

**GENDER DIFFERENCES IN THE RECALL OF NEUTRAL, POSITIVE AND
NEGATIVE EMOTIVE WORDS**

by

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DECLARATION

I declare that the thesis entitled “*Gender Differences in the Recall of Neutral, Positive and Negative Emotive Words*” is the result of my own work except as cited in the references and that it has never been presented anywhere else for a similar purpose. It is submitted to the University of Johannesburg (Department of Psychology) in partial fulfilment of the requirements of the degree Master of Arts in Clinical Psychology.



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SUMMARY

Memory and emotion are two constructs which have received significant attention in the field of psychology. Another area of focus which has become popular in the psychological literature is gender differences. Together, these three constructs have also been investigated in various ways. However, there seems to be little research that has focused specifically on the possible gender differences in the recall of neutral, positive and negative material.

The link between memory and emotion has been demonstrated in a variety of previous research studies. These studies indicate that memory performance is enhanced for emotive material. Gender differences have been noted in the psychological literature in terms of language abilities, emotional functioning, memory, cognitive processing style and neuropsychology. From past research it was unclear as to whether gender differences would be present in the recall of neutral and emotionally arousing words.

This study involved 71 students from the University of Johannesburg. A word list was developed from a database of words rated in terms of valence and arousal, which was used to test the recall of neutral, positive and negative emotive words for each participant. Non-parametric statistical techniques were used to analyse the data.

The results of the study indicated statistically significant differences between male and female participants in the recall of neutral words and the total recall of words. In particular, females recalled significantly more neutral words than males, and the same result was found with regards to the total number of words recalled. There were no statistically significant differences found between male and female participants in the recall of positive and negative emotive words.

Numerous explanations can account for these findings. These include the theory of desensitization, which involves a decreased response to emotionally arousing material due to continuous exposure to aversive stimuli over time. Another explanation focuses on the differences between the biological sex of participants and

their sex-related traits of masculinity or femininity. Finally, the words chosen for the word list may not have had the desired effect on the participants.

It is recommended that future studies develop a database of words which are rated in terms of valence and arousal by a sample in the population of interest. In addition, the language proficiency of the participants should also be determined.

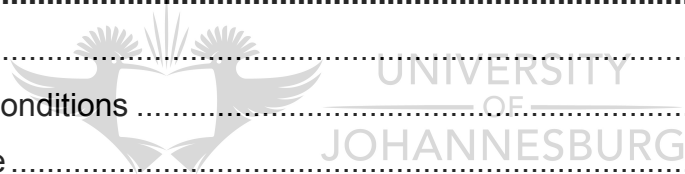


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CHAPTER 1

INTRODUCTION

This chapter will focus on an orientation to the present research study. This will include an introduction to the link between memory and emotion; gender differences in terms of this link; the problem statement and purpose of this study; and finally an overview of the subsequent chapters.

1.1. Orientation

Memory forms an integral part of human functioning and without it everyday life would be a constant struggle. Research suggests that memory is a constructive process that may be influenced by many internal and external factors (Iaccino, 1993). In particular, one of these factors may be emotional arousal (Hamann, 2001). Some research suggests that memory is enhanced for emotional stimuli and this is seen as an evolutionary advantage (Hamann, 2001). The interest in understanding this link led researchers to focus on other important aspects of emotionally arousing material, including the influence of the valence of stimuli, or how positive or negative a stimulus is (Kensinger & Corkin, 2003). However, the results of this research did not produce a consistent finding across studies (Mather & Nesmith, 2008). Past research seems to indicate that differences between males and females in terms of brain anatomy and function may also have an influence on the relationship between memory and emotion (Bourne, 2005). However, research focusing on the variables of memory, emotion, valence and gender has also yet to reveal a consistent pattern of results.

An overview of the link between memory and emotion will now be presented, as well as the effects of valence and gender on this link.

1.1.1. Memory and Emotion

Previous research has placed special focus on the link between memory and emotions (D'argembeau & Linden, 2004; Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003). Phelps (2004) refers to memory as "the recollection of events at will" (p. 198). Findings from research focusing on this link are inconsistent. Some research findings demonstrate a clear link between emotional content and memory enhancement (Manning & Julian, 1975), while others find results in direct contrast to this (Levine & Pizarro, 2004). Early research on this link claimed that "emotional memories often contained vivid, highly idiosyncratic details that seemed to endure for a long time" (Brown & Kulik cited in Levine & Pizarro, 2004, p.532). In addition to this memory enhancement, it was also suggested that emotional memories were indelible. More recent research has questioned this hypothesis. In particular, research indicates that "greater emotional intensity was associated with greater memory confidence but not with consistency" (Levine & Pizarro, 2004, p. 532). Overall, research has indicated that memories are not perfect representations of events, as was originally thought. Instead these emotional memories change over time and are influenced by events and appraisals following the emotional event. The possible reasons that memory is enhanced for emotive events or situations is associated with the degree to which they are novel, distinct and interesting; as well as the rehearsal of this information (Levine & Pizarro, 2004).

Hamann (2001) points to the possible evolutionary advantage of this link. Organisms will have a distinct advantage if they are able to vividly remember information that is directly relevant to the organisms' survival in the future (Hamann, 2001). This is because an emotionally arousing event or stimulus would likely have "both immediate and future relevance to survival and reproductive success" (Hamann, 2001, p. 395). Research in this field has also focused on the regions of the brain that are stimulated when processing emotional content, in order to explain this link. Brain structures that have been consistently implicated in the processing of emotion are the amygdala and the hippocampus (Phelps, 2004). The amygdala processes emotional content and the hippocampus plays a major role in declarative memory (Phelps, 2004). Research demonstrates that stress hormones such as epinephrine

are released when an individual is exposed to a stimulus that evokes strong emotions (Levine & Pizarro, 2004). This then activates noradrenergic systems in the amygdala, which in turn assists in the consolidation of long-term memory in other brain areas (Levine & Pizarro, 2004).

1.1.2. Valence and Memory

Studies on the influence of valence have also demonstrated conflicting results. Results of a study by Mather and Nesmith (2008) on location memory for pictures revealed no significant differences between positive and negative emotionally arousing pictures. According to a study by Libkuman, Stabler and Otani (2004), participants remembered positively valenced pictures better than negatively valenced pictures. Other studies have proposed that negative words are better remembered than positive words (Kousta, Vinson & Vigliocco, 2009). However, Mneimne et al. (2010) claim that this result may reflect a methodological issue, for example a failure to ensure that the arousal ratings for both the positive and negative stimuli are equal.



1.1.3. Memory and Gender Differences

Adding to the complexity of this link, researchers began to study the influence of gender on memory for emotive stimuli. A meta-analytic study conducted by Wagner, Phan, Liberzon and Taylor (2003) of neuroimaging scans of emotional processing indicated more lateralised processing of emotion in males and more brainstem activity in females. Some studies indicate that empathy is another variable on which males and females tend to differ (Rueckert & Naybar, 2008). In general, some studies show that females tend to exhibit higher levels of empathy than males. However, females may explicitly endorse more empathetic attitudes, while other more subtle measures of empathy may demonstrate more equal levels of empathy across the sexes (Rueckert & Naybar, 2008).

Research demonstrates that males tend to outperform females on tasks that involve visuospatial processing and fluid reasoning, while females outperform males in tasks

involving verbal ability, fine motor skills and perceptual speed (Guillem & Mograss, 2005). These findings can be linked to cerebral lateralisation, as the left hemisphere has been associated with verbal processing and the right hemisphere with spatial processing (Bellis, Billiet & Ross, 2008). In addition, research proposes that males and females tend to use different cognitive styles when processing information (Guillem & Mograss, 2005). The findings of research conducted by Guillem and Mograss (2005) suggest that females' style of cognition involves a more detailed elaboration of information, resulting in more specific representations. However, the cognitive style of males involves a less detailed form of information processing and reliance on generic schemas or information themes (Guillem & Mograss, 2005).

In terms of brain anatomy, past research indicates that differences exist in the shape and size of the corpus callosum of males and females (Cahill, 2003). More recently, differences have been noted in the following brain regions: prefrontal cortex, auditory cortex, Broca's and Wernicke's areas and in the relationship of amygdala to hippocampal size (Cahill, 2003). Parts of the frontal cortex and parts of the limbic system were found to be larger in women, while parts of the parietal cortex and amygdala were found to be larger in men (Cahill, 2005). According to Cahill (2003), research has also revealed significant sex-related differences in terms of stress hormones. In particular, a difference between the relationship of cortisol to short-term memory between males and females was found. In addition to this, hormones such as testosterone and estrogen have also been found to have a significant effect on memory (Cahill, 2003). In particular, both estrogen and testosterone may enhance memory for emotional material (Cahill, 2003).

1.1.4. Memory, Gender Differences and Emotion

Burton and colleagues claim that little research has been conducted in the field of memory differences between males and females in terms of emotion (Burton et al., 2004). However, these researchers suggest that the male memory system may discard information that is not important in some way, but becomes more attentive to emotive information. In contrast, the female memory system may regard all verbal information as significant and place equal emphasis on all incoming verbal material

(Burton et al., 2004). There appears to be little, if any, research specifically focused on the effects of gender on the recall of positive and negative emotive words.

1.2. Problem Statement

Although the memory-emotion link has been well established in numerous research studies, a literature survey seems to indicate that this kind of research has not been conducted in a South African context. Moreover, there seems to be no research that has focused specifically on the effects of gender on the recall of neutral, positive and negative words.

1.3. Purpose of the Study

The purpose of the present study is to contribute to the knowledge base concerning gender differences in the memory-emotion link in terms of emotional and neutral words. This research study seeks to determine if statistically significant differences exist between males and females in terms of the recall of emotionally arousing and neutral words. The research question is:

Do differences exist in the recall of neutral, and positive and negative emotive words between males and females?

As stated above, this specific research question does not seem to have been investigated in previous research studies. As people often rely on their memories in many different areas of life, research on the factors affecting memory performance can have important practical implications. These may include learning techniques for students and scholars, as well as the understanding of clinical disorders such as post-traumatic stress disorder and depression, which involve memory and emotion (Cahill, 2003). Rousseau and Grey (2009) also contend that memory and emotion play a significant role in all decision making. Focusing on gender differences may also point to the need to tailor specific treatments for male and female mental health care users.

1.4. Chapter Review

Chapter 2 will provide a detailed discussion of the constructs of memory, emotion and gender. This will include an investigation into the theories of the memory-emotion link, as well as gender differences in terms of this link.

Chapter 3 focuses on the research methodology that will be used in determining the effects of gender in the recall of neutral, positive and negative emotive words.

In Chapter 4 the results of the research study will be presented. This will include a report on each research hypothesis and the corresponding results.

Chapter 5 involves a discussion of the research results. The results are explained in terms of relevant past research and theory. Lastly, conclusions as well as recommendations for future research in this field will be presented.



CHAPTER 2

MEMORY, AFFECT AND GENDER

A special link between memory, affect and gender seems to exist in the psychological literature and is the focus of this study. This chapter will include a review of relevant literature in terms of these three variables: memory, affect and gender. Recent research and literature on each of these variables will be discussed in order to provide an accurate picture of current knowledge in these fields. Finally, research incorporating all three variables will be discussed.

2.1. Memory

In this section, the construct of memory will be discussed, in terms of a definition of this concept, categories of memory, theories of memory and finally the neuropsychology of memory.

2.1.1. Definition of Memory



Memory can be considered to be the store of knowledge and information that humans acquire through events they experience in their lives (Onoda, Okamoto & Yamawaki, 2009). According to Parrot and Spackman (2000), memory forms an integral part of nearly all components of thinking, including perception, social judgement and problem-solving. Although various models of memory exist, human memory is often referred to as a processing system, which involves the three stages of encoding, storage and retrieval of information (Neath & Suprenant, 2003). In this traditional view, each stage of the process is open to both external influences, such as environmental factors, and internal influences, such as mood, that may exist (Neath & Suprenant, 2003).

2.1.2. Categories of Memory

Memory may also be divided into immediate, recent, and long-term memory, based on the length of time that information is stored (Sadock & Sadock, 2007). Immediate memory involves the ability to attend to a stimulus over a period of seconds. Recent memory operates over a period of minutes to days. Together immediate and recent memory form working memory, which is the ability to attend to information, and to hold and process that information in memory (Sadock & Sadock, 2007). Finally, long-term or remote memory stores information over months or years.

2.1.3. Theories of Memory

Two of the most prominent theories of memory are the associative network model of memory and the Parallel Distributed Processing (PDP) model. The associative network model of memory is based on the assumption that the human memory system is made up of nodes, or ideas, which are connected to other nodes by links, or the relation between ideas (Fiske & Taylor, 2008). The most important notion of this model is that "...the more links or associations from other concepts to any given concept in memory, the easier it is to remember that concept because many alternative routes can locate it in memory" (Fiske & Taylor, 2008, p. 75). Another important notion in this system of memory is that the links between nodes are strengthened each time they are activated. Thus, the process of rehearsal makes the information more memorable (Fiske & Taylor, 2008).

The PDP model of memory is more recent and it challenges the notion of memory as a serial sequence of steps. In this view:

...memory consists of elementary units that are connected with facilitative and inhibitory links to each other. The connections represent constraints about what units are associated, and the connection strengths represent the type and magnitude of association. Only the strengths of connections are stored, so that the pattern can be re-created by activating parts of it and waiting for the connections to reverberate throughout the system until the entire pattern is activated (Fiske & Talyor, 2008, p. 87).

