fear, anger, nervous and guilt. Watson, Clark and Tellegen (1988) developed two 10-item mood scales that comprise the PANAS. The schedule consists of 10 positive (e.g. interested) and 10 negative (e.g. guilty) emotional states,

mixed together, rated on 5-point Likert-type scales. Participants are required to rate how they felt during the "last one week" on a scale from 1 (very slightly or not at all) to 5 (extremely). Thus, the total scores for each affect ranges from 10 to 50.

The reliability and validity of the Turkish version of the PANAS was studied by Gençöz (2000). Based on the data collected from 199 university students, the 20 PANAS items loaded on two factors; positive and negative affect, as in the original schedule. Based on the results, the PANAS is a reliable, valid and efficient mean for measuring these two primary dimensions of mood in the Turkish population. Cronbach alpha coefficients were .86 and .83 for positive and negative affect factors, respectively. Test-retest reliability coefficients were .40 and .54, respectively for positive and negative affect (Gençöz, 2000). When these coefficients are compared with the original schedule (.47 for both positive and negative affect factors), they are very similar and acceptable. Commonly, test-retest reliability coefficients are expected to be higher than .70. However, at this schedule, participants were required to rate how they felt during the "last one week" and the test-retest interval was 3 weeks. Namely, after a 3-week interval, the schedule was administered to the participants for the second time. Considering the fact that emotional state is unsteady and unstable, it is admissible that the coefficients were found lower as in the original schedule.

As in the original schedule, the mood measure consists of 10 positive and 10 negative affect items from the PANAS (Gençöz, 2000). In the present study, the schedule (Appendix H) was filled in a form so as to measure participants' mood states, before they performed any of the memory tasks. As a measure of their "last two weeks" state, participants were asked to rate the extent to which they were experiencing the emotion conveyed by each emotion word (e.g., sad, contented) on a 5-point scale ranging from 1=very slightly or not at

all to 5=extremely. The scoring of the schedule is made separately for negative and positive affect. If participant's positive affect score is greater than the negative affect score, s/he is considered to be in positive mood. For the reverse situation, s/he is considered to be in negative mood before the task.

*Five Factor Personality Inventory (5FKI)*

Afterwards, participants were given the Five Factor Personality Inventory (5FKI) to fill. The 5FKI is the most widely used personality test across different cultures and languages (McCrae and Allik, 2002). The inventory is organized into five dimensions: extraversion, neuroticism, agreeableness, conscientiousness and openness to experience (Costa and McRae, 1992). Hence, they are also so called 'Big Five'. The inventory was developed for Turkish culture by Somer, Korkmaz and Tatar (2004). The development of the dimensions was based on item-factor analyses and internal consistency procedures. The results supported reliability and construct validity of Big Five Model. As the result of final item selection, the 5FPI for Turkish culture is a 85-item questionnaire that assesses these five major domains of normal personality functioning (Appendix I).

Items are answered on a 5-point Likert scale ranging from 'completely agreeable' to 'not at all agreeable'. The reliabilities as measured by Cronbach's alpha were acceptable for all five-personality traits (.92 for Neuroticism, .86 for Extraversion, .86 for Openness to Experience, .86 for Agreeableness, and .88 for Conscientiousness) (Somer, Korkmaz and Tatar, 2004).

In the present study, the scores for each of the 5 dimensions were computed according to the scoring procedure suggested by Somer, Korkmaz ve Tatar (2004).

Detailed descriptions of each of the five dimensions of the 5FPI are given below:

*Extraversion:*

Extraversion appears to represent a tendency to prefer social interaction and lively activity. This dimension describes individuals who orient their behavior and experience towards the outer world. For instance, an individual who gets a higher score on Extraversion might be described as energetic, forceful, talkative, and assertive. The active and exciting life of extroverts is reflected emotionally in the experience of positive emotions. On the other hand, an individual who gets a lower score might be described as submissive, and emotionally bland (Somer, Korkmaz and Tatar, 2004).

*Neuroticism:*

Neuroticism appears to represent the proneness of the individual to experience unpleasant and disturbing emotions and have corresponding disturbances in thoughts and actions. Since neuroticism is highly correlated with anxiety, highly neurotic individuals are easily worried and are more likely to experience negative affect and somatic complaints. For instance, an individual who gets a higher score on Neuroticism might be described as nervous, tense, irritable and hostile; whereas a lower scorer might be characterized as calm and relaxed (Somer, Korkmaz and Tatar, 2004).

*Agreeableness:*

Agreeableness appears to reflect a tendency to be interested in and considerate of others' needs, desires, and feelings and to refrain from

aggressing or imposing one's will on others. This dimension of the Five Factors is mainly associated with the maintenance of social stability between individuals. For instance, a person who gets a higher score on Agreeableness might be described as modest, good-natured, eager to cooperate, compassionate, warm, and considerate; whereas a person who gets a lower score might be described as skeptical, hardheaded, tough minded and competitive (Somer, Korkmaz and Tatar, 2004).

*Conscientiousness:*

Conscientiousness appears to reflect the tendency to maintain motivational stability within the individual, to make plans and carry them out in an organized and industrious manner. For instance, a person who gets a higher score on Conscientiousness might be described as dutiful, self-disciplined, rational, hardworking, productive and ambitious; whereas a person who gets a lower score might be described as easygoing, self-indulgent and careless (Somer, Korkmaz and Tatar, 2004).

*Openness to Experience:*

Openness to experience appears to describe a range of traits related to cognitive and perceptual flexibility and exploration. For instance, an individual who gets a higher score on Openness to Experience is more likely to be open to new ideas, approaches and experiences and therefore subjectively experience his/her memories with a stronger sense of sensory reliving, vividness and emotion. By contrast, an individual who gets a lower score might be characterized by a preference for the familiar, practical and concrete and a lack of interest in experience for its own sake (Somer, Korkmaz and Tatar, 2004).

It is also important to mention that these five factors are independent from each other, that is, they cannot be collapsed into one without serious distortions. For example, an individual high on Neuroticism is as likely to be introverted as extraverted, or as likely to be closed as open.

### 3.2.2 Computer-Task-Based Materials

*Materials Used in the Study Session*

In the study session, the words were selected from the Turkish Affective Norms Database (TÜDADEN – Türkçe'de Duygusal Anlamsal ve Değersel Normlar) (Gökçay and Smith, 2011). All words were especially selected from the concrete words in order to eliminate a concreteness effect on recognition memory (Paivio, 1971). The words were also controlled for word length. Since short words, like three letters words, enhance recognition memory performance, they were eliminated during the selection procedure. Likewise, long words having 8 or more letters are more likely to be recognized, so they were not included in the word list, either. Hence, the selected words have 4-7 letters and 2 or 3 syllables.

Since the study's main objective is to assess the effects of valence and arousal on young and older adults' memory performances via a "between-subject design", there exist two word lists manipulated in terms of these dimensions of emotion. In this sense, one of the word lists (Word-List 1) comprised 45 concrete words, which include 15 negative, 15 positive and 15 neutral nonarousing words with varying pleasantness of medium-arousing words (Appendix J). Thus, the words differ in valence (negative, positive and neutral nonarousing) (Figure 3.1). Negative words have valence ratings of

1.98 to 3.76 (on a scale of 1-9, with 1 being highly negative and 9 being highly positive), positive words have valence ratings of 7.02 to 8.51, and neutral nonarousing words have valence ratings of 4.84 to 5.77. On the other hand, the selected words are moderate on the arousal axis of emotion so they are neutral nonarousing (not low, not high) in terms of arousal level. Since negative, positive and neutral nonarousing words are matched on emotional arousal, these medium-arousing words have arousal ratings of 3.78 to 5.70 (on a scale of 1-9, with 1 being calming or soothing and 9 being agitating or exciting). Thus, all of these words (negative, positive and neutral nonarousing valence words) have a medium arousal level (see Table 3.4).

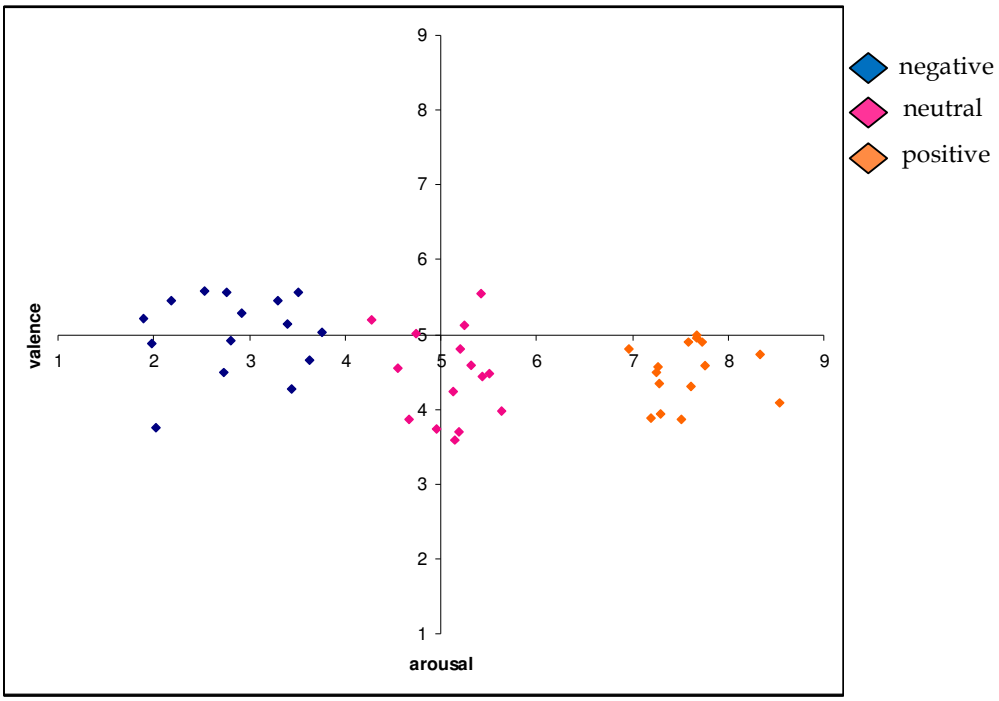


**Figure 3.1.** Word-list 1 – The distribution of words according to the values of two dimensions (valence and arousal) of emotion

**Table 3.4.** Word-list 1 used in the study session

| | Negative | Positive | Neutral |
|---|---|---|---|
| Valence Ratings | 1.98 to 3.76 | 7.02 to 8.51 | 4.84 to 5.77 |
| Arousal Ratings | 3.78 to 5.70 | | |

The other word list (Word-List 2) used in the study session comprised 45 concrete words, which include 15 negative, 15 positive and 15 neutral nonarousing words with varying pleasantness of highly arousing words (Appendix K). In this sense, highly arousing words differ in their valence values. Hence, both positive and negative words are highly arousing and they did not differ from one another in terms of arousal level. However, the positive and negative words are more arousing than neutral nonarousing ones since neutral nonarousing words were added to the study as "control" words (Figure 3.2). Negative words have valence ratings of 1.27 to 3.04 (on a scale of 1-9, with 1 being highly negative and 9 being highly positive), positive words have valence ratings of 6.41 to 8.6, and neutral nonarousing words have valence ratings of 4.53 to 5.81. Except from neutral nonarousing words, which are 'neutral' in both valence and arousal levels; positive and negative highly arousing words have arousal ratings of 5.97 to 7.87 (on a scale of 1-9, with 1 being calming or soothing and 9 being agitating or exciting). On the other hand, neutral nonarousing words have arousal ratings of 3.93 to 5.73 (see Table 3.5).

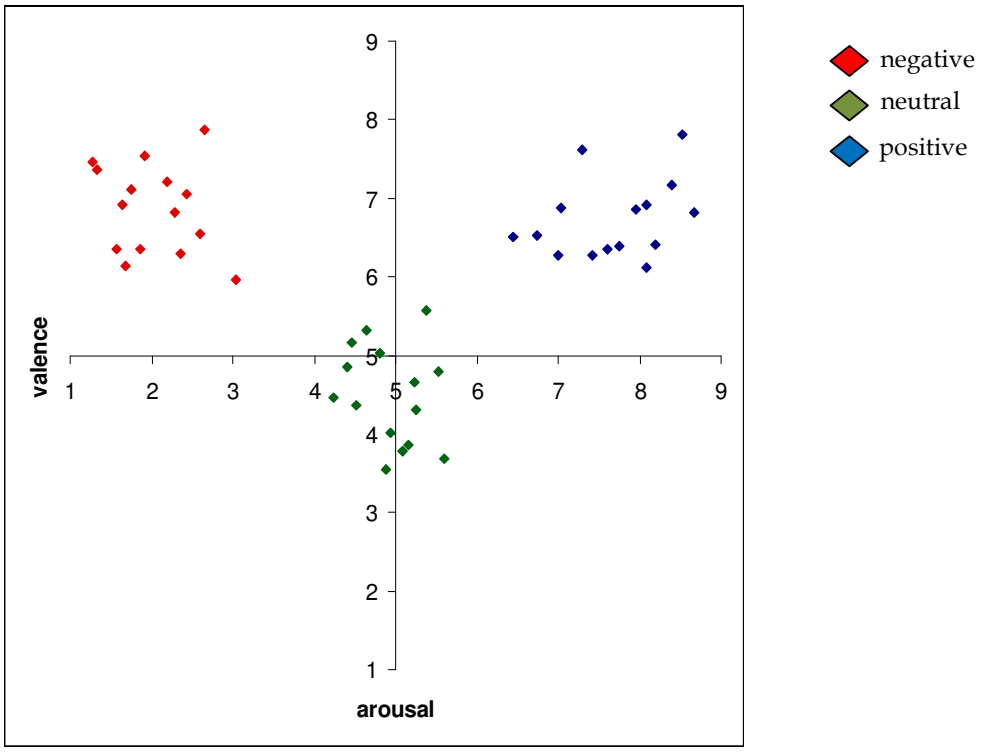


**Figure 3.2.** Word-list 2 – The distribution of words according to the values of two dimensions (valence and arousal) of emotion

**Table 3.5.** Word-list 2 used in the study session

| | Negative | Positive | Neutral |
|---|---|---|---|
| Valence Ratings | 1.27 to 3.04 | 6.41 to 8.6 | 4.53 to 5.81 |
| Arousal Ratings | 5.97 to 7.87 | | 3.93 to 5.73 |

The words of the study session were presented one by one, randomly on the screen of a 15.4 inch laptop computer, on a light gray background, and with letters in 'Arial' font and black color and all in the upper case. Stimulus presentation and response recording for each of these memory experiments were controlled by a laptop, with E-prime v.1.2 software (Psychology Software Tools Inc., Pittsburg, PA).

*Materials Used in the Distractor Session*

In the distractor session, 50 simple mathematical operations requiring deciding whether the number pairs are equal or not were presented on the screen of computer (Figure 3.3). During the self-paced distractor session, for each mathematical operation, participants made a button press to indicate whether the number pairs were equal (press A letter-button on keyboard) or they were not equal (press I letter-button on keyboard). The participants' performances in this task were not evaluated (not scored) and were not analyzed statistically.

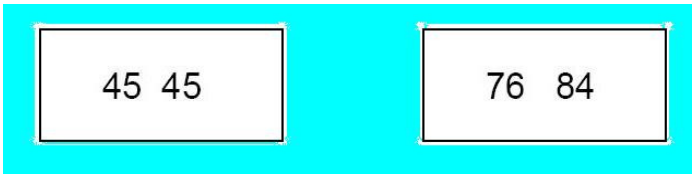


**Figure 3.3.** Two examples of the distractor task (equal, unequal)

*Materials Used in the Test Session*

In the test session, the words were selected from the Turkish Affective Norms Database (TÜDADEN – Türkçe'de Duygusal Anlamsal ve Değersel Normlar) (Gökçay and Smith, 2011). All words were especially selected from the concrete words in order to eliminate a concreteness effect. The words were controlled for word length ranging from 4-7 letters and 2 or 3 syllables. Again, there exist two word lists (Word-List 3 and Word-List 4) manipulated in terms of valence and arousal.

One of the word lists (Word-List 3) comprised 90 concrete words, which included 30 negative, 30 positive and 30 neutral nonarousing words with

varying pleasantness of medium-arousing words (Appendix L). In the test session, all 90 concrete words were presented to the participants and this word-list included 45 "old" words which had been seen in the study session of the experiment and 45 "new" distractor words (15 positive, 15 negative and 15 neutral nonarousing words) which were intermixed with old words.

The words in the Word-List 3 differ on the valence axis of emotion (negative, positive and neutral nonarousing) (Figure 3.4). Negative words have valence ratings of 1.7 to 4 (on a scale of 1-9, with 1 being highly negative and 9 being highly positive), positive words have valence ratings of 6.68 to 8.51, and neutral nonarousing words have valence ratings of 4.04 to 5.77. On the other hand, the selected words are moderate on the arousal axis of emotion so they are neutral nonarousing (not low, not high) in terms of arousal level. Since negative, positive and neutral nonarousing words are matched on emotional arousal, these medium-arousing words have arousal ratings of 3.28 to 5.78 (on a scale of 1-9, with 1 being calming or soothing and 9 being agitating or exciting). Thus, all of these words (negative, positive and neutral nonarousing valence words) have a medium arousal level (see Table 3.6).

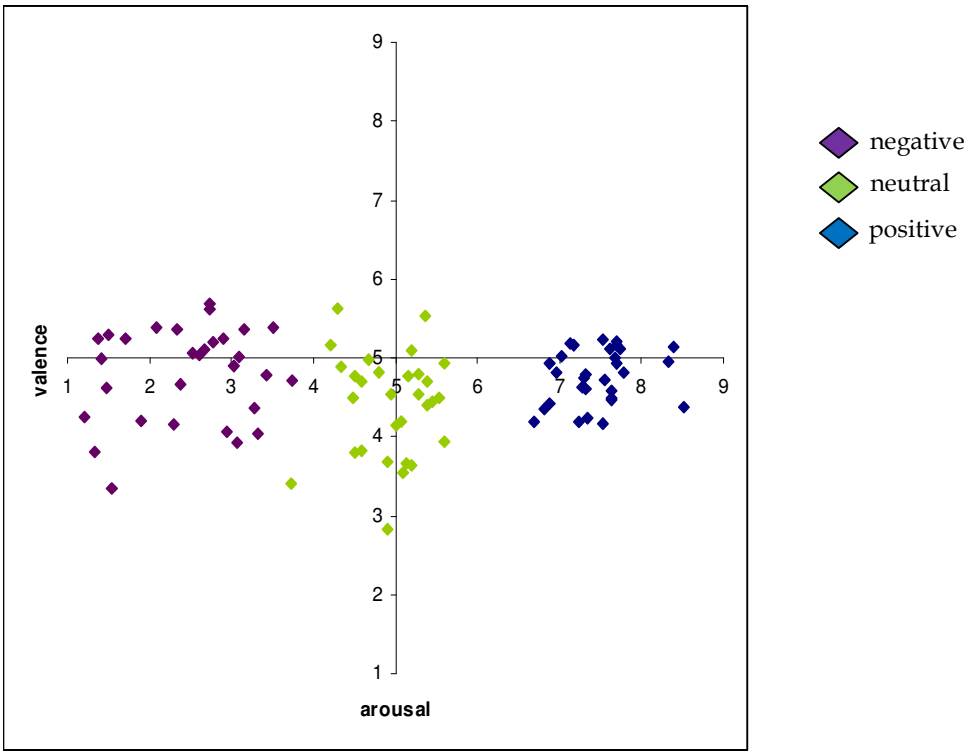


**Figure 3.4.** Word-list 3 – The distribution of words according to the values of two dimensions (valence and arousal) of emotion

**Table 3.6.** Word-list 3 used in the test session

| | Negative | Positive | Neutral |
|---|---|---|---|
| Valence Ratings | 1.7 to 4 | 6.68 to 8.51 | 4.04 to 5.77 |
| Arousal Ratings | 3.28 to 5.78 | | |

Furthermore, the words used in the study session (old words) and the words added in the test session as distractor words (new words) were controlled for word frequency. In Word-List 1, the frequency mean of the negative medium-arousing words is 70.47; the mean frequency of the negative medium-arousing words added as distractor is 50.87. The mean frequency of

the positive medium-arousing words is 102.93; the mean frequency of the positive medium-arousing words added as distractor is 106.47. The mean frequency of the neutral nonarousing words is 64.27; the mean frequency of the neutral nonarousing words added as distractor is 75.4 (see Table 3.7).

**Table 3.7.** Word frequencies of verbal material consist of medium arousing words

| | The mean frequencies | | | | |
|---|---|---|---|---|---|
| Old-Negative Medium Arousing Words | 70.47 | Old-Positive Medium Arousing Words | 102.93 | Old-Neutral Nonarousing Words | 64.27 |
| New-Negative Medium Arousing Words | 50.87 | New-Positive Medium Arousing Words | 106.47 | New-Neutral Nonarousing Words | 75.4 |

The other word list (Word-List 4) used in the test session again comprised 90 concrete words, which included 30 negative, 30 positive and 30 neutral nonarousing words with varying pleasantness of highly arousing words (Appendix M). In the test session, all 90 concrete words were presented to participants. This word-list included 45 "old" words which had been presented in the study session of the experiment and 45 "new" distractor words (15 positive highly arousing, 15 negative highly arousing and 15 neutral nonarousing words) which were intermixed with them.

Highly arousing words in Word-List 4 differ in their valence values; those are negative, positive and neutral nonarousing (Figure 3.5). Negative words

have valence ratings of 1.19 to 3.03 (on a scale of 1-9, with 1 being highly negative and 9 being highly positive), positive words have valence ratings of 6.41 to 8.6, and neutral nonarousing words have valence ratings of 4.53 to 5.81. On the other hand, both positive and negative words are highly arousing and they did not differ from one another in arousal. Except from neutral nonarousing words, which are 'neutral' in both valence and arousal levels; positive and negative highly arousing words have arousal ratings of 5.96 to 7.88 (on a scale of 1-9, with 1 being calming or soothing and 9 being agitating or exciting). On the contrary, neutral nonarousing words have arousal ratings of 3.93 to 5.73. Hence, the positive and negative words are more arousing than neutral nonarousing ones (see Table 3.8).

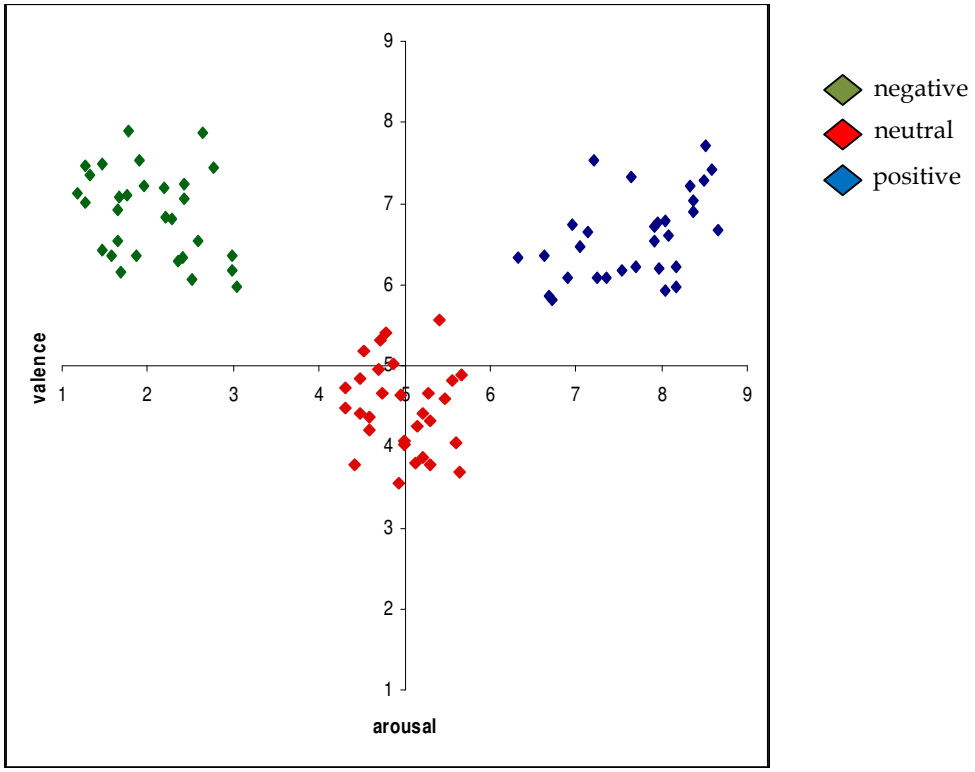


**Figure 3.5.** Word-list 4 – The distribution of words according to the values of two dimensions (valence and arousal) of emotion

**Table 3.8.** Word-list 4 used in the test session

| | Negative | Positive | Neutral |
|---|---|---|---|
| Valence Ratings | 1.19 to 3.03 | 6.41 to 8.6 | 4.53 to 5.81 |
| Arousal Ratings | 5.96 to 7.88 | | 3.93 to 5.73 |

The words used in the study session and the words added in the test session as distractor words were controlled for word frequency. For the Word-List 2, the mean frequency of the negative highly arousing words is 67.2; the mean frequency of the negative highly arousing words added as distractor is 79.53. The mean frequency of the positive highly arousing words is 199.87; mean mean frequency of the positive highly arousing words added as distractor is 198.2. The mean frequency of the neutral nonarousing words is 121.53; the mean frequency of the neutral nonarousing words added as distractor is 129.13 (see Table 3.9).

**Table 3.9.** Word frequencies of verbal material consist of highly arousing words

| | The mean frequencies | | | | |
|---|---|---|---|---|---|
| Old-Negative Highly Arousing Words | 67.2 | Old-Positive Highly Arousing Words | 199.87 | Old-Neutral Nonarousing Words | 121.53 |
| New-Negative Highly Arousing Words | 79.53 | New-Positive Highly Arousing Words | 198.2 | New-Neutral Nonarousing Words | 129.13 |

As in the study session, the words of the test session were randomly presented one by one, on the screen of a 15.4 inch laptop computer, on a light gray background, and with letters in 'Arial' font and black color, all in the upper case. Stimulus presentation and response recording during memory experiments were controlled by a laptop, with E-prime v.1.2 software (Psychology Software Tools Inc., Pittsburg, PA).

*Recognition Memory Task*

In the test session, participants were asked to decide whether they had seen the presenting words in the study session or not. In order to measure memory performances of the participants, 'Signal Detection Theory' (SDT) (Yonelinas, 1994) was used as the theoretical approach. SDT is based on old / new paradigm. SDT assumes that items are represented on this familiarity continuum. For instance, old items are represented on the higher end of the continuum, while new items are represented on the lower end of the continuum. So as to distinguish old and new items from each other, a response criterion should be selected. The items that exceed this criterion are considered as 'hits', these are the participants' old responses given to studied items. On the contrary, the participants' old responses, which are given to non-studied items, are called 'false alarms'. After calculating hits and false alarm rates, recognition accuracy, d', can be computed. d' is the distance between the means of studied items and non-studied items. In this sense, as d' value increases, it can be considered that old and new items are distinguished well by participants. In the present study, percentages of correct responses (namely, hit rates) to medium-arousing positive and negative words, and to highly arousing positive and negative words; as well as false alarms rates of these words were aimed to be measured, so SDT was used.

Participants' responses, as well as their reaction times were recorded via E-prime v.1.2 software (Psychology Software Tools Inc., Pittsburg, PA). To do this, a wireless numeric pad was used. Participants were instructed to press the related button on the numeric pad according to their responses. Hence, each participant's reaction time to medium-arousing positive and negative words, and highly arousing positive and negative words was recorded.

### 3.3 Experimental Design

As experimental design, a 2 (age: young and old) x 2 (arousal levels of words: high and medium) x 3 (valence levels of words: positive, negative, neutral nonarousing) mixed ANOVA was conducted on d-prime scores, hit rates and false alarm rates. According to this design, the variables 'age' and 'arousal levels of words' are between subjects; while the variable 'valence levels of words' is within subjects. Besides d-prime scores, hit rates and false alarm rates, the dependent variable to be measured was reaction times recorded at the test session. In the 2 x 2 x 3 experimental design, the number of participants in each condition can be seen in Table 3.10.

Moreover, as the second purpose of the study, two scales, namely PANAS and 5FPI were used. The current mood state (temporary) measured by PANAS and personality traits (permanent traits as) measured by 5FPI were evaluated.

