

CHAPTER 3: OVERVIEW OF THE PRESENT STUDIES

The literature review above documents the need for a systematic investigation of age-related differences in the positive-negative disparity of emotional memory. This systematic investigation should ensure at least two aspects: First, it should establish conditions under which it is possible to verify or to falsify the proposed positivity effect that older adults' memory prioritizes positive material over negative material and more so than young adults did (Charles et al., 2003). Second, a systematic investigation should provide a systematic variation of conditions that allows a first look at mechanisms that may underlie age-related differences in emotional memory. Thus, a systematic investigation should give answers to two questions: First, are there age-related differences in the positive-negative disparity of emotional memory? In particular, do older adults show a memory advantage for positive over negative information? Second, what is the role of potential mechanisms for age-related differences in remembering emotionally-toned material?

In this dissertation project, I begin such a systematic investigation. Specifically, in a free recall task with multiple learning trials, memory for negative, positive, and neutral words is investigated in young (aged 20 to 30 years) and older adults (aged 64 to 75 years). Moreover, two different long-term retention intervals are used to examine the impact of long-term consolidation on age-related differences in remembering emotionally-toned material. In a between-subject design, list composition is manipulated systematically in order to investigate memory performance under conditions that differently afford processing prioritization: emotion-heterogeneous (mixed valence) and emotion-homogeneous (single valence) list conditions. On the one hand, emotion-heterogeneous lists of positive, negative, and neutral words provide strong cues for differential processing prioritization. On the other hand, emotion-homogeneous lists of either positive, negative, or neutral words provide no cues for differential processing prioritization. This *heterogeneity-homogeneity list paradigm* attempts to disentangle the relative effects of processing prioritization from general memory processes for negative, positive, and neutral material.

To address alternative explanations for differences in remembering emotionally-toned material, potential confounding variables are assessed on two different levels: on the level of person characteristics and on the level of word characteristics. Interindividual differences in person characteristics may influence memory performance generally (e.g., education, perceptual speed) or specifically with regard to the positive-negative disparity of emotional memory (e.g., current mood, negative and positive trait affect). Discrepant word

characteristics for positive, negative, and neutral words (e.g., word frequency) may confound the influence of the emotional tone variation. To address this point beforehand, a separate Word Rating Study is conducted, in which young and older adults rate words on memory-relevant characteristics. Based on these ratings, an item pool of positive, negative, and neutral words is selected.

In this chapter, I discuss the rationale for design decisions in detail. This discussion concentrates on the heterogeneity-homogeneity list paradigm in investigating differential processing prioritization for emotionally-toned material. Hypotheses and research designs are systematically outlined.

3.1 RATIONALE

The main goal of this dissertation project was to investigate the generalizability of the proposed positivity effect in older adults' memory and to disentangle potential explanations for such an effect. To do this, questions about age-related differences in the positive-negative disparity of emotional memory are best considered in the context of research regarding the general role of emotions in memory. As mentioned above (see section *1.3.1 Differential Processing of Positive and Negative Information*), research in several domains suggests that negative entities (e.g., events, objects, information, traits) have a much greater psychological impact than positive entities (for reviews, see Baumeister et al., 2001; Rozin & Royzman, 2001; Taylor, 1991). Pratto and John (1991; see also Dijksterhuis & Aarts, 2003; MacKay et al., 2004) argue that negative information might attract more processing resources than positive information and therefore reduce the resources available to process other stimuli simultaneously: that is *emotion-based processing prioritization for negative information*. There is some evidence for this processing priority of negative information: For example, people report thinking more about negative than about positive events (e.g., Klinger et al., 1980), view negative pictures longer than positive pictures (e.g., Charles et al., 2003; Fiske, 1980), and have slower reaction times and more eyeblinks for negative than for positive words (Ohira et al., 1997; see also Pratto & John, 1991). Such a processing priority given to negative information could influence the memory system in that negative information would be remembered with more accuracy than positive information (i.e., negativity effect) when individuals have to memorize material composed of both positive and negative items (i.e., emotion-heterogeneous context; see Ochsner, 2000, for a similar argumentation).

