THE UNIVERSITY OF HULL

The Retrieval of Episodic Memories in Parkinson's Disease: The Role of Emotion and Subjective Memory States

being a thesis submitted for the degree of Doctor of Clinical Psychology
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By

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Overview

The portfolio thesis has three parts. Part one and two are conceptually linked through their focus on emotional memory in individuals over 60 years of age and in particular on potential memory enhancements for positive material.

Part one comprises a systematic literature review on the positivity effect in older adults' autobiographical memory. It has been proposed that this effect, which is commonly observed in experimental memory paradigms, should also be observed in personally relevant memories. As such, the review asks the question of whether positivity effects extend to older adults' autobiographical memory. Specifically, it evaluates if older adults are more likely than younger adults to recall positive autobiographical memories. Furthermore, the review examines which mechanism may underlie any such potential group differences. In particular, it is investigated whether the positivity effect in autobiographical memory arises as a result of (a) older adults recalling a greater number of positive memories than younger adults or (b) older adults appraising retrieved memories more positively than younger adults.

Part two is an empirical paper. This study investigates the influence of emotion on both episodic memory and subjective memory states in older adults with and without Parkinson's disease. In particular, the study is interested in the phenomenon of emotional memory enhancements as there are reasons to predict that Parkinson's disease may alter the normative way in which emotion influences memory. The study had two primary aims. First, it evaluated if older adults with Parkinson's disease and healthy older adults differ in the level to which emotion enhances memory. Second, it investigated whether

the two groups differ in how emotion influences two subjective memory states known as recollection and familiarity.

Part three comprises the appendices.

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Part One: Systematic Literature Review

Part One: Systematic Literature Review

A Systematic Review of the Evidence for Positivity Effects in Older Adults' Recall of Autobiographical Memories

This paper is written in the format ready for submission to Psychology and Ageing.

Please see Appendix A. for guidelines for authors.

Word count: 9171

A Systematic Review of the Evidence for Positivity Effects in Older Adults' Recall of Autobiographical Memories

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1.0 Abstract

There is increasing evidence of an age-related positivity effect in older adults' memory. Recent meta-analytic studies have shown that the effect is commonly observed in experimental memory paradigms. However, these studies have largely excluded research on autobiographical memory. As such, it is not clear if the positivity effect extends to older adults' memory for personal events. For this reason a systematic literature review was undertaken with the aim to evaluate whether the positivity effect is reliably observed in autobiographical memory. The specific focus was on between group effects and as such the review evaluated whether older adults remember positive autobiographical memories to a greater extent than do younger adults. Furthermore, the review addressed the potential mechanisms underlying the positivity effect in autobiographical memory paying specific attention to the role of memory retrieval and memory appraisal. In total, 17 studies (799 old adults and 835 young adults) were included for analysis. The old adult samples had a mean age of greater than 60 years of age and the young adult samples had a mean age of below 35 years of age. Although the positivity effect was observed in the majority of studies included in the review a number of studies still failed to demonstrate the effect. In addition, no clear mechanism underlying the effect could be determined. It is likely that the variability of findings is explicable by methodological limitations and discrepancies across studies. To gain clarity regarding the conditions under which positivity effects are observed in autobiographical memory more and better controlled research is needed.

Key words: Positivity effect, Ageing, Autobiographical memory, Systematic Review

Word count: 9171

2.0 Introduction

Old age is often thought of as a time of decline. As we age, our bodies usually become weaker, our health may suffer and there is a decline in cognitive functions such as attention, processing speed and memory (Craik & Salthouse, 2011). With age death can also become more present and people may lose important relationships and experience loneliness (Findlay, 2003). It is possible that findings such as these have given rise to the common view that Older Adults (OAs) suffer reduced emotional wellbeing (Röcke & Lachman, 2008; Scheibe & Carstensen, 2010). Indeed, in light of increasing physical, cognitive and social strains it would perhaps not be surprising to find that OAs struggle to adjust emotionally. However, contrary to these assumptions research suggests that, with the exception of very old age, OAs are actually better than Younger Adults (YAs) at regulating emotions and maintaining positive affect. For example, whilst negative emotions decrease with age, the level of positive emotions remain stable or even increase (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Charles, Reynolds, & Gatz, 2001; Mroczek & Kolarz, 1998; Ready, Weinberger, & Jones, 2007; Scheibe & Carstensen, 2010). In addition, when OAs do experience negative emotions, these are less likely to persist (Carstensen et al., 2000; Gross et al., 1997). These findings suggest that as people grow older there may be an enhanced ability to down-regulate negative affect and maintain positive emotional states.

2.1 Valence Specific Cognitive Biases

In the face of potentially mounting stressful life-events how do OAs maintain affective wellbeing? One potential contributor is a valence specific cognitive bias promoting the maintenance of positive affective states. Studies have shown that OAs direct their attention away from negative and towards positive stimuli (Isaacowitz, Wadlinger, Goren, & Wilson, 2006a, 2006b; Mather & Carstensen, 2003). Extensive research also

suggests that OAs have a memory bias that favours positive over negative information (Carstensen & Mikels, 2005; Charles, Mather, & Carstensen, 2003; Mather & Carstensen, 2005; Mather & Knight, 2005; Reed, Chan, & Mikels, 2014).

The finding that OAs preferentially remember positive information has been referred to in the literature as the *'positivity effect'* or *'positivity bias'*. The positivity bias stands in contrast to the normative *'negativity bias'* observed in young adulthood where memory is stronger for negative information (Reed et al., 2014). This change from a negative to positive memory bias is believed to be a gradual process occurring throughout adulthood with preferential memory for positive over negative information considered a fairly stable phenomenon in later life (Reed et al., 2014).

The terms positivity bias and positivity effect have often been used interchangeably. However, Reed et al. (2014) have highlighted the importance of defining these concepts appropriately. A positivity bias refers to the within group finding that OAs have better memory for positive than negative (and neutral) stimuli. As such, studies examining the positivity bias do not allow for conclusions regarding age differences and do not elucidate whether age increases memory for positive information or decreases memory for negative information (Reed et al., 2014; Scheibe & Carstensen, 2010). In contrast, the positivity effect refers to an age x valence interaction showing that OAs remember positive rather than negative information to a greater extent than YAs. It is important to bear in mind that both the positivity bias and the positivity effect concern healthy ageing (Reed et al., 2014). Of course, preferential memory for positive information could also be observed in clinical populations. However, the current review is concerned specifically with these concepts, and in particular the positivity effect, as it is seen in healthy OAs.

Reed et al. (2014) have shown that the positivity effect is a robust finding across more than 100 studies. They also found that although ageing is associated with a reduction in the normative negativity bias, it is also associated with an increase in memory for positive information. Moreover, the size of the positivity effect was found to increase with increasing age differences between YAs and OAs. The authors suggested that this finding indicates that the positivity effect develops gradually over time.

2.2 Theoretical Frameworks Underpinning the Positivity Effect

Two main theories have been postulated to explain the positivity effect. The first, the Ageing Brain Model (ABM; Cacioppo, Berntson, Bechara, Tranel, & Hawkley, 2011), fits into the global theory of ageing as a time of decline and proposes that the effect arises as a result of amygdala degeneration. The theory holds that because the amygdala is primarily associated with negative affect, age-related declines in this region lead to a reduced memory advantage for negative information. In line with this, studies have found that OAs show a reduced amygdala response to negative stimuli (Nashiro, Sakaki, & Mather, 2011; Tessitore et al., 2005).

Although the ABM can account for a reduced negativity bias, evidence of age-related increases in memory for positive information (Reed et al., 2014) are not well explained by the model. An alternative theory may as such be necessary to account fully for findings. Socioemotional Selectivity Theory (SST; Carstensen, Fung, & Charles, 2003) is a motivational theory postulating a key role for goal-oriented cognition in the positivity effect. According to SST, life goals exist in a temporal context. In young adulthood, when people perceive time as expansive, goals are future oriented. As such, YAs might be willing to accept negative experiences for the sake of future gains. However, as people age they may come to perceive time as increasingly limited. SST holds that under these

circumstances goals become focussed on emotional wellbeing and 'feeling good' in the present moment. The theory from Carstensen and colleagues predicts that the increased focus on emotional wellbeing shifts cognitive resources towards positive rather than negative information.