**Table 3.10.** 2 x 2 x 3 mixed factor ANOVA

| N=113 | | | | |
|---|---|---|---|---|
| | | Valence | | |
| | | Positive | Negative | Neutral Nonarousing |
| Young Adults | Medium Arousing | 29 participants (14 female, 15 male) | | |
| | High Arousing | 31 participants (16 female, 15 male) | | |
| Older Adults | Medium Arousing | 24 participants (15 female, 9 male) | | |
| | High Arousing | 29 participants (18 female, 11 male) | | |

### 3.4 General Procedure

#### 3.4.1 Preliminary Study

The purpose of preliminary studies was to determine the verbal materials used in the study and test sessions, the timing parameters for stimulus presentation and instruction type used for recognition memory. Furthermore, during pilot studies, it was aimed to test the proposed experimental procedures.

*Selecting Verbal Materials*

It has been hypothesized that the valence aspect of an emotional stimuli is processed along with its arousal characteristics. In order to examine both dimensions of emotion in the same paradigm, five sets of stimuli should have been used: highly arousing positive words, highly arousing negative words, medium arousing positive words, medium arousing negative words and words that are neutral in terms of both valence and arousal). It should have been assured that highly arousing positive and highly arousing negative words are equated on arousal level. In this sense, negative words should have been as arousing as positive words. Similarly, highly and medium arousing words should have been equated on for each valence level. For instance, negative highly arousing stimuli and negative medium arousing stimuli should have been rated as similarly negative in terms of valence and vice versa. Moreover, these emotional words, selected from TÜDADEN (Türkçe'de Duygusal ve Anlamsal Değerlendirmeli Norm), which is created based on Affective Norms for English Words corpus (ANEW; Bradley and Lang, 1999), were used in such a memory task at first time. ANEW is the most widely used semantic space study of English. As in ANEW, in the TÜDADEN Database there are three orthogonal emotional axes for word norms: valence, arousal and dominance. The database consists of 1020 words. All words on the 3 emotional axes were rated on a 9-point Likert-type scale. TÜDADEN is the only emotional and cognitive norm database for Turkish words (Gökçay and Smith, 2011). This makes the database valuable for studies in cognitive science. The database will be published in the future.

Pilot studies were conducted so as to select the words used in the memory tasks. In these studies, the words were selected from TÜDADEN by considering the "valence" and "arousal" emotional axes. During the selection

process, abstract words were eliminated by using the List of Turkish Word Norms (Tekcan and Göz, 2005). Furthermore, word frequencies were controlled by consulting The Dictionary of The Frequency of Written Turkish Words (Göz, 2003).

*Determining the Timing Parameters for Stimulus Presentation In The Test Session*

Three preliminary studies were conducted in order to decide on the presentation duration and the presentation interval of the words presented to the participants in the study session. In each pilot study, the presentation duration of words and interstimulus interval between words were manipulated. The data of all pilot studies have been collected from young college students under intentional encoding. In one of the pilot studies, each stimulus stayed for 1 second on the computer screen; and the interstimulus interval was 750 milliseconds. Recognition memory performances of 10 young adults were measured immediately after the distractor session. According to the gross results from the descriptive statistics, negative words (hit rate: .61) were better recognized than neutral nonarousing (hit rate: .49) and positive words (hit rate: .51). On the other hand, general recognition memory performances of the participants were under the 60% of the test material. It can be due to the fast presentation of the words. Moreover, since no retention interval between the study and test sessions was given, it might have affected the consolidation process in a negative way.

In another study, each stimulus stayed for 1 second on computer screen; and the interstimulus interval was 750 milliseconds, as in Pilot Study 1. However, in this second pilot study, recognition memory performances of 16 young adults were not measured immediately. Instead, a retention interval of half an hour was given. According to the results, it seems that half an hour

retention interval facilitates memory performance. The mean hit rate of negative words (.80) did not differ from both the mean hit rate of neutral nonarousing (hit rate: .78) and the mean hit rate of positive words (hit rate: .77). It was clear that, at this time interstimulus interval was problematic because no emotional valence effect was found in second study. It seemed that a 750-milliseconds break was not enough for emotional words to facilitate recognition memory. Also, the interstimulus interval – during which they had to press the number button – was not long enough for older subjects. For this reason, a third pilot study was conducted with 21 young adults. In that study, each stimulus stayed on the screen for 1 second, the interstimulus interval was 2 seconds; and half an hour of retention was given. After the retention interval, the classical old/new-decision task was used to measure the recognition memory performance of the participants. The results revealed that interstimulus interval should be 2 seconds because rate of recognition memory was satisfying for the researchers. The results demonstrated that positive words (hit rates=.85) were significantly better recognized than negative words (hit rates=.60). Moreover, negative words (hit rates=.60) were significantly less remembered than neutral nonarousing words (hit rates=.86). There was no significant difference between positive (hit rates=.85) and neutral nonarousing words (hit rates=.86).

The retention interval between study and test session was determined in the light of the literature. A 30-minutes retention interval was chosen since the results of a number of studies (Kensinger, et al., 2002; Kensinger, Garoff-Eaton and Schacter, 2007; Kleinsmith and Kaplan, 1963; LaBar and Phelps, 1998) indicated that neither ceiling nor floor effects existed for participants when tested after at least a 30-minutes delay. Some researchers have proposed that during a longer delay, the arousal-modulated enhancement required for consolidation might play a more important role (McGaugh, 2000; Ritchey, Dolcos and Cabeza, 2008). Similarly, the common findings

from these studies suggested that a delay longer than 20 minutes was sufficient to allow a memory advantage for emotional material to surface. Since many studies (Guy and Cahill, 1999; Talmi and Moscovitch, 2004) suggest an interaction between emotionality and retention interval, it is aimed to avoid such an interaction, which might confound the memory effect.

*Instruction Used for Recognition Memory*

In the present study, memory performance was measured under incidental encoding. It is important to note that 'incidental learning' has been preferred recently in the literature on emotional memory studies (Dolcos, LaBar and Cabeza, 2004; Nielen, et al., 2009; Steinmetz, Addis and Kensinger; 2010; Thomas and Hasher, 2006). In the emotional memory literature, intentional learning of stimuli is considered to be avoided because intentional learning may interfere with the experience of emotions. Voluntary attention to stimuli may differ among participants due to their experienced emotion which may lead to difficulties interpreting the memory effects (Dolcos, LaBar and Cabeza, 2004). Thus, the researcher is especially advised to use 'incidental' encoding and an attention-demanding nonverbal distractor task in order to minimize potential differences at encoding and rehearsal. These considerations are substantial because, under 'intentional' encoding, participants might also use differential encoding strategies or differential rehearsal patterns.

It is also important that the task was not explicitly introduced as an 'attention' task. The reason for that is if participants are instructed to pay attention to whole set of experimental stimuli, it is expected that there will be no difference between emotional and neutral nonarousing stimuli in the recognition tasks. Sharot and Phelps (2004) found when emotional and

neutral nonarousing information capture attention similarly, there will be no significant differences between memory for emotional and neutral nonarousing words in the subsequent recognition test.

Hence, based on these considerations, to be certain about whether the instruction given was "implicit" enough or not, in the subsequent debriefing forms, all participants were asked the question: "Did you know your memory would be tested?". Participants were expected to indicate that they were 'surprised' that their memory performances were assessed.

### 3.4.2 Procedure for Collecting Data

The volunteering participants were taken one-by-one into a quiet room for the study. They firstly, filled out the informed consent form describing the kinds of tasks they would complete during sessions (Appendix B). In order to prevent intentional learning, subjects were not informed about subsequent testing. In the consent form, no mention was made of any forthcoming memory tests. Thus, participants were not informed about the main objective of the study. Instead, it was said that the aim was to examine the differences between young and older adults in terms of processing words and numbers. Before participants were recruited into the study, they were exposed to screening tests in order to ensure that all participants met the selection criteria. After the administration of the screening tests, the study continued with the participants who fulfilled the criteria of 'healthy' participants.

*PANAS Application*

Each volunteer was tested individually in a quiet room. The mood measure (PANAS) was introduced as a measure of their current mood states. The application took approximately 5 minutes for young adults; 10 minutes for older adults. The scores that the young and older participants got from the schedule are given in Table 3.11.

**Table 3.11.** Means and standard deviations of PANAS scores for the young and older Adults

| | Positive Affect | Negative Affect |
|---|---|---|
| Young Adults | M= 33.90<br>SD= 5.90 | M= 19.80<br>SD= 6.13 |
| Older Adults | M= 34.30<br>SD= 5.92 | M= 15.98<br>SD= 4.62 |

Note. M represents mean, SD represents standard deviation.

*Experimental Applications (Study, Distractor and Test Sessions)*

*Study Session*

Following the mood measure, experimental applications started. Participants were randomly assigned to either the 'highly arousing words' or 'medium arousing words' conditions. In the study session, the participants viewed 45 concrete words (one-third of each emotion type, but either highly arousing or medium-arousing words) one at a time in the center of a computer screen for 1 second each. In other words, highly arousing words were presented to half the participants; medium arousing words were presented to the other half.

Participants were told to simply look at the words on the computer screen for 1 second and decide how many vowels each word contained by pressing the respective number button (that is, 2 or 3) within 2 seconds (interstimulus interval) (see Appendix N for the given instruction at the study session). In this way, they were expected to pay attention to the words, not intentionally but incidentally. This was done to minimize the risk that the participants would guess that their memory would be tested later. Hence, the participants did encoding tasks that made it unlikely that they would rehearse the words during the study session. On the other hand, it was important to observe that participants saw and attended to word lists. To ensure that they were attending to the task, their responses were watched by the experimenter carefully. Although the young participants did not have any difficulty to follow the words on the screen, there were a few older participants that could not manage the task. After the study session, the ones who could not follow the words did not get the later sessions, so they were excluded.

Stimuli were presented randomly by using E-Prime 1.2 on a 15.4-inch color monitor. Importantly, half of the participants saw the highly arousing positive, negative and neutral nonarousing words and the other half saw the medium-arousing positive, negative and neutral nonarousing words.

*Distractor Session*

Following the words' presentation, the participants were given a two-minute distractor task. In the distractor task, 50 simple mathematical operations requiring a decision whether the number pairs are equal or not were used (see Appendix N for the given instruction at the distractor session). Afterwards, they were given approximately a 30-minutes delay before the test session. Participants waited outside the room during that period which was not controlled by the experimenter.

*Test Session*

After half an hour retention interval, participants were given a surprise word recognition task. Namely, after the retention interval, the classical old/new decision task was used to measure the recognition memory performance. During the self-paced test session, participants saw all 90 concrete words (either highly arousing words or medium-arousing words) one at a time centered on the computer screen. 45 of the words were the words that had been presented at the study session and 45 of them were new words. For each word, participants made a button press to indicate whether they had seen the word at the study session (old) or whether they had not seen the word at the study session (new). Participants were instructed to press a respective button on the numeric pad according to their responses. For instance, if they were sure that they had seen the presented stimulus in the study session, they were instructed to press '1' on the numeric pad. If they were sure that they had not seen the presented stimulus in the study session, they were told to press '3' (see Appendix N for the given instruction at the test session). The participants were requested to give their responses as accurately as possible, using the specified numeric pad buttons. Furthermore, they were strictly instructed to use just one hand and put it behind the numeric pad after each response. Reaction times of the participants to 'old/new items' were also recorded via the wireless numeric pad.

Afterwards, the participants were asked if they had expected a memory test. Only subjects who had answered the question, "Did you know your memory would be tested?" negatively in the debriefing forms, after the recognition task, were included in the statistical analyses. All participants in the present study indicated that they were 'surprised' that their memory performance was assessed.

*5FPI Application*

After the recognition memory performance has been measured, the participants filled out the 5FPI individually. The application took approximately 15 minutes for young adults; 30 minutes for older adults. The scores that the young and older participants got from the inventory are given in Table 3.12.

**Table 3.12.** Means and standard deviations of 5FPI scores for the young and older adults

| | E | A | C | N | OE |
|---|---|---|---|---|---|
| Young Adults | M= 3.68 SD= .75 | M= 3.84 SD= .69 | M= 3.33 SD= .45 | M= 2.53 SD= .63 | M= 4.29 SD= .35 |
| Older Adults | M= 3.27 SD= .77 | M= 4.10 SD= .61 | M= 3.71 SD= .54 | M= 2.25 SD= .76 | M= 4.20 SD= .37 |

Note. M represents mean, SD represents standard deviation.

E. Extraversion
A. Agreeableness
C. Conscientiousness
N. Neuroticism
OE. Openness to Experience

After the administration of the 5FPI, the participants were presented the debriefing form (see Appendix O) describing the kinds of memory tasks they would do during the test sessions. Since no mention was made of any forthcoming memory tests before, they were not informed about the main objective of the study. Only in the debriefing form, the aim was fully explained. After they were debriefed, they were thanked and dismissed.

# CHAPTER 4

# RESULTS

In this section, results of statistical analyses that were applied to the data set, which were obtained from the applications that were explained in the '*method section*' are reported. The data set comprised of the recognition memory scores that were acquired from the variables 'age', 'valence' and 'arousal'. In other words, the independent variables were 'age groups', 'emotionally valence levels of the words' and 'emotionally arousal levels of the words'; while dependent variable was the 'old/new recognition task scores'. In this respect, the independent variables 'age groups' and 'arousal levels of words' are between subjects; while the independent variable 'valence levels of words' is within subjects. The dependent variable, that is old/new recognition task scores, is calculated separately for hit rates, false alarm rates and recognition accuracy. Hit rates refer to the proportion of 'old' judgments of the participants given to studied words; while false alarm rates refer to the proportion of 'old' judgments of the participants given to unstudied words. Hit and false rates were transformed to standardized scores (that is, z-scores) and recognition accuracy (d-prime) is computed from z-scores of hit and false alarm rates using the signal detection theory. This measure gives information about how accurate are the participants in 'discriminating' old words from new ones. Hence, recognition accuracy is the distance between the means of studied words and unstudied ones. Based on

the signal detection theory (Yonelinas, 1994), it is calculated from *Equation 1* below.

Equation 1:

$$d\text{-}prime = z\ (Hit\ rates) - z\ (False\ alarm\ rates)$$

In this sense, as the d-prime value increases, the participants' sensitivity to discriminate the presented words from non-presented ones increases.

First of all, the screening tests scores were evaluated in order to select the 'healthy-nondemented' young and older sample. The participants whose scores did not fulfill the criteria were excluded from the study. In this respect, two young participant candidates could not be included in the study due to their high points above cut off points on the Beck Depression Inventory. Nine older participant candidates could not be included in the study due to their high points above cut off points on the Standardized Mini Mental State Examination; while two older participant candidates were excluded due to their high points above cut off points on the Geriatric Depression Scale. As a result, the raw data were collected from 125 volunteers; 62 young adults and 63 older adults. Additionally, two older participants were not included in the data set since they could not recognize any of the words in the test session, so after all, the number of older participants was 61.

In the study, two criteria were used to select the data for further analyses. The first one is the 'recognition memory accuracy' that was calculated by d-prime scores. Hit rates were not an appropriate measurement for 'accuracy'. For instance, a participant might have high rates of hit but also have high rates of false alarm. Although s/he gives 'yes' responses to the old words and they are correct responses, s/he also gives 'yes' responses to the new

words and they are mistakes. Hence, only hit rate is not a very useful tool especially for evaluating the 'recognition memory accuracy'. For this purpose, mean recognition memory accuracy per condition was calculated for each young and older participant. The data from one participant at young sample and six participants at older sample were discarded since their mean accuracy was at or below chance ($d' \leq 0$) (Van der Veen, et al., 2006). The second criterion is the 'response bias' as the participant's extreme tendency to say 'yes' or 'no' to the words. It was calculated by subtracting the proportion of 'the total yes response' from the proportion of 'the total no response' for each participant. This is reflected in *Equation 2* below:

Equation 2:

Response bias: (Total yes response/90) - (Total no response/90)

This value ranges from -1.0 and +1.0. In this sense, if response bias value is close to one of these two points, it means that the participants tend to say either 'yes' or 'no' constantly. Thus, the values exceeds the -.8 and +.8 were evaluated as extreme bias.

In order to validate this process, based on the data from 61 young participants and 55 older participants, the curves which plot hits against false alarms as a function of response bias were drawn for young (Figure 4.1) and older participants (Figure 4.2). While drawing the curves, response bias values were checked in terms of normal distribution. After that, the values were grouped according to the frequencies for all participants in the medium and high arousal groups separately. As a function of each response bias group, the related means of hit rates and false alarm rates were calculated. In other words, several mean hit rates and false alarm rates that correspond to several mean response bias were obtained. Polynomial curves were constructed and they were checked against the chance level. These curves

were constructed just to be able to see the distribution of dots which are representing the mean hit rates and false alarm rates. The dots nearest to the upper left corner of the graph represent the higher overall memory accuracy (no false alarms, only hits). The dots nearest to the chance level represent the lower overall memory accuracy (high rates of hit but also high rates of false alarms).

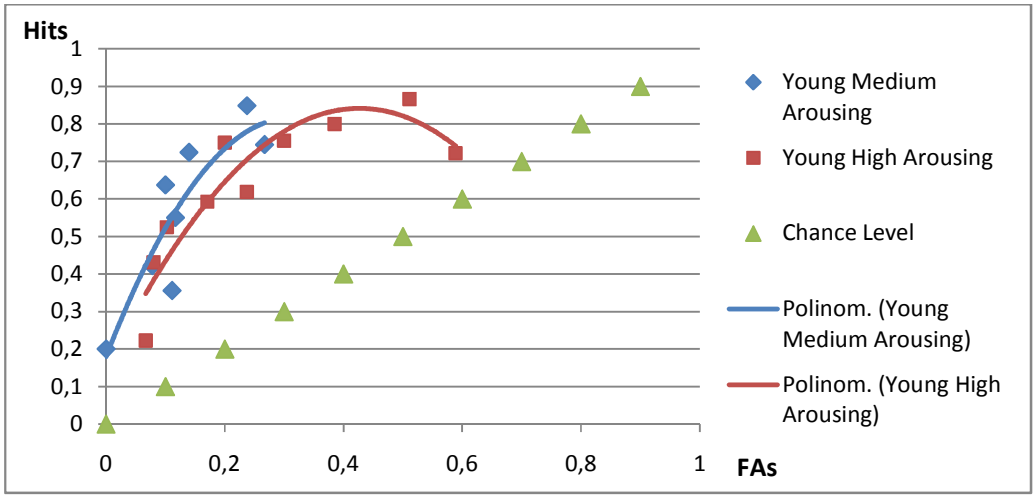


**Figure 4.1.** The curve which plot hits against false alarms as a function of response bias for 61 young participants

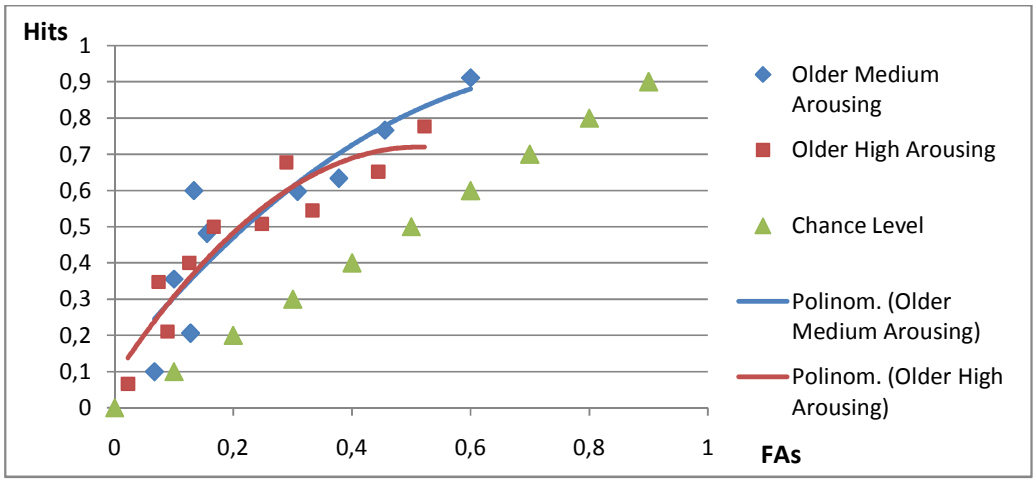


**Figure 4.2.** The curve which plot hits against false alarms as a function of response bias for 55 older participants

As a result, the data from one participant at young sample (response bias value: -.8) and two participants at older sample (response bias values: -.91 and -.8) were excluded. Finally, there were a total of 113 participants (60 young, 53 older).

Afterwards, outliers were detected in order to get the efficient statistical results. For this reason, data values that are very different from the data values for the majority of cases in the data set were examined. Outliers were detected by transforming all of the scores to standardized scores (that is, z-scores). If a case's standard score was ±3.0 or beyond, it was evaluated as an outlier, so it would be excluded from the data set. For analyses of recognition memory scores (i.e., hit and false alarm rates and recognition accuracy), no participant were excluded. Hence, after scanning possible outliers, there were still a total of 113 participants (60 young, 53 older). On the other hand, normalization was also provided. Namely, all continuous variables distributed normally. Analyses were conducted on the data from the remaining 113 participants.

## 4.1 Results of ANOVA Analyses Concerning the Old/New Recognition Task Scores

Before conducting main analyses, probable 'gender effects' were examined. Gender main effect and also interaction effects with other variables were not found significant ($p > .05$) for recognition accuracy (that is, d' score), hit and false alarm rates. Since including gender as a factor in the overall ANOVA did not yield any significant effects of gender, it was not integrated as a dummy independent variable in any of the further analyses.

Data from recognition memory task were analyzed in a series of analyses of variance (ANOVA's). The primary analyses were performed using as the dependent measures the d-prime scores, hit rates and false alarm rates. Memory performance measures (d-prime scores, hit rates and false alarm rates) were statistically evaluated with a mixed factors analysis of variance (ANOVA) with age group (2 levels; old versus young) and arousal (2 levels; highly arousing and medium arousing words) as between-subjects factor, valence (3 levels; positive, negative and neutral nonarousing words) as within-subjects factor. Hence, a 2 x 2 x 3 mixed ANOVA was conducted on recognition accuracy, hit rates, and false alarm rates to compare the effects of age, arousal, and valence. The results of recognition accuracy, hit and false alarm rates are summarized in Table 4.1. The results of recognition accuracy, hit and false alarm rates are reported, respectively.

**Table 4.1.** Summary of the results of ANOVA analyses concerning the old/new recognition task scores

| **Summary of the Significant Results for the Analyses of Recognition Accuracy (d' Scores) as a Function of Age, Emotional Valence Level and Emotional Arousal Level** | | | | | | |
|---|---|---|---|---|---|---|
| **Main Effects** | | | **2-way Interaction Effects** | | | **3-way Interaction Effect** |
| **Age** | **Valence** | **Arousal** | **Age * Valence** | **Age * Arousal** | **Valence * Arousal** | **Age * Valence * Arousal** |
| *** | * | ** | * | n.s. | n.s. | ** |
| **Summary of the Significance Results for the Analyses of Hit Rates as a Function of Age, Emotional Valence Level and Emotional Arousal Level** | | | | | | |
| **Main Effects** | | | **2-way Interaction Effects** | | | **3-way Interaction Effect** |
| **Age** | **Valence** | **Arousal** | **Age * Valence** | **Age * Arousal** | **Valence * Arousal** | **Age * Valence * Arousal** |
| ** | *** | n.s. | ** | n.s. | n.s. | ** |
| **Summary of the Significance Results for the Analyses of False Alarm Rates as a Function of Age, Emotional Valence Level and Emotional Arousal Level** | | | | | | |
| **Main Effects** | | | **2-way Interaction Effects** | | | **3-way Interaction Effect** |
| **Age** | **Valence** | **Arousal** | **Age * Valence** | **Age * Arousal** | **Valence * Arousal** | **Age * Valence * Arousal** |
| ** | n.s. | n.s. | *** | n.s. | *** | n.s. |

Notes. *p< .05, **p< .01, ***p= .000, n.s. nonsignificant

### 4.1.1 Analyses for Recognition Accuracy (d' Scores) as a Function of Age, Emotional Valence Level and Emotional Arousal Level

In order to compare the effects of age (young and older), valence (negative, positive, neutral nonarousing), arousal (high and medium), a 2 x 3 x 2 mixed ANOVA was performed on recognition accuracy (d' scores). The means and standard deviations of recognition accuracy (d') are presented in Table 4.2.

**Table 4.2.** Means and standard deviations of recognition accuracy (d') as a function of age (young and older), emotional valence level (positive, negative and neutral nonarousing), and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Valence** | | |
|---|---|---|---|---|
| **Age Group** | **Arousal** | Positive | Negative | Neutral Nonarousing |
| Young Participants | List 4 - Highly Arousing (n=31) | 1.51 (.65) | 1.34 (.51) | 1.02 (.58) |
| | List 3 - Medium Arousing (n=29) | 1.84 (.66) | 1.42 (.61) | 1.72 (.82) |
| Older Participants | List 4 - Highly Arousing (n=29) | .95 (.75) | .70 (.53) | .87 (.43) |
| | List 3 - Medium Arousing (n=24) | .90 (.75) | 1.13 (.67) | .94 (50) |

Note. Values in parentheses represent standard deviation

Results indicated a main effect of age on d' scores, F(1, 109) = 38.53, p = .000, $\eta_\rho^2$=.26, reflecting greater recognition accuracy at young participants (M=1.48) as compared to older participants (M=.92). The analysis also showed a significant, but smaller main effect of valence on d' scores, F(2, 218) = 3.63, p < .05, $\eta_\rho^2$=.03. Pairwise comparisons analyses revealed that there was no significant difference between the mean recognition of neutral nonarousing words (M=1.14) and negative words (M=1.15). However, the mean recognition accuracy of positive words (M=1.30) was found marginally (p=.07) higher than the mean recognition accuracy of negative words (M=1.15). Moreover, the mean recognition of positive words (M=1.30) was found marginally (p=.08) higher than the mean recognition of neutral nonarousing words (M=1.14). Tests of within-subjects contrasts (Helmert contrast) revealed that positive and negative words together (that is, emotional words) were not recognized more accurately than neutral nonarousing words (that is, nonemotional words).

Results revealed arousal main effect on d' scores, F(1,109) = 8.35, p = .005, $\eta_\rho^2$=.07. The difference between the mean recognition of medium arousing words (M=1.33) and the mean recognition of highly arousing words (M=1.07) was found significant. Namely, medium arousing words were recognized more accurately than highly arousing words.

The age x arousal interaction on d' scores did not reach conventional levels of significance. There was also a significant age x valence interaction, F(2, 218) = 2.93, p = .05, $\eta_\rho^2$=.03 (see Figure 4.3). In a more detailed analysis of post-hoc, paired samples t-tests were conducted in order to isolate where the differences are. Significance levels for each group were determined by using Holm's Sequential Bonferroni correction method. In order to be significant at the .05 level under Bonferroni, .05 was divided by the number of pairwise comparisons. In this respect, further statistics revealed that the mean d' score

of positive words (M=1.68) that young participants recognized was found significantly higher than the mean d' score of positive words (M=.93) that older participants recognized, t(52) = 5.94, p=.000. Young participants also recognized negative words (M=1.38) more accurately than older participants recognized negative words (M=.92), t(52) = 3.80, p=.000. Moreover, young participants also recognized neutral nonarousing words (M=1.37) more accurately than older participants recognized neutral nonarousing words (M=.91), t(52) = 3.49, p=.001. Young participants recognized positive words (M=1.68) more accurately than negative words (M=1.38), t(59) = 3.54, p=.001. Young participants also recognized positive words (M=1.68) more accurately than neutral nonarousing words (M=1.37), t(59) = 3.02, p=.004. However, the difference between the mean recognition of negative (M=1.38) and neutral nonarousing words (M=1.37) was not found significant at young group, t(59) = .16, p=.87. For older participants, d' scores for positive (M=.93), negative (M=.92) and neutral nonarousing words (M=.91) did not significantly differ from each other. The valence x arousal interaction did not found significantly.