These memory systems will be referred to later, with reference to various theories of the emotional memory system.

2.1.4. Neuropsychology of Memory

The neuropsychology of memory refers to the brain structures, processes, and neurotransmitters that underlie the process of memory formation, storage and retrieval. Immediate memory seems to be located in the phonological and visuospatial areas of the brain, while working memory seems to be located in the left frontal cortex of the brain (Sadock & Sadock, 2007). According to Sadock and Sadock (2007), the following three regions of the brain are critical to the formation of memories: the medial temporal lobe, certain diencephalic nuclei, and the basal forebrain. The hippocampus is found in the medial temporal lobe, and is described as an elongated, highly repetitive network (Sadock & Sadock, 2007). This structure plays a particularly important role in the process of short-term memory. Another important structure, the amygdala, lies next to the anterior end of the hippocampus. The amygdala has been suggested to "...rate the emotional importance of an experience and to activate the level of hippocampal activity accordingly" (Sadock & Sadock, 2007, p. 87). In addition to hippocampal activation, there have been several reports that successfully remembering words is associated with activation in the medial temporal cortex, parietal cortex, prefrontal cortex, and occipital cortex (Onoda et al., 2009).

One construct that has been shown to influence human memory in a significant way is emotion. This concept will now be discussed, followed by an examination of the links between memory and emotion.

2.2. Emotion, Affect and Mood

In this section, the concepts of emotion, affect and mood will be described. This will be followed by a discussion of theories of emotion and the neuropsychology of emotion.

2.2.1. Definitions of Emotion, Affect and Mood

Emotion, affect and mood are terms used to describe human emotional functioning. Although used interchangeably, these terms have specific meanings in psychological literature. According to Sadock and Sadock (2007), “Emotion derives from basic drives, such as feeding, sex, reproduction, pleasure, pain, fear, and aggression, which all animals share” (p. 87). Scherer (2000) describes emotion as a “...relatively brief episode of synchronised responses by all or most organismic subsystems to the evaluation of an external or internal event as being of major significance (eg. anger, sadness, joy, fear, shame, pride, elation, desperation)” (p. 140). Mood is described as a “...diffuse affect state, most pronounced as change in subjective feeling, of low intensity but relatively long duration, often without apparent cause (eg. cheerful, gloomy, irritable, listless, depressed, buoyant)” (Scherer, 2000, p. 140).

Frijda (2000) refers to a definition of affect that is similar to valence, as affect is described as an aspect of emotion which involves the evaluation of a stimulus event, and may not have a cognitive basis. However, the term affect is also used to refer to a particular feeling state which is similar to the definition of emotions (Hofer et al., 2006). For the purpose of this study, affective stimuli are defined as any material that is emotionally arousing for the viewer, which can be either positive or negative in valence.

2.2.2. Theories of Emotion

Three important theories of emotion that attempted to capture the nature of feelings include the James-Lange Theory, the Cannon-Bard Theory and the Schachter-Singer Theory (Kalat & Shiota, 2007). These theories focused on three key aspects of emotions, namely cognition, behaviour and action. The James-Lange Theory proposed that an individual experiences an event which prompts an action and then the perception of this action causes the experience of an emotion (Kalat & Shiota, 2007). In contrast, the Cannon-Bard Theory suggests that the three aspects of emotion occur independently of each other. Finally, the Schachter-Singer Theory argued that people use information about a situation to determine what emotion they

are feeling and then determine how strong a feeling is based on the level of physical arousal (Kalat & Shiota, 2007). Another important contribution to the understanding of emotion is the fight-or-flight theory proposed by Walter Cannon (Taylor, 1991). This theory describes the physiological reaction to negative emotions, particularly fear. Once perception of a threat has occurred, the sympathetic nervous system is activated and the body is mobilised so that the organism is prepared to fight the threat or to flee (Taylor, 1991).

Another more recent theory of emotion focuses on two important aspects of emotions, valence and arousal (Nielen et al., 2009). Valence is described as how positive or negative a stimulus is, or alternatively how pleasant it is; while arousal refers to how intensely an event is experienced, with a range from calming to exciting (Nielen et al., 2009). This conception is represented graphically in Figure 2.1 below.

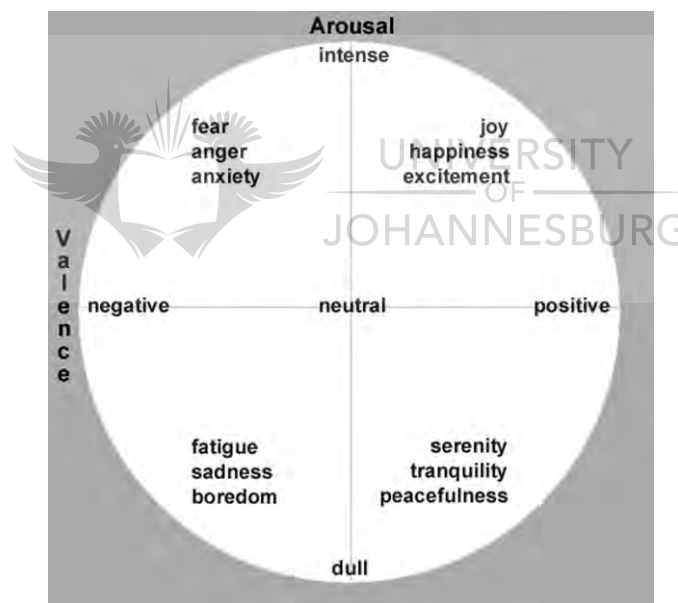


Figure 2.1. An overview of the circumplex model of emotion. (Mneimne et al., 2010).

In contrast, Levine and Pizarro (2004) refer to a theory of emotions that classifies emotions based on their relation to an individual's goals. People feel happy when their goals are being met; fear in response to the threat of goal failure; anger when there are obstacles in the path to goal attainment and sadness when they believe that their goals are permanently unattainable (Levine & Pizarro, 2004).

2.2.3. Neuropsychology of Emotion

Similarly to the neuropsychology of memory, this section will describe the various brain structures, processes and neurotransmitters involved in emotional experiences. Although most authors contend that a complex link exists between the body, brain and emotions, research points to the involvement of two main brain mechanisms underlying the experience of emotions, namely the amygdala and the limbic system (Daum, Markowitsch & Vandekerckhove, 2009). A description of the amygdala, limbic system and other important areas will be provided, as well as the involvement of the two hemispheres of the brain in the memory-emotion link.

2.2.3.1. *The Amygdala*

The amygdala may be most well-known for its role in producing the fear response (Medford et al., 2005). However, the amygdala seems to play an important role in assigning reward value to stimuli, consolidation of memories, and recognizing and responding to emotions (Hamann, 2001; LeDoux & Phelps, 2000; Tomaz, Frank & Conde, 2003). Thus, the amygdala's most significant function seems to be the assignment of affective significance to sensory events (Parrot & Spackman, 2000; Pessoa, Kastner & Ungerleider, 2002). Evidence of these notions includes research on individuals with amygdala lesions, which have been shown to interfere with the ability to determine the motivational significance of stimuli (Parrot & Spackman, 2000).

The amygdala has also been described as a "...critically important gate through which internal and external stimuli are integrated. Information from the primary senses is interwoven with internal drives, such as hunger and thirst, to assign emotional significance to sensory experiences" (Sadock & Sadock, 2007, p. 89). Hamann (2001) claims that certain assumptions can be made based on the results of research on the functioning of the amygdala. These include the observation that the amygdala seems able to modulate or enhance activity of certain brain regions involved in the memory process; stress hormones that are released during emotional

arousal interact with the amygdala; and the amygdala is involved in the consolidation of emotional memories in the hippocampus (Hamann, 2001).

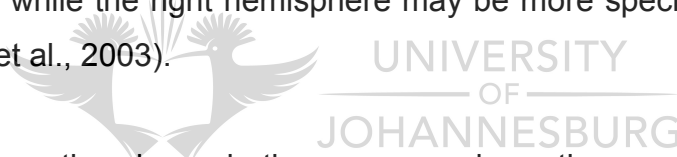
2.2.3.2. The Limbic System and Other Important Areas

The other brain region most often implicated in emotional processing is the limbic system (Daum et al., 2009; Holland & Kensinger, 2010). The limbic system originally consisted of the hippocampus, the fornix, the mamillary bodies, the anterior nucleus of the thalamus, and the cingulated gyrus, and later it expanded to include the amygdala, septum, basal forebrain, nucleus accumbens, and orbitofrontal cortex (Sadock & Sadock, 2007). Although the term limbic system is still used widely today, Gazzaniga, Ivry and Mangun (2002) indicate that not all of the regions identified play a significant role in the processing of emotion. These authors also add that a single neural circuit cannot account for the complex nature of emotional processing in the brain (Gazzaniga et al., 2002). However, research does support the primary roles of the orbitofrontal cortex and the amygdala in this process (Gazzaniga et al., 2002). Although the exact functions of the orbitofrontal cortex are difficult to pinpoint, Gazzaniga et al. (2002) claim that this region is particularly important in social and emotional decision making. Damage to this brain region results in a number of social deficits, such as inappropriate social responses, an inability to detect social cues, and an inability to follow social norms (Gazzaniga et al., 2002). Thus, this brain region appears to play a significant role in processing and evaluating social and emotional information.

According to Sadock and Sadock (2007) emotions such as affection, pride, guilt, pity, envy and resentment would be located in the cortex as they are learned emotions. The frontal cortex also appears to play a significant role in the regulation of emotions. Finally, the prefrontal cortices have also been noted as important regions in emotional processing (Sadock & Sadock, 2007). In particular, activation of the left prefrontal cortex seems to result in a lifted mood, while activation of the right prefrontal cortex seems to result in a lowered mood (Sadock & Sadock, 2007).

2.2.3.3. Lateralisation

According to Wager et al. (2003) traditional theories of emotion propose that the left hemisphere of the brain is specialized for certain cognitive processes, while the right hemisphere is specialized for processing emotional content. Evidence for this theory can be found in the results of various research studies, such as the finding that the left side of the human face is more emotionally expressive, stimuli presented in the left visual field (the right hemisphere) are judged as more emotional, and stimuli in this field are found to elicit greater autonomic responses (Wager et al., 2003). In addition to this, patients with right hemisphere frontal damage often experience deficits in prosody (emotional speech characteristics) and right hemisphere damage is also related to deficits in recognition of emotional facial expressions (Wager et al., 2003). A more recent conceptualization in the literature is that both hemispheres are involved in the processing of emotion, but each one may be specialized for particular types of emotion. It seems that the left hemisphere may be more specialized for positive emotions, while the right hemisphere may be more specialized for negative emotions (Wager et al., 2003).



As can be seen from the above, both memory and emotion are important systems necessary for human functioning. Research seems to indicate that strong connections exist between these two systems, as well as considerable overlapping in terms of underlying brain mechanisms. These connections will now be discussed, with reference to recent literature in this field.

2.3. Memory and Emotion

This section will focus on various aspects of the link between memory and emotion. This will include the process of remembering emotional material, theories of the memory-emotion link, research on discrete emotions, valence and arousal, and finally the neuropsychology of this link. In particular the following theories of the memory-emotion link will be discussed: motivational theory, cognitive theory, evolutionary theory, biological theory and the relatedness and distinctiveness theory.

In the neuropsychology of the memory-emotion link, the role of the amygdala, hippocampus, other brain regions, and specific neurotransmitters will be examined.

2.3.1. Process of Remembering Emotional Material

The relation between emotional functioning and cognitive functioning has received much attention in the psychological literature. Interest in the connection between memory and affect can be traced back in history to William James and Sigmund Freud (Banich, Mackiewicz, Depue, Whitmer, Miller & Heller, 2009). Although early pioneers in the fields of psychology and cognition, such as William James, believed that highly emotional events left a person with near perfect memory for that event (Banich et al., 2009), evidence has been found to suggest that memories are not indelible (Levine & Pizarro, 2004). Research has demonstrated that an individual's memory for an emotional event shortly after the event and over a longer period of time is correlated but not exactly similar (Scollon, Howard, Caldwell & Ito, 2009). This result indicates that emotional material is not stored in a permanent form in the brain. According to Scollon et al. (2009), an individual's current cognitive functioning (such as values, beliefs and motivations) will affect emotional material and thus these memories are constantly reconstructed.

According to Parrott and Spackman (2000) emotion can affect memory in three ways: when the material is emotionally arousing, when an individual is in a particular emotional state during encoding of material, and when an individual is in a particular emotional state during recall of the material. This notion is represented below in Figure 2.2.