However, what happens if individuals have to remember material from an emotion-homogeneous context such as a list of only negatively- or positively-toned words? The valence composition of the to-be-remembered material can be thought of as a contextual cue that could differentially afford processing prioritization. An emotion-heterogeneous or mixed-valence context that includes both positive and negative information, for example, provides strong cues (or opportunities) for *differential processing prioritization*. In contrast, emotion-homogeneous contexts, in which participants have to remember information from only one emotional valence category, minimize cues for processing prioritization. These proposals regarding emotional material are derived from research that shows memory differences between content categories in mixed (heterogeneous) but not in unmixed (homogeneous) lists. Memory researchers have long known that distinctive or unusual items in a list of common items are better recalled than the common items (e.g., Hunt & McDaniel, 1993; Restorff, 1933; Schmidt, 1991). According to Rajaram (1998), distinctiveness may be broadly defined as “the salience of items that make them stand out from among the background items” (p. 72). Many studies have shown that this effect of better memory for distinctive stimuli can be eliminated or even reversed when stimuli are presented in lists composed entirely of stimuli from only one content category (distinct or common) rather than in a mixed list of distinct and common stimuli. McDaniel, DeLosh, and Merritt (2000), for example, examined the distinctiveness effect for common and bizarre material presented in unmixed versus mixed lists. They presented 72 undergraduates either an unmixed list of common sentences (“The minister read the bible after dinner.”), an unmixed list of bizarre sentences (“The minister ate the bible during dinner.”), or a mixed list of common and bizarre sentences. They found that in the mixed (heterogeneous) list presentation bizarre sentences were better recalled than common sentences. In contrast, common sentences presented in unmixed (homogeneous) lists were better recalled than bizarre sentences in unmixed (homogeneous) sentences. Similar effects have been observed with other kinds of material: For example, bizarre items are better recalled than common items in mixed but not in unmixed lists (e.g., Einstein & McDaniel, 1987; McDaniel et al., 2000), humorous sentences are better recalled than nonhumorous sentences in mixed but not in unmixed lists (Schmidt, 1994), and complex pictures are better remembered than simple pictures in mixed but not in unmixed lists (e.g., Peeck & Van Dam, 1978). The general idea is that the distinctive nature of one content category (e.g., bizarre items) relative to another content category (e.g., common items) attracts more elaborate processing in a context that highlights (i.e., mixed, heterogeneous lists) rather than minimizes differences (i.e., unmixed, homogeneous lists).

The present experiment examines memory for positive, negative, and neutral words presented in emotion-heterogeneous (mixed valence) and emotion-homogeneous (single valence) lists. In the emotion-heterogeneous context, I expect a memory advantage for negative words, whereas in the emotion-homogeneous context, no differences in memory for positive and negative words are expected. There are only two studies that in part have employed related designs with emotionally-toned material. Neither study, however, compared memory performance for emotion-heterogeneous and emotion-homogeneous lists. Dewhurst and Parry (2000), for example, investigated young adults' memory for emotionally-toned words under four list conditions: (a) a list of positive and neutral words, (b) a list of negative and neutral words, (c) a list of negative and positive words, and (d) a list of neutral words. They found a memory advantage for negative words in emotion-heterogeneous conditions. Elmes, Dye and Herdelin (1983) investigated young adults' recall for emotion-homogeneous lists of either positive or negative words. They found no recall differences between these emotion-homogeneous contexts. Even though both studies did not compare memory for emotion-heterogeneous and emotion-homogeneous lists, the findings are consistent with expectations for the heterogeneity-homogeneity list paradigm with regards to the positive-negative disparity of emotional memory. Thus, negative information receives prioritized processing in emotion-heterogeneous lists but not in emotion-homogeneous lists.