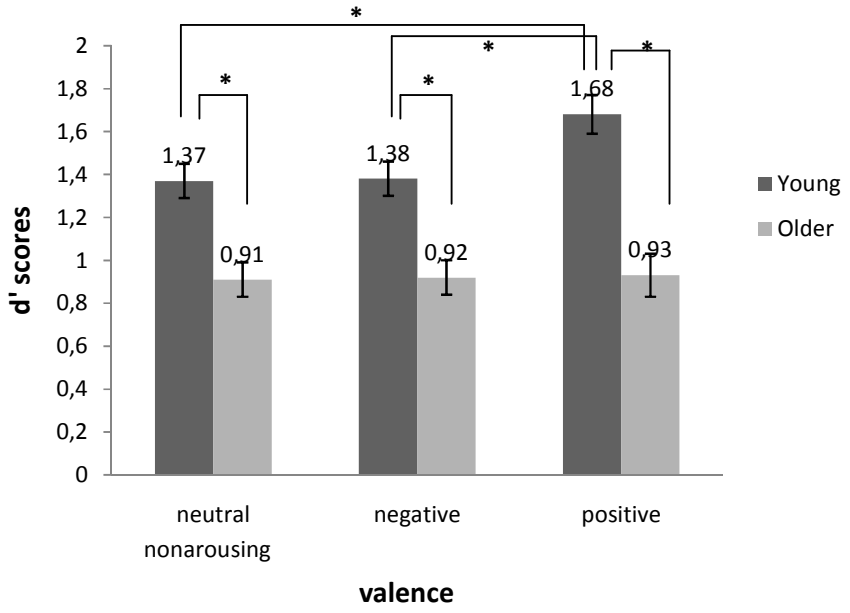


**Figure 4.3.** Age x Valence interaction effect on d' scores. Error bars represent standard error. To show the significant results, the asterisk is used.

On the other hand, results for age x valence x arousal mixed ANOVA indicated a significant 3-way interaction effect of recognition accuracy, $\underline{F}(2, 218) = 7.07$, $p = .001$, $\eta_\rho^2 = .06$ (see Figure 4.4.). Further paired samples t-tests by using Holm's Sequential Bonferroni correction technique showed that young participants recognized highly arousing positive words ($\underline{M}=1.52$) more accurately than neutral nonarousing words used in the highly arousing verbal material list ($\underline{M}=1.02$), $t(30) = 3.13$, $p=.004$. Young participants also recognized highly arousing negative words ($\underline{M}=1.34$) more accurately than neutral nonarousing words used in the highly arousing verbal material list ($\underline{M}=1.02$), $t(30) = 2.50$, $p=.018$. When medium arousing is considered, young participants recognized medium arousing positive words ($\underline{M}=1.84$) more accurately than medium arousing negative words ($\underline{M}=1.42$), $t(28) = 3.67$, $p=.001$. Young participants also recognized medium arousing neutral nonarousing words ($\underline{M}=1.72$) more accurately than medium arousing negative words ($\underline{M}=1.42$), $t(28) = 2.20$, $p=.036$. Furthermore, young

participants recognized neutral nonarousing words used in the medium arousing verbal material list (M=1.72) more accurately than neutral nonarousing words used in the highly arousing verbal material list (M=1.02), t(28) = 4.09, p=.000. However, d' scores of young participants for highly arousing positive (M=1.52) and negative words (M=1.34) did not significantly differ from each other. Also, d' scores of young participants for medium arousing positive (M=1.84) and neutral nonarousing words used in the medium arousing verbal material list (M=1.72) did not significantly differ from each other. Similarly, d' scores of young participants for highly arousing negative (M=1.34) and medium arousing negative words (M=1.42) did not significantly differ from each other. Additionally, d' scores of young participants for highly arousing positive (M=1.52) and medium arousing positive words (M=1.84) did not significantly differ from each other.

For older sample, medium arousing negative words (M=1.13) were recognized more accurately than highly arousing negative words (M=.70), t(23) = 3.71, p=.001. There was no significant difference between the mean recognition of highly arousing positive (M=.95) and medium arousing positive words (M=.90) at older sample, t(23) = .19, p=.85. Moreover, the mean recognition of highly arousing positive (M=.95), highly arousing negative (M=.70) and neutral nonarousing words-used in the highly arousing verbal list- (M=.87) did not significantly differ from each other at older sample. In accordance with, the mean recognition of medium arousing positive (M=.90), medium arousing negative (M=1.13) and neutral nonarousing words-used in the medium arousing verbal list- (M=.95) did not significantly differ from each other at older sample.

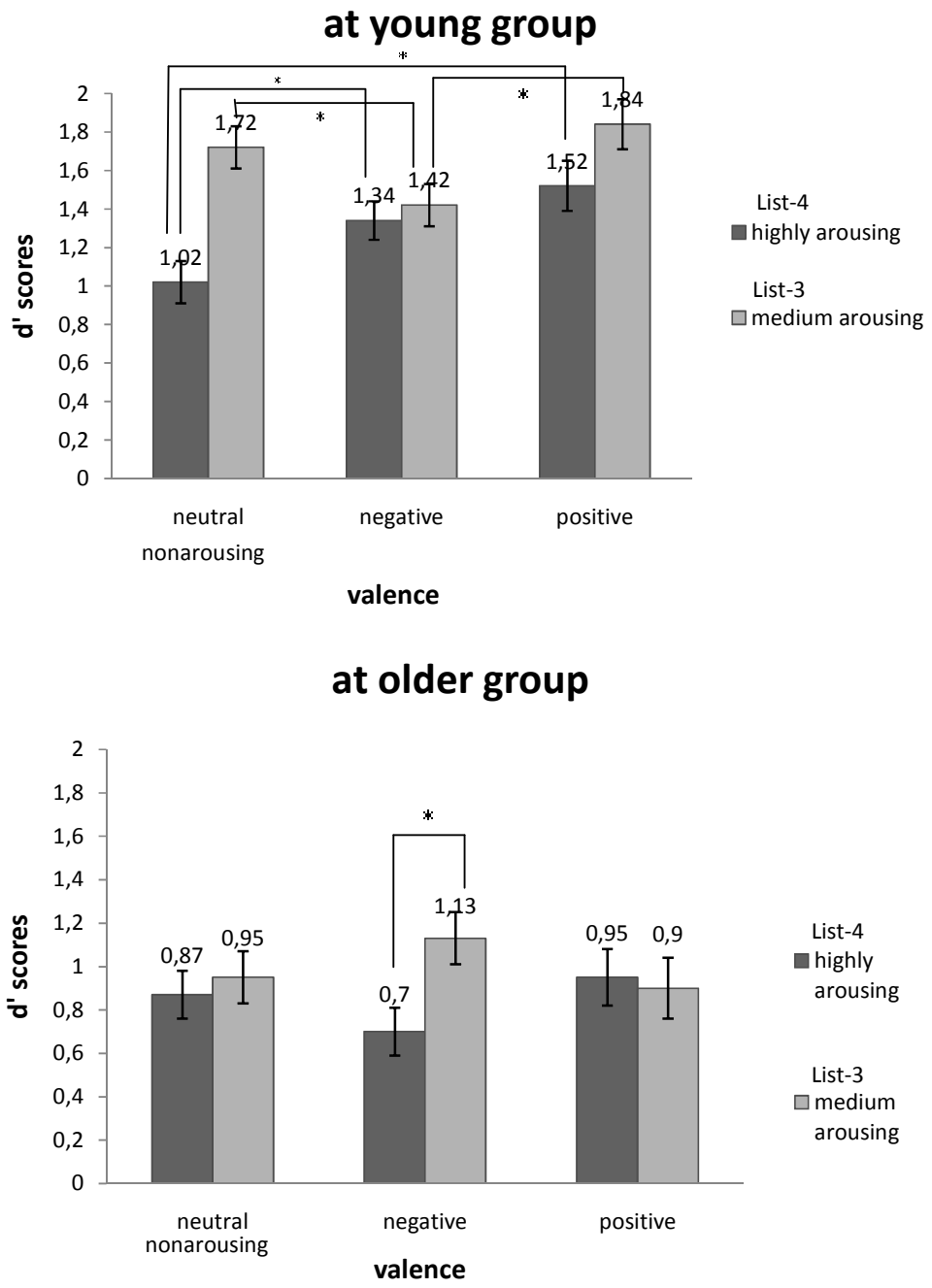


**Figure 4.4.** Age x Valence x Arousal 3-way interaction effect on d′ scores. Error bars represent standard error. To show the significant results, the asterisk is used.

### 4.1.2 Analyses for Hit Rates as a Function of Age, Emotional Valence Level and Emotional Arousal Level

For the analyses, hit rates scores were calculated by the given "old" responses to actually presented words (or old words). In order to compare the effects of age, valence and arousal, a 2 x 3 x 2 ANOVA was conducted on the hit rates. The means and standard deviations of hit rates are presented in Table 4.3.

**Table 4.3.** Means and standard deviations of proportions of hit responses as a function of age (young and older), emotional valence level (positive, negative and neutral nonarousing) and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Valence** | | |
|---|---|---|---|---|
| **Age Group** | **Arousal** | Positive | Negative | Neutral Nonarousing |
| Young Participants | List 4 - Highly Arousing (n=31) | .61 (.22) | .67 (.17) | .58 (.17) |
| | List 3 - Medium Arousing (n=29) | .74 (.14) | .65 (.18) | .65 (.20) |
| Older Participants | List 4 - Highly Arousing (n=29) | .59 (.19) | .44 (.21) | .54 (.18) |
| | List 3 - Medium Arousing (n=24) | .62 (.17) | .55 (.23) | .53 (.17) |

Note. Values in parentheses represent standard deviation

Results yielded a main effect of age on hit rates, F(1, 109) = 11.65, p = .001, $\eta_\rho^2$=.10, reflecting greater proportion of "old" responses given to studied words at young participants (M=.65) as compared to older participants (M=.55). The analysis also showed a significant main effect of valence on hit rates, F(2, 218) = 11.40, p = .000, $\eta_\rho^2$=.10. Pairwise comparisons revealed that positive words (M=.64) were recognized better than both negative words (M=.58) and neutral nonarousing words (M=.57), p=.001 and p=.000, respectively. On the contrary, hit rates for negative words (M=.58) and neutral nonarousing words (M=.57) did not significantly differ from each other. Tests of within-subjects contrasts (Helmert contrast) revealed that positive and negative words together were better recognized than neutral nonarousing words, F(1,109)= 7.66, p< .05, $\eta_\rho^2$=.07. However, there was no main effect of arousal, F(1, 109) = 2.67, p = .105. Namely, hit scores for highly (M=.57) and medium arousing words (M=.62) did not significantly differ from each other.

There was also a significant age x valence interaction on hit rates, F(2, 218) = 5.80, p = < .05, $\eta_\rho^2$=.05 (see Figure 4.5.). In a more detailed analyses of paired samples t-tests, the mean hit rates of negative words (M=.66) that young participants recognized was found significantly higher than the mean hit rates of negative words (M=.50) that older participants recognized, t(52) = 4.76, p=.000. Young participants also recognized neutral nonarousing words (M=.61) better than older participants did (M=.53), t(52) = 2.35, p=.023. However, young participants did not recognize positive words (M=.67) better than older participants (M=.60), t(52) = 1.90, p=.06. Young participants recognized positive words (M=.67) better than neutral nonarousing words (M=.61), t(59) = 3.3, p=.002. Young participants also recognized negative words (M=.66) better than neutral nonarousing words (M=.61), t(59) = 2.41, p=.019. However, the difference between the mean hit rates of negative (M=.66) and positive words (M=.67) was not found significant at young

group. For older participants, hit rates for positive words (M=.60) were found significantly higher than hit rates for negative words (M=.50), t(52) = 4.32, p=.000. Moreover, older participants recognized positive words (M=.60) better than neutral nonarousing words (M=.53), t(52) = 3.00, p=.004. However, negative (M=.50) and neutral nonarousing words (M=.53) did not significantly differ from each other at older sample.

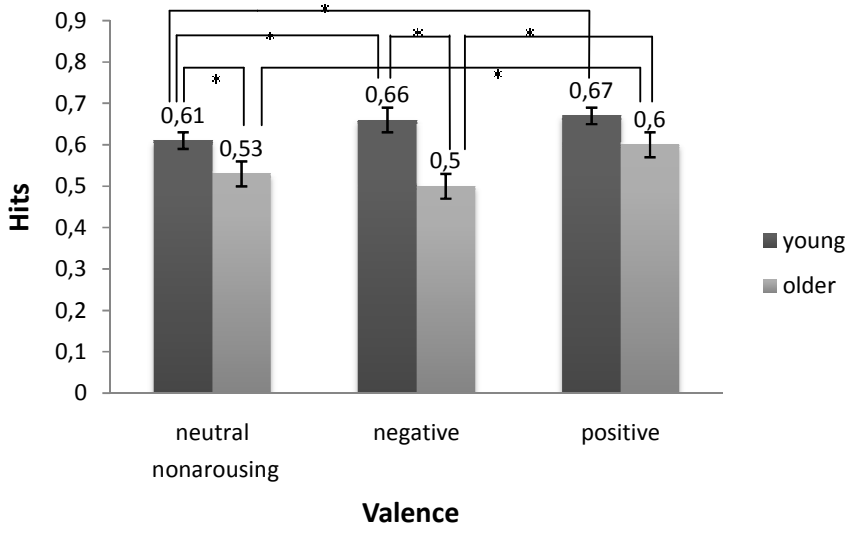


**Figure 4.5.** Age x Valence interaction effect on hit rates. Error bars represent standard error. To show the significant results, asterisk is used.

The valence x arousal interaction did not found significantly. The age x arousal interaction on hits also did not reach conventional levels of significance.

On the other hand, the results for age x valence x arousal mixed ANOVA indicated a significant 3-way interaction effect of hits, F(2, 218) = 7.46, p = .001, $\eta_\rho^2$=.06 (see Figure 4.6.). Further paired samples t-tests by using Holm's Sequential Bonferroni correction technique showed that young participants recognized highly arousing negative words (M= .67) better than neutral

nonarousing words used in the highly arousing verbal material list (M= .58), t(30) = 3.50, p=.001. However, hit rates for highly arousing negative words (M=.67) and highly arousing positive words (M=.61) did not significantly differ from each other at young sample, t(30) = -1.93, p=.06. When medium arousing is considered, young participants recognized medium arousing positive words (M= .74) better than medium arousing negative words (M= .65), t(28) = 3.20, p=.003. Young participants also recognized medium arousing positive words (M= .74) better than medium arousing neutral nonarousing words (M= .65), t(28) = 4.15, p=.000. Hit rates for medium arousing positive words (M=.74) and highly arousing positive words (M=.61) did not significantly differ from each other at young sample, t(28) = -2.00, p=.06.

For older sample, medium arousing positive words (M= .62) were recognized better than neutral nonarousing words-used in the medium arousing verbal list- (M= .53), t(23) = 2.74, p=.012. There was no significant difference between the mean hits of medium arousing positive (M= .62) and medium arousing negative words (M= .55) at older sample, t(23) = 1.99, p=.06. When highly arousing condition is considered, highly arousing positive words (M= .59) were recognized better than highly arousing negative words (M= .44), t(28) = 4.00, p=.000. Furthermore, neutral nonarousing words-used in the highly arousing verbal list- (M= .54) were recognized better than highly arousing negative words (M= .44), t(28) = 2.56, p=.016. There was no significant difference between the mean hits of highly arousing positive (M= .59) and neutral nonarousing words -used in the highly arousing verbal list- (M= .54) at older sample at older sample.

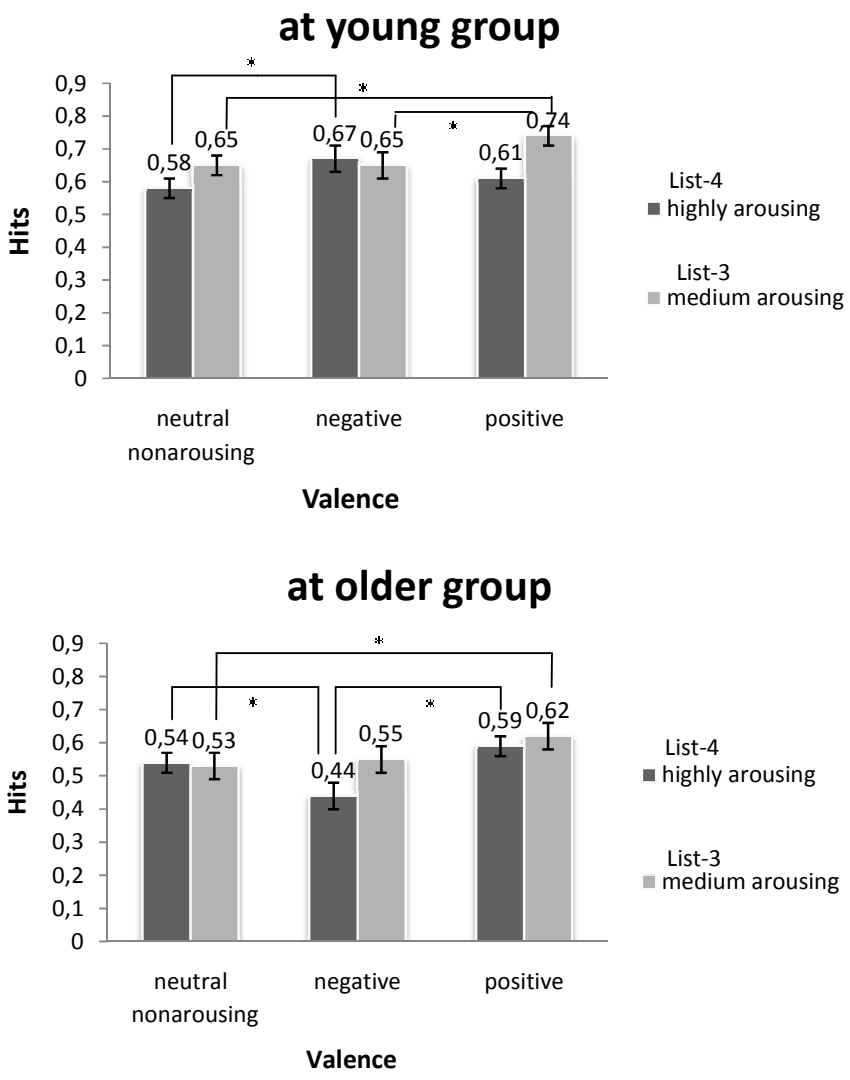


**Figure 4.6.** Age x Valence x Arousal 3-way interaction effect on hits. Error bars represent standard error. To show the significant results, the asterisk is used.

### 4.1.3 Analyses for False Alarm Rates as a Function of Age, Emotional Valence Level and Emotional Arousal Level

For the analyses, false alarm rates were calculated by the given "old" responses for the non-presented words (or new words). False alarm rates

were statistically evaluated with a mixed ANOVA with valence, age group and arousal. The means and standard deviations of false alarm rates are presented in Table 4.4.

**Table 4.4**. Means and standard deviations of proportions of false alarm responses as a function of age (young and older), emotional valence level (positive, negative and neutral nonarousing) and emotional arousal Level (highly and medium)

| N=113 (60 young, 53 older) | | **Valence** | | |
|---|---|---|---|---|
| **Age Group** | **Arousal** | Positive | Negative | Neutral Nonarousing |
| Young Participants | List 4 - Highly Arousing (n=31) | .15 (.12) | .23 (.14) | .25 (.17) |
| | List 3 - Medium Arousing (n=29) | .16 (.11) | .19 (.13) | .12 (.10) |
| Older Participants | List 4 - Highly Arousing (n=29) | .28 (.19) | .24 (.18) | .26 (.16) |
| | List 3 - Medium Arousing (n=24) | .32 (.20) | .19 (.15) | .23 (.15) |

Note. Values in parentheses represent standard deviation

The analysis showed a significant main effect of age on false alarm rates, $\underline{F}(1, 109) = 8.48$, $p < .05$, $\eta_{\rho}^2 = .07$. Older participants ($\underline{M}=.25$) made more false alarms than young participants ($\underline{M}=.18$). However, there was no main effect of valence. Namely, false alarm scores for positive ($\underline{M}=.23$), negative ($\underline{M}=.22$) and neutral nonarousing ($\underline{M}=.22$) words did not significantly differ from

each other. Tests of within-subjects contrasts (Helmert contrast) revealed that false alarm rates for positive and negative words together did not significantly differ from false alarm rates for neutral nonarousing words. Similarly, there was no main effect of arousal. Namely, false alarm scores for highly (M=.24) and medium arousing words (M=.20) did not significantly differ from each other.

Results for age x valence mixed ANOVA indicated a significant interaction effect of false alarm rates, $F(2, 218) = 15.44$, $p = .000$, $\eta_\rho^2 = .12$ (see Figure 4.7.). Further paired samples t-tests revealed that older participants (M=.30) had higher false alarm rates for positive words than young participants (M=.15), $t(52) = 5.45$, p=.000. However, false alarm scores for negative words did not significantly differ at older (M=.22) and young sample (M=.21). Similarly, false alarm scores for neutral nonarousing words did not significantly differ at older (M=.24) and young sample (M=.19).

For young participants, mean false alarm rates for negative words (M = .21) were significantly higher than mean false alarms for positive words (M = .15), $t(59) = 4.15$, p=.000. However, mean false alarm scores for positive (M = .15) and neutral nonarousing words (M=.19) did not significantly differ from each other at young sample. Similarly, mean false alarm scores for negative (M = .21) and neutral nonarousing words (M=.19) did not significantly differ from each other at young sample. For older participants, mean false alarm rates for positive words (M = .30) were significantly higher than mean false alarms for negative words (M = .22), $t(52) = 3.91$, p=.000. In addition, mean false alarm rates for positive words (M = .30) were significantly higher than mean false alarms for neutral nonarousing words (M = .24), $t(52) = 2.51$, p=.015. However, mean false alarm scores for negative (M = .22) and neutral nonarousing words (M=.24) did not significantly differ from each other at older sample.

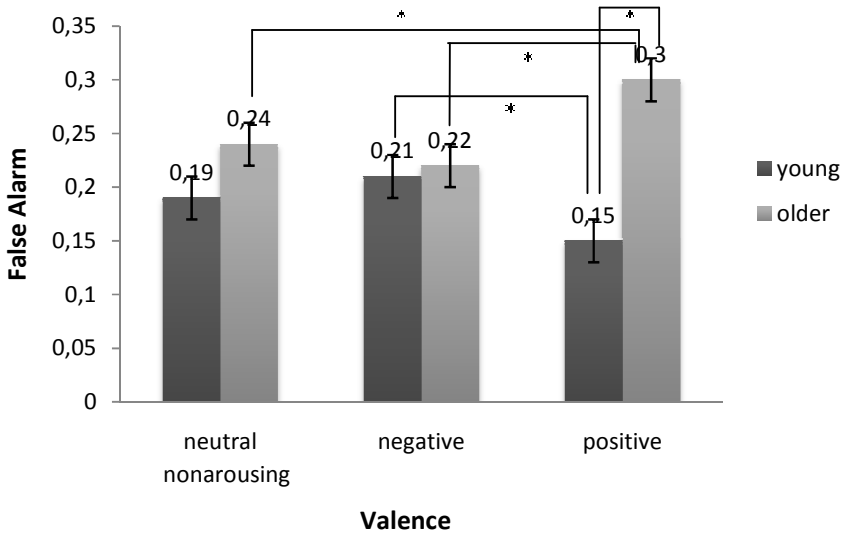


**Figure 4.7.** Age x Valence interaction effect on false alarm rates. Error bars represent standard error. To show the significant results, the asterisk is used.

Results for arousal x valence mixed ANOVA indicated a significant interaction effect of false alarm rates, $\underline{F}(2, 218) = 7.90$, $p = .000$, $\eta_\rho^2 = .07$ (see Figure 4.8.). Further paired samples t-tests revealed that mean false alarm scores for neutral nonarousing words did significantly differ at the highly arousing ($\underline{M}$=.25) from the medium arousing group ($\underline{M}$=.18), $t(52) = 3.66$, p=.001. However, mean false alarm scores for negative words did not significantly differ at the highly arousing ($\underline{M}$=.24) from the medium arousing group. Also, mean false alarm scores for positive words did not significantly differ at the highly arousing ($\underline{M}$=.21) from the medium arousing group ($\underline{M}$=.24). When the highly arousing group is considered, mean false alarm scores for positive ($\underline{M}$=.21), negative ($\underline{M}$=.24) and neutral nonarousing ($\underline{M}$=.25) words did not significantly differ from each other. When the medium arousing group is considered, only, mean false alarm scores for

positive words (M=.24) did significantly differ from neutral nonarousing words (M=.18), t(52) = 3.35, p=.002.

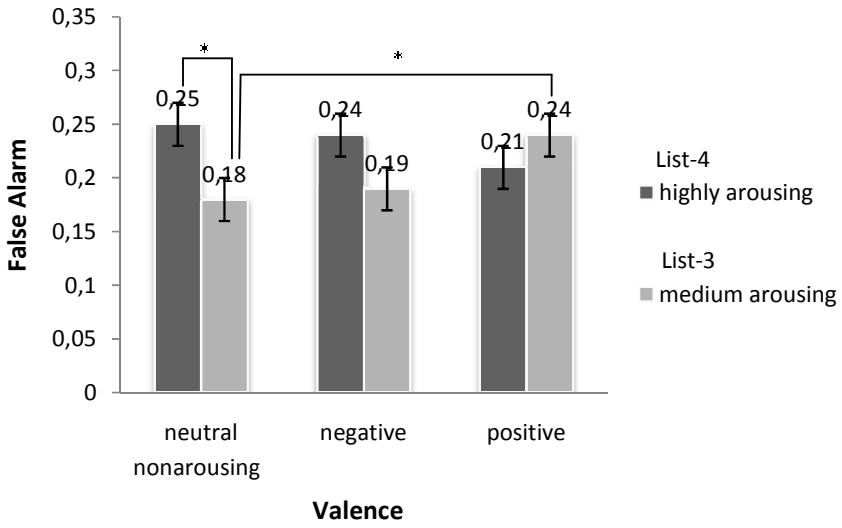


**Figure 4.8.** Arousal x Valence interaction effect on false alarm rates. Error bars represent standard error. To show the significant results, the asterisk is used.

The age x arousal interaction did not found significantly. The age x arousal x valence 3-way interaction on false alarm response also did not reach conventional levels of significance.

### 4.1.4 Analyses for Liberal Bias as a Function of Age, Emotional Valence Level and Emotional Arousal Level

Memory accuracy (discriminability) and bias are the two different measures that should be considered while interpreting the data. When recognition memory is tested, measuring bias gives an opportunity to evaluate the shift in the criterion value since bias is of special concern in memory researches. It

is computed from hit rates and false alarm rates using the signal detection theory (Yonelinas, 1994) and the corresponding equation is,

Equation 3:

$$\text{Criterion} = -0.5 * [z(\text{Hit rates}) + z(\text{False alarm rates})]$$

Since criterion value is the sum of the hit rates and false alarm rates, it actually gives information about liberal bias. Liberal bias quantifies the tendency of participants to respond in a predominantly liberal, that is favoring 'yes' responses. Based on the formula, more negative or relatively lower scores reflect a liberal or 'yes' response set. This means that even the criterion values are all positive (or negative) values; they should not be evaluated only by looking the value one by one; in contrast they should be evaluated by comparing two groups relatively. Hence, positive criterion values do not absolutely represent the tendency to respond with "no" and similarly negative criterion values do not absolutely represent the tendency to respond with "yes". To be able to decide the possible tendency, the criterion values should be assessed comparatively.

Another point is that criterion is different from response bias which was mentioned at the beginning of this chapter. Response bias formula only gives opportunity to detect the participant's extreme tendency to say 'yes' or 'no' to the words. According to the total yes or total no responses, the participants who probably automatically press 'yes' or 'no' button can be determined and disregarded. However, it does not give any information about the memory performance. On the other hand, criterion values are related to memory performances and they are calculated for each participants based on the formula offered by Signal Detection Theory.

In order to compare the effects of age, valence and arousal, a 2 x 3 x 2 ANOVA was conducted on criterion values. The means and standard deviations of criterion values are presented in Table 4.5. The statistical results are summarized in Table 4.6.

**Table 4.5**. Means and standard deviations of criterion values as a function of age (young and older), emotional valence level (positive, negative and neutral nonarousing) and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Valence** | | |
|---|---|---|---|---|
| **Age Group** | **Arousal** | Positive | Negative | Neutral Nonarousing |
| Young Participants | List 4 - Highly Arousing (n=31) | .42 (.51) | .17 (.47) | .29 (.48) |
| | List 3 - Medium Arousing (n=29) | .20 (.37) | .26 (.42) | .42 (.36) |
| Older Participants | List 4 - Highly Arousing (n=29) | .21 (.46) | .50 (.56) | .31 (.46) |
| | List 3 - Medium Arousing (n=24) | .12 (.42) | .43 (.54) | .38 (.46) |

Note. Values in parentheses represent standard deviation

**Table 4.6.** Summary of the results of ANOVA analyses for criterion values as a function of age, emotional valence level and emotional arousal Level

| **Summary of the Significant Results for the Analyses of Bias as a Function of Age, Emotional Valence Level and Emotional Arousal Level** | | | | | | |
|---|---|---|---|---|---|---|
| **Main Effects** | | | **2-way Interaction Effects** | | | **3-way Interaction Effect** |
| **Age** | **Valence** | **Arousal** | **Age * Valence** | **Age * Arousal** | **Valence * Arousal** | **Age * Valence * Arousal** |
| n.s. | ** | n.s. | *** | n.s. | ** | n.s. |

Notes. *p< .05, **p< .01, ***p= .000, n.s. nonsignificant

The analysis showed a significant main effect of valence on criterion values, $\underline{F}(2,218) = 6.91$, $p = .001$, $\eta_p^2 = .06$. Positive words ($\underline{M} = .24$) simply produced a more liberal response bias than do neutral nonarousing words ($\underline{M} = .35$) and negative words ($\underline{M} = .34$). However, there was no main effect of age. Namely, criterion values for older ($\underline{M} = .33$), and young participants ($\underline{M} = .29$) did not significantly differ from each other. Similarly, there was no main effect of arousal. Namely, criterion values for highly ($\underline{M} = .32$) and medium arousing words ($\underline{M} = .30$) did not significantly differ from each other.