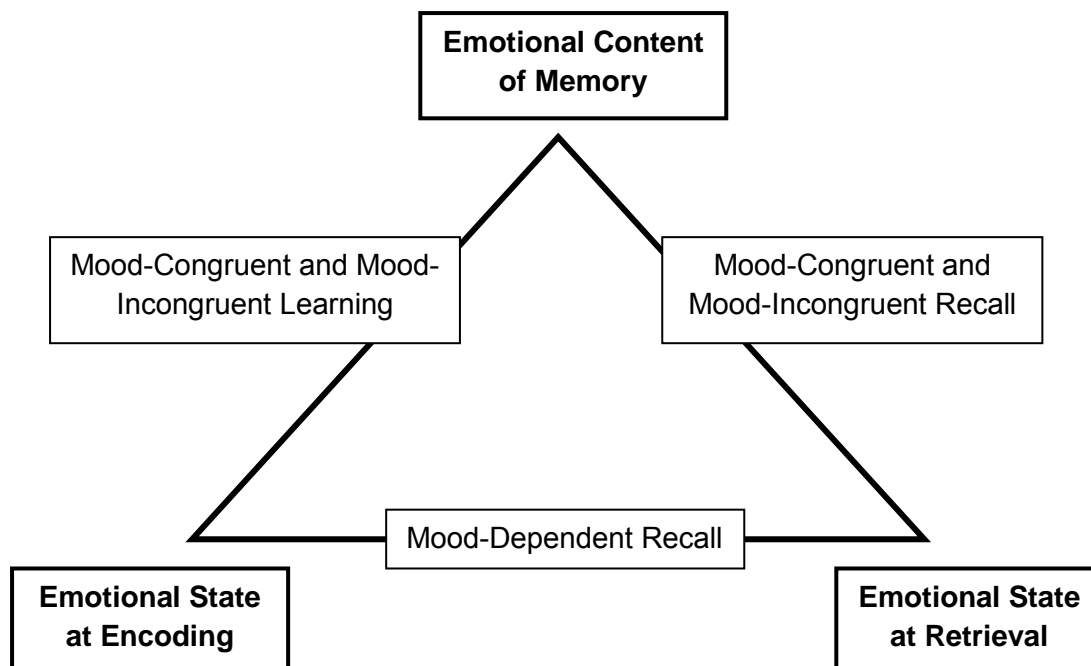


Figure 2.2. The emotion-and-memory triangle. (Parrot & Spackman, 2000)

Onoda et al. (2009) indicate that the relationship between memory and emotion is vitally significant, as most human activities are supported by memory and humans experience a variety of affective states throughout the day. It has been suggested that events with a strong emotional component are more vividly remembered than those without such components (Nielson, Yee & Erickson, 2005).

Ochsner and Schacter (2000) contend that individuals often demonstrate superior memory for the affective significance of a stimulus, while memory for other information is compromised. In other words, the central details are better remembered than the peripheral details. People often believe that they are able to recall emotional events with a great amount of accuracy, a phenomenon often referred to as the flashbulb memory, which likens the level of accuracy to that of near photographic quality (Kensinger, Garoff-Eaton & Schacter, 2006). However, research does not seem to indicate that self-report enhancement of memory for emotional events is linked to actual memory improvements (Kensinger et al., 2006). The consistency of memories of emotional events over time is an area of research which has produced inconsistent results. Some research studies have shown that although individuals had a high level of memory confidence for events with a greater

emotional intensity, this was not related to a higher level of consistency of memory (for an overview see Levine & Pizarro, 2004). Thus, the accuracy of memories for neutral and emotional events declined at a similar rate over time (Levine & Pizarro, 2004). However, other studies have demonstrated a greater level of consistency of emotional memories over time, when compared to memory for more neutral or everyday events (for an overview see Levine & Pizarro, 2004). These inconsistent findings suggest that there is no clear enhancement for memories of emotional events over time.

2.3.2. Theories of the Emotion-Memory Link

In order to explain how people remember emotional material better than neutral material, researchers in this field have drawn upon theories and hypotheses from the fields of cognitive, biological, and evolutionary psychology. Other theories have also been proposed which focus on a motivational aspect and on relatedness and distinctiveness of emotional material. Below is an examination of various theories of the memory-emotion link, including a cognitive theory, biological theory, evolutionary theory, motivational theory and the relatedness and distinctiveness theory.

2.3.2.1. *Cognitive Theory*

Reisberg (2006) presents an explanation that focuses on cognitive psychology. According to his theory, various cognitive processes, both conscious and unconscious, result in a superior memory for emotional stimuli. People firstly attend more closely to events with an emotional content than to neutral events, which is the first stage of the memory process. Secondly, emotional events include issues that people are concerned about and that they may have considered at other times in other situations. This creates connections that promote retention and recall of this material. Finally, after experiencing an emotional event, people often tend to think about the event to the point of rehearsing the event, adding to the storage of the event in memory (Reisberg, 2006).

According to Christianson and Engelberg (2006) "...aspects of past emotion are represented as non-cognitive representations in memory, and these representations are possible to retrieve in a manner that does not require high-level cognitive processing" (p. 72). To substantiate this claim, Christianson and Engelberg (2006) refer to a frequently cited case of a severely amnesic man, who would refuse to shake the hand of a doctor, who had once pricked his hand. Although the man could not remember meeting the doctor, the perceptual cue of seeing him triggered this emotional response (Christianson & Engelberg, 2006). These authors also contend that it is possible for emotional material to be retrieved through systems operating on a non-verbal level of consciousness. Christianson and Engelberg (2006) refer to this type of memory as implicit memory, which consists of learned behaviours and responses that are stored at an unconscious level. Explicit memory refers to a more deliberate process of recalling information and occurs at a conscious level (Christianson & Engelberg, 2006). This makes up the unconscious aspects of emotional events or information which results in enhanced memory for this kind of material.

Pessoa et al. (2002) agree that emotive stimuli are processed automatically and without conscious awareness. Studies have demonstrated the quick, involuntary autonomic responses of participants to emotional stimuli. Neuroimaging studies of the amygdala have confirmed this conclusion (Cahill et al., 2001; Phelps & Anderson, 1997). According to Pessoa et al. (2002) research has revealed that the amygdala is activated when emotional stimuli, such as fearful faces, are masked and the participants are not aware of viewing them. This led Pessoa et al. (2002) to the conclusion that one of the main functions of the amygdala is to detect emotional stimuli in the environment, which may occur in the absence of effortful attention or conscious awareness.

2.3.2.2. Biological Theory

Hadley and Mackay (2006) refer to a more biologically based theory, the arousal hypothesis, in explaining the enhanced memory effect of emotional material. According to this theory,

...low-level sensory inputs directly engage an emotional reaction system (say, the basolateral amygdala) that triggers release of neurotransmitters or endogenous stress hormones (such as epinephrine and cortisol) that facilitate memory consolidation for emotional events that are suprathreshold and not overly traumatic or repression-prone. These amygdala-mediated encoding processes enable consolidation of emotional events in a brain region such as the hippocampus so that the brain can achieve memory strength that is directly proportional to memory importance and arousal without interference from other ongoing events or stimulus factors (Hadley & Mackay, 2006, p. 79).

Other studies have also found that the viewing of emotional material resulted in sympathetic nervous system activation, such as enhanced skin conductance (Hadley & Mackay, 2006; Daum et al, 2009). This indicates an unconscious arousal effect of emotional material which can account for the enhanced memory for this type of information.

2.3.2.3. Evolutionary Theory

Some authors have also noted the evolutionary advantage of enhanced memory for emotive stimuli (Hamann, 2001; Taylor, 1991). From this perspective, an emotionally arousing stimulus would provide information that may be relevant to an organism's immediate and future survival and reproductive success (Hamann, 2001). According to Hamann (2001) organisms will have a distinct advantage if they are able to vividly remember information that is directly relevant to the organisms' survival in the future. Thus, it is important that stimuli with an emotional component results in an enhanced memory effect for that information, so that it is available in the future (Hamann, 2001).

2.3.2.4. Motivational Theory

Ochsner and Schacter (2000) claim that an individual's specific goals are crucial elements in determining the manner in which emotion influences the process of memory formation. This is referred to as a motivational theory of emotional memory, as an individual's motives play a significant role in the kinds of memories they may

recall (Parrot & Spackman, 2000). From this perspective, "...memories are viewed as aspects of a dynamic and developing individual rather than as static nodes in an associative network. Memories can be actively recruited to maintain, alter, or reinforce a person's mood, goals and plans" (Parrot & Spackman, 2000, p. 482).

2.3.2.5. *Relatedness and Distinctiveness Theory*

Talmi, Luk, McGarry and Moscovitch (2007) proposed another theory of memory enhancement for emotional material that focuses on the concepts of relatedness and distinctiveness. In this approach, the emotional aspect of a stimulus has the ability to link separate items together and makes these items stand out relative to neutral items. (Talmi et al., 2007). According to Talmi et al. (2007), negatively-valenced emotional items share a category membership and a thematic relationship, such as the words *torture* and *pain* which may share the category of cruelty or distress. A study conducted by Talmi et al. (2007), demonstrated that once both emotional items and neutral items are equally related, the enhanced memory effect for the emotional material is eliminated. These authors contend that relatedness enhances encoding and retrieval of information, and the results of the above study suggest that relatedness can account for the memory enhancement of negatively-valenced emotional material (Talmi et al., 2007).

In terms of distinctiveness, Talmi et al. (2007) claim that emotional stimuli are more distinct than neutral stimuli. According to this notion, an individual possesses an *active conceptual framework* which contains items stored in long-term memory, usually more neutral images of people and buildings (Talmi et al., 2007). Emotional material usually possesses unique features which are in contrast to the images stored in the active conceptual framework, and are distinct in an absolute way (Talmi et al., 2007).

Another particularly important feature that is distinct to emotional material is its relevance to an individual's goals (Talmi et al., 2007). Talmi et al. (2007) use an example of the image of a hungry child. According to this theory, this image will be emotionally arousing because the observer may have a goal to care for others. This

goal-relevance makes emotional images more interesting for the observer and evokes unique physiological responses (Ochsner & Schacter, 2000). In this sense then, goal-relevance influences both the ability of an event to evoke emotions, as well as the distinctiveness of the event. According to Schmidt (1991), relative or primary distinctiveness is a result of an item's limited overlap with the items stored in the active conceptual framework which participants maintain in working memory. For example, a black letter in a stimulus stream is not absolutely distinct, but is relatively distinct when all other letters are blue. Within the typical experimental context, when emotional items are presented alongside neutral ones, their absolute distinctiveness makes them stand out relative to the neutral items, so that they are both absolutely and relatively distinct (Talmi et al., 2007).

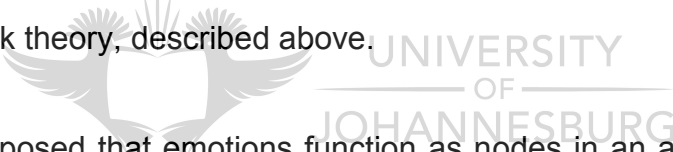
Levine and Pizarro (2004) investigated the contribution of the distinctiveness hypothesis to the enhanced memory for emotional material. They developed a research study which involved using a Positron Emission Tomography (PET) scan while participants viewed positively arousing pictures, negatively arousing pictures, neutral pictures or affectively neutral but interesting pictures. Participants rated each picture on the dimensions of valence, arousal and interestingness, and one month later the participants completed a surprise recognition test. The enhanced memory effect for both the emotional and interesting pictures was observed in the results of the study (Levine & Pizarro, 2004). Although greater amygdala activity during encoding was related to enhanced memory for emotional pictures, this was not observed for the interesting pictures (Levine & Pizarro, 2004). This result led Levine and Pizarro (2004) to the conclusion that different neural mechanisms exist for the memory enhancement effect for emotional stimuli and the memory enhancement effect of distinctive stimuli. In other words, distinctiveness cannot account for the superior memory performance of emotional material.

2.3.3. Research on Discrete Emotions

As mentioned above, the mood of an individual has an impact on how emotional information is encoded and later retrieved. In particular, people seem to attend to information that corresponds with their current mood (Levine & Pizarro, 2004).

Research on specific emotions seems to produce a consistent set of results. For example, it seems that when fear is elicited in an individual his or her memory for threat-related information is better than their memory for threat-irrelevant information (Levine & Pizarro, 2004). This is sometimes referred to as the appraisal theory, which involves determining the functions that discrete emotions perform within the cognitive system (Levine & Pizarro, 2006). Research indicates that eliciting different emotions in participants results in better recall for different kinds of information (Levine & Pizarro, 2006). One study which focused on this aspect included assessing the differences between happiness, anger and sadness in a narrative. According to Levine and Pizarro (2006), the results indicated that happy participants remembered the narrative as a whole, while sad participants remembered more information pertaining to event outcomes of the narrative than angry participants. Finally, the angry participants tended to remember more information concerning the central character's goals from the narrative.

Levine and Pizarro (2004) refer to Bower's explanation of this finding in terms of the associative network theory, described above.



[Bower] proposed that emotions function as nodes in an associative network of information. When an emotion is evoked, the node is activated, and activation spreads to other nodes in the network that are associated with it, such as past experiences, concepts, and emotional behaviours. This related information becomes more accessible as a result, and influences perception, judgment, and memory in an emotion-congruent manner (Levine & Pizarro, 2004, p. 537).

This account links to the notion of mood-congruent biases in individuals with a depressive disorder (Harmer, Shelley, Cowen & Goodwin, 2004). Harmer et al. (2004), note the important maintaining role of negative biases in depression that is prominent in the psychological literature. Studies have found biases for the recall of negatively-valenced information in memory tests, as well as the monitoring and classification of emotional material in individuals diagnosed with depression (Harmer et al., 2004; Yiend & Mackintosh, 2005). Harmer et al. (2004) found that short-term administration of antidepressant drugs in healthy volunteers resulted in significant changes in emotional processing. In particular, the identification of negative facial

expression was decreased, the startle response to negative images was eliminated, and the recall of positive emotive stimuli was increased. Harmer et al. (2004) believe that, “These changes in categorization and memory for positive social information, independent of changes in subjective mood, suggest that antidepressants can directly modulate the neural processing of emotional material” (p. 1260). In this way, it is clear that the valence of emotionally arousing material is also an important concept in terms of the memory-emotion link. The effects of valence of memory for emotional material will now be discussed.