These findings about the effects of list context are relevant for the primary question of this dissertation project: Is there an age-related positivity shift in memory for emotionally-toned material? Researchers in the field of adult development and aging suggest that older adults prioritize positive material more than negative material in memory performance (i.e., positivity effect). As shown in the literature review above (see section 2.2 *Age-related Differences in Emotional Memory: Empirical Findings from Experimental Approaches*), some studies find evidence for this positivity effect (Charles et al., 2003; Knight et al., 2002; Leigland et al., 2004; Experiment 2 of Mather & Carstensen, 2003) whereas others do not (Comblain et al., 2004; Denburg et al., 2003; Kensinger et al., 2002; Experiment 1 of Mather & Carstensen, 2003). These inconsistencies indicate that the positivity effect in old age is not robust. Although these studies involved different types of stimuli and memory tasks, they all had one design feature in common; they all used emotion-heterogeneous lists of to-be-remembered material. Thus, questions about processing prioritization have not been tested directly.

The present experiment aims to fill this gap: It is asked whether older adults only show a bias to selectively process positively-toned material in mixed-valence heterogeneous

contexts or if the bias is also apparent in single-valence homogeneous contexts. If a positivity effect in older adults' memory were due to a processing priority of positive information above negative information, one would expect to observe a positivity effect in an emotionally-heterogeneous context but not within an emotionally-homogeneous context. In contrast, young adults' memory should show no positivity effect in both contexts. Such a differential pattern of age-by-condition interaction would document selective processing prioritization of positive material in older adults. Alternatively, if a positivity effect in older adults' memory were due to more general processes operating in remembering positive and negative information, as suggested by Mather et al. (2004), one would expect to observe a positivity effect in both emotionally-heterogeneous and emotionally-homogeneous contexts.

Specifically, in a free recall task with multiple learning trials, we examine the memory of young and older adults for lists of positive, negative, and neutral words. In a between-subjects design, list composition is manipulated systematically in order to investigate memory performance under conditions that differently afford processing prioritization: one condition with strong cues for differential processing (three emotion-heterogeneous lists of positive, neutral, and negative words) and one condition with no cues for differential processing (emotion-homogeneous lists of either positive, neutral, or negative words). This heterogeneity-homogeneity list paradigm attempts to disentangle the relative effects of processing prioritization at encoding from general processing differences for negative, positive, and neutral stimuli.

To properly address the primary topic of this dissertation project, whether there is an aging bias favoring memory for positively-toned material, I focused on words as to-be-remembered material. Word material is chosen because it permits easy variation of the key feature of this study, the heterogeneity-homogeneity list paradigm. Moreover, word material can be easily controlled for many potential confounding variables that are known to influence memory performance (e.g., word frequency, word length, imagery; Rubin & Friendly, 1986). For example, we know from the memory literature that word frequency is positively related to word recall and negatively to word recognition (i.e., recall-recognition paradox; Glanzer & Bowles, 1976; Hall, 1954; Mandler, Goodman, & Wilkes-Gibbs, 1982). Similar relations are probably true for pictures, but it is much more difficult to measure how often people typically observe a dog, a flower, or a dead body in their lives.⁵¹ Specifically, adjectives are used as to-be-remembered material. This material is used to reduce error variance that is due to item-

⁵¹ Recently, Karlsen and Snodgrass (2004) investigated the recall-recognition paradox with pictures. They used familiarity ratings as proxy for frequency and found a similar pattern for pictures as for words.

specific variations. First, adjectives are typically less variable in their semantic meaning than nouns. For example, the emotional meaning of the noun “dog” may depend on idiosyncratic experiences with dogs, whereas the emotional meaning of the adjective “sad” is for the most part normatively determined. Thus, the use of adjectives compared to nouns should result in a smaller amount of noise in the data and more precise estimates of the observed effects. Second, many adjectives are naturally related to emotions (e.g., sad, happy), which should facilitate the encoding of affective connotations. Again, this should reduce the amount of noise in the data. Beside these theoretical reasons to use adjectives, there is also a more practical reason to select adjectives. From previously conducted rating studies, there is much more data available for adjectives than for nouns, especially regarding the emotional tone of the words.