To date, evidence favours this motivational account. For example, the positivity effect can be modulated by experimental manipulations of goals (Löckenhoff & Carstensen, 2007) and it is most pronounced when OAs have time to control the allocation of cognitive resources (Petrican, Moscovitch, & Schimmack, 2008). These findings are difficult to reconcile with a simple decline in amygdala activity. Instead, Nashiro et al. (2011) have suggested that the positivity effect may be partly mediated by brain structures implicated in cognitive control of emotion like the Prefrontal Cortex (PFC; Ochsner et al., 2004). They propose that for the purpose of emotion regulation OAs may recruit the PFC to down-regulate negative emotions and up-regulate positive ones. This is in line with fMRI evidence showing that relative to YAs, OAs exhibit increased PFC activity and decreased amygdala activity when processing negative material. They also show increased PFC activity in response to positive material (Nashiro et al., 2011; Tessitore et al., 2005).

2.3 Positivity Effects in Autobiographical Memory

It has been argued that if the positivity effect reflects an attempt by OAs to maintain positive affect it should be most pronounced for self-relevant memories (Mather & Carstensen, 2005). Indeed, remembering personal memories in a positive light might increase positive moods. In line with this, pleasant personal memories have been found to reduce negative mood states as well as elicit positive ones (Joormann & Siemer, 2004; Parrot & Sabini, 1990). No memory is perhaps more personally relevant than

Autobiographical Memory (ABM), which refers to our memory for personally experienced events (Conway & Pleydell-Pearce, 2000). Contemporary theories hold that ABMs are not stored as a fully accurate representation of life-events. Instead, ABM retrieval appears to be a constructive process driven by an individual's goals. As such, the ABM system constructs and makes available those memories that are congruent with a person's goals (Conway & Pleydell-Pearce, 2000; Conway, Singer, & Tagini, 2004). If OAs' goals are centred on achieving emotional wellbeing this could consequently lead them to primarily access positive ABMs (ABMs+).

Research shows that OAs recall a higher number of ABMs+ than negative ABMs (ABMs-) (Kennedy, Mather, & Carstensen, 2004; Petrician et al., 2008; Serrano, Latorre, & Gatz, 2007). However, Gallo, Korthauer, McDonough, Teshale, and Johnson (2011) have highlighted that this positivity bias may also be present in YAs due to attempts to establish a positive self-concept (see Conway, 2005 for a review). Therefore, the positivity effect in ABM may perhaps be better understood as a larger positivity effect for OAs than YAs. Research on the positivity effect in ABM has generated somewhat mixed conclusions. A number of correlational studies have treated age as a continuous variable. Three studies of this kind failed to find a relationship between age and emotional valence of retrieved ABMs (Alea & Vick, 2010; Holland & Kensinger, 2012; Siedlecki, Hicks, & Kornhauser, 2015). In contrast, Leist, Ferring, and Filipp (2010) found that increasing age was associated with greater retrieval of ABMs+. However, Webster and Gould (2007) found the opposite relationship where increasing age was associated with greater retrieval of ABMs-. Although these studies are of some relevance to the positivity effect, correlational studies perhaps speak more to its development over time.

Studies treating age as a categorical variable (i.e. between group designs) may provide a more direct test of age x valence interactions. To date, such studies have also generated mixed results. Although some find that compared to YAs, OAs do recall a relatively higher ratio of ABMs+ to ABMs- (Alea. Arneaud, & Ali, 2013; Dijkstra & Kaup, 2005; Kennedy et al., 2004; Ros & Latorre, 2010; Schlagman, Schulz, & Kvavilashvili, 2006) others have failed to replicate this finding (Alea, Bluck, & Segemon, 2004; Fernandes, Ross, Wiegand, & Schryer, 2008).

As such, questions remain about whether positivity effects are present in OAs' ABM and what may explain discrepant results. One possible factor is the age of samples under study. Some studies have treated age as a continuous variable whereas others employ between group designs comparing samples of OAs to YAs. Naturally, this differences in design may produce discrepant results. In addition, between group studies often vary significantly in their age criteria for samples. As a result, age discrepancies between YA and OA groups may vary greatly. Reed et al. (2014) have found that the size of the positivity effect in experimental studies increases with increasing age differences between YAs and OAs. Of course, this may also be the case in ABM studies. As such, studies which employ very small age differences between their young and old samples may fail to demonstrate the effect.

Beyond age there are a number of other variables which may explain discrepant results. For example some, but not all, studies control the time-period from which ABMs can be retrieved. The fading affect bias (Walker & Skowronski, 2009) suggests that negative affect fades quicker than positive affect. In ABM studies, OAs may retrieve memories that are older than those of YAs by virtue of having lived longer. The more rapid fading of negative affect could as such lead to a positivity effect being observed only in studies

which fail to control the age of ABMs. In addition, studies differ in their theoretical conceptualisation of ABMs. Conway and Pleydell-Pearce (2000) suggest that ABM is best understood as being made up of both general ABMs (memories of a class of generic events extending over time e.g. “when I went to university”) and episodic ABMs (memories of specific events lasting less than a day e.g. “the time I did a big university presentation”). In general, OAs retrieve fewer episodic ABMs than YAs (Piolino, Desgranges, Benali, & Eustache, 2002; Ros, Latorre, & Serrano, 2009). Therefore, positivity effects may be more readily observed in studies permitting the retrieval of general (as opposed to only episodic) ABMs.

2.4 Mechanisms Underlying Potential Positivity Effects in ABM

Schlagman et al. (2006) and Schryer and Ross (2014) have discussed at least three potential hypotheses that may explain the positivity effect. First, OAs may simply access or recall fewer ABMs- than YAs (i.e. a reduced negativity bias). Alternatively (or additionally) OAs may construct and access a larger number of ABMs+. Finally, the positivity effect may primarily about the evaluation of the emotional valence of memories rather than the actual memory content. As such, irrespective of the number of ABMs that would be classified as negative or positive, OAs may simply appraise their memories as more positive. According to this hypothesis, evaluations of ABMs- may become less negative with age and/or the evaluation of ABMs+ may become more positive. A finding that OAs retrieve fewer ABMs- or rate their ABMs- as less negative could be consistent with SST (Carstensen et al., 2003) suggesting that OAs use controlled processes to maintain positive emotional states. However, it could also be consistent with a fading affect bias (Walker & Skowronski, 2009). As such, stronger evidence for SST would be that ageing is associated with an increased retrieval or more positive appraisals of ABMs+.

2.5 Aims of the Current Review

Ambiguity exists with regards to whether positivity effects are reliably observed in ABM. In addition, it is unclear whether potential positivity effects result from a reduction in memory for negative life-events, an increase in memory for positive life-events or a positive re-appraisal of ABMs. A systematic literature review was undertaken with the aim to address these points of ambiguity. The first aim of the review was to evaluate whether the positivity effect commonly found in experimental memory paradigms also extends to ABM. The review was primarily concerned with clarifying if the positivity effect is observed in between group studies directly comparing OAs to YAs (rather than with the development of the effect over time). To address this question the review investigated if, compared to YAs, OAs retrieve a relatively higher ratio of ABMs+ to ABMs-. A secondary aim was to assess the mechanisms underlying any observed positivity effects. As such, the review evaluated if the positivity effect appeared to arise because (a) OAs recalled relatively fewer ABMs- (b) OAs recalled relatively more ABMs+ or (c) OAs appraise either ABMs+ and/or ABMs- more positively.

3.0 Method

To ensure that the present review did not replicate previous work a search for existing systematic reviews and meta-analyses was conducted. Two recent meta-analytic reviews examining the positivity effect were identified (Murphy & Isaacowitz, 2008; Reed et al., 2014). However, these studies were not specifically concerned with ABM and in fact the vast majority of ABM studies were excluded from these publications. The reason for this was that only studies reporting objective measures of memory accuracy were included (Dr Andrew Reed, personal correspondence, October, 2014). However, given their retrospective and constructive nature, ABMs are not held to be a fully accurate

representation of past events (Conway & Pleydell-Pearce, 2000). As such, accuracy verification is not common practise.