2.3.4. Emotional Valence and Memory

Taylor (1991) contends that positive and negative events evoke different responses across dimensions of human functioning. According to Taylor (1991), “negative events appear to elicit more physiological, affective, cognitive, and behavioural activity and prompt more cognitive analysis than neutral or positive events” (p. 67). Early theories of emotional valence proposed that the fight-or-flight response elicited by emotional events, and the subsequent activation of the sympathetic nervous system resulted in negative events being more arousing than positive events (Taylor, 1991). Additionally, it was believed that negative events acted as signals that the organism needed to take action, while positive emotions did not (Taylor, 1991).

Studies on the influence of valence, or how positive or negative a stimulus is, have demonstrated conflicting results. Results of a study by Mather and Nesmith (2008) on location memory for pictures revealed no significant differences between positive and negative emotionally arousing pictures. In another study by Libkuman et al. (2004), participants remembered positively-valenced pictures better than negatively-valenced pictures. Other studies have proposed that negative words are better remembered than positive words (Kousta et al., 2009). However, Mneimne et al. (2010) claim that this result may reflect a methodological issue, for example a failure to ensure that the arousal ratings for both the positive and negative stimuli are equal. Motivational theories of emotion have proposed that two systems are responsible for emotional processing: an approach/appetitive system and a withdrawal/aversive system (Kousta et al., 2009).

There is a large body of evidence indicating that negatively-valenced stimuli invoke stronger behavioural responses than positive stimuli, even when arousal (i.e., intensity or degree of activation of each system) is held constant. This property of negatively-valenced stimuli has been termed the negativity bias and has been explained in evolutionary terms: withdrawal from negative stimuli is more critical to survival than approach of pleasant or neutral stimuli, and, hence, the withdrawal system is primary (Kousta et al., 2009, p. 473).

Research has demonstrated that positive and negative valence leads to different types of information processing and effects on memory (Levine & Pizarro, 2006). Positive emotion seems to activate an individual's general knowledge or stereotypes, and also seems to lead to more memory intrusion errors. Negative emotion seems to activate more conservative recognition judgements. The cognitive strategies and central information for discrete emotions are summarised in Table 2.1 below. These findings can also be observed in positive and negative autobiographical memories. In particular, negative autobiographical memories share mainly central information, while positive autobiographical memories share a focus on a wide range of information (Levine & Pizarro, 2006). Individuals also believe that they remember positive events with more accuracy, which is not actually the case. Levine and Pizarro (2006) explain this finding as follows:

When remembering events that made them happy (i.e. events that are consistent with their goals), people seem to draw flexibly on general knowledge, sometimes confusing plausible and actual events. Incorporating plausible or schema-congruent information from general knowledge when remembering events that evoked happiness would result in representations that are experienced as more complete. This may explain why people often rate positive events as better remembered than negative events, even though studies with objective measures tend to show no differences or even superior memory for negative events. When remembering negative events (i.e. events that conflict with their goals) people were more conservative in their memory judgements. People may adopt a more conservative, data-driven strategy when remembering negative events in the service of repairing past negative outcomes or avoiding future ones (p. 43).

Brainerd, Holliday, Reyna, Yang and Toglia (2010) agree with this assertion, and add that people are more attuned to the meaning of positive events, and the surface details of negative events. These authors term this phenomenon, the affect-as-

information hypothesis. Brainerd et al. (2010) also refer to the socio-emotional selectivity theory, which proposes that the reason for the above notion is that negative events include a higher information content than positive events.

Table 2.1. Information processing strategies associated with positive and negative emotions and types of information expected to be central in discrete emotional states (Levine & Pizarro, 2004, p. 543)

Emotional Valence	Motivational State	Information-Processing Strategy
Positive	Goal attained: No immediate problem to be solved	Flexible processing; increased reliance on general knowledge and heuristics
Negative	Actual or threatened goal failure: Change beliefs, plans or behaviours	Analytic, data-driven processing
Discrete Emotions	Motivational State	Central Information
Happiness	Maintain current state; attain new goals	Broad range of information from general knowledge and the environment
Fear	Avoid or escape threat of goal failure	Sources of threat; means of avoiding threat
Anger	Remove obstacle to goal attainment	Goal; agents obstructing goal attainment
Sadness	Adjust to irrevocable goal failure	Outcomes and consequences of goal failure

2.3.5. Neuropsychology of Memory-Emotion Link

As described above, the brain regions specialised for memory and emotion processing seem to work together to produce the enhancing effect of memory for emotional material. This will include a focus specifically on the amygdala, the hippocampus and other important brain regions in the memory-emotion link, as well as important neurotransmitters in this link.

2.3.5.1. The Amygdala, Hippocampus and Other Brain Regions

Research studies have consistently demonstrated the important role of the amygdala and hippocampus in the superior memory performance for emotional stimuli (Banich, et al., 2009; Levine & Pizarro, 2006; Phelps, 2004). Neuroimaging studies have also shown that activity in the amygdala and hippocampal regions during the encoding of emotional material leads to later enhanced recall of that material (Banich et al., 2009). Phelps (2004) claims that the amygdala has an effect on the encoding and storage of emotional material. Emotional stimuli captures the attention of an observer and grants attention to these stimuli even when attentional resources are limited (Phelps, 2004). The reciprocal connections between the amygdala and the sensory cortical processing regions (including the visual cortex) account for the rapid recognition of emotional material. This leads to an enhanced response in both these brain regions to emotional material (Phelps, 2004). The amygdala may also influence the storage process of emotional memories. Phelps (2004) also adds that damage to the amygdala reduces the recall of emotionally arousing material. Hamann (2001) claims that the limbic area is also involved in the encoding and retrieval processes.

A study conducted by Hamann, Cahill, McGaugh and Squire (1997) focused on the distinction between emotional memory and other memory systems. These authors compared a group of amnesic patients of varying etiology and lesion types, with a matched control group in terms of emotional arousal and recall of emotional material. Both groups were similar in terms of their ratings of emotional arousal of certain aspects of a narrative, and both groups displayed the enhanced memory effect for emotional information (Hamann et al., 1997). Thus, despite the mild to moderate memory deficits shared by the amnesic group for verbal recall, the memory enhancing effect of emotional stimuli was still apparent. This led Hamann et al. (1997) to consider that the emotional memory system is distinct from other memory systems. In contrast, patients with bilateral amygdala damage and intact hippocampi demonstrated selective disruption in their recall of an emotional narrative (Tomaz et al., 2003).

Nielen et al. (2009) summaries the findings of neuropsychology research in terms of brain regions with the following three points: “(i) The amygdala and perhaps occipital cortex primarily support processing of arousal, (ii) the prefrontal cortex is most responsive to valence differences, and (iii) the insula is specifically involved in the processing of negative valence” (p. 388).

2.3.5.2. Neurotransmitters

Research on animals indicates the role of stress hormones in the consolidation of hippocampal-dependent memories. It seems that stress hormones, which are released in response to emotional material, activate adrenergic receptors in the basolateral amygdala, altering the hormone’s effect on memory consolidation (Phelps, 2004). Tomaz et al. (2003) report findings that noradrenaline seems to contribute to the memory enhancing effects for emotional stimuli. In particular, drugs that stimulate the noradrenaline system lead to enhanced memory for an emotional narrative, while drugs that block the effects of noradrenaline reduce the recall of emotional material in a narrative (Tomaz et al., 2003).

Serotonin has been widely recognised as an extremely important neurotransmitter involved in emotional functioning. In particular, serotonin levels play a significant role in depression, aggression, risk-taking behaviour and impulsivity (Daum et al., 2009). According to Luciana, Burgund, Berman and Hanson (2001), serotonin has a modulating effect on the functions of certain neurotransmitters. Since neurotransmitters affect both cognitive and emotional functioning, serotonin has also been proposed to influence these systems. Research indicates that high levels of serotonin lead to deficits in working memory for emotional stimuli (Luciana et al., 2001).

The above is a representation of what is currently known about the memory-emotion link in the psychological literature. However, many variables exist which may have an influence on this link, such as gender. The focus will now move to the possible

differences that may exist between males and females in terms of this link, including an examination of relevant research in this area of study.

2.4. Gender Effects on the Link between Memory and Emotion

Research on gender differences in nearly every field is abundant. The fields of emotion and memory are no different. This section will investigate the possible effects of gender on the recall of emotionally arousing material. It will cover gender differences in terms of the following aspects: emotional functioning, memory, cognitive styles, and the neuropsychology of these differences.

2.4.1. Emotional Functioning

Generally, in the field of emotion, women are thought to be more emotionally skilled and expressive than men, specifically in terms of sending and receiving non-verbal cues (Brody & Hall, 2000). Men however, are believed to be more logical and to express more anger than females. In terms of verbalising emotions, women tend to refer to positive and negative emotions more often in interpersonal situations and even in their writing (Brody & Hall, 2000). In terms of facial expressions and non-verbal behaviour, again women are more facially expressive of most emotions and they tend to use more gestures than men (Brody & Hall, 2000). These results have even been found across cultures.

Some studies indicate that empathy is another variable on which males and females tend to differ (Eisenberg, 2000; Rueckert & Naybar, 2008). In general, females tend to exhibit higher levels of empathy than males. However, females may explicitly endorse more empathetic attitudes, while other more subtle measures of empathy may demonstrate more equal levels of empathy across the sexes (Rueckert & Naybar, 2008).

2.4.2. Memory

In terms of memory tasks, females tend to outperform males in tests of episodic memory, while there is no difference in performance on tests of immediate, working and semantic memory between the sexes (Guillem & Mograss, 2005). In terms of autobiographical memory, research seems to indicate that accounts of personal experiences are different for males and females. In particular, women's accounts usually include more detail and content, and they use more references to other people and events (Bloise & Johnson, 2007). There are also significant differences between men's and women's emotional content included in their autobiographical accounts. According to Bloise and Johnson (2007), women tend to make use of more emotive words in their autobiographical accounts, and they make use of more references to their own emotional state, as well as the emotional states of others. Finally, females tend to remember more positive and negative experiences than males.

The affect-intensity hypothesis and the cognitive style hypothesis have been developed in order to explain the superior performance of females for emotional memory (Canli, Desmond, Zhao & Gabrieli, 2002). The first hypothesis involves the assertion that women tend to experience emotional events more intensely than men, which leads to superior encoding of this material. However, most studies control for this by gathering data from large diverse samples on the level of arousal for particular emotional items. The cognitive style hypothesis states that men and women make use of different cognitive strategies in the process of encoding, storing and retrieving emotional material, such as those described above (Canli et al., 2002). An interesting study conducted by Cahill, Gorski, Belcher and Huynh (2004) investigated the relation between biological sex and gender-related traits in terms of memory for emotional material. The results of the study indicated that those who scored high in masculine traits showed better memory for the central information of the emotional narrative. Those participants who scored high in feminine traits showed enhanced memory for the peripheral aspects of the emotional narrative (Cahill et al., 2004). There were no significant differences in terms of memory for peripheral and central details of the narrative between the male and female

participants. This led Cahill et al. (2004) to conclude that gender-related traits may be more indicative of sex-related differences in the recall of emotional material than biological sex.

2.4.3. Cognitive Style

Research also proposes that males and females tend to use different cognitive styles when processing information (Guillem & Mograss, 2005). The findings of research conducted by Guillem and Mograss (2005) suggest that females' style of cognition involves a more detailed elaboration of information, resulting in more specific representations. However, the cognitive style of males involves a less detailed form of information processing and reliance on generic schemas or information themes (Guillem & Mograss, 2005).

2.4.4. Neuropsychology of Gender Differences

Neuroimaging studies have shown inconsistent results in the field of memory, affect and gender. A meta-analytic study conducted by Wager et al. (2003) of neuroimaging scans of emotional processing indicated more lateralised processing of emotion in males and more brainstem activity in females. According to Phelps (2004) some brain imaging studies indicate that different regions of the amygdala are activated during the encoding of emotional material. Cahill et al. (2001) examined male and female participants viewing slides that were either emotionally arousing or neutral in nature. The results showed activation of the left amygdala in females was found to enhance recall of emotional stimuli and activation of the right amygdala in males was found to have the same effect (Phelps, 2004). According to Cahill (2005), traditional theories on brain functioning propose that the right hemisphere is specialised to processing central information of a stimulus, while the left hemisphere is specialised to processing the details of a stimulus.

Cahill and his colleagues conducted a study to investigate the effects of decreasing the amygdala's effect in the process of emotional memory. They believed that this action would produce different effects for male and female participants. In the study, participants were administered Propranolol, a beta blocker which dampens the

activity of adrenalin and noradrenaline, which in turn decreases the activity of the amygdala (Cahill, 2005). This drug interferes with the recall of emotional memories. Male and female participants were exposed to a slide show with an emotionally arousing narrative and they completed a recall test one week later. As these authors predicted, the effects of the beta blocker resulted in different effects for the male and female participants. In particular, the male participants' ability to recall the overall gist or central details of the story was reduced, through decreasing the activity of the right amygdala. In contrast, the female participants' ability to recall the peripheral details of the story was reduced, through decreasing the activity of the left amygdala (Cahill, 2005).

In terms of brain anatomy, past research indicates that differences exist in the shape and size of the corpus callosum of males and females (Cahill, 2003). More recently, differences have been noted in the following brain regions: prefrontal cortex, auditory cortex, Broca's and Wernicke's areas and in the relationship of amygdala to hippocampal size (Cahill, 2003). In particular, parts of the frontal cortex and parts of the limbic system were found to be larger in women; whereas parts of the parietal cortex and amygdala were found to be larger in men (Cahill, 2005). According to Cahill (2005), in general the size of brain structures indicates the importance of the region to an organism. If this is true, the frontal cortex and limbic system would reflect the importance of the higher cognitive functions and emotional functioning to the female brain. The parietal cortex and amygdala would reflect the importance of spatial perception and emotional arousal to the male brain (Cahill, 2005).