I used a free recall task (instead of a recognition task) by two reasons: On the one hand, a free recall task is cognitively more demanding than a recognition task. A free recall task demands an active, self-initiated search for the stored content and a decision whether the located memory trace matches the to-be-remembered item (e.g., Craik, 1986, 2002). In a recognition task, in contrast, there is no need for a search of the store, only a decision need to be made about the presented item (e.g., Mandler, 1980). In accord with differences in cognitive demands, age differences are typically more pronounced under the cognitive more demanding free recall tasks than under simple recognition tasks (Erber, 1974; Kausler, 1994; N. White & Cunningham, 1982). As a consequence, the detection of age-related differences in the positive-negative disparity of emotional memory might be maximized under a free recall task rather than a recognition task. On the other hand, list context effects between mixed (heterogeneous) and unmixed (homogeneous) lists have been typically observed for free recall tasks. In recognition tasks, this context effect is less strong or not apparent (e.g., Ratcliff, Clark, & Shiffrin, 1990). For the primary topic of this dissertation project, that is, potential age-related differences in the heterogeneous-homogeneous list distinction for emotionally-toned words, a free recall task maximizes the possibility to find differences between age groups and list conditions.

It is well-known that young adults recall more items and show steeper learning curves than older adults (e.g., Kausler, 1994). In this study, I expect to replicate these main effects of age but this is not the focus of this dissertation. Instead, I am interested in the relative contribution of positive, negative, and neutral words to total recall in both age groups (i.e., an Age x Valence interaction). To facilitate this comparison, five study and recall trials are introduced to the design. Multiple trials are used to avoid floor effects in the recall data, to

increase power to detect an Age x Valence interaction, and to examine learning rates for positive, negative, and neutral words. Specifically, the multiple learning and recall trials were also introduced to investigate the idea whether the proposed positivity effect in older adults magnifies with increasing learning opportunities. In this regard, the five learning trials were an initial attempt to get information for intraindividual plasticity (see Baltes et al., 2006) and its age-related change in the context of emotion and memory. The findings in this context could be of interest for potential future work with the testing-the-limits paradigm (Baltes & Kliegl, 1992; Kliegl & Baltes, 1987). To my knowledge, no prior study has investigated learning rates for emotionally-toned material.

In addition to learning rates for emotionally-toned words, two different long-term retention intervals are established in the design. As discussed above, there is some empirical evidence that the enhancement of memory by emotion increases with increasing retention interval (e.g., Butter, 1970; Kleinsmith & Kaplan, 1963, 1964; LaBar & Phelps, 1998; Quevedo et al., 2003). Moreover, there is good theoretical reasoning that the positive-negative disparity of emotional memory might change with different retention intervals (Taylor, 1991). In particular, negative material might be better remembered in short-term memory whereas positive material might be better remembered in long-term memory. There is also some initial empirical evidence for this proposed positivity shift in long-term memory (Knight et al., 2002; Leigland et al., 2004; Walker et al., 1997; but see Denburg et al., 2003). Regarding age-related differences, there is no consistent pattern that age differences in the positive-negative disparity of emotional memory vary with different retention intervals (Denburg et al., 2003; Knight et al., 2002; Leigland et al., 2004). However, these studies used either a very short retention interval (15 – 30 minutes; Knight et al., 2002; Leigland et al., 2004) or a very long delay (eight months; Denburg et al., 2003). In this study, I use two intermediate retention intervals: a 1-hour and a 1-week retention interval.

It should be noted beforehand that the present experiment was intended to examine age-related differences in the positive-negative disparity of emotional memory and not the influence of emotional arousal. The memory task is restricted to lists of words differing in emotional tone. This material was chosen because it permits easy variation of the key feature of this study, the heterogeneity-homogeneity list paradigm. Although emotionally-toned words have an affective meaning, they typically do not elicit strong emotional arousal as other kinds of stimuli do (Phelps et al., 1998). Nonverbal material, such as everyday scenes or pictorial material, may have different experimental characteristics. Indeed, the majority of studies investigating age-related differences in the positive-negative disparity of emotional

memory used pictorial material (e.g., Charles et al., 2003; Comblain et al., 2004; Denburg et al., 2003; Kensinger et al., 2002; Leigland et al., 2004; Mather & Carstensen, 2003). There are, however, few studies using verbal material (Kensinger et al., 2002; Knight et al., 2002; Leigland et al., 2004).