3.1 Search Terms

An extensive search for empirical studies relevant to the positivity effect in OAs' ABM up to and including 11/08/2015 was conducted. A range of electronic databases covering psychology related research (psycINFO via EBSCO), health related research (Medline via EBSCO) and multidisciplinary research (WEB of SCIENCE) were searched. Four sets of search terms relating to ageing, ABM and emotion were generated. Key words from relevant papers in the field were used to generate these. The search terms relating to ageing were *Older Adult, Elder*, Age*, Aging, Retired and late* life.* Search terms for memory were *Memor*, Recall*, Recollect*, Narrative*,* and *Remember*.* The memory search terms were combined with a "near to" truncation with the search words *Autobiographic*, Personal* and *Self-relevant* to specify the search to ABMs. Finally, emotion search terms were *Emotion*, Valence*, Positiv*, Happ*, Negativ** and *Sad*.* These search terms were combined using Boolean operators as follows: *(Older Adult OR Elder* OR Age* OR Aging OR retired OR late* life)* AND *(Autobiographic* OR Personal OR Self-relevant)* N2 *(memor* OR Recall* OR Recollect* OR narrative* OR remember*) AND (Emotion* OR valence* OR Positiv* OR Happ* OR Negativ* OR Sad*).* Articles featuring the relevant search terms were identified (see Figure 1 for a flowchart of the search protocol). A search limiter of English language was used to search all databases.

3.2 Inclusion and Exclusion Criteria

The current review was grounded in the definition of the positivity effect as it refers to the finding that OAs retrieve a relatively larger number of positive than negative

memories compared to YAs (Reed et al., 2014). Furthermore, the review is concerned specifically with the positivity effect in ABM as this refers to memories for personally experienced events (Conway & Pleydell-Pearce, 2000). These definitions led to a number of inclusion and exclusion criteria as follows:

a) Included studies needed to incorporate measures of the effect of emotional valence on ABM retrieval. To answer the review questions studies were only included if they reported data on (a) the Number (N) of ABMs with positive and negative content recalled as a function of age or (b) the appraisal of ABM valence as a function of age. For outcome measure (a) studies needed to assess retrieval of both ABMs+ and ABMs- to permit investigation of age x valence interactions. For outcome measure (b) it was sufficient for studies to have elicited either ABMs+, ABMs- or neutral ABMs (ABMs+-) if the measure of memory appraisal permitted ratings on a continuum from positive to negative.

b) As the positivity effect refers to an age x valence interaction only studies which incorporated both an OA and YA group were included. The age criteria for inclusion were based in part on Murphy and Isaacowitz (2008). However, there were a number of factors influencing the age limiters as described below. First, given the potential for positivity effects to support emotion regulation in later life the review was specifically concerned with this effect in OAs. As such, age criteria were set to ensure the average age of the OA sample would not be less than 60 years of age. Therefore, the mean age of OA groups could not be <60 years and no participant could be younger than 55 years. If no age range was reported and the OA sample had a mean age of <67 samples with a SD >7 were excluded as these would likely contain OAs younger than 55. In light of the possibility that very small age differences between samples may obscure positivity effects (Reed

et al., 2014) it was also important to ensure a sufficient age gap between OAs and YAs. As such, the mean age of YA samples could not be >35 years, and no YA participant could be older than 40. If no age range was reported and YAs had a mean age >28, the SD could not be >7 as this would likely include participants over 40 years. No participants in the YA group could be younger than 17 years (common youngest age of undergraduate samples). Finally, studies with continuous age criteria were excluded unless they also carried out analysis for specific age groups in line with above age criteria. This ensured that the studies included employed between group designs enabling consistent comparisons across research.

c) As discussed in the introduction, the positivity effect concerns normal ageing. Therefore studies including samples with diagnosed clinical conditions (e.g. cognitive impairments or mental health conditions) were excluded. If relevant outcome data was reported for a healthy OA and YA group this was included.

d) Studies where mood was experimentally manipulated were excluded due to a possible confound of the manipulation with the underlying emotion effect (Murphy & Isaacowitz, 2008).

e) To permit comparison across publications only quantitative empirical studies were included.

f) Studies not in the English Language were excluded as these could not be adequately understood.

g) Finally, to ensure high quality of studies, only published or '*in press*' journal articles were included. Thus conference abstracts, theses and dissertations were excluded. It is acknowledged that this review may as such be subject to a publication bias.

Initially, titles and abstracts of papers from electronic resources were screened against these inclusion and exclusion criteria to assess the relevance of studies to the review. In cases where uncertainty around study relevance remained the full text paper was reviewed (N=49). This led to the inclusion of 15 studies from electronic resources (see Appendix B for references of excluded papers). The reference and citation lists of these included articles were searched for further relevant studies. Finally, key authors in the field (see Appendix C) were contacted to obtain relevant *'in press'* articles and additional publications not identified during the search process. The reference list search, citation list search and contacting of authors identified two further studies for inclusion (see Figure 1 for the number of articles excluded based on each inclusion and exclusion criteria). Where further information was necessary to make a decision regarding inclusion of a study the author was contacted. One author (Alea et al., 2004, see Appendix B) failed to provide needed information on the age of their sample leading to the exclusion of this paper.

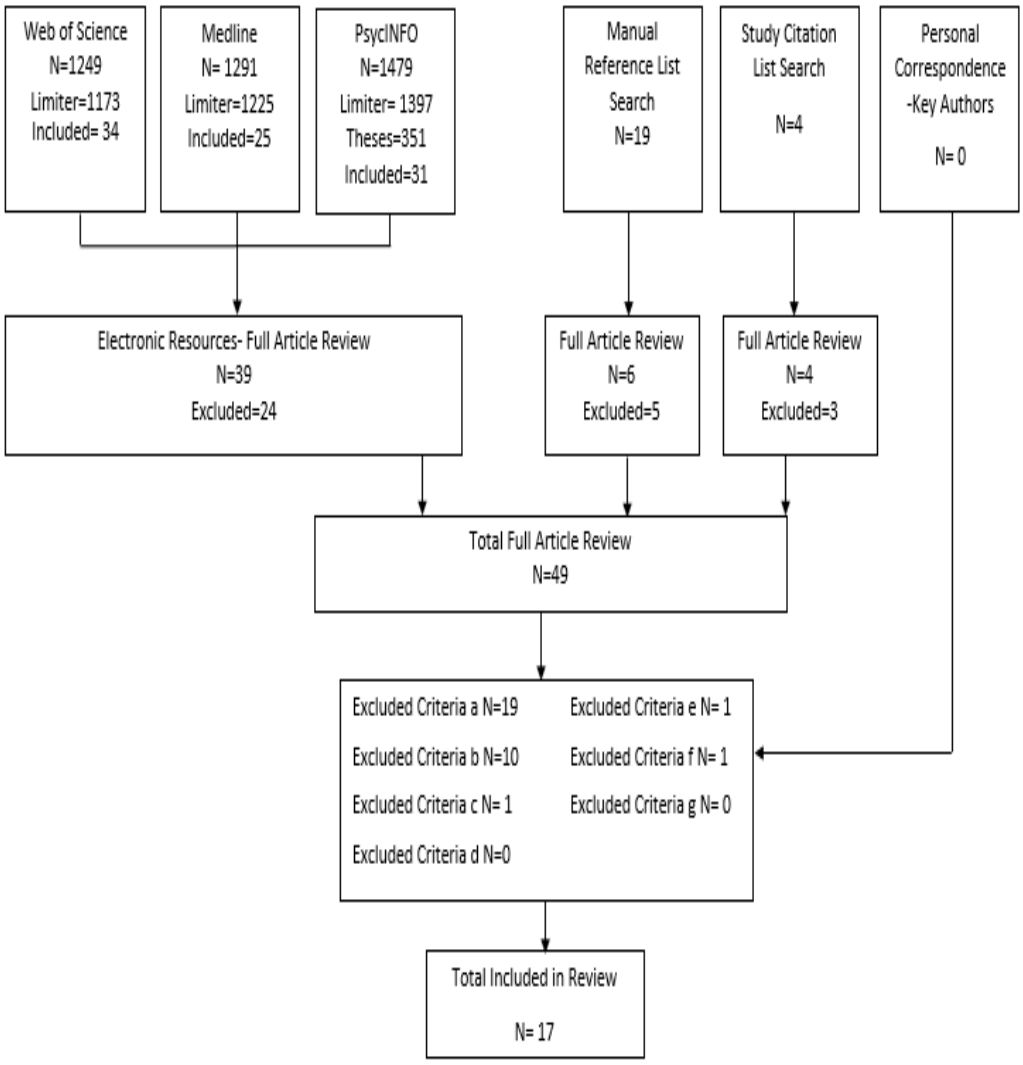

Figure 1.