Cahill (2005) also notes that sex-related hemispheric differences in emotional processing occur almost immediately in response to viewing emotionally arousing stimuli. In fact PET scans reveal that response times to emotionally arousing pictures occur after about 300 milliseconds, which indicates that these responses occur without conscious awareness or effortful processing. In line with previous research described above, this response was found to be stronger in the right hemisphere in male participants and stronger over the left hemisphere in female participants (Cahill, 2005).

A functional MRI study conducted by Hofer et al. (2006) revealed differential brain activation between men and women while viewing positive and negative emotive words. When processing positively-valenced words, differential brain activation was observed in the right putamen, the right superior temporal gyrus, and the left supramarginal gyrus. Conversely, when processing negatively-valenced words, increased brain activation was observed in the left perirhinal cortex and hippocampus for women, while increased activation was observed in the right supramarginal gyrus for men (Hofer et al., 2006).

2.4.5. Role of Sex Hormones on Memory

Some authors have indicated the potential effects of sex hormones on memory and emotional memory in particular (Andreano & Cahill, 2009; Cahill, 2003; Gasbarri et al., 2008). Research on female participants has identified the role of estrogen in modulating neurotransmitter systems, such as acetylcholine, catecholamines, serotonin and GABA (Gasbarri et al., 2008). According to Gasbarri et al. (2008) estrogen receptors have been found in the limbic regions, including the hippocampus, amygdala, and cerebral cortex, which are involved in learning and memory. Gasbarri et al. (2008) explain the effects of estrogen as follows:

Due to the fact that estrogen acts across a broad range of neural systems, it is likely that it exerts its actions on cognition by altering the relative participation of specific memory systems, thus acting as a conductor, orchestrating the dynamics, timing and coordination of multiple cognitive strategies during learning (p. 965).

Less research has been focused on the role of testosterone in emotional memory. However, research has shown that testosterone deprivation is linked to poor memory performance in men (Janowsky, 2006). Like estrogen, androgen activity has been found in the prefrontal cortex, hippocampus and amygdala. There seem to be inconsistent effects of testosterone on working memory and other executive functions, however, it seems that this hormone can enhance memory functioning in

older men (Janowsky, 2006). Finally, according to Janowsky (2006), the effects of testosterone on memory for emotional stimuli are not yet known.

According to Cahill (2003), research has also revealed significant sex-related differences in terms of stress hormones. In particular, one study found a difference between the relationship of cortisol to short-term memory between males and females. A high correlation between cortisol response to a stressor and memory was found in male participants but this correlation was not observed in female participants (Cahill, 2003).

Together these research results covering the various aspects of gender differences, suggests that significant differences may exist between males and females in terms of memory for emotional material. This may be attributed to different cognitive processing styles, socialisation, brain anatomy or the effects of hormones. However, research into this field is still vital, as numerous inconsistent results make it difficult to draw any solid conclusions.

2.5. Research on Memory, Affect and Gender



After a review of the research concerning each of the three variables of memory, affect, and gender, this section focuses on past research which combines all three variables. In particular, this section examines whether research has been conducted on the possible gender differences that may exist in the recall of neutral, positive and negative emotive words.

When reviewing the research on gender differences in emotional functioning, Hofer et al. (2006) claim that while certain "...differences between men and women in processing emotions may be attributable to social factors and learned patterns of behaviour, it is likely that emotional differences also reflect genotypic differences in the sexual dimorphism of the nervous system" (p. 854). In terms of emotional memory, Burton et al. (2004) suggest that the male memory system may discard information that is not important in some way, but becomes more attentive to emotive information. In contrast, the female memory system may regard all verbal

information as significant and place equal emphasis on all incoming verbal material (Burton et al., 2004).

There appears to be little, if any, research specifically focused on the effects of gender on the recall of positive and negative emotive words. Armony and Sergerie (2007) found a memory enhancement effect for fearful faces for both male and female participants in comparison to happy and neutral faces. This suggests that negatively valenced material is better remembered than positively valenced material, and there are no significant gender differences in this regard. Mather and Nesmith (2008) indicate that memory was enhanced for the location of emotionally arousing pictures compared to neutral pictures. This effect was most pronounced for the negatively valenced pictures. Again, no significant gender differences were found in this study (Mather & Nesmith, 2008). These results seem to be in contrast with some studies suggesting that women recall more emotive material than men. A problem with these studies is that both made use of emotionally arousing pictures, and it is not known whether this can be generalised to other stimuli. The following study will investigate the existence of any significant gender differences in the recall of positive and negative emotive words.

2.6. Summary

This chapter has focused on an investigation into the three key variables of this study, namely memory, emotion and gender. Memory is described as the total store of knowledge and information acquired through life experiences. Two prominent theories of memory include the associative network model and the PDP model. Various brain regions have been implicated in the process of memory, most importantly the hippocampus, amygdala, medial temporal lobe and the basal forebrain.

Affect is described as a particular feeling state, and is contrasted with emotion and mood. Prominent theories of emotion include the James-Lange Theory, the Cannon-Bard Theory and the Schachter-Singer Theory. Valence and arousal are important aspects of specific emotions and forms a more recent technique of conceptualising

emotions. The amygdala and the limbic system are brain regions that have been identified as important in the process of emotion functioning.

Strong links seem to exist between the memory and emotion systems. Research seems to indicate that material with a strong affective component is recalled better than material without this component. Many theories have been developed in order to explain this link, including the motivation theory, cognitive theory, evolutionary theory, biological theory, and the relatedness and distinctiveness theory.

Research on discrete emotions suggests that an individual's mood can have a significant impact on the type of information they remember. The valence of a stimulus, or how positive or negative a stimulus is, also seems to have an effect on memory and how information is processed. Important brain structures in the memory-emotion link again include the amygdala and the hippocampus, while serotonin and stress hormones are important neurotransmitters in this link.

Significant gender differences have been investigated in terms of emotional functioning, memory, cognitive style and neuropsychology. Differences have been found in the structure and functioning of the male and female brains. Importantly, activation of the left amygdala in females has been found to enhance recall of emotional stimuli while activation of the right amygdala in males was found to have the same effect. Sex hormones may also play an important role in emotional memory. Unfortunately there appears to be little, if any, research specifically focused on the effects of gender on the recall of positive and negative emotive words. Research results in this field have been inconsistent, making it difficult to arrive at any certain conclusions regarding the results of this particular study.

CHAPTER 3

RESEARCH DESIGN, METHODOLOGY AND ANALYSIS

This chapter will focus on the methodology of this research study. In particular the research problems and goals will be discussed, along with the research design of the study. Following this, the participants, materials and procedure, data analysis techniques and ethical considerations will be described.

3.1. Research Problems and Goals

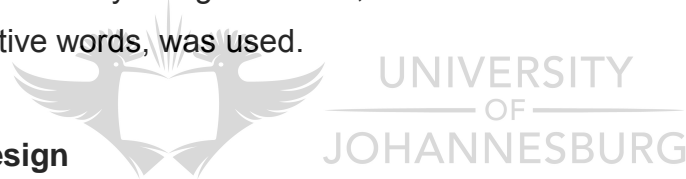
The primary aim for this research study was to establish if there were gender differences in the recall of neutral, and positive and negative emotive words. In order to investigate the effects of gender on the recall of positive and negative emotive words, a quantitative study using word lists, which include neutral and highly emotive positive and negative words, was used.

3.2. Research Design

A quantitative approach was proposed for this research study and a between-participants design was implemented. This study also incorporated a quasi-experimental design. This type of design cannot eliminate threats to internal validity but does make an attempt to approach the rigor of an experimental design (Gravetter & Forzano, 2006). This design was used as the study involves a comparison between two groups (males and females). The recall of positively valenced, negatively valenced and neutral words made up the dependent variables measured in each of the two groups, and gender made up the grouping variable.

3.3. Participants

The sample was made up of university students currently enrolled at the University of Johannesburg as these students fall into the appropriate age range for the study,



as discussed below. The size of the sample was 71 participants, with 12 male and 59 female participants. The age of the participants fell between the range of 19 to 25 years. According to research, older adults possess greater *control* over their emotions and they are less aroused by negative images (Neiss, Leigland, Carlson & Janowsky, 2009). As the aim of the study is to evaluate the arousal caused by emotive words, a younger sample would be more appropriate. These voluntary participants were selected by means of a convenience sampling method. Gravetter and Forzano (2006) describe convenience sampling as a method of obtaining a sample by selecting individuals who are easily accessible and willing to participate in a study. Students enrolled for the third year psychology course at the University of Johannesburg were contacted to voluntarily participate in the research study. Students in this year are expected to have acquired an adequate grasp of English, to ensure that language differences do not contribute to misleading results.

3.4. Materials and Procedure

Participation in this research study was electronically advertised to students at the University of Johannesburg. The data was collected in a group setting at a venue in the University of Johannesburg. Students were given information about the research study and informed about the procedure of the study. Students did not receive any compensation or course credit for participation. The data collection stage consisted of two phases. During the first phase the participants were given instructions detailing the steps of the procedure. The instructions informed the participants that they will be presented with a list of words on a projector screen which they will need to recall at a later stage.

This research study consists of two stages. In the first stage you will be presented with a list of words which will be flashed briefly on the projector screen. Please pay careful attention to these words, as you will be asked to later recall as many of these words as possible. In the next stage you are requested to write out as many words from the presented list as possible, in any order.

Following this, the participants were presented with the word list, as shown in Table 3.1. Words were typed in a black font on a white background and placed in a random order. Each word was presented for two seconds, with a blank white screen in between each word presented for one second. Once the 36 words had been presented, the participants were presented with instructions to recall as many of the previously presented words as possible in a free recall test. Each participant had five minutes to complete this test.

Table 3.1. Word list presented to participants

	Positive	Neutral	Negative
1.	Angel	Ankle	Anger
2.	Baby	Bake	Burn
3.	Comedy	Column	Cruel
4.	Dazzle	Detail	Devil
5.	Fun	Frog	Fire
6.	Gift	Glass	Guilty
7.	Happy	Habit	Hatred
8.	Intimate	Industry	Intruder
9.	Miracle	Market	Murderer
10.	Party	Paper	Pain
11.	Success	Street	Slave
12.	Treasure	Truck	Torture

The word list contained 12 positive emotive (such as baby), 12 negative emotive (such as burn) and 12 neutral words (such as bake) derived from Bradley and Lang's (1999) Affective Norms for English Words (ANEW), which were matched in terms of word length, arousal and similarity. The ANEW is a list of 1034 English words,

including verbs, nouns and adjectives, which have each been rated in terms of valence, arousal and dominance (Bradley & Lang, 1999).

Bradley and Lang (1999) developed a system to assess the three dimensions of emotions described above. This Self-Assessment Manikin (SAM) has been used in a large sample of people in order to arrive at the ratings of these dimensions for the words contained in the ANEW list. This list of words seems to be widely used in the psychological literature focusing on emotional stimuli (Kensinger & Corkin, 2003; Kousta et al., 2009; Nielson & Powless, 2007; Nielson et al., 2005). As such, this database seems to be an accepted standard instrument to use in studies concerning the effects of emotionally arousing words.

3.5. Hypotheses

From the literature survey, various hypotheses concerning the effects of gender on the recall of neutral, positive and negative emotive words were developed. These hypotheses are stated as follows:

Hypothesis 1. Recall of neutral words. There will be statistically significant differences between males and females in the recall of neutral words.

Hypothesis 2. Recall of positively valenced words. There will not be statistically significant differences between males and females in the recall of positive words.

Hypothesis 3. Recall of negatively valenced words. There will not be statistically significant differences between males and females in the recall of negative words.

Hypothesis 4: Recall of word list. There will be statistically significant differences between males and females in the total amount of words recalled.

3.6. Data Analysis

Non-parametric statistical techniques were used to analyse the data. These techniques are often used when the requirements of parametric techniques cannot be met and/or the sample size is very small (Pallant, 2010). These assumptions include that the data is normally distributed; homogeneity of variance; interval level data and independence of the data for different participants (Field, 2005). In particular the Mann-Whitney U Test was used in this study, as this test is used to identify differences between two independent groups on a continuous variable (Pallant, 2010). The Mann-Whitney U Test is often used as an alternative to the t-test. Where the t-test compares means, the Mann-Whitney U compares medians of two groups. The scores on the continuous variable are converted to ranks and these are then evaluated to determine whether these ranks differ significantly between the two groups (Pallant, 2010).

In this research study, the categorical variable is the gender of the participants and the continuous variable is the number of words recalled for each participant. Thus, the analysis focused on establishing if statistically significant differences existed between the recall of neutral, positive and negative emotive words, as well as the total number of words recalled from the word list between male and female participants. In addition to the statistical analysis of the data, an inspection of the methods employed in the recall of words from the word list will be presented which will include a qualitative examination of the data obtained in the study.

Recall scores were obtained for each participant in terms of four categories: neutral words, positive emotive words, negative emotive words, and total number of words recalled. These were obtained by adding the number of correct responses for each category based on the words that appeared in the word list found above. Responses with minor spelling errors were accepted, as well as those with minor mistakes such as Murder instead of Murderer. The programme Statistical Package for the Social Sciences (SPSS) was used to conduct the data analysis of the study. This programme is widely used in the social sciences field, and is able to perform various statistical procedures on data sets (Pallant, 2010).