3.2 HYPOTHESES

The hypotheses are organized around the main research questions of this dissertation project: First, are there age-related differences in the positive-negative disparity of emotional memory? Specifically, do older adults' memory prioritize positive information more than negative information in emotion-heterogeneous than in emotion-homogeneous lists? Second, is negative information better recalled in emotion-heterogeneous but not in emotion-homogeneous list contexts suggestive of emotion-based processing prioritization for negative information? The research predictions are listed in Table 3. Table 3 informs about the type of comparison and the result section, in which the corresponding prediction was addressed.

Hypothesis 1. If a positivity effect in older adults' memory exists, it is expected that this preference for positive information be pronounced under conditions in which positive and negative information is presented together. Thus, in an emotion-heterogeneous list context, older adults should recall relatively more positive than negative words than young adults. This would be evidence for the proposed positivity effect in older adults' memory (e.g., Charles et al., 2003).

Hypothesis 2. In a condition in which positive and negative information compete for resources, negative information is expected to be prioritized in information processing resulting in a memory advantage for negative information. An emotion-heterogeneous list condition, in which positive, negative, and neutral words are intermixed is such a condition. Thus, despite the potential positivity effect in older adults (i.e., older adults remember relative more positive than negative material than young adults), I expect a general memory advantage for negative information in an emotion-heterogeneous list context.

Hypothesis 3. If the expected memory pattern in an emotion-heterogeneous list condition is due to differential processing prioritization for emotionally-toned information, no differences in memory for emotion-homogeneous lists of negative, positive, or neutral information are expected.

Hypothesis 4. If a positivity effect in older adults and a general negativity bias exist, I hypothesize that the effects magnify with increasing learning opportunities. This prediction is

informed by the training research with the research paradigm testing-the-limits (Baltes & Kliegl, 1992; Kliegl, Smith, & Baltes, 1989, 1990). With this paradigm, age differences in reserve potentials in memory performance were examined.

Table 3

*Overview of Research Predictions**Main Prediction in the Learning Phase*

H1) Older adults are expected to recall more positive than negative words in the emotion-heterogeneous list condition. <i>If older adults prioritize positive information in memory, this effect should be evident in the heterogeneous list condition.</i>	A x V	5.2.1.1
H2) In the heterogeneous list condition, negative words are better recalled than positive words. <i>This would indicate emotion-based processing prioritization for negative information.</i>	N-P	5.2.1.1
H3) Emotion-homogeneous lists of negative and positive words are equally well recalled. <i>This demonstrates that the pattern in the heterogeneous list condition is not due to general differences in remembering positive and negative material.</i>	N-P	5.2.1.2
H4) Effects are magnified by learning opportunities.		5.2.1.1
H5) Effects are <u>not</u> mediated by person characteristics rather than age.		5.2.3
H6) Effects are <u>not</u> mediated by subjective perceived valence.		5.2.5
H7) Effects are also <u>not</u> mediated by word characteristics (e.g., word frequency, word length, and imagery).		5.2.7

Main Predictions in the Retention Phase

H8) With longer retention intervals, memory differences between neutral and emotional words are maximized. <i>This would indicate enhanced consolidation processes for emotional material.</i>	E-O	5.2.2
H9) With longer retention intervals, memory for negative words, in contrast to positive words, show steeper forgetting curves. <i>This would signify differences in consolidation processes for positive and negative material.</i>	N-P	5.2.2

Note. Three hypotheses are related to the positive-negative disparity of emotional memory (i.e., N-P); two hypotheses are related to the general enhancement of memory by emotion (i.e., E-O); and one hypotheses concern age-related differences in the positive-negative disparity of emotional memory (i.e., A x V). The last column indicates the result section in which the hypotheses were primarily addressed.