Flow Chart of Search Protocol.

3.3 Data Extraction and Quality Review

To enable consistent and unbiased extraction of data across studies a standardised data extraction protocol was created (see Appendix D). The data considered relevant was (a) sample size, (b) mean age and age range (c) gender split. In addition, data on variables relating to the ABM procedure was collected as follows; (d) method for eliciting ABM, (e) age of ABMs (f) whether ABMs were general or episodic (g) N of ABMs retrieved

and (h) data on relevant dependent variables defined as the N or proportion of ABMs+/ABMs- recalled or a valence based appraisal of ABMs.

All studies were subjected to a quality assessment to evaluate the general quality of research in the field and how quality impacted on findings. A number of standardised quality checklists exist in the literature. However, as highlighted by King et al. (2002), most are developed for quality assessment of randomised controlled trials. As such, an adapted 17 item checklist was developed (see Appendix E for this checklist, its development and scoring system). It is important to bear in mind that quality in the present review relates in part to how well a study investigates the positivity effect in ABM. For some studies this was not a primary aim but variables of relevance to the review were still measured. Such studies might have been high quality pieces of research in relation to their own aims. However, they obtained a lower quality score here because they did not design their experiments to be a high quality measure of the positivity effect.

Seven studies were assessed by an independent rater to reduce potential bias in the quality assessment procedure. Overall agreement by item on the quality checklist was 83.2% (Cohen's K= .656, $p < .001$) indicating good inter-rater agreement (see Appendix F). Overall agreement by total study quality score was assessed using an intraclass correlation (ICC). This again indicated good inter-rater agreement (ICC= .799, $p = .045$) (see Appendix F). Disagreements between the two raters were resolved through discussion.

3.4 Narrative Synthesis

Because studies varied significantly in the type of ABM tested, the paradigm used, and the outcome measures employed, statistical pooling of findings was not deemed appropriate. Instead a narrative synthesis (Popay et al., 2006) was used to integrate

findings (see Appendix G for the synthesis process). In general, synthesis involved grouping studies according to their outcome measure and considering how study characteristics, methodology and quality may have impacted on results.

4.0 Results

The result section is organised in accordance with the synthesis protocol. First, a description of study characteristics is provided. The results from studies measuring the proportion of ABMs+/ABMs- are then discussed followed by the results from studies measuring valence based appraisals. Note that some studies employed both of these measures and are therefore discussed in both sections.

4.1 Characteristics of Studies

In total, 17 studies published between 1997 and 2014 were included for analysis. There were a total of 799 OA participants and 835 YA participants across studies. The mean age of the YA groups was 21.61 (SD=2.95) and the mean age of the OA groups was 71.38 (SD=4.41). The mean proportion of females was 61.25% (SD=13.06) in the OA groups and 60.41% (SD=13.90) in the YA groups. As such, samples generally included more female than male participants. Ten of 17 studies provided data on the proportion of ABMs classified as positive and negative as a function of age. 13 of 17 studies measured valence based appraisals. Table 1 provides an overview of demographic characteristics, experimental paradigms and key findings from each study. This table is organised according to study outcomes (i.e. proportion of ABMs+/ABMs- retrieved and valence based appraisals of ABMs). Note that a number of studies included both of these measures. These studies appear in the table twice, once for each respective outcome measure.

Table 1.

Overview of Study Demographics, Experimental Paradigm and Key Findings from All Studies.

	Outcome	Paradigm	N/ Valence of	Sample size OA / YA	Mean age and standard OA / YA	N OA / YA	Positivity effect primary focus?[9]	Study	Quality score
Chessel et al. (2014)	Proportion of $ABMs^{+/-/+-}$	Category cuing (self-images)	15	24 21	69.1(8.90) 21.0(1.14)	72% 51%	No	OAs/YAs retrieved a similar number of $ABMs^{+}$ and $ABMs^{-}$ ($p > .05$).	8/18
Dijkstra & Kaup (2005; study 1)	Proportion of $ABMs^{+/-/+-}$	Category cuing/ cue-word method	8 / 10	62 51	71.6 (7.1) 20.8(2.7)	58% 63%	No	OAs retrieved more $ABMs^{+}$ than YAs ($p < .001$) and fewer $ABMs^{-}$ than YAs ($p < .001$).	6/18
Dijkstra & Kaup (2005; Study 2)	Proportion of $ABMs^{+/-/+-}$	Category cuing/ cue-word method	8 / 6	79 64	71.8(6.6) 18.6(1.5)	65% 81%	No	OAs retrieved more $ABMs^{+}$ than YAs ($p < .001$). OAs/YAs retrieved similar numbers of $ABMs^{-}$ ($p = .180$).	8/18
Fernandes et al. (2008)*	Proportion of $ABMs^{+/-/+-}$	Valence based cuing	4^{+}, 4^{-}, 4^{+-}	48 49	72.3(7.83) 19.0(2.14)	58% 63%	Yes	OAs recalled less $ABMs^{-}$ than YAs ($p < .01$) but similar numbers of $ABMs^{+}$	10/18
	Proportion of $ABMs^{+/-/+-}$	1 week recall						YAs recalled more $ABMs^{+}$ than $ABMs^{-}$ ($p < .01$). OAs recalled similar levels of $ABMs^{-}/ABMs^{+}$ ($p = .39$).	

	Outcome	Paradigm	N/ Valence of	Sample size OA / YA	Mean age and standard OA / YA	N OA / YA	Positivity effect primary focus?[9]	Study	Quality score
Holland et al. (2012)*	Proportion of $ABMs^{+/-/+-}$	Autobiographical Memory Test	5^{+}, 5^{-}, 5^{+-}	21 25	69.5(10.52) 21.6(4.65)	U/	Yes	OAs and YAs retrieved similar proportions of $ABMs^{+}$/$ABMs^{-}$ ($p > .017$)[11]	12/18
Ros & Latorre (2010)	Proportion of $ABMs^{+/-}$	Autobiographical Memory Test	5^{+}, 5^{-}	46 50	66.0(5.54) 26.6(2.07)	76% 58%	Yes	OAs retrieved less $ABMs^{-}$ than YAs ($p = .002$) but similar levels of ABMs+.	11/18
Schlagman et al. (2006)*	Proportion of $ABM^{+/-/+-}$	Diary study (involuntary ABM)	Variable	10 11	74.2 (U/D) 23.6(U/D)	73% 40%	Yes	OAs retrieved less $ABMs^{-}$ than YAs but similar $ABMs^{+}$ ($p < .001$).	10/18
Schlagman et al. (2009)*	Proportion of $ABMs^{+/-/+-}$	Cue word method	10^{+} 10^{-} 1 0^{+-}	38 44	74.6(3.19) 21.0(2.41)	43% 66%	Yes	OAs/YAs retrieved similar numbers of $ABMs^{+}$ and $ABMs^{-}$ ($p > .05$).	9/18
Schryer & Ross (2014)	Proportion of $ABMs^{+/-}$	Diary study	1^{+}, 1^{-} (for 5 days)	29 30	75.8(5.31) 20.0(2.00)	48% 63%	Yes	OAs retrieved less $ABMs^{-}$ than YAs per day ($p = .02$) but similar numbers of $ABMs^{+}$ ($p = .49$).	12/18
	Proportion of $ABMs^{+/-}$	1 week recall						OAs/YAs recalled similar proportions of $ABMs^{+/-}$ at the 1 week recall test ($p = .92$).	