3.7. Ethical Considerations

The main ethical consideration in this particular study involves the emotional arousal caused by viewing emotive words. The possibility of a participant experiencing an overwhelming and lasting negative experience needs to be taken into consideration. For this reason, a full debriefing was offered to the participants, following participation in the study. In addition, confidentiality and informed consent were addressed in order to ensure the rights of the participants were upheld. Participation in this research study was voluntary. The participants were anonymous and written consent was obtained from each participant.

3.8. Summary

This chapter served to provide a discussion of the various aspects that make up the methodology of the present study. The following chapter (*Results*) will present the findings of this study.



CHAPTER 4

RESULTS

This chapter will focus on a discussion of the results of this research study. The first section will focus on the frequencies and descriptive statistics of the sample. This will be followed by a presentation of the non-parametric statistics, including the results of the Mann-Whitney U Test.

4.1. Descriptive Statistics

The sample group consisted of 71 third year students, including 12 males and 59 females. The participants were between the ages of 19 and 25, from four ethnic groups and 11 home languages. Tables 4.1, 4.2, and 4.3 present the descriptive statistics regarding age, gender, home language and ethnic group variables for the sample.

Table 4.1. Age statistics for the sample

Total	Minimum	Maximum	Mean	Std. Deviation
71	19.00	25.00	21.20	1.12

Table 4.1 indicates that the total number of participants in the study was 71. The age statistics indicate that the minimum age for the group was 19 years and the maximum age was 25 years. The mean age for the group was 21.20 years and the standard deviation was 1.12.

Table 4.2. Gender statistics for the sample

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	12	16.9	16.9	16.9
Female	59	83.1	83.1	100.0
Total	71	100.0	100.0	

Table 4.2 indicates that females made up the majority of the sample (83.1%) and males made up 16.9% of the sample.

Table 4.3. Ethnic group statistics for the sample

	Frequency	Percent	Valid Percent	Cumulative Percent
Black	44	62.0	62.0	62.0
White	19	26.8	26.8	88.7
Coloured	6	8.5	8.5	97.2
Indian	2	2.8	2.8	100.0
Total	71	100.0	100.0	

Table 4.3 shows that the majority of the sample (62%) was made up of Black individuals, followed by White individuals which made up 26.8% of the sample. Coloured and Indian individuals made up the rest of the sample with a representation of 8.5% and 2.8% respectively (Also see Figure 4.1).

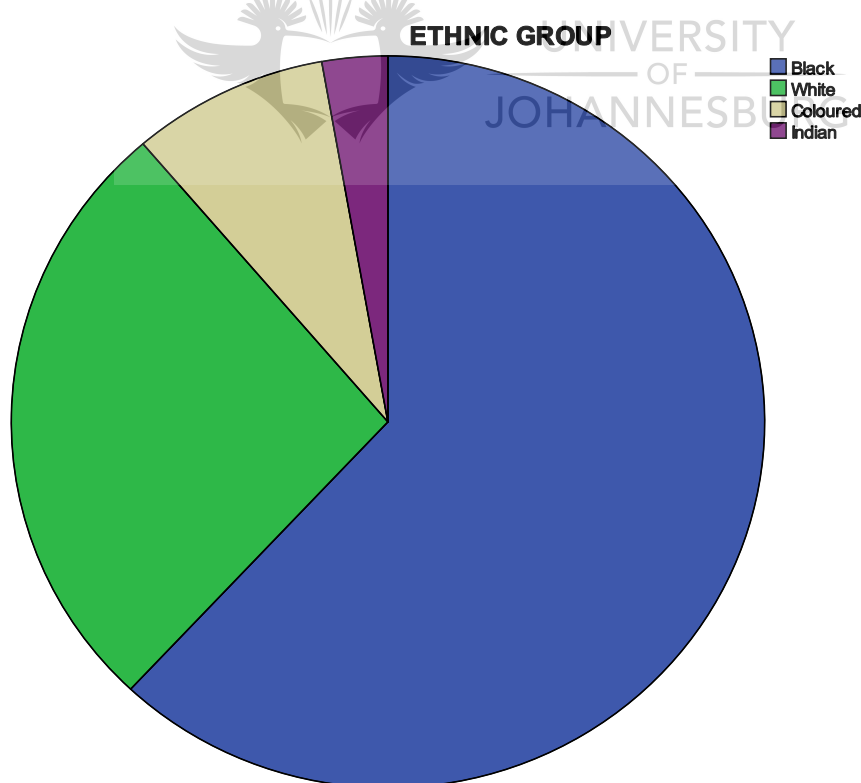


Figure 4.1. Diagrammatic representation of the ethnic group composition of the sample

Table 4.4. Home language statistics for the sample

	Frequency	Percent	Valid Percent	Cumulative Percent
English	26	36.6	36.6	36.6
Afrikaans	3	4.2	4.2	40.8
Sotho	8	11.3	11.3	52.1
Zulu	12	16.9	16.9	69.0
Xhosa	5	7.0	7.0	76.1
Setswana	5	7.0	7.0	83.1
Tshivenda	5	7.0	7.0	90.1
Sepedi	5	7.0	7.0	97.2
Xitsonga	1	1.4	1.4	98.6
Swati	1	1.4	1.4	100.0
Total	71	100.0	100.0	

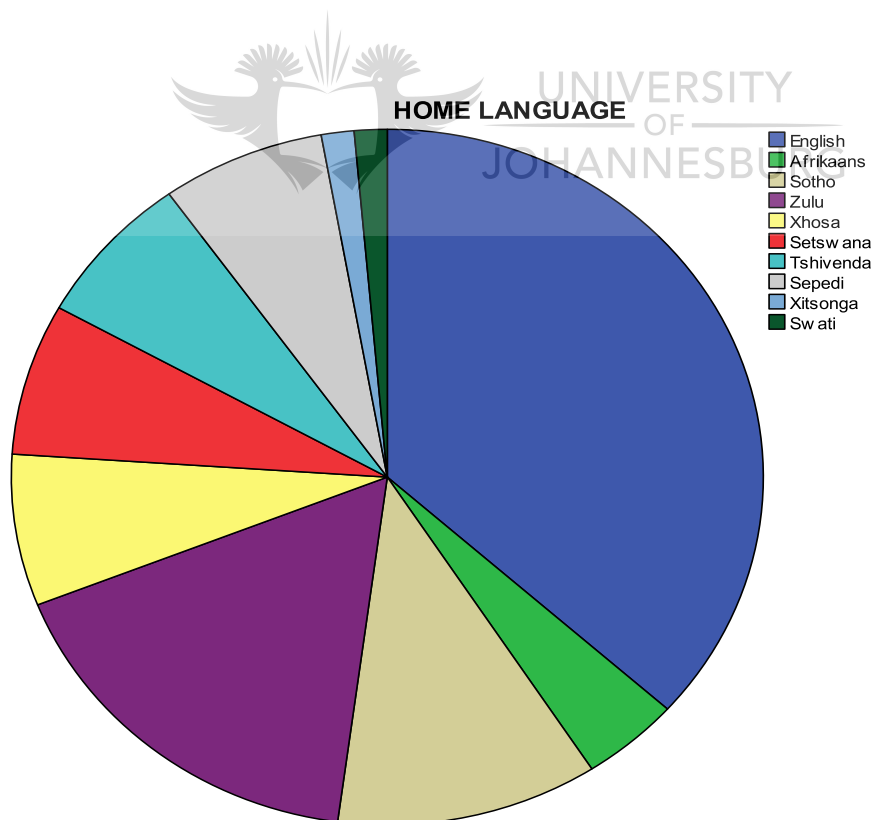


Figure 4.2. Diagrammatic representation of the home language composition of the sample

In terms of the home languages of the participants reported in Table 4.4, most of the participants reported that English was their home language (36.6%). The next most common home language was Zulu (16.9%), followed by Sotho (11.3%), Xhosa, Setswana, Tshivenda, and Sepedi (all 7%), Afrikaans (4.2%) and finally Xitsonga and Swati (both 1.4%) (Also see Figure 4.2).

The results of the non-parametric statistics will now be presented, in terms of the gender differences found in the recall for neutral, positive and negative emotive words, as well as the total recall of words.

4.2. Recall of Neutral, Positive, and Negative Emotive Words, and the Effects of Gender

The results of the study pertaining to the particular hypotheses stated in Chapter 3 (*Methodology*) will now be discussed.

4.2.1. Results Relating to Hypothesis One: Recall of Neutral Words

Hypothesis one states that there will be statistically significant differences between males and females in the recall of neutral words.

Table 4.5. Mann-Whitney U Test results for neutral words

	Neutral
Mann-Whitney U	176.50
Wilcoxon W	254.50
Z	-2.794
Asymp. Sig. (2-tailed)	.005

a. Grouping Variable: SEX

Neutral		
Sex	N	Median
Male	12	3.00
Female	59	4.00
Total	71	4.00

The Mann-Whitney U Test revealed a significant difference between males and females in the recall of neutral words, with males ($Md = 3, n = 12$) and females ($Md = 4, n = 59$), $U = 176.5, z = -2.794, p = .005, r = .33$. In terms of Cohen's criteria (as cited in Pallant, 2010) this is considered a medium effect size. Thus, females were demonstrated to have remembered significantly more neutral material than males. This result is represented in Table 4.5.

4.2.2. Results Relating to Hypothesis Two: Recall of Positively Valenced Words

Hypothesis two states that there will be no statistically significant differences between males and females in the recall of positive words. The results of the present study echoed the findings of previous research. The Mann-Whitney U Test revealed no significant differences in the recall of positively valenced words between males ($Md = 4.5, n = 12$) and females ($Md = 5, n = 59$), $U = 275.5, z = -1.23, p = .22, r = .15$. This result is represented in Table 4.6.

Table 4.6. Mann-Whitney U Test results for positive words

	Positive
Mann-Whitney U	275.50
Wilcoxon W	353.50
Z	-1.232
Asymp. Sig. (2-tailed)	.218

a. Grouping Variable: SEX

Positive		
Sex	N	Median
Male	12	4.50
Female	59	5.00
Total	71	5.00

4.2.3. Results Relating to Hypothesis Three: Recall of Negatively Valenced Words

Hypothesis three states that there will be no statistically significant differences between females and males in the recall of negative words. The Mann-Whitney U Test revealed no significant differences in terms of recall for negatively emotive words of males ($Md = 4.5, n = 12$) and females ($Md = 5, n = 59$), $U = 273, z = -1.27, p = .20, r = .15$. This result is represented in Table 4.7.

Table 4.7. Mann-Whitney U Test results for negative words

	Negative
Mann-Whitney U	273.00
Wilcoxon W	351.00
Z	-1.269
Asymp. Sig. (2-tailed)	.204

a. Grouping Variable: SEX

Negative		
Sex	N	Median
Male	12	4.50
Female	59	5.00
Total	71	5.00



4.2.4. Results Relating to Hypothesis Four: Recall of Word List

Hypothesis four states that there will be statistically significant differences between males and females in the total amount of words recalled. The Mann-Whitney U Test revealed a significant difference in the total number of words recalled from the word list, with females ($Md = 14, n = 59$) recalling significantly more words than males ($Md = 11.5, n = 12$), $U = 162.5, z = -2.95, p = .003, r = .35$. This is a medium effect size according to the criteria set by Cohen (as cited in Pallant, 2010). This result is represented in Table 4.8.

Table 4.8. Mann-Whitney U Test results for total number of words

	Total
Mann-Whitney U	162.50
Wilcoxon W	240.50
Z	-2.953
Asymp. Sig. (2-tailed)	.003

a. Grouping Variable: SEX

Total		
Sex	N	Median
Male	12	11.50
Female	59	14.00
Total	71	14.00

4.3. Summary

The results of the non-parametric tests indicate that significant differences exist in terms of the recall of neutral words and the total amount of words recalled from the word list between males and females. Female participants tended to recall more neutral words than the male participants, and this same result was found in the total number of words recalled from the word list. In terms of memory for positively and negatively valenced words, the results indicated that no significant differences exist between males and females.

This chapter provided an overview of the results of the descriptive and nonparametric statistics used in this study. The next chapter will focus on a discussion of these findings with reference to relevant literature and past research conducted in this field.

CHAPTER 5

DISCUSSION AND CONCLUSION

The aim of this chapter is to present a discussion of the results reported in Chapter 4 (*Results*). Previous research has demonstrated mixed results in terms of the effects of gender on the recall of neutral, positive and negative emotive material. Few, if any, studies have specifically focused on the research question of this particular study. The findings of this study will now be examined in relation to the results of past research studies, followed by possible explanations for the results. Finally, conclusions will be presented along with recommendations for future research in this field.

5.1. Explanation of Results

In an attempt to explain the results of the present study, various theories and possible explanations will be consulted. This will include an examination of previous research findings in the field under study, the associative network model of memory, desensitisation theory, motivational theory, distinctiveness theory and cognitive styles.

5.1.1. Recall of Neutral Words

In the present study females were found to recall significantly more neutral words than males. Although previous research studies revealed inconsistent results regarding memory performance between genders, there is some agreement that females generally perform better than males in tests of episodic memory (Burton et al., 2004; Canli et al., 2002). Some authors contend that males' cognitive style is attuned to the overall gist of material, while females' cognitive style is a more detailed elaboration of information (Guillem & Mograss, 2005). A more detailed style of processing may lead women to encode words better than men, whose cognitive style would not lead to more effortful processing. In terms of the associative network model of memory (Fiske & Taylor, 2008), a more detailed processing style would

lead to more connections being made in memory, thus making information more memorable. This explanation of cognitive style may help to explain this finding.