There was also a significant age x valence interaction on criterion values, $\underline{F}(2, 218) = 18.53$, $p = .000$, $\eta_p^2 = .15$ (see Figure 4.9.). In a more detailed analyses of paired samples t-tests, young participants were more willing to classify negative words ($\underline{M} = .21$) as old than neutral nonarousing words ($\underline{M} = .36$), $t(59) = 2.89$, $p = .005$. Moreover, young participants were more willing to classify negative words ($\underline{M} = .21$) as old than positive words ($\underline{M} = .31$), $t(59) = 2.09$, $p = .041$. However, criterion values for neutral nonarousing ($\underline{M} = .36$) and positive words ($\underline{M} = .31$) did not significantly differ from each other. On the other hand, older participants were more willing to classify positive words ($\underline{M} = .17$) as old than both neutral nonarousing words ($\underline{M} = .35$) and negative words ($\underline{M} = .47$), $t(52) = 3.88$, $p = .000$, $t(52) = 6.34$, $p = .000$, respectively. Moreover, criterion values for neutral nonarousing ($\underline{M} = .35$) and negative words ($\underline{M} = .47$) did significantly differ from each other, $t(52) = 2.63$, $p = .011$, reflecting greater liberal bias for neutral nonarousing words at older group. In addition, young participants ($\underline{M} = .21$) were more willing to classify negative words as old than older adults ($\underline{M} = .47$) were, $t(52) = 3.15$, $p = .003$. Regarding the criterion values of positive words, young ($\underline{M} = .31$) and older participants ($\underline{M} = .17$) did not differ significantly.

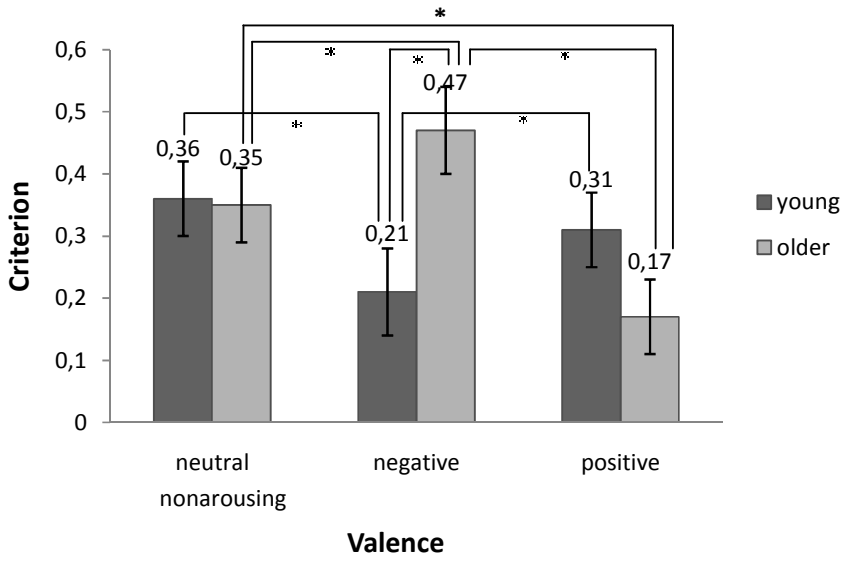


**Figure 4.9.** Age x Valence interaction effect on criterion values. Error bars represent standard error. To show the significant results, the asterisk is used.

Results for arousal x valence mixed ANOVA indicated a significant interaction effect of criterion values, $\underline{F}(2, 218) = 7.65$, $p = .001$, $\eta_\rho^2 = .07$ (see Figure 4.10.). Further paired samples t-tests revealed that mean criterion values for the medium arousing negative words ($\underline{M}$=.34) did significantly differ from the medium arousing positive words ($\underline{M}$=.16), $t(52) = 5.30$, $p$=.000. Also, mean criterion values for the medium arousing neutral nonarousing words ($\underline{M}$=.40) did significantly differ from the medium arousing positive words ($\underline{M}$=.16), $t(52) = 3.73$, $p$=.000. However, mean criterion values for negative ($\underline{M}$=.34), positive ($\underline{M}$=.32) and neutral nonarousing words ($\underline{M}$=.30) did not significantly differ at the highly arousing group.

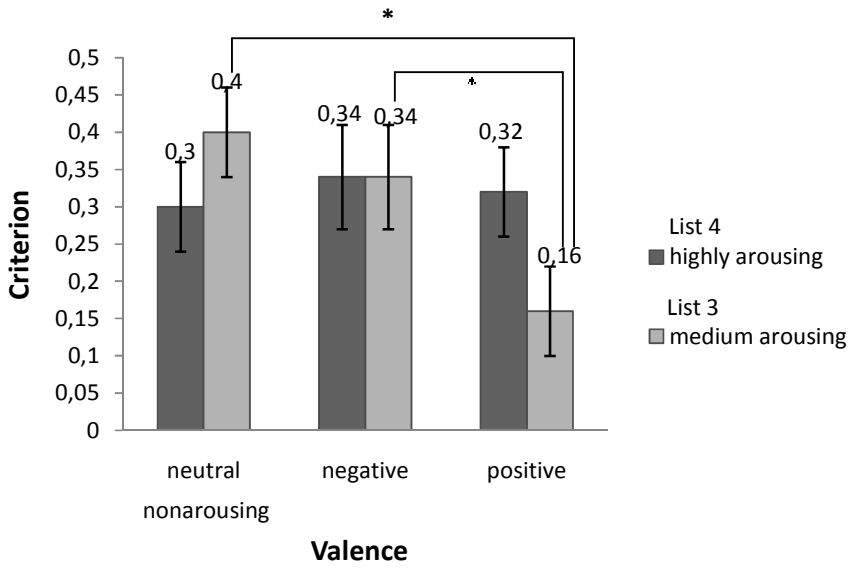


**Figure 4.10.** Arousal x Valence interaction effect on criterion values. Error bars represent standard error. To show the significant results, the asterisk is used.

The age x arousal interaction did not found significantly. The age x arousal x valence 3-way interaction on criterion values also did not reach conventional levels of significance.

### 4.1.5 Analyses for Overall Bias as a Function of Age

In order to detect a difference concerning criterion values at young and older participants, independent t-tests were performed. In this analysis, the criterion values of all words were calculated based on SDT. To do that, each participants' responses towards all words were combined. According to the results, the criterion values of the young participants (M= .29, SD = .38) was not significantly different from the criterion values of the older participants (M= .32, SD = .44), t(111) = -.38, p>.05.

### 4.1.6 Analyses for Reaction Times as a Function of Age, Emotional Valence Level and Emotional Arousal Level

Reaction times were calculated for all studied (or old) and unstudied (or new) words of three categories (i.e., positive, negative and neutral nonarousing words). In order to compare the effects of age (young and older), valence (negative, positive, neutral nonarousing), arousal (high and medium), a 2 x 3 x 2 mixed ANOVA was performed on mean reaction times (RTs). First of all, means and standard deviations of reaction times for the studied words are presented in Table 4.7.

**Tablo 4.7.** Means and standard deviations of reaction times (msec) for the studied words as a function of age (young and older), emotional valence level (positive, negative and neutral nonarousing) and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Valence** | | |
|---|---|---|---|---|
| **Age Group** | **Arousal** | Positive | Negative | Neutral Nonarousing |
| Young Participants | List 4 - Highly Arousing (n=31) | 1457.72 (414.72) | 1410.24 (371.89) | 1432.57 (442.83) |
| | List 3 - Medium Arousing (n=29) | 1447.26 (392.15) | 1503.25 (483.13) | 1654.77 (616.77) |
| Older Participants | List 4 - Highly Arousing (n=29) | 2314.62 (1270.89) | 2299.61 (953.56) | 2277.46 (1169.91) |
| | List 3 - Medium Arousing (n=24) | 2289.01 (911.49) | 2186.80 (810.22) | 2274.48 (772.58) |

Note. Values in parentheses represent standard deviation

According to the results of ANOVA applied to RTs for studied words, only a main effect of age group, $\underline{F}(1,109) = 33.70$, $p = .000$, $\eta_\rho^2 = .24$ was found. The older participants ($\underline{M}$ =2273.67) responded slower than the young participants ($\underline{M}$ = 1484.30). However, there was no main effect of valence. Namely, there was not any significant difference between the total RTs of positive ($\underline{M}$ = 1877.15), negative ($\underline{M}$ = 1849.98) and neutral nonarousing ($\underline{M}$ = 1909.82) old words. There was also no main effect of arousal. So, there was not any significant difference between the total RTs of highly arousing ($\underline{M}$ = 1865.37), and medium arousing ($\underline{M}$ = 1892.60) old words.

There was no interaction effect of age and valence. There was also no interaction effect of arousal and valence. There was no interaction effect of age and arousal. There was no 3-way interaction effect of age, valence, and arousal (see Figure 4.11.).

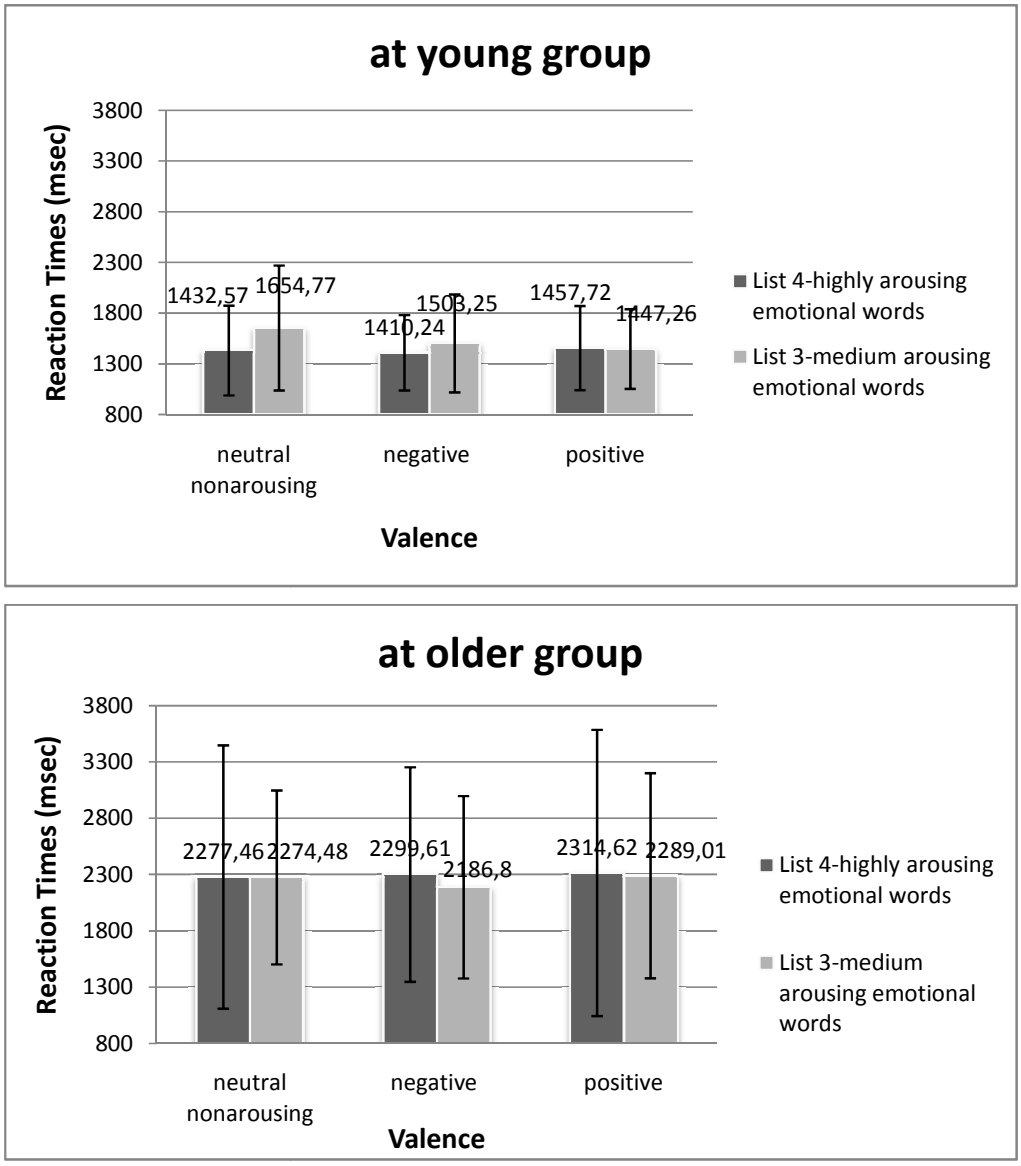


**Figure 4.11.** Mean RTs of young and older participants for studied words as a function of valence and arousal. Error bars represent standard error.

Secondly, means and standard deviations of reaction times for the unstudied words are summarized in Table 4.8.

**Tablo 4.8.** Means and standard deviations of reaction times (msec) for the unstudied words as a function of age (young and older), emotional valence level (positive, negative and neutral nonarousing) and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Valence** | | |
|---|---|---|---|---|
| **Age Group** | **Arousal** | Positive | Negative | Neutral Nonarousing |
| Young Participants | List 4 - Highly Arousing (n=31) | 1493.92 (514.99) | 1496.62 (627.33) | 1476.62 (420.46) |
| | List 3 - Medium Arousing (n=29) | 1445.60 (487.06) | 1586.63 (514.29) | 1538.48 (570.64) |
| Older Participants | List 4 - Highly Arousing (n=29) | 2361.23 (957.21) | 2407.89 (1477.22) | 2475.91 (1377.53) |
| | List 3 - Medium Arousing (n=24) | 2192.22 (831.41) | 2173.69 (904.49) | 2414.78 (675.89) |

Note. Values in parentheses represent standard deviation

According to the results of 2 x 3 x 2 mixed ANOVA applied to total RTs for unstudied words, only a main effect of age group, $\underline{F}(1,109) = 31.40$, $p = .000$, $\eta_p^2 = .22$ was found. The older participants ($\underline{M} = 2337.62$) responded slower than the young participants ($\underline{M} = 1506.31$). However, there was no main effect of valence. Namely, there was not any significant difference between the total RTs of positive ($\underline{M} = 1873.24$), negative ($\underline{M} = 1914.21$) and neutral

nonarousing (M = 1976.45) new words. There was also no main effect of arousal. So, there was not any significant difference between the total RTs of highly arousing (M = 1952.03), and medium arousing (M = 1891.90) new words.

There was no interaction effect of age and valence. There was also no interaction effect of arousal and valence. There was no interaction effect of age and arousal. There was no 3-way interaction effect of age, valence, and arousal (see Figure 4.12.).

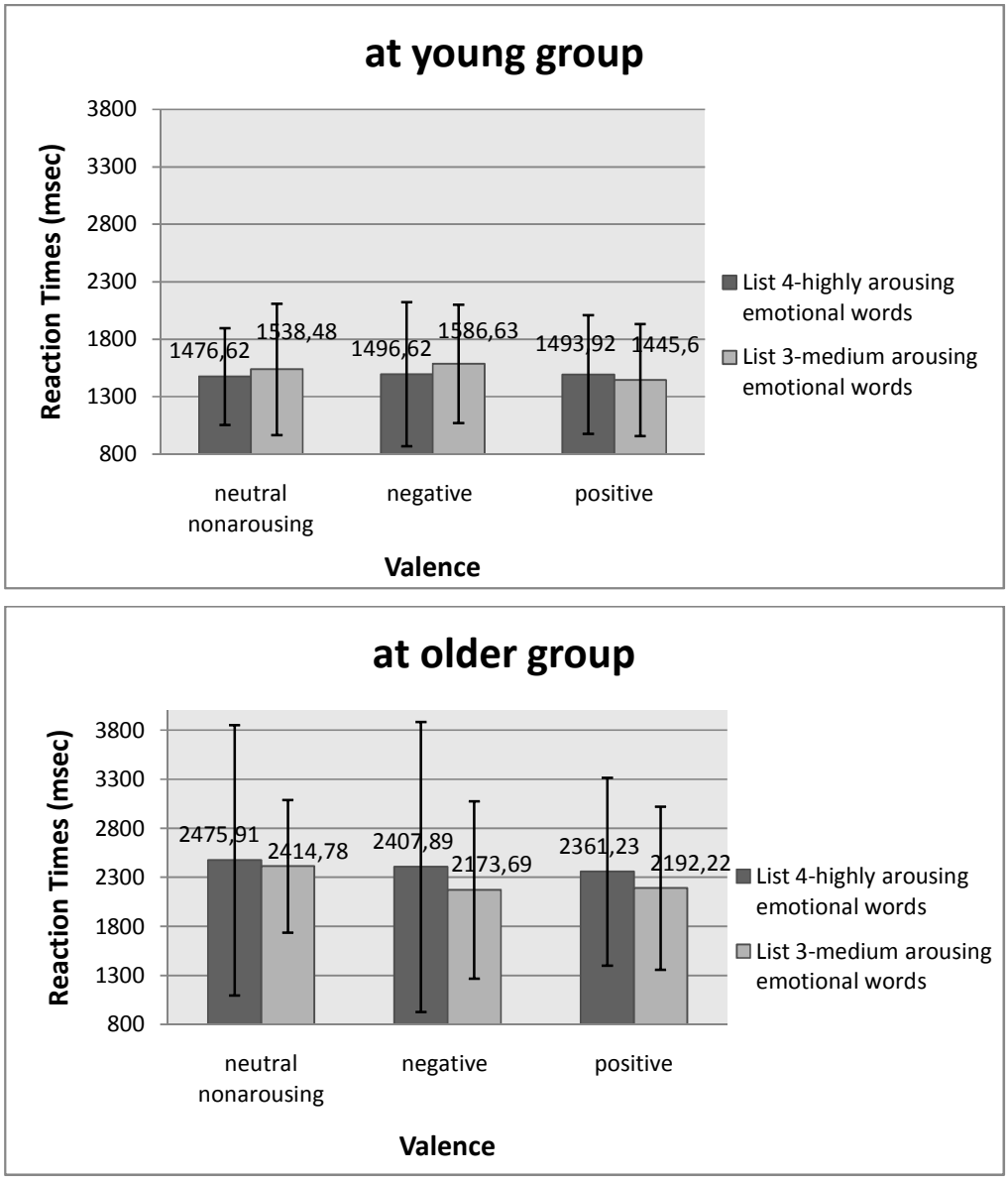


**Figure 4.12.** Mean RTs of young and older participants for unstudied words as a function of valence and arousal. Error bars represent standard error.

### 4.1.7 Analyses for Recognition Accuracy (d' Scores) as a Function of Age, Emotionality and Emotional Arousal Level

In addition to emotional valence level, it is also essential to evaluate recognition memory for emotional and nonemotional words in the participants. For this reason, a 2 x 2 x 2 mixed ANOVA was performed on recognition accuracy (d' scores) in order to compare the effects of age (young and older), emotionality (emotional and nonemotional), arousal (high and medium). Mauchly's test indicated that the assumption of sphericity had been violated for the dependent variable, d' scores; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. The means and standard deviations of recognition accuracy (d') are presented in Table 4.9.

**Table 4.9.** Means and standard deviations of recognition accuracy (d') as a function of age (young and older), emotionality (emotional and nonemotional words), and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Emotionality** | |
|---|---|---|---|
| **Age Group** | **Arousal** | Emotional Words | Nonemotional Words |
| Young Participants | List 4 - Highly Arousing (n=31) | 1.41 (.51) | 1.02 (.58) |
| | List 3 - Medium Arousing (n=29) | 1.62 (.59) | 1.72 (.82) |
| Older Participants | List 4 - Highly Arousing (n=29) | .80 (.54) | .87 (.43) |
| | List 3 - Medium Arousing (n=24) | 1.01 (.63) | .94 (50) |

Note. Values in parentheses represent standard deviation

Results indicated a main effect of age on d' scores, $\underline{F}(1, 109) = 33.95$, $p = .000$, $\eta_\rho^2 = .24$, reflecting greater recognition accuracy at young participants ($\underline{M}=1.44$) as compared to older participants ($\underline{M}=.91$). The analysis also showed a significant main effect of arousal on d' scores, $\underline{F}(1, 109) = 10.60$, $p < .05$, $\eta_\rho^2 = .09$. Pairwise comparisons analyses revealed that the difference between the mean recognition of medium arousing words ($\underline{M}=1.33$) and the mean recognition of highly arousing words ($\underline{M}=1.03$) was found significant. Namely, medium arousing words were recognized accurately than highly arousing words. However, the main effect of emotionality on d' scores did not reach conventional levels of significance, revealing that there was no

significant difference between the mean recognition of emotional words (M=1.21) and nonemotional words (M=1.14).

When interaction effects are evaluated, the emotionality x age interaction did not found significantly. Similarly, the emotionality x arousal interaction did not found significantly. The age x arousal interaction on d' scores did not reach conventional levels of significance.

On the other hand, the results for age x emotionality x arousal mixed ANOVA indicated a significant 3-way interaction effect of d' scores, $F(1, 109) = 6.63$, $p < .05$, $\eta_\rho^2 = .06$ (see Figure 4.13.). Further paired samples t-tests by using Holm's Sequential Bonferroni correction technique showed that young participants recognized highly arousing emotional words (M=1.41) more accurately than nonemotional words (M=1.02)- used in the highly arousing group, $t(30) = 2.92$, $p=.007$. Young participants also recognized nonemotional words (M=1.72) used in the medium arousing group more accurately than nonemotional words (M=1.02) used in the highly arousing group, $t(28) = 4.09$, $p=.000$. Other comparisons were not found significant at young group. On the other hand, at older group, the comparisons regarding emotionality and arousal groups were not found significant.

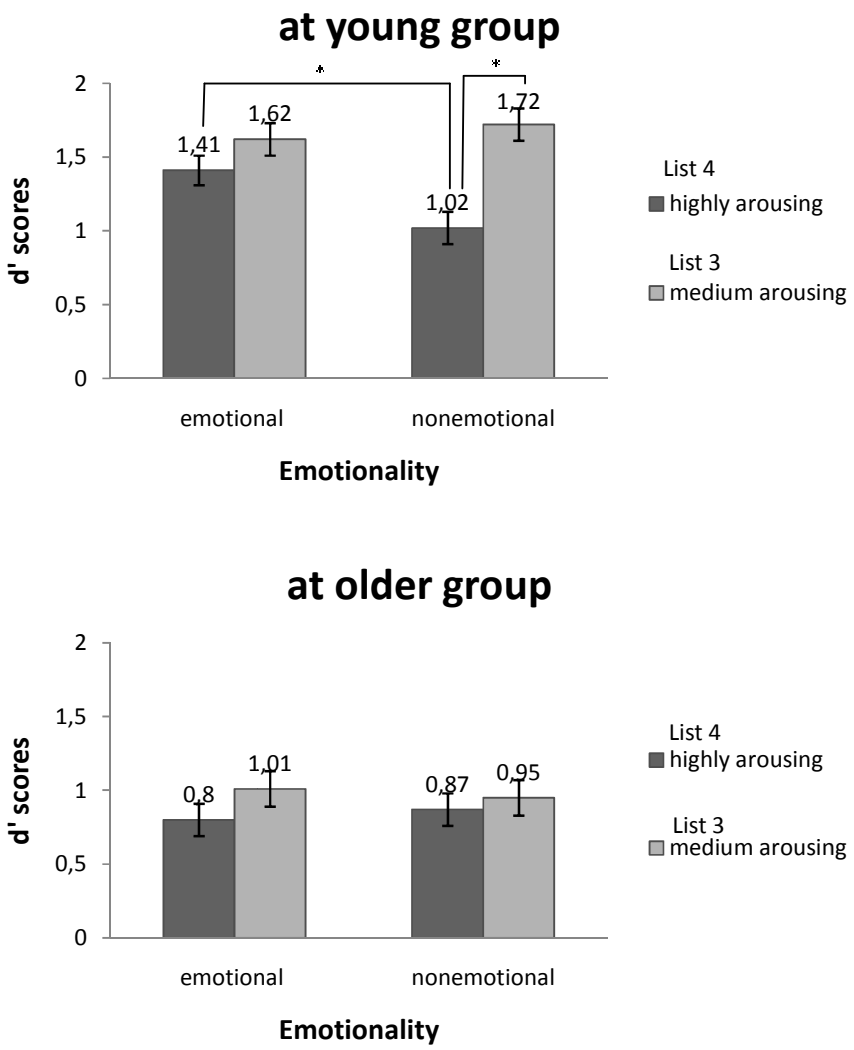


**Figure 4.13.** Age x Emotionality x Arousal 3-way interaction effect on d' scores. Error bars represent standard error. To show the significant results, the asterisk is used.

### 4.1.8 Analyses for Hit Rates as a Function of Age, Emotionality and Emotional Arousal Level

In order to compare the effects of age, emotionality and arousal, a 2 x 2 x 2 ANOVA was conducted on the hit rates. Mauchly's test indicated that the

assumption of sphericity had been violated for the dependent variable, hit rates; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. The means and standard deviations of hit rates are presented in Table 4.10.

**Table 4.10.** Means and standard deviations of proportions of hit responses as a function of age (young and older), emotionality (emotional and nonemotional words) and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Emotionality** | |
|---|---|---|---|
| **Age Group** | **Arousal** | Emotional Words | Nonemotional Words |
| Young Participants | List 4 - Highly Arousing (n=31) | .64 (.18) | .58 (.17) |
| | List 3 - Medium Arousing (n=29) | .70 (.15) | .65 (.20) |
| Older Participants | List 4 - Highly Arousing (n=29) | .52 (.17) | .54 (.18) |
| | List 3 - Medium Arousing (n=24) | .58 (.18) | .53 (.17) |

Note. Values in parentheses represent standard deviation

Results yielded a main effect of age on hit rates, $\underline{F}(1, 109) = 10.23$, $p = .002$, $\eta_\rho^2 = .09$, reflecting greater proportion of "old" responses given to studied words at young participants ($\underline{M} = .64$) as compared to older participants ($\underline{M} = .54$). The analysis also showed a significant main effect of emotionality on hit rates, $\underline{F}(1, 109) = 7.71$, $p = .006$, $\eta_\rho^2 = .07$. Pairwise comparisons revealed that emotional words ($\underline{M} = .61$) were recognized better than nonemotional

words (M=.57). However, there was no main effect of arousal. Namely, hit scores for highly (M=.57) and medium arousing words (M=.61) did not significantly differ from each other.

The age x emotionality 2-way interaction did not found significantly. The emotionality x arousal 2-way interaction did not found significantly, either. The age x arousal interaction on hits also did not reach conventional levels of significance. The results for age x emotionality x arousal mixed ANOVA did not indicate a significant 3-way interaction effect of hits.

### 4.1.9 Analyses for False Alarm Rates as a Function of Age, Emotionality and Emotional Arousal Level

False alarm rates were statistically evaluated with a mixed ANOVA with age group, emotionality, and arousal. Mauchly's test indicated that the assumption of sphericity had been violated for the dependent variable, false alarm rates; therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity. The means and standard deviations of hit rates are presented in Table 4.11.