	Outcome	Paradigm	N/ Valence of	Sample size OA / YA	Mean age and standard OA / YA	N OA / YA	Positivity effect primary focus?[9]	Study	Quality score
Schulkind & Woldorf (2005)*	Proportion of ABMs$^{+/-}$	Music cued ABMs	20^{+}, 20^{-}	20 20	70.1(6.1) 19.6(0.9)	U/	No	OAs/YAs retrieved more ABMs^{+} than ABMs^{-}. OAs retrieved more ABMs+ than YAs (p= .05).	5/18
Tomaszczyk & Fernandes (2012)*	Proportion of ABMs$^{+/-/+-}$	Cue-word method	3^{+}, 3^{-} 3^{+-}	55 55	71.7(6.53) 19.6(1.5)	69% 62%	Yes	OAs retrieved more AMs^{+} than ABMs^{-} (p< .0005). YAs retrieved similar numbers of ABMs^{+} and ABMs^{-} (p > .05).	11/18
Bluck & Alea (2009)	Appraisal: Likert rating of ABM valence	Category cuing	2^{+}	33 32	74.3(6.07) 27.8(4.49)	48% 50%	Yes	OAs rated their ABMs as lower in +affect than YAs (p< .01). YAs and OAs rated –affect the same (p> .05).	10/18
Boals, Hayslip & Banks (2014)	Appraisal: Likert rating of ABM valence ( )	Valence cued ABM	1^{-}	126 119	73.3(7.3) 19.4(1.9)	73% 82%	Yes	OAs rated ABMs- as lower in –affect (p< .001) and higher in +affect (p< .001) than YAs.	10/18
Comblain et al. (2005)	Appraisal: Likert rating of ABM valence ( )	Valence based cuing	2^{+}, 2^{-},2^{+-}	40 40	63.5(2.76) 22.1(3.36)	48% 48%	Yes	OAs rated ABMs^{-} higher in +affect than YAs (p< .05). There were no group differences in affect ratings of ABMs^{+} or ABMs^{+-} (p> .05).	12/18

	Outcome	Paradigm	N/ Valence of	Sample size OA / YA	Mean age and standard OA / YA	N OA / YA	Positivity effect primary focus?[9]	Study	Quality score
Fernandes et al. (2008)*	Appraisal: Likert rating of ABM valence	Valence based cuing	4^{+}, 4^{-} ,4^{+-}	48 49	72.3(7.83) 19.0(2.14)	58% 63%	Yes	There were no group differences in affect ratings for $ABMs^{+}$ or $ABMs^{+-}$ (p>.05)	10/18
Gallo et al. (2011)	Appraisal: Likert rating of ABM valence	Cue-word method	8^{+}, 8^{-}, 8^{+-}	24 24	75.0(6.9) 20.0(1.6)	79% 88%	Yes	OAs rated $ABMs^{+/-/+-}$ as more positive than YAs (p< .05)	9/18
Holland et al. (2012)*	Appraisal: Likert rating of ABM valence	Autobiographical Memory Test	5^{+}, 5^{-}, 5^{+-}	21 25	69.5(10.52) 21.6(4.65)	U/D	Yes	OAs and YAs rated ABMs retrieved to positive and negative cue-words as similar in affect (p> .05)	12/18
Rice & Pasupathi (2010)	Appraisal: Likert rating of ABM valence	Category cuing	1	62 115	73.3(7.74) 20.6(2.83)	75% 54%	No	OAs rated their self-consistent ABMs as greater in +affect and lower in negative affect than YAs (p< .05).	9/18
Rubin & Schulkind (1997)	Appraisal: Likert rating of ABM valence	Category cuing (important) Cue-word method	5 12-14	60	72.5(U/D) 28.0(U/D)[6]	40% 42%[6]	No	OAs rated their word cued and category cued ABMs as greater in +affect than YAs (p< .001 and p< .05 respectively).	8/18

	Outcome	Paradigm	N/ Valence of	Sample size OA / YA		Mean age and standard OA / YA		N OA / YA		Positivity effect primary focus?[9]	Study	Quality score
Schlagman et al. (2006)*	Appraisal: Likert rating of ABM valence	Diary study (involuntary ABM)	Variable	10	11	74.2 (U/D)	23.6(U/D)	73%	40%	Yes	OAs rated ABMs^{-} as higher in +affect than YAs ($p < .001$). OAs and YAs rated ABMs^{+} as similar in +affect ($p= .17$)	10/18
Schlagman et al. (2009)*	Appraisal: Likert rating of ABM valence	Cue-word method	10^{+}, 10^{-}, 10^{+-}	38	44	74.6(3.19)	21.0(2.41)	43%	66%	Yes	OAs rated ABMs^{-} as higher in –affect ($p= .007$). OAs/YAs rated ABMs^{+} as similar in affect ($p>.05$).	9/18
	Appraisal: Likert rating of ABM valence	Diary study (involuntary ABM)	Variable								OAs rated involuntary ABMs as greater in +affect than YAs ($p= .04$).	
Schryer & Ross (2012)	Appraisal: Likert rating of ABM valence	Valence based cuing	2^{+}, 2^{-},2^{+-}	22	25	76.1(7.35)	19.7(1.88)	55%	56%	Yes	OAs rated all ABMs^{+} and ABMs^{-} as higher in +affect than YAs ($p= .01$)	9/18
Schulkind & Woldorf (2005)*	Appraisal: Likert rating of ABM valence	Music cued ABMs	20^{+}, 20^{-}	20	20	70.1(6.1)	19.6(0.9)	U/D		No	OAs rated ABMs retrieved to both positive and negative music clips as higher in +affect than YAs ($p< .01$).	5/18

	Outcome	Paradigm	N/ Valence of	Sample size OA / YA	Mean age and standard OA / YA	N OA / YA	Positivity effect primary focus?[9]	Study	Quality score
Tomaszczyk & Fernandes (2012)*	Appraisal: Likert rating of ABM valence	Cue-word method	3^{+}, 3^{-} 3^{+-}	55 55	71.7(6.53) 19.6(1.5)	69% 62%	Yes	OAs generated more ABMs they currently felt positive about in response to positive and negative cue-	11/18

[1] A number of studies measured both proportion of autobiographical memories and valence based appraisals. These studies have been marked with *. = Autobiographical Memories. + denotes positive ABMs, - denotes negative ABMs and +- denotes neutral ABMs. [3] AMQ = Autobiographical Memory Questionnaire. [4] MCQ = Memory Characteristics Questionnaire. [5] Number (N) of ABMs to be retrieved in the experimental task and the valence of these. If no ABM valence is specified this indicates that the experimental methodology did not constrain participants to generate ABMs of a specific valence. [6] This study included 2 YA groups which were combined for the relevant analysis. In this study, sample size, age and gender is calculated based on the combined groups. deviations given in brackets. U/D=Unable to Determine. This denotes studies where it was not possible to establish the standard deviation. of Females. Gender distribution for each study was recalculated to proportions to enable comparison across studies. U/D denotes studies where the gender distribution of samples was not measured. [9] Investigation of the positivity effect was not the main aim of all studies. Yes indicates studies where the primary aim was to measure the positivity effect. No denotes those studies that did not primarily aim to measure the positivity effect but nevertheless measured variables of relevance to the review. = Older Adults, YAs = Younger Adults. +affect denotes positive affect and –affect denotes negative affect. corrected alpha. rated as –1, to –3 were binned into a 'negative-feeling' category, memories rated +1 to +3 were binned into a 'positive-feeling' category.

4.2 Positivity Effects in the Proportion of ABMs Retrieved

Ten studies measured the proportion of ABMs+ and ABMs- recalled as a function of age. Three of these measured this outcome on two separate occasions (either within one experiment following a delay or in two separate experiments). As such there were a total of 13 experimental outcomes. As can be seen in Table 2, eight of 13 experiments found a positivity effect in OAs' ABM. As such, even though the majority of studies found a positivity effect a significant minority did not. The review will first analyse those studies finding a positivity effect (paying specific attention to whether it arose because OAs retrieved less ABMs- or more ABMs+) followed by an analysis of studies failing to find such effects.