5.1.2. Recall of Positive Words

The findings of this study revealed no significant differences between males and females in the recall of positively valenced words. Males and females remembered approximately an equal number of positively emotive words from the word list. This finding seems to be in line with previous research (Arnone, Pompili, Tavares & Gasbarri, 2010). Although women are thought to remember more positive and negative experiences, this seems to relate to autobiographical memory specifically (Canli et al., 2002). Thus, in a memory test of episodic memory, there are generally no significant differences between males and females (Guillem & Mograss, 2005). Burton et al. (2004) claim that there are few studies on gender differences in affective memory, and this makes it difficult to establish a stable pattern of results in this regard.

According to Rozenkrants and Polich (2008) some research indicates that females react more strongly to negatively valenced material and males react more strongly to positively valenced material. This stronger reaction may indicate that females would recall negatively valenced material better than males and males would recall positively valenced material better than females. However, the results of their own study revealed no significant differences in brain activity between genders when viewing positive or negative material. In addition, there were no differences found in relation to the direction of valence of the material (Rozenkrants & Polich, 2008). In other words, males and females reacted in a similar way to emotionally arousing material, and this did not differ significantly between positive and negative material.

5.1.2.1. *Biological Sex and Psychological Gender Identity*

Another possible explanation to account for the present finding involves the biological sex of the participant versus psychological gender identity (Cahill et al., 2004). Cahill et al. (2004) conducted research to determine whether biological sex or

psychological masculinity and femininity of individuals are predictive of memory for emotional material. The results of the study indicated that the psychological gender identity of individual participants were better indicators of sex-related differences in the recall of emotional material than biological sex (Cahill et al., 2004). For example, those who scored high on masculine traits recalled more central information than those who scored high on feminine traits. However, when comparing males and females in terms of biological sex, this result was not found. This may need to be considered in the interpretation of the results. Although the results seem to be in line with previous research, this research by Cahill et al. (2004) is an important aspect that may have influenced the results of the present study.

5.1.3. Recall of Negative Words

The results of this study did not identify significant differences between males and females in the recall of negatively valenced words. Thus, male and female participants remembered approximately the same number of negatively emotive words. Once again, this seems to be in agreement with past research studies (Canli et al., 2002). Negatively valenced words are thought to create a stronger behavioural response and thus may have a stronger enhancing effect on memory (Kousta et al., 2009). Again the study by Cahill et al. (2004) could account for this result.

5.1.3.1. *Desensitization*

One possible explanation of the results found in this study is linked to the theory of desensitization. Fanti, Vanman, Henrich and Avraamides (2009) define desensitization as “the diminished emotional responsiveness to a negative or an aversive stimulus after repeated exposure to it” (p. 179). Being repeatedly exposed to real-life or media violence may lead to significant changes in behaviour, thoughts and emotional functioning (Funk, Baldacci, Pasold & Baumgardner, 2004). Although initial reactions to violence may be strong, over time these reactions diminish and an individual becomes habituated to violence (Fanti et al., 2009).

Research has demonstrated that exposure to real-life and media violence can lead to this desensitization effect, decreasing subsequent reactions to violence exposure (Carnagey & Anderson, 2004). Thus, it may be concluded that individuals in a South African context may be desensitized to negatively arousing words. South Africa has a violent history and although major changes have been made with regards to human rights and equality issues according to The Centre for the Study of Violence and Reconciliation (CSVR) the country still remains one of the most violent, with extremely high rates of crime and violence (CSVR, 2010). Thus, South Africa is still considered a violent country, and South Africans may be considered to have been exposed to a significant amount of real-life and media violence that may be attributed to the violent society they live in. For this population the negative words in the word list may not be emotionally arousing, and may not have had an effect on the encoding and retrieval process.

5.1.4. Total Recall of Words

According to the findings of the present study, there were significant differences in the total number of words recalled from the word list between male and female participants. Specifically, females recalled significantly more words than males from the presented word list. Research results focusing on the effects of gender on memory have been inconsistent in the past (Arnone et al., 2010; Guillem & Mograss, 2005). However, females have been traditionally thought to excel in tasks involving verbal ability and memory (Guillem & Mograss, 2005). Cahill (2005) claims that studies have revealed that the hippocampus, a structure that is important in memory, is larger in women's brains. In addition to this, differences in areas such as cognitive processing style, socialisation and the effects of hormones, may all contribute to females superior performance in tasks of memory and verbal ability. This explanation is also applicable to females' superior performance in the recall of neutral words; see 5.1.1 (Recall of Neutral Words).

In addition to the quantitative analysis of the results of this study found above, a qualitative assessment of the results will now be presented.

5.2. Qualitative Assessment

A qualitative assessment of the manner of responding on the recall test was included in addition to the statistical analysis. From the results of the recall test, it seemed that the primacy and recency effects were evident (Neath & Suprenant, 2003). The manner of responding also indicated that many participants remembered certain groups of similar words. This can be seen in response sets with words grouped together such as *murderer*, *intruder* and *pain*. This is in line with the associative network model of memory (Fiske & Taylor, 2008), as these words are related to each other, thus strengthening the association between these words and resulting in better memory for these words. As each word is remembered, such as *murderer*, similar words such as *intruder* and *pain* are activated in memory and recalled by the participant. This is also in line with the theory on relatedness and distinctiveness proposed by Talmi et al (2007), which states that emotionally arousing words enhance memory because of their similarity to each other and their distinctiveness relative to neutral words.



The limitations of the present study will now be presented. This will be followed by the recommendations and conclusions.

5.3. Limitations

The potential limitations of this study are explored below. This includes a consideration of the sample of participants, the testing conditions, the language of participants, the word list and the emotional state of the participant during testing.

5.3.1. Sample

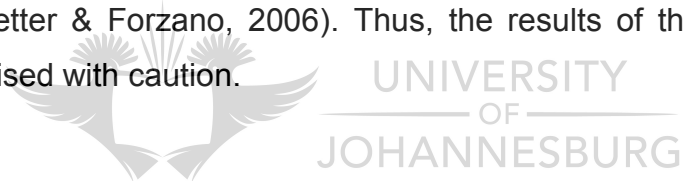
One possible limitation of the present study is the small number of participants, in particular the limited number of male participants. However, research suggests that even small samples with unequal numbers of males and females can be used to generate reliable and valid results regarding the larger population group (Highhouse

& Gillespie, 2009). In addition, the use of non-parametric tests also contributes to the reliability and validity of the results.

5.3.2. Testing Conditions

The data collection was conducted at the end of a lecture the participants attended. The participants may have been fatigued at the end of the lecture, which may have affected the results of the study. In addition to this the testing conditions for the study were not ideal, as some distractions were present in the immediate environment, such as noise from outside of the venue.

As participation in the study was voluntary, the participants in the study may not have been representative of the population. Previous studies have demonstrated that individuals who participate in voluntary research studies may have similar characteristics and thus may not reflect an accurate picture of the population they come from (Gravetter & Forzano, 2006). Thus, the results of this particular study should be generalised with caution.



5.3.3. Language

Another possible limitation of the study concerns the home language of the participants in the study. More than 60% of the sample did not speak English as their home language. Although university students in their third year of study are assumed to have an appropriate level of proficiency in English, this aspect may have impacted the results of the study as language proficiency was not evaluated as part of the study.

5.3.4. Word List

Finally, the words contained in the word list may not have had the desired effect on the participants. Although the words contained in the word list have been used widely with different populations in the psychological literature, they may not have been appropriate in this context. The South African context may present unique

challenges in this type of study that may not exist in other contexts. Thus, words that are expected to be emotionally arousing for this population may not have had the expected effect and thus did not produce a significant effect on memory.

5.3.5. Emotional State of the Participant

The emotional state of the participant during the encoding and retrieval of emotive material may also have an impact on the recall of the word list (Parrot & Spackman, 2000). According to research in this field, the emotional state of the participant corresponds with the material which is remembered by that individual. Material that corresponds with an individual's current mood seems to be better remembered (Levine & Pizarro, 2006). In terms of this study, the current mood of the participants may have influenced the results that were found and this should be considered in the interpretation of these results.

These potential limitations serve as important guidelines for future research in this field. The conclusions and recommendations of the present study will now be discussed below, in light of the results and explanations of these findings.

5.4. Conclusions and Recommendations

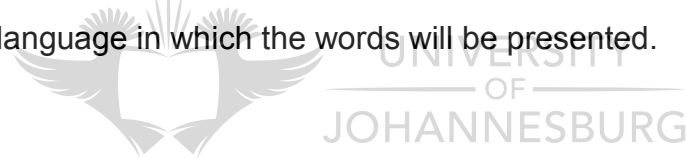
The results of this study indicated that significant gender differences exist in terms of the recall of neutral words and the total recall of words from the word list. However, there were no gender differences found in the recall of positive or negative emotive words. There are many possible explanations to account for these results, including desensitization, biological sex versus sex-related traits, and the words chosen for the list.

Although there were certain limitations of this study that may have impacted on the results, the data gathered in this study may serve as a foundation for future research to build on. It seems that this study was one of the first to focus on gender, memory and affect using a word list in a South African context. The results of this study are not in line with the superior memory performance for emotive material that has been

found in other populations. This may point to an important difference in this population when compared to previous studies in other areas.

Further studies in this field might be able to establish if the memory-emotion link exists in this population, as well as the possible effects of gender on this link. In particular, a word list using Bradley and Lang's (1999) Affective Norms for English Words (ANEW) may be useful in compiling a list of words which have been rated in terms of valence and arousal in this population. In order to create this database of words a sample of the population could have been asked to rate each word in the list on its valence and arousal qualities. This would ensure that the emotionally arousing words are experienced as significantly arousing. However, time constraints made this procedure unfeasible in the current study.

Following this, a list of words containing neutral, positive and negative emotive words could be developed which could be used accurately and reliably in this population. Lastly, as part of such a study, it may be important to also determine participants' proficiency in the language in which the words will be presented.



REFERENCES

- Andreano, J. M., & Cahill, L. (2009). Sex influences on the neurobiology of learning and memory. *Learning and Memory, 16*, 248 – 266.
- Armony, J. L., & Sergerie, K. (2007). Own-sex effects in emotional memory for faces. *Neuroscience letters, 426*, 1 – 5. doi: 10.1016/j.neulet.2007.08.032.
- Arnone, B., Pompili, A., Tavares, M., & Gasbarri, A. (2010). Sex-related memory recall for emotional stimuli: An event related potential study. *Neurobiologia, 73*, 9 – 22.
- Banich, M. T., Mackiewicz, K. L., Depue, B. E., Whitmer, A. J., Miller, G. A., & Heller, W. (2009). Cognitive control mechanisms, emotion and memory: A neural perspective with implications for psychopathology. *Neuroscience and Biobehavioral Reviews, 33*, 613 – 630. doi: 10.1016/j.neubiorev.2008.09.010.
- Bellis, T. J., Billiet, C., & Ross, J. (2008). Hemispheric lateralisation of bilaterally presented visual and auditory stimuli in normal adults, normal children and children with central auditory dysfunction. *Brain and Cognition, 66*, 280 – 289.
- Bloise, S. M., & Johnson, M. K. (2007). Memory for emotional and neutral information: Gender and individual differences in emotional sensitivity. *Memory, 15*, 192-204.
- Bourne, V. J. (2005). Lateralised processing of positive facial emotion: Sex differences in strength of hemispheric dominance. *Neuropsychologia, 43*, 953-956.
- Bradley, M. M., & Lang, P. J. (1999). *Affective norms for English words (ANEW): Instruction manual and affective ratings*. Technical Report C-1, The Center for Research in Psychophysiology, University of Florida, Gainesville.
- Brainerd, C. J., Holliday, R. E., Reyna, V. F., Yang, Y., & Toglia, M. P. (2010). Developmental reversals in false memory: Effects of emotional valence and arousal. *Journal of Experimental Child Psychology, 107*, 137-154. doi: 10.1016/j.jecp.2010.04.013.

- Brody, L. R. & Hall, J. A. (2000). Gender, emotion, and expression. In M. Lewis, & J. M. Haviland-Jones (Eds.). *Handbook of Emotions* (2nd ed, pp. 338 – 349). New York, NY: Guilford Press.
- Burton, L. A., Rabin, L., Vardy, S. B., Frohlich, J., Wyatt, G., Dimitri, D., ... Guterman, E. (2004). Gender differences in implicit and explicit memory for affective passages. *Brain and Cognition*, *54*, 218-224.
- Cahill, L. (2003). Sex- and hemisphere-related influences on the neurobiology of emotionally influenced memory. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, *27*, 1235 - 1241.
- Cahill, L. (2005). His brain, her brain. *Scientific American*, *292*, 40-47.
- Cahill, L., Gorski, L., Belcher, A., & Huynh, Q. (2004). The influence of sex versus sex-related traits on long-term memory for gist and detail from an emotional story. *Consciousness and Cognition*, *13*, 391-400.
- Cahill, L., Haier, R. J., White, N. S., Fallon, J., Kilpatrick, L., Lawrence, C., Potkin, S. G., & Alkire, M. T. (2001). Sex-related difference in amygdala activity during emotionally influenced memory storage. *Neurobiology of Learning and Memory*, *75*, 1-9. doi: 10.1006/nlme.2000.3999.
- Canli, T., Desmond, J. E., Zhao, Z., & Gabrieli, J. D. E. (2002). Sex differences in the neural basis of emotional memories. *Proceedings of the National Academy of Sciences*, *99*, 10789 – 10794.
- Carnagey, N. L., & Anderson, C. A. (2004). Violent video game exposure and aggression. *Minerva Psychiatry*, *45*, 1-18.
- Centre for the Study of Violence and Reconciliation (CSVV). (2010). *Why South Africa is so violent and what we should be doing about it*. Johannesburg, Gauteng: CSVV.
- Christianson, S. A., & Engelberg, E. (2006). Remembering emotional events: The relevance of memory for associated emotions. In B. Uttl, N. Ohta, & A. L.