**Table 4.11.** Means and standard deviations of proportions of false alarm responses as a function of age (young and older), emotionality (emotional and nonemotional words) and emotional arousal level (highly and medium)

| N=113 (60 young, 53 older) | | **Emotionality** | |
|---|---|---|---|
| **Age Group** | **Arousal** | Emotional Words | Nonemotional Words |
| Young Participants | List 4 - Highly Arousing (n=31) | .18 (.12) | .25 (.17) |
| | List 3 - Medium Arousing (n=29) | .17 (.11) | .12 (.10) |
| Older Participants | List 4 - Highly Arousing (n=29) | .26 (.17) | .26 (.16) |
| | List 3 - Medium Arousing (n=24) | .25 (.17) | .23 (.15) |

Note. Values in parentheses represent standard deviation

The analysis showed a significant main effect of age on false alarm rates, $\underline{F}(1, 109) = 7.65$, $p = .007$, $\eta_\rho^2 = .07$. Older participants ($\underline{M} = .25$) made more false alarms than young participants ($\underline{M} = .18$). However, there was no main effect of emotionality. Namely, false alarm scores for emotional ($\underline{M} = .22$), and nonemotional words ($\underline{M} = .22$) did not significantly differ from each other. Similarly, there was no main effect of arousal. Namely, false alarm scores for highly ($\underline{M} = .24$) and medium arousing words ($\underline{M} = .19$) did not significantly differ from each other.

Results for emotionality x arousal mixed ANOVA indicated a significant interaction effect of false alarm rates, $\underline{F}(1,109) = 8.07$, $p = .005$, $\eta_\rho^2 = .07$ (see

Figure 4.14.). Further paired samples t-tests revealed that mean false alarm rates for medium arousing emotional words (M=.21) did significantly differ from nonemotional words at the medium arousing group (M=.18), t(52) = 2.32, p=.02. Furthermore, mean false alarm rates for nonemotional words at the highly arousing group (M=.26) was found significantly higher than mean false alarm rates for nonemotional words at the medium arousing group (M=.18), t(52) = 3.56, p=.001. Other comparisons were not found significant.

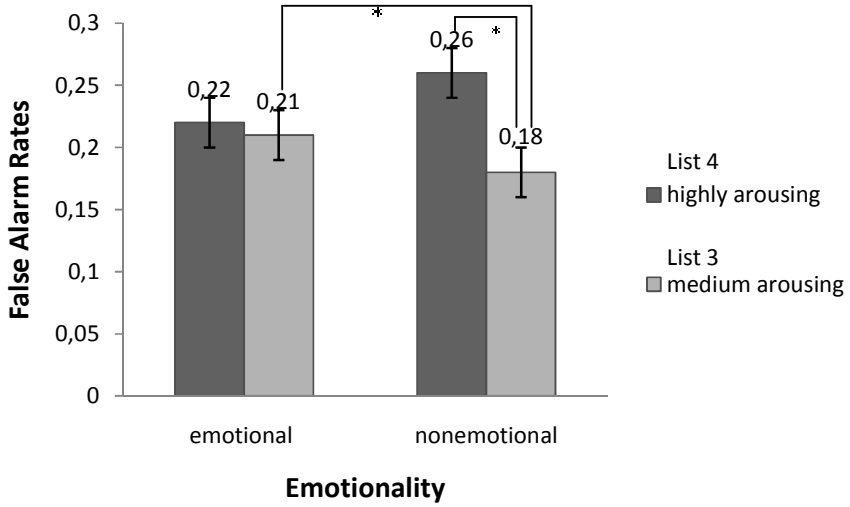


**Figure 4.14.** Emotionality x Arousal interaction effect on false alarm rates. Error bars represent standard error. To show the significant results, the asterisk is used.

Results for age x emotionality mixed ANOVA did not indicate a significant interaction effect of false alarm rates. The age x arousal interaction was not found significantly, either. The age x arousal x emotionality 3-way interaction on false alarm response also did not reach conventional levels of significance.

## 4.2 Analyses for the Relation between Memory Performance and Current Mood State

In order to examine how well PANAS dimensions (i.e., positive and negative affects) of mood predict d' scores (recognition accuracy) and hit rates of the participants, simple linear regression analyses were performed. First of all, in order to eliminate age effect, statistical analyses were applied to young and older participants, separately. The means and standard deviations of PANAS scores are presented in Table 4.12.

**Table 4.12.** Means and standard deviations for PANAS (PA-Positive affect and NA-Negative affect) of the young and older sample

| N=113 | Young Participants n=60 | | Older Participants n=53 | |
|---|---|---|---|---|
| | **PA** | **NA** | **PA** | **NA** |
| **Mean** | 33.80 | 19.80 | 34.30 | 15.98 |
| **SD** | 5.90 | 6.13 | 5.92 | 4.62 |
| Possible Range | 10-50 | 10-50 | 10-50 | 10-50 |

First of all, in order to detect a difference concerning PA and NA scores at young and older participants, independent t-tests were performed. According to the results, older participants experienced somewhat greater positive affect ($\underline{M}$=34.40, SD = 5.92), than young participants did ($\underline{M}$ = 33.80, SD = 5.90). However, this difference was not significant, $t(111) = -.45$, $p>.05$.

On the other hand, young participants experienced greater negative affect (M=19.80, SD =6.13), than older participants did (M =15.98, SD = 4.62) and this difference was significant, t(111) = 3.70, p=.000.

So as to evaluate the prediction of d' scores (of positive and negative words) from the PANAS scores for young participants, a linear regression analysis was conducted. The results indicated that the variables were not linearly related (Table 4.13). Namely, PA dimension did not predict d' scores of positive words (F(1,58)=.13, p=.72). The sample simple correlation coefficient was .05. Similarly, NA dimension did not predict d' scores of negative words (F(1,58)=1.20, p=.28) for young participants. The sample simple correlation coefficient was .14. Further, a linear regression analysis was conducted again so as to evaluate the prediction of hit rates (of positive and negative words) from the PANAS scores for young participants. The results indicated that the variables were not linearly related. Namely, PA dimension did not predict hit rates of positive words (F(1,58)=.001, p=.97). The sample simple correlation coefficient was .005. Similarly, NA dimension did not predict hit rates of negative words (F(1,58)=.05, p=.83) for young participants. The sample simple correlation coefficient was .03.

**Table 4.13.** Results of linear regression analyses for memory performance and PANAS in young adults

| | Unstandardized Coefficients | | Standardized Coefficients |
|---|---|---|---|
| d' for positive | B | Std. Error | Beta |
| Constant | 1.67 | .09 | |
| Positive Affect Score | -.03 | .09 | -.05[n.s.] |
| | Unstandardized Coefficients | | Standardized Coefficients |
| d' for negative | B | Std. Error | Beta |
| Constant | 1.38 | .07 | |
| Negative Affect Score | -.08 | .07 | -.14[n.s.] |
| | Unstandardized Coefficients | | Standardized Coefficients |
| hits for positive | B | Std. Error | Beta |
| Constant | .67 | .03 | |
| Positive Affect Score | .00 | .03 | .01[n.s.] |
| | Unstandardized Coefficients | | Standardized Coefficients |
| hits for negative | B | Std. Error | Beta |
| Constant | .66 | .02 | |
| Negative Affect Score | -.01 | .02 | -.03[n.s.] |

Note. n.s. nonsignificant

For older participants, a linear regression analysis was performed to evaluate the prediction of d' scores (of positive and negative words) from the PANAS scores. The results yielded that the variables were not linearly related (Table 4.14). Namely, PA dimension did not predict d' scores of positive words ($F(1,51)=.10$, $p=.75$). The sample simple correlation coefficient was .05.

Similarly, NA dimension did not predict d' scores of negative words ($F(1,51)=1.62$, $p=.21$) for young participants. The sample simple correlation coefficient was .18. Further, a linear regression analysis was conducted again so as to evaluate the prediction of hit rates (of positive and negative words) from the PANAS scores for young participants. The results declared that the variables were not linearly related. Namely, PA dimension did not predict hit rates of positive words ($F(1,51)=.17$, $p=.68$). The sample simple correlation coefficient was .06. Similarly, NA dimension did not predict hit rates of negative words ($F(1,51)=.34$, $p=.57$) for young participants. The sample simple correlation coefficient was .08.

**Table 4.14.** Results of linear regression analyses for memory performance and PANAS in older adults

| | Unstandardized Coefficients | | Standardized Coefficients |
|---|---|---|---|
| d′ for positive | B | Std. Error | Beta |
| Constant | .93 | .10 | |
| Positive Affect Score | -.03 | .10 | -.04[n.s.] |
| | Unstandardized Coefficients | | Standardized Coefficients |
| d′ for negative | B | Std. Error | Beta |
| Constant | .90 | .09 | |
| Negative Affect Score | .11 | .09 | .18[n.s.] |
| | Unstandardized Coefficients | | Standardized Coefficients |
| hits for positive | B | Std. Error | Beta |
| Constant | .60 | .03 | |
| Positive Affect Score | .01 | .03 | .06[n.s.] |
| | Unstandardized Coefficients | | Standardized Coefficients |
| hits for negative | B | Std. Error | Beta |
| Constant | .49 | .03 | |
| Negative Affect Score | .02 | .03 | .08[n.s.] |

Note. n.s. nonsignificant

## 4.3 Analyses for the Relation between Memory Performance and Personality Characteristics

In order to examine how well personality dimensions (i.e., extraversion, agreeableness, conscientiousness, neuroticism and openness to experience) predict d' scores (recognition accuracy), and hit rates of the participants, simple linear regression analyses were performed.

Again, statistical analyses were applied to young and older participants, separately so as to eliminate age group effect. Means and standard deviations of personality characteristics for the young and older sample can be seen in Table 4.15.

**Table 4.15.** Means and standard deviations of personality characteristics for the young and older sample

| N=113 | E | A | C | N | OE |
|---|---|---|---|---|---|
| Young Adults n=60 | M= 3.68 (.75) | M= 3.84 (.69) | M= 3.33 (.45) | M= 2.53 (.63) | M= 4.29 (.35) |
| Older Adults n=53 | M= 3.27 (.77) | M= 4.10 (.61) | M= 3.71 (.54) | M= 2.25 (.76) | M= 4.20 (.37) |

Note. Values in parentheses represent standard deviations.
E. Extraversion
A. Agreeableness
C. Conscientiousness
N. Neuroticism
OE. Openness to Experience

First of all, in order to detect a difference concerning extraversion, agreeableness, conscientiousness, neuroticism and openness to experience scores at young and older participants, independent t-tests were performed, respectively.

According to the results, the young participants' extraversion scores (M =3.68, SD = .75) were significantly higher than the older participants' extraversion scores (M =3.27, SD = .77), t(111) = 2.87, p=.005. On the other hand, the older participants' agreeableness scores (M =4.10, SD = .61) were significantly higher than the young participants' agreeableness scores (M =3.84, SD = .69), t(111) = 2.09, p<.05. Similarly, the older participants' conscientiousness scores (M =3.71, SD = .54) were significantly higher than the young participants' conscientiousness scores (M =3.33, SD = .45), t(111) = 4.15, p=.000. Besides, the young participants' neuroticism scores (M =2.53, SD = .63) were significantly higher than the older participants' neuroticism scores (M =2.25, SD = .76), t(111) = 2.12, p<.05. However, openness to experience scores of the young participants (M =4.29, SD = .35) and older participants (M =4.20, SD = .37) did not differ from each other significantly, t(111) = 1.30, p=.20.

In order to evaluate the prediction of d' scores and hit rates (of positive, negative and neutral nonarousing words) from the extraversion, agreeableness, conscientiousness, neuroticism, openness to experience dimensions of 5FPI scores for young and older participants, linear regression analyses were conducted. The results are summarized in Table 4.16.

**Table 4.16.** Summary of the results of simple regression analyses for the relation between memory performance and personality characteristics

| **Young Adults** | **Recognition Memory Scores** | | | | | |
|---|---|---|---|---|---|---|
| **5FPI Dimensions** | **d' scores** | | | **Hit rates** | | |
| | **Positive** | **Negative** | **Neutral** | **Positive** | **Negative** | **Neutral** |
| **Extraversion** | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |
| **Agreeableness** | n.s. | * | * | n.s. | n.s. | n.s. |
| **Conscientiousness** | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |
| **Neuroticism** | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |
| **Openness to Experience** | ** | n.s. | * | n.s. | n.s. | n.s. |
| **Older Adults** | **Recognition Memory Scores** | | | | | |
| **5FPI Dimensions** | **d' scores** | | | **Hit rates** | | |
| | **Positive** | **Negative** | **Neutral** | **Positive** | **Negative** | **Neutral** |
| **Extraversion** | n.s. | n.s. | * | n.s. | n.s. | n.s. |
| **Agreeableness** | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |
| **Conscientiousness** | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |
| **Neuroticism** | n.s. | n.s. | * | n.s. | n.s. | n.s. |
| **Openness to Experience** | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. |

Notes. *p< .05, **p< .01, n.s. nonsignificant

### 4.3.1 Memory Performance and Extraversion Dimension of 5FPI

In order to evaluate the prediction of d' scores and hit rates (of positive, negative and neutral nonarousing words) from the extraversion dimension of 5FPI scores for young and older participants, a linear regression analysis was conducted. Only significant results are reported in detail in Table 4.17. The results indicated that the variables were not linearly related. Namely, extraversion dimension did not predict d' scores of positive words ($F(1,58)=.02$, $p=.91$) for young participants. The sample simple correlation coefficient was .02. Similarly, extraversion dimension did not predict d' scores of negative words ($F(1,58)=.05$, $p=.83$), d' scores of neutral nonarousing words ($F(1,58)=.30$, $p=.59$), hit rates of positive words ($F(1,58)=.44$, $p=.51$), hit rates of negative words ($F(1,58)=.31$, $p=.58$), and hit rates of neutral nonarousing words ($F(1,58)=1.56$, $p=.22$) for young participants. The sample simple correlation coefficients were .03, .07, .09, .07, and .16 respectively. For older adults, extraversion dimension did not predict d' scores of positive words ($F(1,51)=1.68$, $p=.08$). The sample simple correlation coefficient was .24. Similarly, extraversion dimension did not predict d' scores of negative words ($F(1,51)=2.56$, $p=.12$). The sample simple correlation coefficient was .22. On the other hand, extraversion dimension predicted d' scores of neutral nonarousing words ($F(1,51)=4.37$, $p<.05$), $t(51)=-2.09$, $p<.05$ for older sample. The sample simple correlation coefficient was .28. For older adults, extraversion dimension did not predict hit rates of positive words ($F(1,51)=.01$, $p=.92$), hit rates of negative words ($F(1,51)=.02$, $p=.89$), and hit rates of neutral nonarousing words ($F(1,51)=.06$, $p=.80$). The sample simple correlation coefficients were .01, .02, and .04, respectively.

**Table 4.17.** The significant results of linear regression analyses for memory performance and extraversion dimension of the 5FPI in young and older adults

| In Older Adults | Unstandardized Coefficients | | Standardized Coefficients |
|---|---|---|---|
| d' for neutral nonarousing | B | Std. Error | Beta |
| Constant | .90 | .06 | |
| Extraversion | -.13 | .06 | -.28 * |

Note. * p<.05

### 4.3.2 Memory Performance and Agreeableness Dimension of 5FPI

In order to evaluate the prediction of d' scores and hit rates (of positive, negative and neutral nonarousing words) from the agreeableness dimension of 5FPI scores for young and older participants, a linear regression analysis was conducted. Only significant results are reported in detail in Table 4.18. Based on the results, agreeableness dimension did not predict d' scores of positive words ($F(1,58)=.92$, $p=.34$) for young participants. The sample simple correlation coefficient was .13. On the other hand, agreeableness dimension predicted d' scores of negative words ($F(1,58)=4.33$, $p<.05$), $t(58)= 2.08$, $p<.05$ and d' scores of neutral nonarousing words ($F(1,58)=5.99$, $p<.05$), $t(58)= 2.45$, $p<.05$ for young participants. The sample simple correlation coefficients were .26 and .31 respectively. However, agreeableness dimension did not predict hit rates of positive words ($F(1,58)=.03$, $p=.87$), hit rates of negative words ($F(1,58)=.47$, $p=.50$) and hit rates of neutral nonarousing words ($F(1,58)=2.39$, $p=.13$) for young participants. The sample simple correlation coefficients were .02, .09 and .20 respectively. For older participants, agreeableness dimension did not predict d' scores of positive words ($F(1,51)=.24$, $p=.63$), d' scores of negative words ($F(1,51)=.03$, $p=.87$), d'

scores of neutral nonarousing words (F(1,51)=.57, p=.46), hit rates of positive words (F(1,51)=.64, p=.43), hit rates of negative words (F(1,51)=.04, p=.85), and hit rates of neutral nonarousing words (F(1,51)=2.17 p=.15). The sample simple correlation coefficients were .07, .02, .11, .11, .03 and .20 respectively.

**Table 4.18.** The significant results of linear regression analyses for memory performance and agreeableness dimension of the 5FPI in young and older adults

| In Young Adults | Unstandardized Coefficients | | Standardized Coefficients |
|---|---|---|---|
| d' for negative | B | Std. Error | Beta |
| Constant | 1.38 | .07 | |
| Agreeableness | .15 | .07 | .26 * |
| In Young Adults | Unstandardized Coefficients | | Standardized Coefficients |
| d' for neutral nonarousing | B | Std. Error | Beta |
| Constant | 1.36 | .10 | |
| Agreeableness | .24 | .10 | .31 * |

Note. * p<.05

### 4.3.3 Memory Performance and Conscientiousness Dimension of 5FPI

In order to evaluate the prediction of d' scores and hit rates (of positive, negative and neutral nonarousing words) from the conscientiousness dimension of 5FPI scores for young and older participants, a linear regression analysis was conducted. For young participants, conscientiousness dimension did not predict d' scores of positive words (F(1,58)=.17, p=.68), d' scores of negative words (F(1,58)=2.17, p=.15), d'

scores of neutral nonarousing words (F(1,58)=.18, p=.67), hit rates of positive words (F(1,58)=.03, p=.87), hit rates of negative words (F(1,58)=.40, p=.53), and hit rates of neutral nonarousing words (F(1,58)=.45, p=.51). The sample simple correlation coefficients were .05, .19, .06, .02, .08 and .09 respectively. For older participants, conscientiousness dimension did not predict d' scores of positive words (F(1,51)=.31, p=.58), d' scores of negative words (F(1,51)=.01, p=.94), d' scores of neutral nonarousing words (F(1,51)=1.02, p=.32), hit rates of positive words (F(1,51)=.01, p=.94), hit rates of negative words (F(1,51)=.69, p=.41), and hit rates of neutral nonarousing words (F(1,51)=.02 p=.90). The sample simple correlation coefficients were .08, .01, .14, .01, .12 and .02, respectively. Since there are not any significant results, the table is not drawn for this dimension.

### 4.3.4 Memory Performance and Neuroticism Dimension of 5FPI

In order to evaluate the prediction of d' scores and hit rates (of positive, negative and neutral nonarousing words) from the neuroticism dimension of 5FPI scores for young and older participants, a linear regression analysis was conducted. Only significant results are reported in detail in Table 4.19. For young participants, neuroticism dimension did not predict d' scores of positive words (F(1,58)=.10, p=.76), d' scores of negative words (F(1,58)=2.25, p=.14), d' scores of neutral nonarousing words (F(1,58)=.49, p=.49), hit rates of positive words (F(1,58)=.03, p=.86), hit rates of negative words (F(1,58)=.10, p=.75), and hit rates of neutral nonarousing words (F(1,58)=.38, p=.54). The sample simple correlation coefficients were .04, .19, .09, .02, .04 and .08, respectively. For older participants, neuroticism dimension only predicted d' scores of neutral nonarousing words (F(1,51)=5.64, p<.05), t(51)= 2.37, p<.05. The sample simple correlation coefficient was .32. However, neuroticism dimension did not predict d' scores of positive words

(F(1,51)=.05, p=.82), d' scores of negative words (F(1,51)=1.33, p=.25), hit rates of positive words (F(1,51)=.85, p=.36), hit rates of negative words (F(1,51)=.11, p=.74), and hit rates of neutral nonarousing words (F(1,51)=.01, p=.92). The sample simple correlation coefficients were .03, .16, .13, .05, and .01, respectively.

**Table 4.19.** The significant results of linear regression analyses for memory performance and neuroticism dimension of the 5FPI in young and older adults

| In Older Adults | Unstandardized Coefficients | | Standardized Coefficients |
|---|---|---|---|
| d' for neutral nonarousing | B | Std. Error | Beta |
| Constant | .90 | .06 | |
| Agreeableness | .15 | .06 | .32 * |

Note. * p<.05

### 4.3.5 Memory Performance and Openness to Experience Dimension of 5FPI

In order to evaluate the prediction of d' scores and hit rates (of positive, negative and neutral nonarousing words) from the openness to experience dimension of 5FPI scores for young and older participants, a linear regression analysis was conducted. Only significant results are reported in detail in Table 4.20. For young participants, openness to experience dimension predicted d' scores of positive words, F(1,58)=11.31, p=.001, t(58)= 3.36, p=.001, and d' scores of neutral nonarousing words, F(1,58)=4.81, p<.05, t(58)= 2.19, p<.05. The sample simple correlation coefficients were .40 and .28, respectively. However, openness to experience dimension did not predict d' scores of negative words (F(1,58)=2.90, p=.09), hit rates of positive words (F(1,58)=1.44, p=.24), hit rates of negative words (F(1,58)=.05, p=.82), and hit

rates of neutral nonarousing words (F(1,58)=1.36, p=.25). The sample simple correlation coefficients were .22, .16, .03, and .15, respectively. On the other hand, for older participants, openness to experience dimension did not predict d' scores of positive words (F(1,51)=.57, p=.46), d' scores of negative words (F(1,51)=.01, p=.92), d' scores of neutral nonarousing words (F(1,51)=.6, p=.80), hit rates of positive words (F(1,51)=3.01, p=.09), hit rates of negative words (F(1,51)=.12, p=.73), and hit rates of neutral nonarousing words (F(1,51)=2.46, p=.12). The sample simple correlation coefficients were .11, .02, .04, .24, .05 and .21, respectively.

**Table 4.20.** The significant results of linear regression analyses for memory performance and openness to experience dimension of the 5FPI in young and older adults

| In Young Adults | Unstandardized Coefficients | | Standardized Coefficients |
|---|---|---|---|
| d' for positive | B | Std. Error | Beta |
| Constant | 1.67 | .08 | |
| Agreeableness | .27 | .08 | .40 ** |
| In Young Adults | Unstandardized Coefficients | | Standardized Coefficients |
| d' for neutral nonarousing | B | Std. Error | Beta |
| Constant | 1.36 | .10 | |
| Agreeableness | .22 | .10 | .28 * |

Note. * p<.05, ** p<.001.

# CHAPTER 5

# DISCUSSION

In the current study, the effect of arousal and valence axes of emotion on incidentally encoded recognition memory were examined for emotional words selected from TÜDADEN (2011). Participants formed two different broad groups, young and older adults. The study was designed to reveal recognition memory differences for emotional words and to determine the variables that may possibly affect the system. For this purpose, memory was assessed with a surprise old/new recognition task and the participants' scores were calculated from hit and false alarm responses. In addition to hit and false alarm responses, d-prime scores were treated as dependent variable. Since these three dependent variables are not independent of each other [*d-prime = z (Hit rates) – z (False alarm rates)*] congruent results between outcomes of the three dependent variables are to be expected.

Since the old/new recognition task was intended to be encoded incidentally, the participants were required to decide how many vowels each word contained within 2 seconds during the study session. The participants who were primed with old, emotional words and neutral words were required to discriminate the new, emotional words and neutral words from old ones in a surprise, explicit recognition task. All participants indicated which word had been on the study list and this measurement was treated as dependent variable.

Before entering the data into ANOVA analyses, one important criterion for exclusion was to detect the extreme 'yes' or 'no' responses of the participants. It was calculated by subtracting the proportion of 'the total no response' from the proportion of 'the total yes response' for each participant.

The curves which plot hits (sensitivity) against false alarms (1-specificity) were drawn for all participants. Sensitivity is the likelihood of identifying a studied item as studied when it is really present to the participants; on the other hand, specificity is the proportion of identifying an unstudied item as unstudied when it is really absent. For memory tests, there is usually a trade-off between these measures. This trade-off can be represented graphically as a receiver operating characteristic (ROC) curve. ROC curves are (see Figure 4.1 and 4.2 at Results section) constructed for the young and older participants to determine the data which would excluded from the data set. Data which were close to the chance level in terms of memory performance were not included.

Furthermore, mood states (positive and negative affects) and personality characteristics (openness to experience, agreeableness, conscientiousness, extraversion and neuroticism) were considered. We investigated how well these temporary (current mood state assessed by PANAS) and permanent dimensions (relatively, stable personality characteristics assessed by 5FPI) predict memory performances of the participants.

In this section, the results obtained from the experiments were discussed in the light of relevant literature. The findings related to word categories or age are discussed in terms of d-prime scores, hit rates and false alarm rates reported as parts of recognition memory performances. Since d-prime score is described as the accuracy of discrimination the old words from new words, it is also called '*recognition accuracy*'. In the current study, it is

calculated by using hit rates and false alarm rates based on signal detection theory (Yonelinas, 1994). Recognition accuracy, calculated as d' scores may decrease because of these two processes: (1) decline in hit rate; (2) increase in false alarm rates. Hit and false alarm rates are converted to z-scores separately and d' scores are calculated by subtracting z-scores of the false alarms from z-scores of the hit rates. For instance, a d' score can be found lower just because of lower hit rates although participant does not have any false alarm. Or a low d' score may due to high hit rates as well as high false alarms. Hence, it should not be established that hit rate is not more important than false alarm rate or, vice versa.

### 5.1 Aging Effect on Recognition Memory of Incidentally Encoded Words

As it can be remembered from 'results' section, the findings revealed that discrimination the old words from new words were significantly different across ages. In this respect, young participants were more accurate in discriminating the old words from new ones as compared to older participants. This expected finding was consistent with the literature indicating that recognition memory performance declined with aging, replicating the classic effect (Denburg, Tranel and Bechara, 2005; Dennis, Kim and Cabeza, 2007; Grady, 2000; Gutchess et al., 2005; Makris et al., 2007; Picq, 2007; Thapar and Rouder, 2009; van der Veen et. al., 2006). Moreover, the finding stated that age-related memory decrements reflect inefficiencies of incidental encoding. Hence, as hypothesized (H1), recognition memory performance for emotionally charged words under incidental encoding declined with aging.

Age main effect was also found on hit rates. More specifically, it was postulated that older adults are impaired in their ability to unconsciously encode the emotional words and then consciously recollect them. Since age-related losses are substantial in recognition memory tasks (Grady, 2000), the reduction in hit rates with aging was an expected result. The analysis on false alarm rates stated that older participants produced significantly more false alarm rates than young participants. Normal aging is associated with an increased tendency to make false recognition (Norman and Schacter, 1997). Due to the increment in false alarm rates and additionally the decrement in hit rates with aging, overall recognition accuracy declined. To sum up, age effect was observed for emotional words in the current study.

### 5.2 Valence Effect on Recognition Memory of Incidentally Encoded Words

There was a marginally significant valence main effect as indicated by d' scores that positive words were recognized more accurately than both negative and neutral nonarousing words. On the other hand, negative words could not be discriminated better than neutral words. Hence, emotional effect, in terms of valence axis of it, was only observed for positive words. Based on the recent literature, it had been hypothesized (H2) that positive and negative words were recognized more accurately than neutral nonarousing so our hypothesis was partially verified.

Secondly, when the hit rates were treated as dependent variable, it was found that positive words were better recognized than both negative and neutral words; while negative words could not be better recognized than neutral words. Based on the studies carried out, emotional words are better recognized than their neutral equivalents (Kensinger and Corkin, 2004; LaBar and Phelps, 1998). More specifically, the emotional enhancement is greater

for negative stimuli than positive ones (Kensinger, Garoff-Eaton and Schacter, 2007; Mickley and Kensinger, 2008). The findings of the current study were contradictory with the previously reported *'negativity bias'* indicating from an evolutionary perspective that negative information is more attended since it is more important not to miss negative than to miss positive information (Grossmann et al. 2005). In the present study, negative words encoded incidentally did not need to capture attention more than positive words. On the other hand, Fredrickson and Branigan (2005) stated that positive information has a possible advantage that it is naturally more salient than negative and neutral word so people show an automatic preference toward positive words. Hence, there is attention bias that is automatically driven toward positive words. Since the participants in the present study were not aware that the task they were doing was a memory task, indeed; automatic processing of the cognitive system was on duty. While encoding the words in the study session, participants did this unconsciously, metaphorically. That is, they did not have the conscious control to avoid from or approach to any type of word. Encoding is only one of three stages (encoding-storage and retrieval) of memory. In the present study, encoding was characterized by unawareness and automaticity due to the incidental encoding during the study session of the recognition memory task.

Lastly, the finding of false alarm rates showed that there was no valence main effect indicating that accepting the new words as old words was not influenced by emotional valence dimension of the words.