Hypothesis 5. Interindividual differences in person characteristics may influence memory performance for emotionally-toned material: On the one hand, interindividual differences in intellectual functioning (e.g., fluid and crystallized intelligence) may be related

to general memory performance. On the other hand, interindividual differences in affect (e.g., current mood, negative and positive trait affect) may be related to differential memory performance for positive, negative, and neutral material. Despite these potential associations between memory for emotionally-toned material and person characteristics, I expect that the hypothesized effects for the emotion-heterogeneous and emotion-homogeneous list conditions remain significant after controlling for interindividual differences in person characteristics. This would document the robustness of the predicted effects.

Hypothesis 6. The findings by Kensinger and colleagues (2003) give some support for the idea that age-related shifts in the subjective emotional meaning of the to-be-remembered material moderate age-related differences in the positive-negative disparity of emotional memory. Based on a preparatory Word Rating Study, I will select a final item pool of to-be-remembered words that should show high consensus between young and older adults' perception. In the central experiment, age-related differences in perceived valence of the to-be-remembered words should be diminished. Despite this preparatory work, it might still be that interindividual differences in perceived valence of the word material influence memory performance. However, I expect that the pattern of findings for subjectively-based valence categories resemble the pattern of findings for a priori valence categories. This would indicate that age-related differences are not due to interindividual differences in perceived valence.

Hypothesis 7. The positive, negative, and neutral to-be-remembered material could differ on a large number of variables. It might well be that memory differences for positive, negative, and neutral words are due to differences in word characteristics other than the valence category. However, I expect that the proposed effects for the emotion-heterogeneous and emotion-homogeneous list conditions remain significant after controlling for inter-item differences in word characteristics. This would document the robustness of the predicted effects.

Hypothesis 8. With longer retention intervals, I hypothesize that memory differences between neutral and emotional words are magnified. This would indicate preferred long-term consolidation for emotional material.

Hypothesis 9. With longer retention intervals, I expect that the positive-negative disparity of emotional memory progress in favor of positive words. To say it differently, with longer retention intervals, negative words are easier forgotten than positive words. This finding would signify differences in long-term consolidation processes for positive and negative information.

For the retention phase, no specific hypotheses are stated with regard to age-related differences in the positive-negative disparity of emotional memory. Previous studies did not observe a different memory pattern for positive and negative material in young and older adults with different retention intervals (Denburg et al., 2003; Knight et al., 2002; Leigland et al., 2004). Despite some methodological problems in these studies, their findings do not provide an empirical basis for specific hypotheses. However, from a theoretical perspective, age-related differences in the positive-negative disparity may be magnified with longer retention intervals. The reason for this idea is that the cognitive demands of a free recall task increase with longer retention intervals because of effortful searches in long-term memory. If age differences in memory for positive and negative material are due to limited cognitive resources, the more demanding long-term memory task may increase differences between positive and negative material.

Past research has not consistently found sex-related differences in remembering emotionally-toned material (e.g., van Stegeren et al., 2005). This null finding in emotional memory is consistent with research on sex-related differences in emotional reactivity. Even though women are typically more expressive than men on a behavioral level (e.g., Carstensen, Gottman, & Levenson, 1995; Kring & Gordon, 1998), no consistent pattern emerged on a physiological and subjective level (e.g., Kring & Gordon, 1998; Kunzmann & Gröhn, 2005; Labouvie-Vief et al., 2003; Levenson et al., 1991, 1994). The inclusion of both female and male participants in the design provided an opportunity to examine the issue of sex differences in memory for emotionally-toned words. However, the main focus of this dissertation project is on age-related differences in the positive-negative disparity of emotional memory. No specific hypotheses are stated for sex-related differences in memory for emotionally-toned words.