- Siegenthaler (Eds.), *Memory and emotion: Interdisciplinary perspectives*. (pp. 59 - 82). Malden, MA: Blackwell Publishing.
- Daum, I., Markowitsch, H. J., & Vandekerckhove, M. (2009). Neurobiological basis of emotions, 111 - 138. doi: 10.1007/978-0-387-09546-2.
- D'argembeau, A., & Linden, M. (2004). Influence of affective meaning on memory for contextual information. *Emotion*, 4, 173-188.
- Doerksen, S., & Shimamura, A. (2001). Source memory enhancement for emotional words. *Emotion*, 1, 5-11.
- Eisenberg, N. (2000). Empathy and sympathy. In M. Lewis, & J. M. Haviland-Jones (Eds.). *Handbook of emotions* (2nd ed., pp. 677 – 691). New York, NY: Guilford Press.
- Fanti, K. A., Vanman, E., Henrich, C. C., & Avraamides, M. N. (2009). Desensitization to media violence over a short period of time. *Aggressive Behavior*, 35, 179-87.
- Field, A. (2005). *Discovering statistics using SPSS* (2nd ed.). London: Sage.
- Fiske, S. T., & Taylor, S. E. (2008). *Social cognition: From brains to culture*. New York, NY: McGraw-Hill.
- Frijda, N. H. (2000). The psychologist's point of view. In M. Lewis, & J. M. Haviland-Jones (Eds.). *Handbook of emotions* (2nd ed., pp. 68 – 87). New York, NY: Guilford Press.
- Funk, J. B., Baldacci, H. B., Pasold, T., & Baumgardner, J. (2004). Violence exposure in real-life, video games, television, movies, and the internet: Is there desensitization? *Journal of Adolescence*, 27, 23-39.
- Gasbarri, A., Pompili, A., D'Onofrio, A., Cifariello, A., Tavares, M. C., & Tomaz, C. (2008). Working memory for emotional facial expressions : Role of the estrogen in young women. *Methods*, 964-972. doi: 10.1016/j.psyneuen.2008.04.007.

- Gazzaniga, M. S., Ivry, R. B. & Mangun, G. R. (2002). *Cognitive neuroscience: The biology of the mind* (2nd ed.). New York, NY: W. W. Norton & Company.
- Gravetter, F. J. & Forzano, L. B. (2006). *Research methods for the behavioral sciences* (2nd ed.). Belmont, CA: Wadsworth/Thomson.
- Guillem, F. & Mograss, M. (2005). Gender differences in memory processing: Evidence from event-related potentials to faces. *Brain and Cognition*, 57, 84 – 92. doi: 10.1016/j.bandc.2004.08.026.
- Hadley, C. B., & Mackay, D. G. (2006). Does emotion help or hinder immediate memory? Arousal versus priority-binding mechanisms. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 32, 79 - 88. doi: 10.1037/0278-7393.32.1.79.
- Hamann, S. (2001). Cognitive and neural mechanisms of emotional memory. *Trends in Cognitive Sciences*, 5, 394-400.
- Hamann, S. B., Cahill, L., McGaugh, J. L., & Squire, L. R. (1997). Intact enhancement of declarative memory for emotional material in amnesia. *Learning & Memory*, 4, 301-309. doi: 10.1101/lm.4.3.301.
- Harmer, C. J., Shelley, N. C., Cowen, P. J., & Goodwin, G. M. (2004). Increased positive versus negative affective perception and memory in healthy volunteers following selective serotonin and norepinephrine reuptake inhibition. *American Journal of Psychiatry*, 161, 1256-1263.
- Highhouse, S., & Gilespie, J. Z. (2009). Do samples really matter that much? In C. E. Lance, & R. J. Vandenberg (Eds.), *Statistical and methodological myths and urban legends* (pp. 247 – 265). New York: Routledge.
- Hofer, A., Siedentopf, C. M., Ischebeck, A., Rettenbacher, M. A., Verius, M., Felber, S., & Fleischhacker, W. W. (2006). Gender differences in regional cerebral activity during the perception of emotion: A functional MRI study. *NeuroImage*, 32, 854 - 862. doi: 10.1016/j.neuroimage.2006.03.053.
- Holland, A. C., & Kensinger, E. A. (2010). Emotion and autobiographical memory. *Physics of Life Reviews*, 7, 88 - 131. doi: 10.1016/j.plrev.2010.01.006.

- Iaccino, J. F. (1993). *Left brain-right brain differences: Inquiries, evidence and new approaches*. New Jersey: Lawrence Erlbaum.
- Janowsky, J. S. (2006). Thinking with your gonads: Testosterone and cognition. *Trends in Cognitive Sciences*, 10, 77 - 82. doi: 10.1016/j.tics.2005.12.010.
- Kalat, J. W., & Shiota, M. N. (2007). *Emotion*. Belmont, CA: Thomson Wadsworth.
- Kensinger, E. A., & Corkin, S. (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words. *Memory & Cognition*, 31, 1169-1180.
- Kensinger, E. A., Garoff-Eaton, R. J., & Schacter, D. L. (2006). Memory for specific visual details can be enhanced by negative arousing content. *Journal of Memory and Language*, 54, 99-112.
- Kousta, S., Vinson, D. P., & Vigliocco, G. (2009). Emotion words, regardless of polarity, have a processing advantage over neutral words. *Cognition*, 112, 473-481.
- LeDoux, J. E., & Phelps, E. A. (2000). Emotional networks in the brain. In M. Lewis, & J. M. Haviland-Jones (Eds.). *Handbook of emotions* (2nd ed, pp. 157 – 172). New York, NY: Guilford Press.
- Levine, L. J., & Pizarro, D. A. (2004). Emotion and memory research: A grumpy overview. *Social Cognition*, 22, 530-554.
- Levine, L. J., & Pizarro, D. A. (2006). Discrete emotions and memory. In B. Uttil, N. Ohta, & A. L. Siegenthaler (Eds.), *Memory and emotion: Interdisciplinary perspectives* (pp. 37 – 58). Malden, MA: Blackwell Publishing.
- Libkuman, T. M., Stabler, C. L., & Otani, H. (2004). Arousal, valence and memory for detail. *Memory*, 12, 237-248.
- Luciana, M., Burgund, E. D., Berman, M., & Hanson, K. L. (2001). Effects of tryptophan loading on verbal, spatial and affective working memory functions in healthy adults. *Journal of Psychopharmacology*, 15, 219 – 230. doi: 10.1177/026988110101500410.

- Manning, S. K., & Julian, L. (1975). Recall of emotional words. *The Journal of General Psychology*, 92, 237-244.
- Mather, M., & Nesmith, K. (2008). Arousal-enhanced location memory for pictures. *Journal of Memory and Language*, 58, 449-464.
- Medford, N., Phillips, M. L., Brierley, B., Brammer, M., Bullmore, E. T., & David, A. S. (2005). Emotional memory: Separating content and context. *Psychiatry Research: Neuroimaging*, 138, 247 - 258. doi: 10.1016/j.psychresns.2004.10.004.
- Mneimne, M., Powers, A. S., Walton, K. E., Kosson, D. S., Fonda, S., & Simonetti, J. (2010). Emotional valence and arousal effects on memory and hemispheric asymmetries. *Brain and Cognition*, 74, 10-17.
- Neath, I., & Suprenant, A. M. (2003). *Human memory: An introduction to research, data and theory (2nd ed.)*. Australia: Thomson/Wadsworth.
- Neiss, M. B., Leigland, L. A., Carlson, N. E., & Janowsky, J. S. (2009). Age differences in perception and awareness of emotion. *Neurobiology of Aging*, 30, 1305-1313.
- Nielen, M. M. A., Heslenfeld, D. J., Heinen, K., Van Strien, J. W., Witter, M. P., Jonker, C., & Veltman, D. J. (2009). Distinct brain systems underlie the processing of valence and arousal of affective pictures. *Brain and Cognition*, 71, 387 – 396.
- Nielson, K. A., & Powless, M. (2007). Positive and negative sources of emotional arousal enhance long-term word-list retention when induced as long as 30 min after learning. *Neurobiology of Learning and Memory*, 88, 40-47.
- Nielson, K. A., Yee, D., & Erickson, K. I. (2005). Memory enhancement by a semantically unrelated emotional arousal source induced after learning. *Neurobiology of Learning and Memory*, 84, 49-56. doi: 10.1016/j.nlm.2005.04.001.

- Ochsner, K. N., & Schacter, D. L. (2000). A social cognitive neuroscience approach to emotion and memory. In J. C. Borod (Ed.), *The neuropsychology of emotion* (pp. 163 - 193). New York, NY: Oxford University Press.
- Onoda, K., Okamoto, Y., & Yamawaki, S. (2009). Neural correlates of associative memory: The effects of negative emotion. *Neuroscience Research*, *64*, 50-55. doi: 10.1016/j.neures.2009.01.008.
- Pallant, J. (2010). *SPSS survival manual* (4th ed.). London: McGraw-Hill.
- Parrot, W. G. & Spackman, M. P. (2000). Emotion and memory. In M. Lewis, & J. M. Haviland-Jones (Eds.). *Handbook of Emotions* (2nd ed., pp. 476 – 490). New York, NY: Guilford Press.
- Pessoa, L., Kastner, S., & Ungerleider, L. G. (2002). Attentional control of the processing of neutral and emotional stimuli. *Cognitive Brain Research*, *15*, 31-45.
- Phelps, E. A. (2004). Human emotion and memory: interactions of the amygdala and hippocampal complex. *Current Opinion in Neurobiology*, *14*, 198-202. doi: 10.1016/j.conb.2004.03.015.
- Phelps, E. A., & Anderson, A. K. (1997). Emotional memory: What does the amygdala do? *Current Biology*, *7*, 311-314.
- Reisberg, D. (2006). Memory for emotional episodes: The strengths and limits of arousal-based accounts. In B. Uttil, N. Ohta, & A. L. Siegenthaler (Eds.), *Memory and emotion: Interdisciplinary perspectives*. (pp. 15 – 36). Malden, MA: Blackwell Publishing.
- Rousseau, D. L., & Grey, W. (2009). Memory, emotion, and decision making in international affairs. Paper prepared for the annual meeting of the International Studies Association, February 15th – 18th, 2009, New York, NY. Retrieved from <http://0-web.ebscohost.com.ujlink.uj.ac.za/ehost/pdfviewer/pdfviewer?vid=5&hid=15&sid=e3cb9a10-8acd-4348-a67c-296f3a71046c%40sessionmgr13>.

- Rozenkrants, B., & Polich, J. (2008). Affective ERP processing in a visual oddball task: Arousal, valence, and gender. *Clinical Neurophysiology*, *119*, 2260-2265. doi: 10.1016/j.clinph.2008.07.213.
- Rueckert, L., & Naybar, N. (2008). Gender differences in empathy: The role of the right hemisphere. *Brain and Cognition*, *67*, 162 – 167.
- Sadock, B. J., & Sadock, V. A. (2007). *Kaplan and Sadock's synopsis of psychiatry: Behavioral sciences/clinical psychiatry*. (10th ed.). Philadelphia, Pa: Lippincott Williams & Wilkins.
- Scherer, K. R. (2000). Psychological models of emotion. In J. C. Borod (Ed.), *The neuropsychology of emotion* (pp. 137–162). New York, NY: Oxford University Press.
- Schmidt, S. R. (1991). Can we have a distinctive theory of memory? *Memory & Cognition*, *19*, 523–542.
- Scollon, C. N., Howard, A. H., Caldwell, A. E., & Ito, S. (2009). The role of ideal affect in the experience and memory of emotions. *Journal of Happiness Studies*, *10*, 257-269. doi: 10.1007/s10902-007-9079-9.
- Talmi, D., Luk, B. T., McGarry, L. M., & Moscovitch, M. (2007). The contribution of relatedness and distinctiveness to emotionally-enhanced memory. *Journal of Memory and Language*, *56*, 555-574. doi: 10.1016/j.jml.2007.01.002.
- Taylor, S. E. (1991). Asymmetrical effects of positive and negative events: The mobilization-minimization hypothesis. *Psychological Bulletin*, *110*, 67-85.
- Tomaz, C., Frank, J. E., & Conde, C. (2003). Integrative function of the amygdala in emotional memory storage. *International Congress Series*, *1250*, 335 - 346. doi: 10.1016/S0531-5131(03)00516-8.
- Wager, T. D., Phan, K. L., Liberzon, I., & Taylor, S. F. (2003). Valence, gender, and lateralization of functional brain anatomy in emotion: A meta-analysis of findings from neuroimaging. *Neuroimage*, *19*, 513 – 531. doi: 10.1016/S1053-8119(03)00078-8.

Yiend, J. & Mackintosh, B. (2005). Cognition and emotion. In N. Braisby & A. Gellatly (Eds.). *Cognitive psychology*. (pp. 463 – 506). Oxford: The Open University.