### 5.3 Arousal Effect on Recognition Memory of Incidentally Encoded Words

The results revealed that discrimination of the old words from new words were affected from the differences in arousal dimension of emotion. Particularly, medium arousing words were better discriminated rather than highly arousing ones. However, this significant main effect of arousal was not observed on hit rates. It is well-known that high arousing words boost memory since the process is automatic; on the contrary, medium arousing words need elaborative encoding strategies in the study session of experiment to be recognized in the test session (Kensinger and Corkin, 2004). In the present study, both high and medium arousing words were encoded without conscious attention. Thus, based on the recent literature, it had been hypothesized (H3) that participants would recognize high arousing words better than medium arousing words. Notwithstanding, this expected result in d' scores could not be obtained. Furthermore, the analysis on false alarm rates noted that there was no arousal main effect declaring that accepting the new words as old words was not influenced by emotional arousal dimension of the words.

As it was stated in the *'results section'*, the analyses on d-prime scores, hit and false alarm rates did not reveal a significant age x arousal 2-way interaction. In other words, d-prime scores, hit and false alarm rates of both age groups were not influenced by arousal levels (i.e. highly arousing and medium arousing). Furthermore, the analyses on d-prime scores and hit rates did not reveal a significant valence x arousal interaction. Namely, d-prime scores and hit rates of valence groups (i.e. positive, negative and neutral) were not influenced by arousal levels (i.e. highly arousing and medium arousing). On the contrary, according to our hypothesis (H3), we expected that highly arousing words would have been recognized more accurately than medium arousing. However, this hypothesis was not verified.

There are two possible explanations why the arousal effect we had hypothesized was not observed.

1. Incidental encoding is impartial to arousal manipulation in the verbal domain. However, further analysis revealed that highly arousing positive and negative words were less discriminated than medium arousing positive and negative words. The factor that could be responsible for this finding is that 'highly' arousing words could constrain attention resources and this could lead to decrement in memory performance. When the arousal level of stimuli is high, attentional resources, which requires deliberate and conscious processing cannot be used doing tasks. In other words, participants can not apply to their attentional resources when they encounter highly arousing stimuli.
2. There are experimental confounds in manipulating the arousal level of words. Although the arousal level means of the selected highly and medium arousing words were significantly different, this difference could not be enough to reveal different d-prime scores, hit and false alarm rates at both age groups. The words categorized as 'highly arousing' and 'medium arousing' might both be perceived as exciting and agitating. Since the words that can be categorized as 'low arousing' are limited at the database (that is, TÜDADEN, 2011), in the current study, there could not be any category consisting of 'low arousing' words. Alternatively, as opposed to pictures, words may not trigger high arousal. The highly and medium arousing words might both be perceived as non-arousing. When TÜDADEN was constructed, although subjects were able to classify these words as highly and medium arousing words, this did not mean that they also experienced high or medium arousal.

## 5.4 Positivity Bias and Negativity Bias in Older and Young Participants Respectively

As it was noted in the *'results section'*, the analysis on d-prime scores, hit rates and false alarm rates revealed a significant age x valence 2-way interaction effect. In order to examine the basis of the interaction effect, a series of pairwise t-tests were conducted. When paired samples t-tests were performed for the different age groups, it was found that young participants recognized positive words more accurately than negative and neutral words. There was no significant difference between the recognition accuracies of negative and neutral words. On the contrary, according to our hypothesis (H4), we expected that young participants recognized negative words better than positive words. This finding was inconsistent with the literature indicating that negative items are vividly remembered due to the increment in sensory processing operated by temporo-occipital regions (Mickley and Kensinger, 2008). There are also other related studies indicating that younger adults are more likely to recognize negative items (Kennedy, Mather and Carstensen, 2004; Mikels et al., 2005; Tapar and Rouder, 2009). Hence, based on the studies carried out on Western samples, *'negativity bias'* was widely observed in young samples but was not observed in the present study. Before the participants are included in the study, they were screened rigorously.[1] For instance, young participants were administered the Beck Depression Inventory and the participants who got 17 or higher scores were excluded. Furthermore, Positive and Negative Affect Schedule was another scale used in order to evaluate the current mood before the experiment. According to the scores, the young participants were more likely to exhibit *'positive affect'* because their positive affect scores were higher than negative

[1] In the memory literature, participants have been commonly selected from a population with no history of a neuropsychological or psychiatric disorder, and also with no taking medication affecting cognitive system. On the other hand, to the best of our knowledge, no study examined participants administering such a rigorous screening.

affect. All these factors could have resulted in recruiting a young sample consisted of individuals who had a *'positive'* tendency.

On another front, according to our hypothesis for the aging population (H5), we expected that the older participants would have recognized positive words more accurately than both negative ad neutral words. When paired samples t-tests were performed on d-prime scores for older participants, there was no significant difference between the recognition accuracies of positive, negative and neutral words. This finding was inconsistent with the studies concluding that *'positivity bias'* was so widely observed in older samples. At this point, evaluating these d-prime scores results considering the hit and false alarm rates separately would be reasonable.

The analysis on hit rates revealed that older participants responded correctly to studied positive words better than studied negative ones. In this sense, *'positivity bias'* was noted in older sample. Conversely, older participants produced significantly more false alarm rates for positive words as compared to negative and neutral ones. Since d-prime scores are calculated by converting hit and false alarm rates to z-scores and then subtracting the false alarms from the hits, though hit rates for positive words were higher than negative ones at older sample, overall recognition accuracy decreased due to the higher rate of false alarm for positive words. In this respect, both findings related to the hit and false alarm rates at older sample were consistent with the literature. There is a general consensus among aging studies that older adults are more likely to remember positive information than negative information (Carstensen and Mikels, 2005; Kennedy, Mather and Carstensen, 2004; Kensinger and Leclerc, 2009; Leigland, Schulz and Janowsky, 2004; Mather and Knight, 2005). This bias is addressed to their *'emotional regulation'* strategies. In connection with the underlying process that leads to positivity effect, older adults have deliberate control upon their

emotions. They are more likely to approach to positive information; while avoiding from negative information (Williams et al., 2006). This was supported in the current study that older participants recognized positive words significantly better than negative words. On the other hand, older participants got the highest false alarm rates for positive words. It was observed because *'positivity bias'* also showed its strength on false alarm rates. Hence, ignoring the negative words resulted in approaching the positive words too liberally. Older subjects seem to "expect" more positive words or are more susceptible to thinking they had encountered a positive while they actually had not. "Liberal criterion" analysis also emphasized the same pattern that older participants showed a more liberal tendency than young participants towards positive words as it is discussed in detail at subtitle 5.6.

As it was noted at the very beginning of this subtitle, there was a significant age x valence interaction on hit rates. According to the detailed analysis of post-hoc on hit rates, young participants, rather than older ones, got the highest score for negative and neutral words. The mean difference for negative words between young and older participants' hit rates was so remarkable that this finding demonstrated that older adults are able to dissipate negative information and affect more effectively than young adults are (Carstensen et al., 2000; Marter and Carstensen, 2003).

Afterwards, recognition memory performances of participants were compared for positive, negative, and neutral words. It was found that young participants got the highest hit rate for both positive and negative words as compared to neutral words. However, older participants got the highest hit rate for only positive words as compared to negative and neutral words. According to 'socioemotional selectivity theory', older adults are highly motivated to seek meaningful and positive emotional experiences on a daily

basis (Carstensen, Isaacowitz, and Charles, 1999). Hence, as compatible with the literature, age-related '***positivity effect***' was observed for older adults in the current study. Moreover, getting higher hit rates for positive words rather than neutral words indicated that older adults, like young adults, are more likely to detect and attend emotional information than they are to detect and attend non-emotional information (Leclerc and Kensinger, 2008).

On the other hand, young adults did not show any specific valence effect on emotion. Both positive and negative words' hit rates were almost same; while these emotional words were better recognized than their neutral equivalents. '***Negativity bias***' asserts that negative stimuli have a greater impact on cognition. The phenomenon of negativity bias has been replicated in some studies (Carstensen and Mikels, 2005; Fung et al., 2008; Kennedy, Mather and Carstensen, 2004; Mather and Carstensen, 2005; Mikels et al., 2005; Tapar and Rouder, 2009). In all these studies, it was mentioned that negative stimuli are often more adaptively informative, so negativity bias are explained from an evolutionary perspective. On the contrary, in the present study, verbal materials (i.e. words) were used rather than visual materials as stimuli. From this point of view, it seems that verbal materials could not trigger any mentalizing, simulation of dangerous situation and could not be adaptively informative and so could not induce in memory enhancement. Although 'negativity bias' was not fully observed in terms of hit rates in the study, this could not be evaluated as a support for 'anti-negativity', considering the finding that the young participants displayed a liberal response bias toward negative words (see subtitle 5.6).

The analysis of age and valence interaction on false alarm rates showed that older participants had more false alarms than young adults for only positive words. This finding stated that older participants had poorer performance when discriminating new positive words. Higher false alarm rates for

positive items showed that older participants were biased so positively that they were more likely to indicate that the positive words were present. This same finding was replicated by Fernandes, Ross, Wiegand and Schryer (2008) in which they used three types of material (autobiographical memories, pictures and words) in order to examine the effect of valence component of emotion on memory performance. The results of false alarm rates for words stated that older adults had greater false alarm rates for positive words than negative and neutral words. It can be concluded that the older participants preferentially recognized positive words in the present study. On the other hand, the most interesting result was found when the words were negative. Older and young participants had the almost same rates of false alarm on negative words. While older participants got the lowest score of false alarm rate on negative words, young participants got the highest score of false alarm rate on negative words. This same finding was replicated by Dougal and Rotello's (2007) research conducted with undergraduate students. In this study, the proportion of 'old' judgments was higher for 'new' negative words than for 'new' positive and 'new' neutral words.

## 5.5 Age, Valence and Arousal Interaction Supporting Carstensen's Socioemotional Selectivity Theory

In order to compare memory performances, means and standard deviations of d-prime scores, hit and false alarm rates for both young and older participants (in Table 5.1.) are summarized below.

**Table 5.1.** Means and Standard Deviations of Hit and False Alarm Rates and d' Scores as a Function of Emotional Valence Type (Positive, Negative and Neutral) and Emotional Arousal (Highly and Medium Arousing) in Young and Older Adults

| YOUNG | Hit Rates | False Alarm Rates | Sensitivity, d' |
|---|---|---|---|
| **Medium Arousing Group** | | | |
| **Positive** | .74 (.14) | .16 (.11) | 1.84 (.66) |
| **Negative** | .65 (.18) | .19 (.13) | 1.42 (.61) |
| **Neutral Nonarousing** | .65 (.20) | .12 (.10) | 1.72 (.82) |
| **Highly Arousing Group** | | | |
| **Positive** | .61 (.22) | .15 (.12) | 1.51 (.65) |
| **Negative** | .67 (.17) | .23 (.14) | 1.34 (.51) |
| **Neutral Nonarousing** | .58 (.17) | .25 (.17) | 1.02 (.58) |
| **OLDER** | | | |
| **Medium Arousing Group** | | | |
| **Positive** | .62 (.17) | .32 (.20) | .90 (.75) |
| **Negative** | .55 (.23) | .19 (.15) | 1.13 (.67) |
| **Neutral Nonarousing** | .53 (.17) | .23 (.15) | .94 (50) |
| **Highly Arousing Group** | | | |
| **Positive** | .59 (.19) | .28 (.19) | .95 (.75) |
| **Negative** | .44 (.21) | .24 (.18) | .70 (.53) |
| **Neutral Nonarousing** | .54 (.18) | .26 (.16) | .87 (.43) |

Note. Values in parentheses represent standard deviation.

As it was stated in the *'results section'*, the analysis on d-prime scores revealed a significant age x valence x arousal 3-way interaction effect. The highest recognition accuracy of young sample was obtained from positive medium arousing words; while the highest recognition accuracy of older sample was obtained from negative medium arousing words. This result concluded that, emotional words which carried either approach or avoidance information resulted in better memory performance, but differently at age groups.

When paired samples t-tests were performed for only young participants, it was found significantly that the recognition accuracy of positive medium arousing words was better than negative medium arousing words for the young participants. As summarized in Table 5.1 above, regardless of polarity (high or medium in terms of arousal), young participants had a tendency to approach to positive words. In this respect, it was again repeated that young sample had *'positivity bias'* in the present study.

When paired samples t-tests were performed for only older participants, it was found significantly that the recognition accuracy of negative medium arousing words was significantly better than negative highly arousing words for the older participants. Strictly speaking, while they approached to negative medium arousing words, they avoided from negative highly arousing words. The other group differences were not found significant. This result asserted that when verbal material list were consisted of medium arousing word, older sample had a tendency to approach to the negative words in terms of valence. However, it should also be emphasized that negative medium arousing were not discriminated better than positive medium arousing or neutral words. Thus, this finding should not be interpreted as *'negativity bias'* for older sample. Hit rates scores for age x valence interaction effect also supported this result.

The analysis on hit rates also revealed a significant age x valence x arousal 3-way interaction effect. The highest hit rates of young sample was obtained from positive medium arousing words; and the highest hit rates of older sample was also obtained from positive medium arousing words. At both age groups, not highly arousing but medium arousing positive words were better recognized than negative and neutral words.

When paired samples t-tests were performed for only young participants, it was found significantly that the hit rates of positive medium arousing words was higher than negative and neutral medium arousing words for the young participants. Moreover, the hit rates of negative highly arousing words were significantly better than neutral words used in the highly arousing group. However, the hit rates of negative and positive highly arousing words did not significantly differ from each other. These findings suggested that when the words were highly arousing, the young participants recognized positive and negative words equally; on the other hand, when the words were medium arousing, the young participants recognized positive words better than negative ones. Thus, *'positivity bias'* was observed at valence axis, not the arousal axis of emotion. The other group differences were not found significant.

When paired samples t-tests were performed for only older participants, it was found significantly that the hit rates of positive medium arousing words was higher than neutral words used in the medium arousing group at the older participants. When the words were highly arousing, the hit rates of positive words were also significantly higher than the hit rates of negative words. Thus, regardless of polarity in terms of arousal axis, the older adults had a tendency to approach to the positive words. This finding should be interpreted as *'positivity bias'* for older sample. Moreover, when the words were highly arousing, the hit rates of neutral words used in the highly

arousing group were also significantly higher than the hit rates of negative words. This result indicated that the older participants' cognitive system seek calm information (that is, either neutral or positive) rather than negative information. The other group differences were not found significant.

Finally, age x emotionality (emotional vs. nonemotional) x arousal 3-way interaction effect on recognition memory was only reliably noted for d' scores, not for hit and false alarm rates. It reflected that in the highly arousing group, young participants discriminated emotional words better than nonemotional ones. However, this emotionality difference could not be detected in the medium arousing group in young participants. On the other hand, at older group, the comparisons regarding emotionality and arousal groups were not found significant.

When non-emotional words are considered, interestingly, the recognition accuracy of neutral words in the medium arousing word list was significantly better than neutral words used in the highly arousing word list for the young participants. This needs further investigation. Due to the non-emotional nature of these words, their recognition rate should not have differed across experiments. However, it is possible that the neutral words do not adhere to the same category when inserted among highly arousing words versus medium arousing words. Neutral non-arousing words have the following nature: they are neutral across both valence and arousal axes. In the highly arousing word list, the emotional words consist of positive or negative valence and positive arousal. Hence emotional words differ in both valence and arousal dimensions compared to neutral words. On the other hand, in the medium arousing word list, the emotional words consist of positive or negative valence, and neutral arousal. Hence emotional words differ only across valence dimension compared to neutral words. We may speculate that there is an interference effect of arousal on attention in the

highly arousing word list, causing neutral words to be treated less. Again speculatively, in the medium arousing word list, there is no such interference due to normalized arousal values; hence all words receive similar attention. This may explain why neutral words on the medium arousing word list are recognized better than those on the highly arousing word list.

### 5.6 Liberal Bias in Young and Older Adults

Regardless of the recognition memory accuracy (discriminability), the participants can exhibit a liberal response bias. Liberal bias is observed by increasing hit and false alarm rates. It is the tendency to respond in a predominantly liberal way, responding 'yes' most of the time. Based on the findings, valence main effect was significant in liberal bias. More specifically, when all participants' responses were combined, positive words produced a more liberal response bias than negative words and neutral words, but there was not a reliable difference in bias between negative and neutral words. This is consistent with the study of Grider and Malmberg (2008) in which they preferred incidental learning in order to examine the memory enhancement and bias for emotional and nonemotional words. In the research, when the participants were instructed to simply read the words silently in an incidental study session, it was found that bias was more liberal for positive words than for negative and neutral words (Grider and Malmberg, 2008). On the other hand, arousal did not reliably affect old response bias. Grider and Malmberg (2008) also did not observe a significant difference in liberal bias between highly and low arousal words in the Experiment 2 they conducted in the same research. In this way, recent findings also provide support for the notion that, valence and arousal are two distinct components of emotion that these components are affected by response bias differently (Grider and Malmberg, 2008).

On the other hand, in our study, as hypothesized (H6), the young and older participants differed in terms of liberal bias with respect to valence categories: The analysis revealed a significant age x valence 2-way interaction effect. Based on the further analysis on bias scores, the older participants had significantly more liberal response bias for positive words compared to negative and neutral words. The older participants also had significantly more liberal response bias for neutral words when compared to negative words. These findings are consistent with a liberal shift in response bias for especially positive information in older adults. On the other hand, just reverse bias was exhibited at the young participants. They had significantly more liberal response bias for negative words compared to both positive and neutral words, but there was not a reliable difference in bias for positive and neutral words. Hence, post hoc analysis indicated that increasing age was associated with more liberal bias in older for positive words, but not in the young participants. Conversely the young participants adopted a more liberal bias for negative words. This same finding was published by Thapar and Rouder (2009). In their study, recognition memory was tested by an unspecified memory task, which is intentional learning. Thapar and Rouder (2009) concluded that valence component of emotion influenced the young and older participants' memory performance by influencing response bias, with older participants displaying a more liberal bias for positive words and young participants displaying a more liberal bias for negative words. Consistent with this finding, Dougal and Rotello (2007) also found that negative words resulted in more liberal response bias in young adults, but in this study this was concluded under 'intentional' encoding.

Moreover, it was observed that when the criterion values of all words were combined, we did not observe a significant difference in terms of bias in young and older participants. This finding stated that the age groups did not

display a general liberal bias towards all words. Instead, the older participants displayed significantly more liberal response bias for positive words specifically and the young participants displayed significantly more liberal response bias for only negative words.

Furthermore, the analysis revealed a significant arousal x valence 2-way interaction effect. Based on the further analysis on bias scores, the participants responded more liberally for medium arousing positive words compared to medium arousing negative words and neutral words. On the other hand, there was not a reliable difference in bias between highly arousing negative and positive words. That is, the words with high in terms of arousal did not affect bias. This brings back the discussion regarding the possible interference effect due to attention in the highly arousing word list. It is speculative, but we may interpret this result as follows. Subjects respond more naturally to the medium arousing word list, exhibiting any preferential biases at the absence of other demanding factors such as arousal. On the contrary for the highly arousing word list, attentional resources are captured creating an interference effect for the natural biases of the subjects.

## 5.7 An Integrative Interpretation: Memory Accuracy with or without Liberal Bias

Memory accuracy (obtained from d' scores based on signal detection theory) and liberal bias (obtained from criterion scores based on signal detection theory) may be evaluated in an integrative manner. In terms of valence main effect and then age x valence 2-way interaction effect, assessments are made in the following.

First, the valence main effect results were found significant. Although it was found marginally significant that positively valenced words were discriminated better than neutral and negative words, there was also a greater tendency to respond old to positive words as 'old' than to both negative and neutral words (hit rates of positive words were high). On the other hand, false alarm scores for positive did not significantly differ from false alarm scores for negative and neutral words.

Second, age x valence 2-way interaction effect results indicated that recognition accuracy (d' scores) was greater for positive words than for negative and neutral words at young group. It was observed due to the higher hit rates for positive words and lower false alarm rates for positive words. Moreover, young participants did not display liberal bias for positive words, but for negative words. Hence, their recognition accuracy for positive words was not contaminated by liberal response bias. On the other hand, although hit rates for negative words were higher, false alarm rates for negative words were also higher in young participants. These results lead to liberal bias for negative bias. Accordingly, a decrement in recognition accuracy (d') for negative words was observed.

The older participants had both higher hit rates and higher false alarm rates for positive words and also more liberal bias for positive words. The results revealed that the emotional enhancement effect in older age group was due to a more liberal response bias for emotional words, especially for positive words. In sum, in the older group, recognizing emotional words is based on response bias, not memory accuracy.

On the whole, it is more informative to interpret the recognition memory scores (d' scores, hit and false alarms rates) with taking into account the response bias. There is a noteworthy body of literature which confirms that

what differs across the age groups is the nature of liberal bias (Dougal and Rotello, 2007; Kapucu, Rotello, Ready and Seidl, 2008; Thapar and Rouder, 2009). On the other hand, it is important to note that these studies have been conducted under intentional encoding. In the present study, under incidental encoding, both young and older adults under incidental encoding are more willing to recognize emotional words over nonemotional ones; however they differed in their bias toward positive and negative words. While young adults had a liberal bias for negative words, older adults had a liberal bias for positive words. This sort of reverse bias also provided support for the notion stated in Carstensen's socioemotional selectivity theory that older adults seek information to promote emotional well-being (Carstensen, Isaacowitz and Charles, 1999; Carstensen and Mikels, 2005). More importantly, although young adults had liberal bias for negative words, they exhibited recognition memory accuracy for positive words. We can say that young adults selectively performed better at recognizing positive words.

**5.8 Reaction Time**

The findings of age, valence and arousal interaction effect on reaction time are discussed for both old and new words. At the time of encoding in the study, the participants were presented the words for a fixed time-period of 1 second and we did not record reaction times of them at the study session. On the other hand, reaction times were recorded at the test session. Additionally, the participants were not explicitly instructed to react "as quickly as they could", but they were warned to respond quickly when they got slower. As it was stated in the *'results section'*, the reaction times differed with respect to age for both old and new words. Reaction times were higher in older adults compared to younger adults, which is in accordance with a general finding in the cognitive aging literature that response speed declines with age

(Baltes, 1993; Salthouse, 1996; Van der Veen, 2006) so as expected, the older participants responded slower than the young participants, consistent with the studies of life-span development.

Valence differences of stimuli showed no main effect on reaction time for both old and new words. Although reaction times were found lower as compared to these studies, this same finding was replicated by Thomas and Hasher, 2006; Leclerc and Kensinger (2008) declaring no differences in older adults.

### 5.9 Current Mood State and Memory Performance

Current mood state is the variable which is not controlled experimentally but it is a factor for which possible influence was evaluated. All participants' mood states were assessed by using PANAS before the experiments started. Since the participants were not induced any positive or negative mood, PANAS scores obtained from the positive and negative affects were calculated for each young and older participants in order to determine their mood tendency (either positive or negative). For both young and older adults, positive affect scores were higher than negative affect scores. This finding stated that the participants generally tend to be in positive mood. Hence, the present study lacked participants who were in negative mood. According to our hypothesis (H7), we expected that while positive mood state would predict memory performance of positively valenced words; negative mood state would predict memory performance of negatively valenced words. However, analysis did not yield any significant differences of mood state on positive-negative valenced memory performance. Unfortunately, 'negative affect' dimension of the schedule did not show enough variation among both young and older participants so this might be

the reason why no effect of mood on memory performances for emotional words was observed. In further studies, the effect of mood could be investigated by controlling it in an experimental set-up.

Furthermore, PA and NA scores of the entire set of participants in both age groups were evaluated in order to detect the difference in current mood state. The finding was that young participants experienced greater negative affect than older participants. It is consistent with the notion that self-reported negative affect is lower in older adults than in young adults (Lawton, Kleban, Rajagopal and Dean, 1992). This result also concludes that older adults report lower frequencies of negative emotions in daily life. On the other hand, positive affect was not rated higher for older than young adults.

**5.10 Personality Characteristics and Memory Performance**

The theories of personality state that people are inherently disposed to some tendency; they possess enduring attributes that guide their thinking and behavior across different situations (Kantner and Lindsay, 2012). In this sense, considering individual differences in emotional word processing is essential and evaluating possible influence of personality traits on cognitive processing of emotional and nonemotional words is a secondary target of the present study. In terms of recognition memory performance, substantial individual differences might underlie group differences. Memory as a cognitive performance is not expected to be fully independent of personality traits. Personality traits as underlying process are expected to show a particular pattern of associated recognition memory performance. Terracciano, McCrae, Hagemann and Costa (2003) argued that different people experience and report affect differently so individual difference

variables influence affective differentiation. Emotion processing of cognitive system may represent a domain of human behavior moderated by personality (Canlı et. al., 2001). Hence, the possibility that recognition memory performance is a function of personality traits was investigated in the present study. For this purpose, the Big Five consisting of very broad components manifested across many types of response classes, such as behavior, emotion and cognition (John and Gross, 2007; Pytlik Zillig, Hemenover and Dienstbier, 2002) is utilized.

As it was reported in the *'results section'*, the young and older participants were grouped separately so as to examine how well personality dimensions of the Big Five (extraversion, agreeableness, conscientiousness, neuroticism and openness to experience) predict d' scores (recognition accuracy), and hit rates. In this section, the results will be discussed separately on the personality dimensions. According to our hypotheses (H8), we expected that the participants' higher scores in extraversion and openness to experience would have predicted better memory performances for positive words, and the participants' higher scores in neuroticism would have predicted better memory performances for negative words. These hypotheses were not fully verified except that the young participants' higher scores in openness to experience predicted better d' scores for positive words, .

For **extraversion**, the results were not significant considering recognition accuracy and hit rates at young sample. At older sample, however, there was a significant difference in terms of recognition accuracy for neutral words. Older participants' lower scores in extraversion predicted better d-prime scores for neutral words. It was stated previously that individuals who gets lower score are described as reserved, submissive, passive, quiet, and emotionally bland (Somer, Korkmaz and Tatar, 2004). Since extraversion was correlated positively with the processing of pleasant information, this kind of

result was unexpected. In an fMRI study in which personality influences in brain reactivity to emotional stimuli was examined (Canlı et. al., 2001), it was noted that while extraversion was correlated with brain reactivity to positive stimuli in amygdala, caudate and putamen. These results indicated that individual differences in brain reactivity to emotional stimuli were associated with specific personality traits (Canlı et. al., 2001). In the study, it was concluded that a highly extraverted person's brain might be more biased to respond to positive stimuli rather than negative ones (Canlı et. al., 2001). Furthermore, there are several studies that found a positive correlation between extraversion scores and memory performance (Arbuckle et al., 1992; Hultsch et al., 1999 and Meier et al., 2002). On the other hand, in our study, there was no significant result for hit rates of positive words. In addition, memory performance (d', hit and false alarm rates) could not be predicted by extraversion, neither for young nor for older participants.

For **agreeableness**, the results were significant considering recognition accuracy only at the young population sample. However, their higher scores in agreeableness predicted better d-prime scores for both negative and neutral words, but not for positive words. Agreeable people are the ones who are acceptant, helpful and compassionate so it seems that they were more prone to discriminate old words from new ones in experiments. However, the lack of the agreeableness effect for positive words needs further investigation.

**Conscientiousness** is characterized by competence, organized, hardworking, punctual, self-disciplined and ambitiousness (Costa and McCrae, 1992). People high in conscientiousness have a tendency to use problem-focused coping strategies in their lives. These strategies include planning, and especially positive reappraisal (Watson and Hubbard, 1996). For conscientiousness, the results were not significant considering recognition

accuracy and hit rates at both young and older population samples. From this perspective, it seems that this trait is not the dimension that memory performance is associated with. Considering conscientiousness is related to problem-focused strategies, the incidental encoding session, which consisted of automatic unconscious information processing, seems to be uncorrelated with this aspect of personality.

For **neuroticism**, the results were not significant considering recognition accuracy and hit rates at young sample. On the contrary, the results were significant considering recognition accuracy for neutral words at older sample. Namely, the older participants' higher scores in neuroticism predicted better d-prime scores for neutral words. However, it was hypothesized (H8) that the participants' higher scores in neuroticism predicted better d-prime scores for especially negative words. It is well-known that neuroticism is related to a memory bias for negative material. However, the finding is not consistent with the literature. One factor, which could be responsible for this result, is current mood state. In the study of Bradley, Mogg, Galbraith and Perrett (1993), the participants with high and low levels of neuroticism were induced either neutral or depressed mood. The researchers examined the recall of negative and positive words in these groups. They found an interaction effect between mood and trait on memory performance. Interestingly, the participants who were high in neuroticism and in neutral mood had poorer recall of negative words as compared to the participants high in neuroticism but in depressed mood. In the current study, PANAS scores declared that positive affect scores of older participants were higher than their negative affect scores. Thus, older participants were not in a negative mood during experiments. In addition, GDI was especially used to eliminate participants who had a tendency to depression. From this perspective, it is plausible not to observe memory bias for negative words at older adults.