Table 2.

Outcome of Studies Assessing Proportion of ABMs Classified as Positive and Negative.

Author	Evidence of a positivity effect?[2]	OAs recalled < ABMs- than	OAs recalled > ABMs+ than
Chessel et al. (2014)	N	N	N
Dijkstra & Kaup (2005; exp. 1)	Y	Y	Y
Dijkstra & Kaup (2005; exp. 2)	Y	N	Y
Fernandes et al. (2008; exp. 1)[1]	Y	Y	N
Fernandes et al. (2008; exp. 2; 1 week delay)[1]	N	N	N
Holland et al. (2012)	N	N	N
Ros & Latorre (2010)	Y	Y	N
Schlagman et al. (2006)	Y	Y	N
Schlagman et al. (2009; exp. 2)	N	N	N
Schryer & Ross(2014; exp.1)[1]	Y	Y	N
Schryer & Ross (2014; exp. 2; 1 week delay)[1]	N	N	N
Schulkind &Woldorf (2005)	Y	U/	Y
Tomaszczyk & Fernandes (2012)	Y	N	Y
Total Yes:	8/13	5/13	4/13

[1] These studies involved two sessions 1 week apart. Results for these two sessions are reported separately. [2] Y = Yes, N = No. [3] OAs = Older Adults, ABMs- = Negative Autobiographical Memories, YAs = Younger Adults. [4] U/D = Unable to Determine. The manner in which results were reported made it difficult to determine age differences in proportion of ABMs-. + = Positive Autobiographical Memories.

4.2.1 Evidence of a Positivity Effect

As can be seen in Table 2, only one study (Dijkstra & Kaup, 2005; exp. 1) found that OAs retrieved both less ABMs- and more ABMs+ than YAs. This study employed a category cuing (asking for eventful, non-eventful or vivid ABMs) and a word cuing method (retrieval of ABMs in response to specific cue-words). Following retrieval, participants classified their ABMs as positive, negative or neutral. The finding that OAs retrieved more ABMs+ and less ABMs- must be interpreted with caution in light of methodological issues. For example, the study failed to control potentially confounding variables relating to both participant characteristics (such as mood and cognitive function) and the experimental paradigm (such as age and specificity of ABMs). Therefore, group differences may not necessarily be attributable to age.

Four studies found that the positivity effect arose from reduced retrieval of ABMs-. Ros and Latorre (2010) employed a modified version of the Autobiographical Memory Test (AMT; Williams & Broadbent 1986) which required participants to retrieve episodic ABMs in response to positive and negative cue-words. Whilst OAs and YAs retrieved similar numbers of ABMs+, OAs retrieved fewer ABMs-. Unfortunately, because this study did not control for age of ABMs it is open to a fading affect bias interpretation (Walker & Skowronski, 2009). Three studies overcame this limitation and controlled the age of ABMs. Fernandes et al. (2008; exp. 1) used a valence based cuing paradigm where participants were asked to retrieve ABMs-, ABMs+ and ABMs+- from the last 2 weeks. OAs retrieved fewer ABMs- than YAs but similar levels of ABMs+. These findings were replicated in two studies employing diary paradigms. Schryer and Ross (2014; exp. 1) asked participants to record one ABM+ and one ABM- for five consecutive days. Schlagman et al. (2006) asked participants to record involuntary ABMs (ABMs which come to mind spontaneously without deliberate retrieval attempts) for seven days. Both

studies found that OAs retrieved similar numbers of ABMs+ but fewer ABMs- than YAs. The studies from Schlagman et al. (2006) and Fernandes et al. (2008) obtained "fair" quality scores and the study from Schryer and Ross (2014) obtained a "good" quality score (see Table 1). However, all three studies still suffered limitations which may have impacted on findings. Across studies there was a failure to control all or some principally confounding participant variables. As such, observed group differences may be explicable by factors other than age. By virtue of using diary paradigms, the studies from Schlagman et al. (2006) and Schryer and Ross (2014) are somewhat higher in external validity than lab-based studies. However, for Schlagman et al. this appeared to be at the expense of internal validity.

Three studies found that positivity effects arose as a result of increased retrieval of ABMs+. The first of these, Dijkstra and Kaup (2005; exp. 2), employed a paradigm similar to Dijkstra and Kaup (2005; exp. 1) but with control over ABM age. Although this study found no age-differences in the proportion of ABMs-, OAs retrieved a higher proportion of ABMs+. This finding was replicated by Schulkind and Woldorf (2005) in a study using differently valenced music clips to cue ABMs. Unfortunately, the way in which results were reported in this study made it difficult to ascertain if there were also age differences in retrieval of ABMs-. Finally, Tomaszczyk and Fernandes (2012) employed a cue-word paradigm asking participants to generate ABMs in response to emotional and neutral cue-words and classify these as positive, negative or neutral. OAs generated more ABMs+ than ABMs-, whereas YAs generated similar numbers of ABMs+ and ABMs-. As such, OAs, but not YAs, preferentially recalled positive events. The quality of studies finding that OAs retrieved more ABMs+ was more variable than the quality of studies finding reduced retrieval of ABMs-. The conclusions from Schulkind and Woldorf (2005) and Dijkstra and Kaup (2005; exp. 2) should be interpreted

with significant caution given their low quality score (see Table 1). For example, both studies failed to control the majority of confounding variables relating to participant characteristics. Although the study from Tomaszczyk and Fernandes (2012) did control participant variables, this study still failed to control confounds relating to design (such as age and specificity of ABMs).

4.2.2 No Evidence of a Positivity Effect

Five of 13 experiments found no evidence of a positivity effect. Employing cue-word paradigms, Holland, Ridout, Walford, and Geraghty (2012) and Schlagman, Kliegel, Schulz, and Kvavilashvili, (2009; exp. 2) both found that OAs and YAs retrieved similar numbers of ABMs+ and ABMs-. Despite finding positivity effects in their first experiments (see section 4.2.1) Schryer and Ross (2014; exp. 2) and Fernandes et al. (2008; exp. 2) failed to do so when they asked participants to recall the ABMs they had previously reported following a one week delay. Schryer and Ross found that OAs and YAs recalled similar proportions of ABMs- and ABMs+. Fernandes and colleagues found that YAs recalled more ABMs+ than ABMs- whereas OAs recalled similar levels of ABM+ and ABMs-. However, it is important to note that asking participants to recall previously reported ABMs is a somewhat different task than asking participants to retrieve emotional ABMs in that it imposes an accuracy criterion (i.e. correctly recalling previously reported ABMs). Imposing such a criterion means that the task may be inherently different to normal ABM retrieval which is held to be a constructive process where memory accuracy is not a defining feature (Conway, 2005). In addition, it is well established that memory accuracy declines with age (Craik & Salthouse, 2011). As such, in the second experiments of these two studies, YAs potentially superior memory abilities may have obscured any positivity effects that were present in the first experiments. Finally, Chessel, Rathbone, Souchay, Charlesworth, and Moulin (2014) asked

participants to generate ABMs in response to various self-images and classify these as positive or negative. Both groups generated a significantly higher proportion of ABMs+ than ABMs- and there were no group differences.

Study heterogeneity made it difficult to establish any clear methodological patterns explaining why some studies found positivity effects whilst others did not (see Appendix G). Overall quality of studies finding and not finding positivity effects was similar. As such, individual methodological limitations are more likely to explain variable outcomes. For example, studies differed in terms of what was reflected in outcome measures. With the exception of Schlagman et al. (2006) studies finding positivity effects all measured ABM valence as classified by participants themselves. However, this was not the case in three studies failing to find positivity effects. The studies from Schryer and Ross (2014; exp. 2) and Fernandes et al. (2008; exp. 2) used the proportion of ABMs+/ABMs- previously recalled. In Schlagman et al. (2009; exp. 2) the outcome measure reflected the number of ABMs retrieved in response to positive and negative cue-words. However, participants were not asked to classify these ABMs as positive or negative. Thus, it is not necessarily the case that participants were retrieving ABMs congruent with the cue-words. Despite measuring participant classified valence Holland et al. (2012) and Chessel et al. (2014) failed to find positivity effects. In Holland et al. this may reflect a small sample size. In fact, in a very similar study, Ros and Latorre (2010) only obtained a small effect size (partial eta squared=0.05) despite using a sample size twice as big. Finally, Chessel and colleagues suggested that the lack of positivity effect in their study may be the result of using self-images to elicit ABMs. It is possible that a wish to support a positive self-image biased retrieval for both groups towards ABMs+.