3.3 RESEARCH DESIGN

In order to begin a systematic investigation of age-related differences in emotional memory, two studies are conducted: a preparatory Word Rating Study and the central experiment.

3.3.1 Preparatory Word Rating Study

As discussed above (see section 2.2.4 *Potential Reasons for Inconsistent Findings about the Positive-Negative Disparity*), one crucial design issue in research on memory for

emotionally-toned material is the selection of the to-be-remembered material. On the one hand, positive, negative, and neutral materials should be matched on memory-relevant characteristics. This important issue has not always been addressed in previous research. It is often the case that the emotional tone of the to-be-remembered material varies systematically with other characteristics (i.e., confounding dimensions). Such failures to distinguish the emotional tone from other factors could contribute to interpretation problems. On the other hand, previous studies have not been ensured beforehand that young and older adults have the same perception of the to-be-remembered material. Thus, inconsistent findings across studies might be due to age-related differences in the perception of the to-be-remembered material.

To properly address the primary topic of this dissertation project, whether there is an aging bias favoring memory for positively-toned material, the Word Rating Study was conducted. The rationale for the Word Rating Study was to systematically study the to-be-remembered material *before* conducting the memory experiment. The Word Rating Study had three goals: (a) to select a final item pool for the experiment, (b) to obtain rating information for the to-be-remembered words that could be used as covariates in the experiment, and (c) to explore age-related differences in the perception of the words.

As a preparatory study, the Word Rating Study provided information about memory-relevant characteristics of a pool of adjectives. Twenty-four young (aged 20 to 30 years) and 24 older adults (aged 65 to 75 years) were asked to rate 200 adjectives on memory-relevant dimensions. The 200 adjectives were first selected based on eight selection criteria from available rating data. The six rating dimensions in the Word Rating Study were valence, arousal, control, imagery, self-relevance, and age-relevance. Based on the Word Rating Study, a final item pool of 30 negative, 30 positive, and 30 neutral words was selected for the central experiment.

3.3.2 Central Study: A Multitrial Homogeneous-Heterogeneous List Paradigm

In the experiment, memory for positive, negative and neutral words was investigated in 72 young (aged 20 to 30 years) and 72 older adults (aged 65 to 75 years) using the heterogeneity-homogeneity list paradigm. The sample was stratified by sex and educational level. Half of the sample learned words presented in emotion-heterogeneous contexts whereas the other half learned the same words in emotion-homogeneous contexts. The general ideas for this study were outlined above. A detailed description of the design and the methods is provided in Chapter 5.

3.4 DATA ANALYSES

For all analyses, the alpha level was set at $\alpha = .05$. The alpha level represents the a priori probability of an acceptable level of falsely rejecting a given null hypothesis. Following the recommendations of the Task Force on Statistical Inference (Wilkinson, 1999), the empirically derived p values (significance probability) were reported exactly with a precision of three decimals. If the null hypothesis is true, the p value represents the a posteriori likelihood of obtaining a result that is as extreme or more extreme than the observed value. P values below .001 were reported as $p < .001$.

In this dissertation project, I focused on effect sizes and confidence intervals as the primary sources to indicate the magnitude of an effect or the precision of this effect. Most analyses were conducted with a form of analyses of variance. In the analyses of variance, *partial Eta squared* (η_p^2) was reported as effect size (J. Cohen, 1973). Partial Eta squared is the proportion of the effect and error variance that is attributable to the effect.

$$\eta_p^2 = S_{\text{seffect}} / (SS_{\text{effect}} + SS_{\text{error}})$$

For the one factorial design, partial Eta squared and simple Eta squared result in the same value. In a multifactorial design, the sum of the partial Eta squared values do not sum to the amount of variance accounted for by the independent variables. Thus, it is possible for the sums of the partial Eta squared values to be greater than 1.00. Similar to the p values, the exact estimates with a precision of three decimals were reported.

In all figures, 95% confidence intervals were reported. The confidence interval is an interval estimate of the population mean. Throughout this dissertation, I follow the recommendations by Cumming and Finch (2005) to present confidence intervals.