For **openness to experience**, the results were significant considering recognition accuracy for positive and neutral words at young sample. On the contrary, at older sample, the results were not significant considering recognition accuracy and hit rates. Young participants' higher scores in openness to experience predicted better d-prime scores for both positive and neutral words, but not for negative words. This finding is just as hypothesized (H8). Of the traits featured by the Big Five, openness to experience is the one that is most associated with having a rich inner mental life (Rasmussen and Berntsen, 2010). As it is well-established, people high in openness to experience are seeking out new experiences. High scorers of this trait tend to experience a diversity of emotions, to prefer variety (Costa and McCrae, 1992). Our results confirmed the anticipated relationship between openness to experience and recognition accuracy of positive and neutral words. The absence of this relationship with negative words needs further investigation. Possibly, the liberal bias of young population for negative words dominated the results and caused us not to observe any relationships with respect to personality.

### 5.11 Limitations of the Study

To assess the participants' mood at the time of test and to obtain a measure of their initial emotional state, PANAS was used as the mood scale. In this way, the relation between current mood state and recognition memory performance was evaluated. The participants filled out the PANAS form before the memory task. PANAS was developed for Turkish culture on the adults whose ages range between 18 – 34 years (Gençöz, 2000). In the present study, the mean age of the young adult participants is 20.77 and age range is 18 – 24 years. From this perspective, there was no problem. On the other hand, the mean age of the older adult participants is 77.43 and age range is

65 – 91 years. In this respect, using PANAS whose reliability and validity studies were not conducted in Turkish older population is a limitation of the study. It is necessary to extend the existing norms to older groups.
Similarly, another related criticism about the experiments was that although 5FPI was standardized in both young and older adults, the sample size of older adults was not adequate to declare norms. As a result of this, norms above the age of 65 years should be available. It is crucial to consider the contribution of individual differences in personality traits in order to explain inter-individual differences in recognition memory for emotional words. It seems that relationship between individual differences and memory performances is worthy to examine more in depth at especially in older adults.

Furthermore, in the present study, the words were presented visually on the computer screen. During the study session, the words stayed on the screen for 1 second and the participants made their vowel number decisions within 2 seconds. Especially for older participants, the suitability of the 2-second time period for decision making is not justified. This time period could have been longer, and possibly decided after a pilot study in the older population.

The use of confidence ratings in analyses of recognition data is recommended. For each item, when participants respond with some level of confidence, each level corresponds to a different degree of response bias (Verde, Macmillan and Rotello, 2006). By this way, ROC curves can be constructed efficiently with a rating design. It is recommended the use of confidence ratings in analyses of recognition data. Since the area under curve is an unbiased measure of discriminability, A', it gives information about more reliable 'memory accuracy', uncontaminated by liberal response bias. In our study, confidence ratings for recognized items were not collected. This prohibited the use of some tools such as ROCs for more detailed analysis.

# CHAPTER 6

# CONCLUSION

> "Whether implicit or explicit, our memories connect the past to the present and allow us to form expectations of the future." (McGaugh, 2003).

The motivation for the present study was to shed light on the essential roles of cognition and emotion in the understanding of cognitive science. For this purpose, in this dissertation, the behavioral experiments were performed to examine the effects of age, valence and arousal on old/new recognition memory task. As it was hypothesized (H1), young participants recognized the verbal items more accurately as compared to older participants. In addition, reaction times, false alarm rates were higher in older participants compared to younger participants. Recognition performances of younger and older adults were also compared with respect to negative, positive, and neutral words. Valence differences of words showed significant effect on memory performance in terms of hit rates: positive words were recognized better in both age groups. In terms of d' scores, older adults were unable to discriminate between old and new words that were either positive, negative or neutral. Young adults correctly discriminated a greater proportion of positive words compared to negative and neutral words. Thus, results of the present study provide an evidence of an age-related difference in memory

performance that occurs even when participants do not expect a memory test.

While evaluating the recognition memory performance, liberal response bias was also taken into account. The hypothesis (H6) was that liberal response bias for positive words would increase with age. Based on the results, it was observed that there was a significant bias to respond 'old' only to positive words, not to negative and neutral words in older group. Older participants showed a positivity bias and they seem to focus on their emotions spontaneously. Importantly, this age-related bias is established in this study, in which encoding session of the words was employed without deliberate attentional resources. On the contrary, young participants displayed a liberal bias towards to negative words. Hence, without regulating their attention, young participants were preferentially biased for negative words and older participants were preferentially biased for positive words.

Considering the study's contribution to cognitive science in terms of aging literature, it is strongly documented that older participants did not process emotional words as young participants did. That is, older participants seemed to place more emphasis on positive words than on negative words. Thus, older participants had a tendency to respond 'yes' for positive words regardless of they are studied (old) or unstudied words (new). This age-related change suggested that older participants regulated their emotion in favour of maintaining well-being. Over time, aged people used their expectations in order to guide emotional processing even under the incidental encoding session. Thomas and Hasher (2006) suggested that older adults may spontaneously rehearse or dwell on positive stimuli immediately after they occur and not engage such reflection for negative stimuli even when a memory test is unanticipated.

In the present study, the possible relationship between memory performance and current mood was considered (H7). The results did not reliably support mood dependent recognition. For word recognition, current mood was uncorrelated with memory for positively and negatively valenced words in either age group. Hence, differences in the participants' current moods were largely unrelated to variations in the positivity of their recognition. It might be because the participants got higher scores at positive affect dimension of the schedule rather than negative affect dimension of it.

Although the emotional system seems to be involved in retrieval of emotionally valenced information, its mechanism is not clear yet (Lewis and Critchley, 2003). It is an open question whether this involvement differs for positively and negatively valenced information. This effect should be studied further by more neuroimaging studies of mood, in order to suggest a neural basis for emotion specific regions of the brain. Moreover, in further studies, the effect of mood could be investigated by controlling it in an experimental set-up. For instance, mood induction can be applied by listening to music or watching videos (Forgas, Laham, Vargas, 2005; Lewis and Critchley, 2003; Pliner and Sterevango, 1994).

Personality factors might have contributed to recognition memory performance for emotional words in both early and later adulthood. Only a few studies have focused on this relationship. It seems that the effects of individual differences on experimental memory tests have been underestimated so far in literature. In order to fill the gap, the present study investigated the impact of five personality characteristics on inter individual differences in recognition memory for emotional words. Especially for openness to experience dimension of personality scale, young participants got better d-prime scores for positive words when they were open to new experiences, so our hypothesis (H8) is verified. However in general, except

for a few significant correlations, there were no consistent relations between personality traits and recognition memory performance in this study. While doing the personality inventory, although the participants were warned that they should have answered the questions reflecting their real personality, they might have had a tendency to display a personality which they would like to have but do not have indeed. Although it is a commonly seen problem about administering tests, it might have affected the relation in this study.

Overall, when encoding was incidental and memory assessment was unexpected, a greater bias to respond 'old' was observed only for positive words, and not for negative words or words with high or medium arousal values in older adults. This result pointed out the importance of the distinction between incidental and intentional recognition memory. Mostly in the literature, the data have been collected under intentional encoding. For further investigation, more studies should be carried on by incidental recognition memory task. With more data of older adults, findings should be evaluated in terms of eyewitness phenomenon. Especially bias is of special concern in this area. Thus, it is still an open question how emotion influence eyewitness memory.

To sum up, our study pointed out the importance of valence related bias factors in the responses of different populations in recognition memory tasks, pointing out the importance of teasing out age-related bias factors from the memory performance metrics.

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# APPENDICES

## APPENDIX A – DEMOGRAPHIC INFORMATION FORM

### Demografik Bilgi Toplama Formu

Kişisel Bilgiler:
Adı Soyadı: Uygulama Tarihi:...../...../.....
Cinsiyeti: Kadın ( ) Erkek ( )
Doğum Tarihi:...../...../.....
Yaşı: .....
Medeni Hali: Evli ( ) Bekar ( ) Dul ( ) Boşanmış ( )
Mesleği:
El Tercihi: Sağ ( ) Sol ( )
Eğitim Durumu: İlkokul (0-5 yıl) ( )
Ortaokul (6-8 yıl) ( )
Lise (9-11 yıl) ( )
Üniversite (11+) ( )
Sağlık Durumuna İlişkin Bilgiler:
İşitme Bozukluğu: Var ( ) Yok ( )
Varsa düzeltilmiş mi?.....
Görme Bozukluğu: Var ( ) Yok ( )
Varsa düzeltilmiş mi?.....
Renk Körlüğü: Var ( ) Yok ( )
Fiziksel Özür: Var ( ) Yok ( )
Varsa türü:.....
Geçirdiği Önemli Rahatsızlıklar (özellikle Psikiyatrik, Nörolojik veya Psikolojik):
Halen Kullanmakta Olduğu İlaç: Var ( ) Yok ( )
Varsa ilacın/ilaçların adı: .....
Uzun Süre Kullanıp Bıraktığı İlaç: Var ( ) Yok ( )
Varsa ilacın/ilaçların adı:.....
Varsa kullanım süresi:.....

Not: Katılımcının halen kullanmakta olduğu ilaçlar bilişsel süreçleri etkileyen türden ise deneye katılımları konusunda dikkatli olunuz.

## APPENDIX B - INFORMED CONSENT FORM

### Gönüllü Katılım Formu

Orta Doğu Teknik Üniversitesi Enformatik Enstitüsü Bilişsel Bilimler Bölümü'nde yürütülen bu araştırma, Yrd. Doç. Dr. Didem GÖKÇAY danışmanlığında, Bilişsel Bilimler Doktora Programı öğrencisi Hande KAYNAK'ın doktora tez çalışmasının bir gereği olarak yapılmaktadır. Tez çalışması için, sağlıklı genç ve yaşlı/ileri yaşlı yetişkin bireylere ihtiyaç duyulmaktadır. Araştırma kapsamında, yürütülecek uygulamaların tamamı Hande KAYNAK tarafından yapılacaktır.

Bu tez çalışmasının amacı; sağlıklı genç ve yaşlı yetişkinleri bilişsel işlevleri açısından karşılaştırmak ve incelenen sağlıklı bireylerden bilgi toplamak, katılımcıyı daha yakından tanımak, hakkında incelenen konuyla ilgili ayrıntılı bilgilere ulaşmaktır. Uygulamalar katılımcının ve araştırmacının uygun oldukları bir zaman içerisinde gerçekleşecektir. Görüşmeler iki farklı oturumda gerçekleştirilecek olup her oturumun yaklaşık süresi 45 dakika olacaktır. Uygulama boyunca katılımcıya bazı psikolojik değerlendirme ölçekleri (psikolojik ölçekler/nöropsikolojik testler) uygulanacaktır. Katılım sırasında sorulardan ya da herhangi başka bir nedenden ötürü rahatsızlık hisseden katılımcılar, cevaplama işini yarıda bırakabilirler. Böyle bir durumda katılımcıların çalışmayı uygulayan kişiye, çalışmayı tamamlayamayacaklarını söylemeleri yeterli olacaktır. Gerçekleştirilen görüşme sonunda uygulanan test ve ölçeklerin puanlanıp, bu puanlama doğrultusunda katılımcıya, uygulamanın bitiminde açıklama ve bilgilendirme yapılacaktır. Çalışma hakkında daha fazla bilgi almak için Uzm. Psk. Hande Kaynak (E-posta: handekaynak@gmail.com) ya da Yrd. Doç. Dr. Didem Gökçay (E-posta: didem@ii.metu.edu.tr) ile iletişim

kurulabilir.

Görüşme sırasında katılımcının izni doğrultusunda yazılı kayıtları alınacaktır. Daha sonra bu kayıtlar, katılımcının kimlik bilgileri gizli tutularak bilimsel nitelikli çalışmalarda ve eğitim amaçlı olarak kullanılabilir. Bu amaçların dışında bu kayıtlar kullanılmayacak ve başkaları ile paylaşılmayacaktır.
(Katılımcının Beyanı)

Sayın Hande KAYNAK (uzman psikolog) ve Yrd. Doç. Dr. Didem GÖKÇAY (danışman) tarafından Orta Doğu Teknik Üniversitesi Enformatik Enstitüsü Bilişsel Bilimler Bölümü'nde yürütülen araştırma ile ilgili bilgiler bana aktarıldı. Bu bilgilendirmenin ardından bu araştırma faaliyetine katılımcı olarak davet edildim.

Eğer bu araştırma faaliyetine katılırsam bana ait bilgilerin gizliliğine büyük bir özen ve saygıyla yaklaşılacağına inanıyorum. Toplanan her türlü verinin eğitim ve bilimsel amaçlarla kullanımı sırasında kişisel bilgilerimin ihtimamla korunacağı konusunda bana yeterli güven verildi.
Bu görüşme süresince yapılacak harcamalarla ilgili herhangi bir parasal sorumluluk altına girmiyorum. Ayrıca herhangi bir tazminat talebim olmayacaktır.

Bana yapılan tüm açıklamaları ayrıntılarıyla anlamış durumdayım. Kendi başıma belli bir düşünme süresi sonunda:

1-Yapılan görüşme kapsamında kendime ilişkin katıldığım her türlü çalışmanın ya da değerlendirmenin araştırma ve eğitim amaçlı olarak kullanılabileceğini biliyorum ve onaylıyorum.

2-Yapılan görüşme, değerlendirme ve faaliyetlere ilişkin yazılı kayıtların araştırma ve eğitim amaçlı olarak kullanılabileceğini biliyorum ve onaylıyorum.
Bu konuda yapılan daveti gönüllülük çerçevesinde kabul ediyorum.

Katılımcı
Adı, soyadı:
Adres:
Tel.
İmza

Görüşme tanığı
Adı, soyadı:
Adres:
Tel.
İmza:

Katılımcı ile görüşen araştırmacı
Adı soyadı, unvanı:
Adres:
Tel.
İmza:

1858

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## APPENDIX C - INFORMATICS INSTITUTE

## INFORMED CONSENT FORM

B.30.2.ODT.0.44.01.00/473 - 8528

27.06.2011

GÖNDERİLEN: Prof.Dr.Belgin Ayvaşık
Rektör Danışmanı

GÖNDEREN: Prof.Dr.Nazife Baykal
Enformatik Enstitüsü Müdür

KONU: Hande Kaynak

Enstitümüz "Bilişsel Bilimler Anabilim Dalı (COGS) Doktora Programı" öğrencisi Hande Kaynak'ın, Mayıs 2011 – Eylül 2012 tarihleri arasında "TANIMA BELLEĞİNİN YAŞLA İLGİLİ DEĞİŞİMİNİN 5-FAKTÖR KİŞİLİK ENVANTERİYLE ANALİZİ: KELİMELERİN DUYGUSAL OLUMLULUK VE HEYECAN DÜZEYLERİNİN ETKİSİ" başlıklı araştırma çalışmasına ilişkin ODTÜ (Ankara), Hacettepe Üniversitesi (Ankara), İstanbul Üniversitesi (İstanbul), Marmara Üniversitesi (İstanbul), Emekli Sandığı Etiler Dinlenme ve Bakım Evi (İstanbul), Emekli Sandığı 75.Yıl Dinlenme ve Bakımevi (Ankara), Darüşşafaka Huzurevi (İstanbul), SHÇEK Huzurevleri (İstanbul ve Ankara)'nde uygulama yapmak için görevlendirme başvurusu incelenmiş, ilgili EABD Başkanlığı'nın görüşüne dayanarak adı geçen öğrencinin isteği doğrultusunda görevlendirilmesine Etik Komite Onayı koşulu ile uygun görülmüştür.

Saygılarımla,

Ek: YKK
EABD

Etik Komite Onayı
Uygundur
27.06/2011

**Prof. Dr. Canan ÖZGEN**
Uygulamalı Etik Araştırma Merkezi
(UEAM) Başkanı
ODTÜ 06531 ANKARA

# APPENDIX D - STANDARDIZED MINI MENTAL STATE EXAMINATION

**Ad Soyad:** **Tarih:** **Yaş:**
**Eğitim (yıl):** **Meslek:** **Aktif El:**
**T. Puan:**

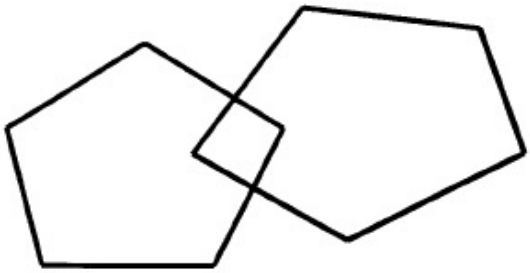
YÖNELİM (Toplam puan 10)
Hangi yıl içindeyiz..... ( )
Hangi mevsimdeyiz ..... ( )
Hangi aydayız ..... ( )
Bu gün ayın kaçı ..... ( )
Hangi gündeyiz ..... ( )

Hangi ülkede yaşıyoruz ..... ( )
Şu an hangi şehirde bulunmaktasınız ..... ( )
Şu an bulunduğunuz semt neresidir ..... ( )
Şu an bulunduğunuz bina neresidir ..... ( )
Şu an bu binada kaçıncı kattasınız ..... ( )

KAYIT HAFIZASI (Toplam puan 3)
Size birazdan söyleyeceğim üç ismi dikkatlice dinleyip ben bitirdikten sonra tekrarlayın
(Masa, Bayrak, Elbise) (20 sn süre tanınır) Her doğru isim 1 puan ..... ( )
DİKKAT ve HESAP YAPMA (Toplam puan 5)
100'den geriye doğru 7 çıkartarak gidin. Dur deyinceye kadar devam edin.
Her doğru işlem 1 puan. (100, 93, 86, 79, 72, 65) ..... ( )

HATIRLAMA (Toplam puan 3)
Yukarıda tekrar ettiğiniz kelimeleri hatırlıyor musunuz? Hatırladıklarınızı söyleyin.
(Masa, Bayrak, Elbise)..... ( )

LİSAN (Toplam puan 9)
a) Bu gördüğünüz nesnelerin isimleri nedir? (saat, kalem) 2 puan (20 sn tut)
..... ( )
b) Şimdi size söyleyeceğim cümleyi dikkatle dinleyin ve ben bitirdikten sonra tekrar edin. "Eğer ve fakat istemiyorum" (10 sn tut) 1 puan..... ( )
c) Şimdi sizden bir şey yapmanızı isteyeceğim, beni dikkatle dinleyin ve söylediğimi yapın. "Masada duran kağıdı sağ/sol elinizle alın, iki elinizle ikiye katlayın ve yere bırakın lütfen" Toplam puan 3, süre 30 sn, her bir doğru işlem 1 puan..... ( )
d) Şimdi size bir cümle vereceğim. Okuyun ve yazıda söylenen şeyi yapın. (1 puan)
"GÖZLERİNİZİ KAPATIN" (arka sayfada)..... ( )
e) Şimdi vereceğim kağıda aklınıza gelen anlamlı bir cümleyi yazın (1 puan)..... ( )
f) Size göstereceğim şeklin aynısını çizin. (arka sayfada) (1 puan) ..... ( )



## APPENDIX E - GERIATRIC DEPRESSION SCALE

### Geriatrik Depresyon Ölçeği

Ad Soyad: ..... Puan:.....

Lütfen yaşamınızın son bir haftasında kendinizi nasıl hissettiğinize ilişkin aşağıdaki sorularda uygun olan yanıtı daire içine alınız.

1) Yaşamınızdan temelde memnun musunuz?
Evet Hayır
2) Kişisel etkinlik ve ilgi alanlarınızın çoğunu halen sürdürüyor musunuz ?
Evet Hayır
3)Yaşamınızın bomboş olduğunu hissediyor musunuz?
Evet Hayır
4) Sık sık canınız sıkılır mı?
Evet Hayır
5) Gelecekten umutsuz musunuz?
Evet Hayır
6) Kafanızdan atamadığınız düşünceler nedeniyle rahatsızlık duyduğunuz olur mu?
Evet Hayır
7) Genellikle keyfiniz yerinde midir?
Evet Hayır
8) Başınıza kötü birşey geleceğinden korkuyor musunuz?
Evet Hayır
9) Çoğunlukla kendinizi mutlu hissediyor musunuz?
Evet Hayır
10) Sık sık kendinizi çaresiz hissediyor musunuz?
Evet Hayır
11) Sık sık huzursuz ve yerinde duramayan biri olur musunuz?
Evet Hayır
12) Dışarıya çıkıp yeni birşeyler yapmaktansa, evde kalmayı tercih eder misiniz?
Evet Hayır
13) Sıklıkla gelecekten endişe duyuyor musunuz?
Evet Hayır
14) Hafızanızın çoğu kişiden zayıf olduğunu hissediyor musunuz?
Evet Hayır

15) Sizce şu anda yaşıyor olmak çok güzel bir şey midir?
Evet Hayır
16) Kendinizi sıklıkla kederli ve hüzünlü hissediyor musunuz?
Evet Hayır
17) Kendinizi şu andaki halinizle değersiz hissediyor musunuz?
Evet Hayır
18) Geçmişle ilgili olarak çokça üzülüyor musunuz?
Evet Hayır
19) Yaşamı zevk ve heyecan verici buluyor musunuz?
Evet Hayır
20) Yeni projelere başlamak sizin için zor mudur?
Evet Hayır
21) Kendinizi enerji dolu hissediyor musunuz?
Evet Hayır
22) Çözümsüz bir durum içinde bulunduğunuzu düşünüyor musunuz?
Evet Hayır
23) Çoğu kişinin sizden daha iyi durumda olduğunu düşünüyor musunuz?
Evet Hayır
24) Sık sık küçük şeylerden dolayı üzülür müsünüz?
Evet Hayır
25) Sık sık kendinizi ağlayacakmış gibi hisseder misiniz?
Evet Hayır
26) Dikkatinizi toplamakta güçlük çekiyor musunuz?
Evet Hayır
27) Sabahları güne başlamak hoşunuza gidiyor mu?
Evet Hayır
28) Sosyal toplantılara katılmaktan kaçınır mısınız?
Evet Hayır
29) Karar vermek sizin için kolay oluyor mu?
Evet Hayır
30) Zihniniz eskiden olduğu kadar berrak mıdır?
Evet Hayır

# APPENDIX F - FUNCTIONAL ACTIVITIES QUESTIONNAIRE

## İşlevsel Faaliyetler Anketi Cevap Formu

İFA 10 adet karmaşık günlük hayat faaliyetine ilişkin performansı değerlendiren kısa ve bilgi kaynağı kişiye ait dayalı bir ankettir. Bilgi kaynağı hastanın geçmişine ve bugününe ilişkin gerçek ve doğru (güvenilir) kişisel bilgilere sahip olmalıdır. Anket genellikle, hastaya bakmakla yükümlü aile fertlerinden birine uygulanmaktadır. Bu anket kurum personeli tarafından, doktor muayenesi öncesinde ya da muayene sırasında uygulanabilir.

**Puanlama:**

| Puanlar | Hastanın her bir faaliyetteki performansı |
|---|---|
| **3** | Performans göstermekte tamamen başarısız |
| **2** | Yardım gerekiyor |
| **1** | Güçlük çekmesine rağmen görevi yapmayı başarıyor ya da<br>Görevi hiçbir zaman yapmadı ancak hakkında bilgi veren kişi hastanın bu görevi güçlükle de olsa yapabileceğini düşünüyor |
| **0** | Normal performans gösteriyor ya da<br>Görevi hiçbir zaman yapmadı ancak hakkında bilgi veren kişi hastanın şu anda bu görevi yapabileceğini düşünüyor. |

**Yorumlama:** 50-69 yaş grubunda iki ya da daha fazla faaliyetten '5 ya da daha fazla' puan; 70 yaş ve üstü grupta üç ya da daha fazla faaliyetten '9 ya da daha fazla' puan almış olmak işlevsel faaliyetlerde bozukluk olduğuna ve bağımlılığa işaret etmektedir. Günlük hayat aktivitelerinde meydana gelen değişim ve bu değişimin hızı özellikle demans tanısı ile ilgili olabilecek işlevlerin değerlendirilmesinde klinisyen açısından kritiktir. Buna karşın, anketten alınan puan tek başına demansı belirleyici bir ölçüt değildir. Daha ileri bilişsel değerlendirmelerin yapılması gerekir.

| Madde No | Günlük Hayat Faaliyetleri | Puan |
|---|---|---|
| 1 | Fatura ödemek, gelir ve giderleri dengelemek, para hesabı yapmak. | |
| 2 | Vergi, aidat, elektrik-su-telefon makbuzlarını, KDV fişlerini, işe ait evrakları tasnif etmek. | |
| 3 | Giyecek, ev ihtiyaçları veya yiyecek almak için tek başına alışverişe çıkmak. | |
| 4 | Beceri gerektiren oyun oynamak, bir hobiyle uğraşmak. | |
| 5 | Su kaynatmak, bir bardak hazır kahve ya da çay yapmak, ocağı söndürmek. | |
| 6 | Besin dengesi olan bir öğün (yemek) hazırlamak. | |
| 7 | Gündelik olayları takip etmek. | |
| 8 | Bir TV programını, kitabı veya gazeteyi dikkatle izlemek ya da okumak, anlamak, tartışmak. | |
| 9 | Randevuları, ailenin özel günlerini, tatilleri, ilaç tedavilerini (ilaç dozlarını ve ne zaman alınacağını) düzenli olarak sürdürebilmek. | |
| 10 | Şehiriçi ulaşım araçları (taksi, dolmuş, belediye otobüsü) ile bulunduğu semtin dışına seyahat etmek, şehirlerarası ulaşım araçlarından (otobüs, tren, uçak) yer ayırtmak ya da otomobil kullanmak. | |
| | **TOPLAM PUAN** | |

## APPENDIX G - BECK DEPRESSION INVENTORY

### Beck Depresyon Envanteri

Aşağıda, kişilerin ruh durumlarını ifade ederken kullandıkları bazı cümleler verilmiştir. Her madde, bir çeşit ruh durumunu anlatmaktadır. Her maddede o ruh durumunun derecesini belirleyen 4 seçenek vardır. Lütfen bu seçenekleri dikkatle okuyunuz. Son bir hafta içindeki (şu an dahil) kendi durumunuzu göz önünde bulundurarak, size en uygun ifadeyi bulunuz. Daha sonra o maddenin yanındaki harfin üzerine (X) işareti koyunuz.

1. (a) Kendimi üzgün hissetmiyorum.
   (b) Kendimi üzgün hissediyorum.
   (c) Her zaman için üzgünüm ve kendimi bu duygudan kurtaramıyorum.
   (d) Öylesine üzgün ve mutsuzum ki dayanamıyorum.

2. (a) Gelecekten umutsuz değilim.
   (b) Geleceğe biraz umutsuz bakıyorum.
   (c) Gelecekten beklediğim hiçbir şey yok.
   (d) Benim için bir gelecek yok ve bu durum düzelmeyecek.

3. (a) Kendimi başarısız görmüyorum.
   (b) Çevremdeki bir çok kişiden daha fazla başarısızlıklarım oldu sayılır.
   (c) Geriye dönüp baktığımda, çok fazla başarısızlığımın olduğunu görüyorum.
   (d) Kendimi tümüyle başarısız bir insan olarak görüyorum.

4. (a) Her şeyden eskisi kadar zevk alabiliyorum.
   (b) Her şeyden eskisi kadar zevk alamıyorum.
   (c) Artık hiçbir şeyden gerçek bir zevk alamıyorum.
   (d) Bana zevk veren hiçbir şey yok. Her şey çok sıkıcı.

5. (a) Kendimi suçlu hissetmiyorum.
   (b) Arada bir kendimi suçlu hissettiğim oluyor.
   (c) Kendimi çoğunlukla suçlu hissediyorum.
   (d) Kendimi her an için suçlu hissediyorum.

6. (a) Cezalandırıldığımı düşünmüyorum.
   (b) Bazı şeyler için cezalandırılabileceğimi hissediyorum.
   (c) Cezalandırılmayı bekliyorum.
   (d) Cezalandırıldığımı hissediyorum.

7. (a) Kendimden hoşnutum.
   (b) Kendimden pek hoşnut değilim.
   (c) Kendimden hiç hoşlanmıyorum.
   (d) Kendimden nefret ediyorum.

8. (a) Kendimi diğer insanlardan daha kötü görmüyorum.
   (b) Kendimi zayıflıklarım ve hatalarım için eleştiriyorum.
   (c) Kendimi hatalarım için çoğu zaman suçluyorum.
   (d) Her kötü olayda kendimi suçluyorum.