4.3 Do OAs Appraise ABMs More Positively than YAs?

13 studies measured the appraisal of ABM valence. One of these studies provided data from two separate experiments. As such, there were a total of 14 experimental outcomes. As can be seen in Table 3, ten of 14 experiments found that OAs appraised their ABMs more positively than YAs. Broadly there were two types of appraisal studies. The first provided data on whether or not OAs appraised ABMs more positively than YAs irrespective of ABM valence. The second assessed appraisals of differently valenced ABMs.

Table 3.

Outcome of Studies Measuring OAs' and YAs' Valence Based Appraisals of ABMs.

Author	Evidence of a positivity effect?[1]	OAs rated ABMs- less negatively than	OAs rated ABMs+ more positively than
Bluck & Alea (2009)	N	N/	N
Boals et al. (2014)	Y	Y	N/
Comblain et al. (2005)	Y	Y	N
Fernandes et al. (2008)	N	N	N
Gallo et al. (2011)	Y	Y	Y
Holland et al. (2012)	N	N	N
Rice & Pasupathi (2010)	Y	N/	N/
Rubin & Schulkind (1997)	Y	N/	N/
Schlagman et al. (2006)	Y	Y	N
Schlagman et al. (2009; exp. 1)	Y	N/	N/
Schlagman et al. (2009; exp. 2)	N	N	N
Schulkind & Woldorf (2005)	Y	Y	Y
Schryer & Ross (2012)	Y	Y	Y
Tomaszczyk & Fernandes (2012)	Y	Y	Y
Total Yes:	10/14	7/10	4/10

[1] Y = Yes, N = No. [2] OAs = Older Adults, YAs= Younger Adults, ABMs-= Negative Autobiographical Memories. + = Positive Autobiographical Memories. [4] N/A= Not Applicable.

4.3.1 Positive Re-appraisal of ABMs

Three studies assessed ABM appraisals without paying attention to the valence of memories. In an early study, Rubin and Schulkind (1997) asked participants to (a) retrieve ABMs in response to cue-words and (b) retrieve five important ABMs. Following retrieval participants rated the pleasantness of these memories. OAs rated both important and word-cued ABMs more positively than YAs. Unfortunately, this study did not control age of ABMs. Overcoming this limitation, Rice and Pasupathi (2010) asked participants to provide a self-discrepant or self-consistent ABM from the last month and rate the level of positive and negative affect experienced during these events. Compared to YAs, OAs rated self-consistent (but not self-discrepant) ABMs as higher in positive and lower in negative affect. Thus, positive re-appraisals occurred only for ABMs consistent with OAs' self-conceptions. Finally, in a diary paradigm, Schlagman et al. (2009; exp. 1) asked participants to record involuntary ABMs for seven days and rate (a) how positive or negative the ABMs felt now and (b) the level of positive and negative affect experienced during the event. OAs rated the pleasantness of their ABMs higher on both of these measures. Although the above studies suggest that OAs engage in positive re-appraisals of ABMs, methodological flaws limit such conclusions. Both the study from Rice and Pasupathi (2010) and Rubin and Schulkind (1997) failed to control confounding participant variables (including mood, cognitive function and gender distribution). Although Schlagman et al. (2009) controlled relatively more confounding participant variables they still failed to control group differences in gender distribution. In addition, they did not control the age of ABMs.

4.3.2 Positive Re-appraisal of Valenced ABMs

Three studies found that OAs positively re-appraised ABMs- but not ABMs+. Boals, Hayslip, and Banks (2014) asked participants to nominate a very negative ABM and rate

the level of positive and negative emotion associated with it using the Autobiographical Memory Questionnaire (AMQ; Rubin, Schrauf, & Greenberg, 2003). Compared to YAs, OAs rated their ABM- as higher in positive but lower in negative affect. In addition to measuring proportions of ABMs- and ABMs+ (see section 4.2.2), Schlagman et al. (2006) also measured how positively or negatively participants rated their involuntary ABMs. OAs did not differ from YAs in ratings of ABMs+ but rated their ABMs- as less negative. Finally, Comblain, D'Argembeau, and Van der Linden, (2005) asked participants to retrieve ABMs+ and ABMs- and rate the intensity of positive and negative emotion experienced during the events using the Memory Characteristics Questionnaire (MCQ; Johnson, Foley, Suengas, & Raye, 1988). OAs rated their ABMs- as lower in negative affect than YAs. However, ABMs+ were not rated as more positive. The studies from Boals et al. (2014) and Schlagman et al. (2006) achieved fair quality ratings (see Table 1). Nevertheless, these studies failed to control confounding variables relating to participant characteristics. In addition, Schlagman et al. (2006) failed to control ABM age. The study from Comblain et al. (2005) achieved a good quality score and controlled important variables such as age and specificity of ABMs. However, the study still failed to control for group differences in important participant characteristics such as mood and cognitive function.

Four studies showed that in addition to appraising ABMs- more positively, OAs also appraised ABMs+ more positively. Schulkind and Woldorf (2005) used differently valenced music clips to cue ABMs which were subsequently rated according to how much positive or negative affect they contained. OAs rated ABMs retrieved to both positive and negative music cues as higher in positive affect leading authors to conclude that OAs positively re-appraised ABMs- and ABMs+. However, this conclusion is based on the assumption that positive and negative music clips elicited ABMs+ and ABMs-. Close

analysis of the data shows that this was not the case. Instead, the mean valence rating for ABMs elicited by negative music cues was still positive. As such, the study may only speak to appraisals of ABMs+. In their study Gallo et al. (2011) asked participants to retrieve ABMs congruent with positive and negative cue-words and rate how positive and negative these were. OAs rated both ABMs- and ABMs+ as higher in positive affect than YAs. Replicating these findings, Schryer and Ross (2012) asked participants to retrieve ABMs+, ABMs- and ABMs+- from the past 12 months. OAs rated both ABMs+ and ABMs- more positively than YAs. Finally, Tomaszczyk and Fernandes (2012) asked participants to generate ABMs in response to valenced cue-words and rate how they currently felt about them. ABMs were categorised as either 'currently feel positive about' or 'currently feel negative about'. OAs generated more ABMs which they currently felt positive about in response to positive and negative cue-words. Although higher in quality than Schulkind and Woldorf (2005), the studies from Gallo et al. (2011), Schryer and Ross (2012) and Tomaszczyk and Fernandes (2012) still had several limitations. Gallo et al. and Schryer and Ross both failed to control for group differences in relevant participant characteristics and neither Gallo et al. nor Tomaszczyk and Fernandes controlled ABM age.

4.3.3 No Evidence of Positive Re-appraisals

Four studies found no evidence that OAs positively re-appraised ABMs. When asking participants to rate the valence of retrieved ABMs Fernandes et al. (2008) found no age differences in ratings of either ABMs- or ABMs+. Holland et al. (2012) replicated these results and found no differences between OAs' and YAs' ratings of ABMs+ or ABMs-. In addition to studies finding no age differences in appraisals, two studies showed that YAs actually appraised ABMs more positively than OAs. Bluck and Alea (2009) asked participants to recall a memory of a romantic evening and a vacation and rate how

positively or negatively these memories made them feel. YAs reported higher levels of positive affect associated with these ABMs. Finally, Schlagman et al. (2009; exp. 2) asked participants to retrieve memories in response to positive and negative cue-words and rate (a) how positive or negative the ABMs were now and (b) the level of positive and negative affect experienced during the event. Although there were no age differences in the ratings of ABMs retrieved to positive cues, OAs rated ABMs retrieved to negative cues more negatively. Unfortunately (as discussed in section 4.2.2) in this study there is no guarantee that OAs retrieved ABMs consistent with the cue-word valence. Therefore, this finding is difficult to interpret.