9. (a) Kendimi öldürmek gibi düşüncelerim yok.
   (b) Bazen kendimi öldürmeyi düşünüyorum, fakat bunu yapmam.
   (c) Kendimi öldürebilmeyi isterdim.
   (d) Bir fırsatını bulsam kendimi öldürürdüm.

10. (a) Her zamankinden daha fazla ağladığımı sanmıyorum.
    (b) Eskisine göre şu sıralarda daha fazla ağlıyorum.
    (c) Şu sıralarda her an ağlıyorum.
    (d) Eskiden ağlayabilirdim, ama şu sıralarda istesem de ağlayamıyorum.

11. (a) Her zamankinden daha sinirli değilim.
    (b) Her zamankinden daha kolayca sinirleniyor ve kızıyorum.
    (c) Çoğu zaman sinirliyim.
    (d) Eskiden sinirlendiğim şeylere bile artık sinirlenemiyorum.

12. (a) Diğer insanlara karşı ilgimi kaybetmedim.
    (b) Eskisine göre insanlarla daha az ilgiliyim.
    (c) Diğer insanlara karşı ilgimin çoğunu kaybettim.
    (d) Diğer insanlara karşı hiç ilgim kalmadı.

13. (a) Kararlarımı eskisi kadar kolay ve rahat verebiliyorum.
    (b) Şu sıralarda kararlarımı vermeyi erteliyorum.
    (c) Kararlarımı vermekte oldukça güçlük çekiyorum.
    (d) Artık hiç karar veremiyorum.

14. (a) Dış görünüşümün eskisinden daha kötü olduğunu sanmıyorum.
    (b) Yaşlandığımı ve çekiciliğimi kaybettiğimi düşünüyor ve üzülüyorum.
    (c) Dış görünüşümde artık değiştirilmesi mümkün olmayan olumsuz değişiklikler olduğunu hissediyorum.
    (d) Çok çirkin olduğumu düşünüyorum.

15. (a) Eskisi kadar iyi çalışabiliyorum.
(b) Bir işe başlayabilmek için eskisine göre kendimi daha fazla zorlamam gerekiyor.
(c) Hangi iş olursa olsun, yapabilmek için kendimi çok zorluyorum.
(d) Hiçbir iş yapamıyorum.

16. (a) Eskisi kadar rahat uyuyabiliyorum.
(b) Şu sıralarda eskisi kadar rahat uyuyamıyorum.
(c) Eskisine göre 1 veya 2 saat erken uyanıyor ve tekrar uyumakta zorluk çekiyorum.
(d) Eskisine göre çok erken uyanıyor ve tekrar uyuyamıyorum.

17. (a) Eskisine kıyasla daha çabuk yorulduğumu sanmıyorum.
(b) Eskisinden daha çabuk yoruluyorum.
(c) Şu sıralarda neredeyse her şey beni yoruyor.
(d) Öyle yorgunum ki hiçbir şey yapamıyorum.

18. (a) İştahım eskisinden pek farklı değil.
(b) İştahım eskisi kadar iyi değil.
(c) Şu sıralarda iştahım epey kötü.
(d) Artık hiç iştahım yok.

19. (a) Son zamanlarda pek fazla kilo kaybettiğimi sanmıyorum.
(b) Son zamanlarda istemediğim halde üç kilodan fazla kaybettim.
(c) Son zamanlarda istemediğim halde beş kilodan fazla kaybettim.
(d) Son zamanlarda istemediğim halde yedi kilodan fazla kaybettim.
Daha az yemeye çalışarak kilo kaybetmeye çalışıyorum.
Evet ( ) Hayır( )

20. (a) Sağlığım beni pek endişelendirmiyor.
(b) Son zamanlarda ağrı, sızı, mide bozukluğu, kabızlık gibi sorunlarım var.
(c) Ağrı, sızı gibi bu sıkıntılarım beni epey endişelendirdiği için başka şeyleri düşünmek zor geliyor.
(d) Bu tür sıkıntılarım beni öylesine endişelendiriyor ki, artık başka hiçbir şey düşünemiyorum.

21. (a) Son zamanlarda cinsel yaşantımda dikkatimi çeken bir şey yok.
(b) Eskisine oranla cinsel konularla daha az ilgileniyorum.
(c) Şu sıralarda cinsellikle pek ilgili değilim.
(d) Artık cinsellikle hiçbir ilgim kalmadı.

## APPENDIX H: POSITIVE AND NEGATIVE AFFECT SCHEDULE

### Pozitif ve Negatif Duygu Ölçeği

Bu ölçek farklı duyguları tanımlayan bir takım sözcükler içermektedir. Son iki hafta nasıl hissettiğinizi düşünüp her maddeyi okuyun. Uygun cevabı her maddenin yanında ayrılan yere (puanları daire içine alarak) işaretleyin. Cevaplarınızı verirken aşağıdaki puanları kullanın.

1. Çok az veya hiç
2. Biraz
3. Ortalama
4. Oldukça
5. Çok fazla

| | | | | | |
|---|---|---|---|---|---|
| 1. İlgili | 1 | 2 | 3 | 4 | 5 |
| 2. Sıkıntılı | 1 | 2 | 3 | 4 | 5 |
| 3. Heyecanlı | 1 | 2 | 3 | 4 | 5 |
| 4. Mutsuz | 1 | 2 | 3 | 4 | 5 |
| 5. Güçlü | 1 | 2 | 3 | 4 | 5 |
| 6. Suçlu | 1 | 2 | 3 | 4 | 5 |
| 7. Ürkmüş | 1 | 2 | 3 | 4 | 5 |
| 8. Düşmanca | 1 | 2 | 3 | 4 | 5 |
| 9. Hevesli | 1 | 2 | 3 | 4 | 5 |
| 10. Gururlu | 1 | 2 | 3 | 4 | 5 |
| 11. Asabi | 1 | 2 | 3 | 4 | 5 |
| 12. Uyanık (dikkati açık) | 1 | 2 | 3 | 4 | 5 |
| 13. Utanmış | 1 | 2 | 3 | 4 | 5 |
| 14. İlhamlı (yaratıcı düşüncelerle dolu) | 1 | 2 | 3 | 4 | 5 |
| 15. Sinirli | 1 | 2 | 3 | 4 | 5 |
| 16. Kararlı | 1 | 2 | 3 | 4 | 5 |
| 17. Dikkatli | 1 | 2 | 3 | 4 | 5 |
| 18. Tedirgin | 1 | 2 | 3 | 4 | 5 |
| 19. Aktif | 1 | 2 | 3 | 4 | 5 |
| 20. Korkmuş | 1 | 2 | 3 | 4 | 5 |

# APPENDIX I - FIVE-FACTOR PERSONALITY INVENTORY

## 5 Faktör Kişilik Envanteri

Aşağıda insanların bazı özelliklerini tanımlayan cümleler verilmiştir. Lütfen dikkatlice okuyarak her ifadenin sizi tanımlamakta ne derece uygun olduğunu belirten seçeneklerden bir tanesini işaretleyiniz.

Eğer cümle sizi tanımlamakta;

| | | | |
|---|---|---|---|
| **T**amamen **U**ygunsa | baş harfleri olan | "**TU**" yu | (TU) BU ? PUD HUD |
| **B**iraz **U**ygunsa | baş harfleri olan | "**BU**" yu | TU (BU) ? PUD HUD |
| **P**ek **U**ygun **D**eğilse | baş harfleri olan | "**PUD**" yi | TU BU ? (PUD) HUD |
| **H**iç **U**ygun **D**eğilse | baş harfleri olan | "**HUD**" yi | TU BU ? PUD (HUD) |

daire içine alın. Eğer hiç bir seçenek size uymuyorsa veya **kararsızsanız** " **?** " ni daire içine alınız. Lütfen karar vermekte çok zorlanmadığınız sürece soru işaretini ( **?** ) kullanmayınız.

Bu anketteki hiç bir sorunun doğru ya da yanlış cevabı yoktur. Bizim için önemli olan sizin samimi görüşünüzü almaktır. Lütfen cevaplarınızı **genel halinize göre, çoğunlukla nasıl olduğunuzu** düşünerek veriniz. Ayrıca olmak istediğinize göre değil, şu anda kendinizi nasıl görüyorsanız ona göre cevaplayınız.

| Tamamen Uygun TU | Biraz Uygun BU | Kararsız ? | Pek Uygun Değil PUD | Hiç Uygun Değil HUD |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** | Çekingen bir insanım. | TU | BU | ? | PUD | HUD | **14.** | Emirlere uyarım. | TU | BU | ? | PUD | HUD |
| **2.** | Her şeyi son dakikada yaparım. | TU | BU | ? | PUD | HUD | **15.** | Başkalarının göremediği güzellikleri fark ederim. | TU | BU | ? | PUD | HUD |
| **3.** | Etrafımdaki insanları eğlendiririm. | TU | BU | ? | PUD | HUD | **16.** | Her şeyi sorun haline getiririm. | TU | BU | ? | PUD | HUD |
| **4.** | Farklı düşünen insanları anlarım. | TU | BU | ? | PUD | HUD | **17.** | Yabancı ortamlarda rahatımdır. | TU | BU | ? | PUD | HUD |
| **5.** | Otoriteye saygı duyarım. | TU | BU | ? | PUD | HUD | **18.** | Zamanımı boşa harcarım. | TU | BU | ? | PUD | HUD |
| **6.** | Düşüncelerimi hayata geçiremem. | TU | BU | ? | PUD | HUD | **19.** | Bağışlayıp unutmaya çalışırım. | TU | BU | ? | PUD | HUD |
| **7.** | Coşkulu bir grupta olmaktan hoşlanırım. | TU | BU | ? | PUD | HUD | **20.** | Hayatımın bir yönü olmadığını hissediyorum. | TU | BU | ? | PUD | HUD |
| **8.** | Başkalarını bağışlamakta güçlük çekerim. | TU | BU | ? | PUD | HUD | **21.** | Çılgın hayallere dalmaktan hoşlanırım. | TU | BU | ? | PUD | HUD |
| **9.** | İnsanlara acı konuşurum. | TU | BU | ? | PUD | HUD | **22.** | Kolayca kızmam. | TU | BU | ? | PUD | HUD |
| **10.** | Değişiklik fikrinden hoşlanmam. | TU | BU | ? | PUD | HUD | **23.** | Kendimi olduğumdan daha aşağıda görürüm. | TU | BU | ? | PUD | HUD |
| **11.** | Çalışırken sıklıkla canım sıkılır. | TU | BU | ? | PUD | HUD | **24.** | Şiddetli arzularımı kontrol edebilirim. | TU | BU | ? | PUD | HUD |
| **12.** | Derin umutsuzluklara kapılırım. | TU | BU | ? | PUD | HUD | **25.** | Benden beklenenden fazlasını yaparım. | TU | BU | ? | PUD | HUD |
| **13.** | Her şeye endişelenirim. | TU | BU | ? | PUD | HUD | **26.** | Hiç okula gitmedim. | TU | BU | ? | PUD | HUD |

| Tamamen Uygun TU | Biraz Uygun BU | Kararsız ? | Pek Uygun Değil PUD | Hiç Uygun Değil HUD |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27. | Yalnız olmaktan hoşlanırım. | TU | BU | ? | PUD | HUD | 57. | Kin tutarım. | TU | BU | ? | PUD | HUD |
| 28. | Başkalarına tepeden bakarım. | TU | BU | ? | PUD | HUD | 58. | Kurallara sıkı sıkıya bağlıyımdır. | TU | BU | ? | PUD | HUD |
| 29. | Geçmiş hatalarımı düşünerek zaman harcarım. | TU | BU | ? | PUD | HUD | 59. | Olayları analiz etmeye çalışırım. | TU | BU | ? | PUD | HUD |
| 30. | Disiplinli bir insanım. | TU | BU | ? | PUD | HUD | 60. | Ruh halim çok sık değişir. | TU | BU | ? | PUD | HUD |
| 31. | Rekabetten çok işbirliğine önem veririm. | TU | BU | ? | PUD | HUD | 61. | Kendi fikirlerimi oluşturmak isterim. | TU | BU | ? | PUD | HUD |
| 32. | Hayal kırıklıklarımın acısını başkalarından çıkarırım. | TU | BU | ? | PUD | HUD | 62. | Aynı anda birçok şeyi idare edebilirim. | TU | BU | ? | PUD | HUD |
| 33. | Macera ararım. | TU | BU | ? | PUD | HUD | 63. | Kahkahayla gülerim. | TU | BU | ? | PUD | HUD |
| 34. | Yapacağım işlerin listesini çıkarırım. | TU | BU | ? | PUD | HUD | 64. | Eleştirileri kızmadan kabul edebilirim. | TU | BU | ? | PUD | HUD |
| 35. | Fırsatını buldum mu gösteriş yaparım. | TU | BU | ? | PUD | HUD | 65. | Duygularımın altında ezilirim. | TU | BU | ? | PUD | HUD |
| 36. | Az konuşurum. | TU | BU | ? | PUD | HUD | 66. | Sivri dilliyim. | TU | BU | ? | PUD | HUD |
| 37. | Duygusal davranan insanları anlayamam. | TU | BU | ? | PUD | HUD | 67. | Vücut ağırlığım yüz elli kilonun altındadır. | TU | BU | ? | PUD | HUD |
| 38. | Düşünmeye iten filmleri severim. | TU | BU | ? | PUD | HUD | 68. | Göze girmek için insanlara yaranırım. | TU | BU | ? | PUD | HUD |
| 39. | Kalabalıktan hoşlanmam. | TU | BU | ? | PUD | HUD | 69. | Her zaman faalimdir. | TU | BU | ? | PUD | HUD |
| 40. | Başkalarını memnun etmek isterim. | TU | BU | ? | PUD | HUD | 70. | Amaçlarıma ulaşmak için sıkı çalışırım. | TU | BU | ? | PUD | HUD |
| 41. | Her zaman göründüğüm gibi değilimdir. | TU | BU | ? | PUD | HUD | 71. | Her zaman söylediğimi yapmam. | TU | BU | ? | PUD | HUD |
| 42. | Hazır cevap biriyimdir. | TU | BU | ? | PUD | HUD | 72. | Yeni hiçbir şey söylemem. | TU | BU | ? | PUD | HUD |
| 43. | Özürleri kolayca kabul ederim. | TU | BU | ? | PUD | HUD | 73. | Kolayca etki altında kalırım. | TU | BU | ? | PUD | HUD |
| 44. | Arkadaşlarımı güldürürüm. | TU | BU | ? | PUD | HUD | 74. | Harekete bayılırım. | TU | BU | ? | PUD | HUD |
| 45. | Başkalarına çok fazla önem veririm. | TU | BU | ? | PUD | HUD | 75. | Genellikle eşyaları yerine koymayı unuturum. | TU | BU | ? | PUD | HUD |
| 46. | Hiç baş ağrısı yaşamadım. | TU | BU | ? | PUD | HUD | 76. | Okumaktan hoşlanırım. | TU | BU | ? | PUD | HUD |
| 47. | Olaylara yalnız tek bir açıdan bakarım. | TU | BU | ? | PUD | HUD | 77. | Kolayca kendimi baskı altında hissederim. | TU | BU | ? | PUD | HUD |
| 48. | Kendimi bir şeylere veremem. | TU | BU | ? | PUD | HUD | 78. | Duygularımı yoğun yaşarım. | TU | BU | ? | PUD | HUD |
| 49. | Kendimi anlamaya çalışırım. | TU | BU | ? | PUD | HUD | 79. | Tehlikeli şeyler yaparım. | TU | BU | ? | PUD | HUD |
| 50. | İnsanları kolayca bağışlayabilirim. | TU | BU | ? | PUD | HUD | 80. | Bazen yalan söylemek zorunda kalırım. | TU | BU | ? | PUD | HUD |
| 51. | İşleri planlayarak yaparım. | TU | BU | ? | PUD | HUD | 81. | Cesaretim çabuk kırılır. | TU | BU | ? | PUD | HUD |
| 52. | Yakalanmayacağımı bilsem dahi vergi kaçırmam. | TU | BU | ? | PUD | HUD | 82 | Sonradan pişman olacağım şeyler yaparım. | TU | BU | ? | PUD | HUD |
| 53. | Sanata ilgi duymam. | TU | BU | ? | PUD | HUD | 83. | Konuşkan bir insanım. | TU | BU | ? | PUD | HUD |
| 54. | Sürekli aynı şeyleri yapmaktan hoşlanmam. | TU | BU | ? | PUD | HUD | 84. | Başkaları için uğraşmaktan hoşlanmam. | TU | BU | ? | PUD | HUD |
| 55. | Kolayca huzursuz olurum. | TU | BU | ? | PUD | HUD | 85. | İnsanlara güvenirim. | TU | BU | ? | PUD | HUD |
| 56. | Düzensizlikten rahatsız olmam. | TU | BU | ? | PUD | HUD | | | | | | | | |

## APPENDIX J - WORD-LIST 1 - MEDIUM-AROUSING WORDS USED IN THE STUDY SESSION

| **Medium-Arousing Positive Words** | **Medium-Arousing Negative Words** | **Non-Arousing Neutral Words** |
|---|---|---|
| Gökyüzü | Kirlilik | Asansör |
| Papatya | Esir | Bilek |
| Dede | Nezle | Yakıt |
| Konser | Çöplük | Şoför |
| Ziyafet | Sigara | Bozkır |
| Kumsal | Mikrop | Kemik |
| Kuzu | Masraf | Bayi |
| Masaj | Mezar | Tırnak |
| Yatak | Leke | Depo |
| Okyanus | Solucan | Buhar |
| Şömine | Idrar | Boğa |
| Zeytin | Kilo | Mantar |
| Kokteyl | Gözyaşı | Sandık |
| Şarkı | Zincir | Metal |
| Vapur | Dilenci | Avuç |

## APPENDIX K - WORD-LIST 2 - HIGHLY AROUSING WORDS USED IN THE STUDY SESSION

| **Highly-Arousing Positive Words** | **Highly -Arousing Negative Words** | **Non-Arousing Neutral Words** |
|---|---|---|
| Kelebek | Tüfek | Değnek |
| Arkadaş | Yangın | Düğüm |
| Seyahat | Tabut | Çekiç |
| Altin | Zulüm | Maske |
| Maaş | Iltihap | Davul |
| Alkış | Ceza | Kaya |
| Çarşı | Düşman | Büro |
| Sinema | Intihar | Montaj |
| Gelin | Şehit | Işçi |
| Ödül | Eroin | Perde |
| Şelale | Soygun | Berber |
| Para | Terör | Demir |
| Elmas | Kanser | Yabancı |
| Uçak | Idam | Cadde |
| Gösteri | Çığlık | Masa |

## APPENDIX L: WORD-LIST 3 - MEDIUM-AROUSING WORDS USED IN THE TEST SESSION

| Medium-Arousing Positive Words | Medium-Arousing Negative Words | Non-Arousing Neutral Words |
|---|---|---|
| Doğa | Ülser | Tadilat |
| İncir | Kırık | Ödeme |
| Yıldız | Ağrı | Tilki |
| Çimen | Mayın | Kamyon |
| Güneş | Çamur | Sprey |
| Yoğurt | Pıhtı | Bagaj |
| Kucak | İshal | Kabuk |
| Tatlı | Küfür | Ticaret |
| İlim | Tekme | Tabure |
| İpek | Kurban | Ketçap |
| Torun | Balçık | Çerçeve |
| Yazar | Vergi | Döviz |
| Civciv | Bakteri | Kepenk |
| Turist | Gübre | Surat |
| Ördek | Pire | Ekran |
| Gökyüzü | Kirlilik | Asansör |
| Papatya | Esir | Bilek |
| Dede | Nezle | Yakıt |
| Konser | Çöplük | Şoför |
| Ziyafet | Sigara | Bozkır |
| Kumsal | Mikrop | Kemik |
| Kuzu | Masraf | Bayi |
| Masaj | Mezar | Tirnak |
| Yatak | Leke | Depo |
| Okyanus | Solucan | Buhar |
| Şömine | Idrar | Boğa |
| Zeytin | Kilo | Mantar |
| Kokteyl | Gözyaşı | Sandık |
| Şarkı | Zincir | Metal |
| Vapur | Dilenci | Avuç |

## APPENDIX M - WORD-LIST 4 - HIGHLY AROUSING WORDS USED IN THE TEST SESSION

| Highly-Arousing Positive Words | Highly-Arousing Negative Words | Non-Arousing Neutral Words |
|---|---|---|
| Deniz | Karakol | İlaç |
| Müzik | Yumruk | Takoz |
| Evlat | Mafya | Iskelet |
| Sevgili | Mahkeme | Delik |
| Gençlik | Eziyet | Sermaye |
| Hazine | Şiddet | Makas |
| Bayrak | Bıçak | Madde |
| Vatan | Tecavüz | Dikiş |
| Araba | Ceset | Şişe |
| Mektup | Katliam | Heykel |
| Orman | Kuduz | Şalter |
| Girişim | Silah | Koridor |
| Yavru | Uçurum | Malzeme |
| Otel | Deprem | Tahta |
| Lider | Kaza | Harita |
| Kelebek | Tüfek | Değnek |
| Arkadaş | Yangın | Düğüm |
| Seyahat | Tabut | Çekiç |
| Altin | Zulüm | Maske |
| Maaş | Iltihap | Davul |
| Alkış | Ceza | Kaya |
| Çarşı | Düşman | Büro |
| Sinema | İntihar | Montaj |
| Gelin | Şehit | Işçi |
| Ödül | Eroin | Perde |
| Şelale | Soygun | Berber |
| Para | Terör | Demir |
| Elmas | Kanser | Yabancı |
| Uçak | Idam | Cadde |
| Gösteri | Çığlık | Masa |

## APPENDIX N: THE INSTRUCTIONS USED IN THE RESEARCH

**I. Recognition Memory Instruction Used in Study Session**

"Katılacağınız araştırma, üç aşamalı olup genç ve yaşlı bireylerde, kelime ve sayıları işleme süreci açısından farklılıklar araştırılmaktadır. Çalışmanın birinci aşamasında bilgisayar ekranında art arda kelimeler göreceksiniz. Lütfen bu kelimeleri öncelikle içinizden dikkatli okuyunuz. Daha sonra her bir kelimenin kaç sesli harften oluştuğunu, önünüzdeki sayı klavyesinde (numpad) ilgili sayı tuşuna (örneğin 2 ya da 3) basarak belirtiniz. Sormak istediğiniz bir soru yoksa başlayabiliriz. Çalışmayı başlatmak için herhangi bir tuşa basabilirsiniz."

**II. Recognition Memory Instruction Used in Distractor Session**

"Çalışmanın bu ikinci aşamasında bilgisayar ekranında yan yana sayılar göreceksiniz. Bu sayılar birbirine eşitse klavyedeki 'A' harfi tuşuna, eşit değilse 'İ' harfi tuşuna basınız. Hazırsanız, çalışmayı başlatmak için herhangi bir tuşa basabilirsiniz."

**III. Recognition Memory Instruction Used in Test Session**

"Çalışmanın üçüncü ve son aşamasında bilgisayar ekranında yine art arda kelimeler göreceksiniz. Bu kelimelerin bazıları bir önceki aşamada gördüğünüz, diğer bir deyişle eski kelimeler, bazıları da bir önceki aşamada görmediğiniz, yeni kelimeler olacaktır. Bu aşamada sizden beklenen, kelimeleri bir önceki aşamada görüp görmediğinizi bildirmenizdir. Eğer ekrana gelen kelimeyi hatırlıyorsanız ve kelimenin bir önceki listede olduğunu düşünüyorsanız lütfen klavyedeki '1' tuşuna basınız. Eğer kelimeyi bir önceki aşamada görmediğinizi düşünüyorsanız, yani o kelime yeniyse '3' tuşuna basınız ve bir sonraki kelimeye geçiniz. Şimdi lütfen bir elinizi numpadin önüne koyunuz ve tüm işlem boyunca o elinizi kullanınız. Tuşa her bastıktan sonra elinizi yine numpadin önüne geri koyunuz. Hazırsanız, çalışmayı başlatmak için herhangi bir tuşa basabilirsiniz."

## APPENDIX O - DEBRIEFING FORM

### Katılım Sonrası Bilgi Formu

Bu çalışma, Orta Doğu Teknik Üniversitesi Enformatik Enstitüsü Bilişsel Bilimler Bölümü'nde Yrd. Doç. Dr. Didem GÖKÇAY danışmanlığında, Bilişsel Bilimler Doktora Programı öğrencisi Hande KAYNAK'ın doktora tez çalışmasının bir gereği olarak yapılmaktadır. Bu çalışmada temel olarak, kelimelerin duygusal olumluluk ve heyecan düzeylerinin sağlıklı yaşlanmayla birlikte tanıma belleğini geliştirip geliştirmediğinin incelenmesi planlanmaktadır. Ayrıca, ülkemiz kültürü için uyarlama, norm belirleme, standardizasyon ve/veya geçerlik/güvenirlik çalışmaları yapılmış olan kişilik envanteri aracılığıyla duygusal bellek performanslarının yaşla ilişkili değişiminin incelenmesi amaçlanmaktadır.

Literatürdeki duygusal bellek çalışmalarında öne çıkan iki boyut, duygu içerikli uyarıcıların 'olumluluk' ve 'heyecan' boyutlarıdır. Mevcut araştırmada kelimelerin duygusal olumluluk ve heyecan düzeylerinin tanıma belleğini geliştirip geliştirmediğinin incelenmesi açısından 2 farklı duygusal bellek deneyi tasarlanmıştır. Bu anlamda, sağlıklı yaşlanmayla birlikte, bahsi geçen iki duygu boyutun (olumluluk ve heyecan) tanıma belleği performanslarına katkılarını netleştirmek amaçlanmaktadır. Ayrıca, bireysel farklılıklar kapsamında bellek performansına etkisi olabileceği düşünülen kişilik özelliklerin, 5-Faktör Kişilik Envanteri aracılığıyla ölçülmesi hedeflenmektedir. Envanterde yer alan 'Duygusal Tutarsızlık' ve 'Gelişime Açıklık' alt boyutlarından elde edilecek toplam puanlara göre, genç ve yaşlı katılımcıların hatırlama performanslarında fark beklenmektedir. Katılımcıların son bir haftalık dönemdeki duygu düzeylerinin değerlendirilmesi amacıyla kullanılan Pozitif ve Negatif Duygu

Ölçeği'nin pozitif özellikler ve negatif özellikler boyutlarından alınacak puanlar ile tanıma belleği performansı arasında ilişki beklenmektedir.

Bu çalışma kapsamındaki tüm verilerin Eylül 2012 sonunda elde edilmesi amaçlanmaktadır. Elde edilen bilgiler sadece bilimsel araştırma ve yazılarda kullanılacaktır. Çalışmanın sonuçlarını öğrenmek ya da bu araştırma hakkında daha fazla bilgi almak için aşağıdaki isimlere başvurabilirsiniz. Bu araştırmaya katıldığınız için tekrar çok teşekkür ederiz.

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| 2005 – 2006 | Saygı Special Education and Rehabilitation Center, Ankara, Turkey<br>*Psychologist* |
| 2004 – 2005 | Sistem Special Education and Rehabilitation Center, Ankara, Turkey<br>*Psychologist* |
| 1999 – 2000 | METU Presidency, Press Office, Ankara, Turkey<br>*METU Press Coordinator Assistant* |

| **Presentations & Publications** |
| --- |
| Kaynak, H. (2012). Implicit and explicit memory with aging. Poster presented at ESF FENS Conferences on Dynamic Brain: The Neurobiology of Emotion, Stresa, Italy |
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## References

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**TEZ FOTOKOPİ İZİN FORMU**

**ENSTİTÜ**

| | |
|---|---|
| Fen Bilimleri Enstitüsü | ☐ |
| Sosyal Bilimler Enstitüsü | ☐ |
| Uygulamalı Matematik Enstitüsü | ☐ |
| Enformatik Enstitüsü | X |
| Deniz Bilimleri Enstitüsü | ☐ |

**YAZARIN**

Soyadı : KAYNAK
Adı : HANDE
Bölümü : BİLİŞSEL BİLİMLER

**TEZİN ADI** (İngilizce) **: RECOGNITION MEMORY FOR EMOTIONAL WORDS UNDER INCIDENTAL ENCODING: EFFECTS OF VALENCE, AROUSAL AND AGE**

**TEZİN TÜRÜ :** Yüksek Lisans ☐ Doktora X

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. ☐

2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullanıcılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) X

Yazarın imzası ..... Tarih 08.01.2013