As for studies measuring proportions of ABMs+ and ABMs-, there was great methodological heterogeneity across appraisal studies (see Appendix G). Therefore, it was not possible to detect systematic differences in design which appeared associated with those studies which did and those which did not find evidence of positive re-appraisals. As can be seen in Table 1, quality of studies finding that OAs appraised ABMs more positively was similar to studies which did not. As such, discrepant results are likely explained by individual study variability. The limitations to some of the studies which failed to find a positive re-appraisal (Fernandes et al., 2008; Holland et al., 2012; Schlagman et al., 2009) have been previously discussed as including poor control over confounding participant variables and age of ABMs. The study from Bluck and Alea (2009) suffered from these same limitations.

4.4 Overall Quality of Literature

Overall quality of literature will be discussed without separating studies according to their outcome measure. This is because (a) many study limitations were present across either

study type (b) overall quality of literature using both outcome measures was comparable and (c) a number of studies employed both measures.

4.4.1 Internal Validity

This referred specifically to how well a study controlled for a number of confounds relating to both experimental design and relevant participant variables. Across all 17 studies, only one (Tomaszczyk & Fernandes, 2012) was found to have controlled all confounding variables relating to participant characteristics. With regards to the experimental paradigm, nine of 27 experiments controlled age of ABMs and 8 studies controlled or measured the specificity of ABMs. In addition, it was not possible for most studies to determine if those coding data were blind to study hypothesis and experimental group.

4.4.2 External Validity

Most studies were low in external validity involving primarily lab-based experiments where participants retrieved a number of ABMs in response to cues. Such studies are unlikely to represent an ecologically valid measure of ABM. Although designing ecologically valid ABM studies is difficult, diary studies could perhaps be considered more representative of everyday ABM retrieval. It is notable that the three studies (Schlagman et al., 2009; exp. 1; Schlagman et al., 2006; Schryer and Ross 2014; exp. 1) which employed such paradigms all found positivity effects.

4.4.3 Construct Validity

Only four experiments employed a validated and reliable measure of emotional ABM. However, most other studies (with the exception Schlagman et al. 2009; exp. 2 and Schulkind & Woldorf, 2005) employed measures with reasonable face validity. As

discussed in section 4.2.2 outcomes from studies may have varied depending on whether or not outcome measures reflected participant classified valence of ABM

5.0 Discussion

This review aimed to evaluate whether the positivity effect found in experimental memory paradigms extends to ABM and if so whether it arises because (a) OAs recall relatively fewer ABMs- (b) OAs recall relatively more ABMs+ or (c) OAs positively re-appraise ABMs.

5.1 Do OAs Retrieve More ABMs+ and Fewer ABMs- than YAs?

Eight of 13 experiments found that compared to YAs, OAs retrieved a relatively higher ratio of ABMs+ to ABMs- (i.e. a positivity effect). When positivity effects were observed, four studies found that it arose from decreased retrieval of ABMs-, three that it arose from increased retrieval of ABMs+ and one that it arose from both of these. As such, although a minority of studies do not find a positivity effect in OAs' ABM, the majority of studies do. However, when positivity effects are found, it is not clear what mechanism underlies this. Whereas some studies indicate that the effect arises from reduced retrieval of ABMs- others indicate that it arises from increased retrieval of ABMs+. As such, the research on mechanisms underlying the positivity effect is less conclusive.

Mather and Carstensen (2005) have suggested that if the positivity effect reflects an attempt to enhance emotional wellbeing it should be greatest in ABM. This suggestion makes sense in the context of ABM theory where the ABM system is held to construct and make available memories that are congruent with a person's goals (Conway, 2005; Conway & Pleydell-Pearce, 2000). Because SST holds that OAs' goals are centred on emotional wellbeing it follows that they may preferentially access and construct ABMs+.

The finding in this review that the majority of studies do find a positivity effect provides some support for this suggestion. However, it is of note that a fairly significant minority of studies failed to find positivity effects. One suggestion from the experimental literature is that the effect may be greatest in studies with fairly large age differences between YAs and OAs (Reed et al., 2014). The current review specifically set the age exclusion criteria with an aim to ensure that age differences between samples in included studies were not so small that they would obscure potential positivity effects. As a result, age differences between OA and YA samples were fairly large across studies. Therefore, large variability in the age of samples should not have explained the discrepant results. Instead, other methodological flaws and inconsistencies may have given rise to varied study outcomes.

One possibility is that the positivity effect is more readily observed under certain experimental conditions. This would be in line with findings from the experimental literature showing that the effect is sensitive to moderation via methodological manipulations (Reed et al., 2014). Because ABM is a complex and multifaceted memory system (Conway, 2005) designing studies high in experimental control might be inherently difficult (especially given the lack of control over encoding conditions and memory accuracy). Unfortunately, this lack of experimental control may produce inconsistent results. For example both the cuing method and the way in which ABM valence is classified may impact on findings. For instance, the use of self-images to cue ABMs in Chessel et al. (2014) potentially biased both OAs and YAs to retrieve ABMs+ thus concealing any positivity effects. In addition, some studies may not have found positivity effects because outcome measures did not reflect participant classified valence or because an accuracy criterion was imposed on ABM retrieval (Fernandes et al., 2008; exp.2; Schlagman et al., 2009; exp. 2; Schryer & Ross 2014; exp.2).

5.2 Do OAs Positively Re-appraise ABMs?

The positivity effect may primarily be about the evaluation of ABM valence rather than age differences in the ratio of ABMs+ to ABMs- (Schlagman et al., 2006; Schryer & Ross, 2014). Therefore, it may be more readily observed in studies measuring valence based appraisals. Ten of 14 experiments found that OAs appraised their ABMs more positively than YAs. As such, overall, the literature does suggest that OAs positively re-appraise their ABMs. Still, a small number of studies failed to replicate this result. This pattern of results resembles that for studies measuring the ratio of ABMs+ to ABMs- retrieved. Therefore, the evidence for a positivity effect appears largely comparable for recall and appraisal studies indicating that positivity effects may be observed both in OAs' retrieval and appraisals of ABMs.

There was somewhat more evidence suggesting that OAs positively re-appraised ABMs- (seven studies found this) than ABMs+ (four studies found this). Although the finding of a positive re-appraisal strategy for ABMs- could be consistent with SST it could also be consistent with a fading affect bias. If OAs retrieved older ABMs- than YAs, valence may have been rated more positively due to more rapid fading of negative affect. Still, a number of studies found evidence of positive re-appraisals even when controlling for ABM age. This does appear to provide some support for SST.

As for studies measuring the ratio of ABMs+ to ABMs-, it is likely that methodological inconsistencies across appraisal studies led to some variation in outcomes. For example, studies differed with respect to whether participants rated the emotion experienced during the original event or the emotion associated with the retrieved ABM. For a number of reasons, emotional valence at the time of an event may be rated differently to emotional valence of a retrospective ABM. Similarly, cuing methodology and how valence of the

to-be-rated-ABM was classified differed across studies and this could plausibly have impacted on results. Unfortunately, because appraisal studies were so heterogeneous it was difficult to determine clear methodological patterns associated with specific outcomes. This is discussed in more detail below.

5.3 Methodological Concerns; Implication for Findings

As alluded to already, studies varied greatly in methodology and many studies suffered from significant limitations. Naturally, this may have produced some variability in study outcomes. In addition, reduced methodological quality of studies somewhat limits the conclusions which can be drawn from this review. With regards to internal validity, all but one study failed to control confounding participant variables (such as gender, mood and cognitive function). Therefore, findings of a positivity effect cannot be reliably attributed to age. For example, there are well established gender differences in emotional processing and memory (Bradley, Codispoti, Sabatinelli, & Lang, 2001; McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008). Thus, a failure to equate gender distributions across samples means that positivity effects may result from gender rather than age differences. Many studies also failed to control potential group differences in mood. Research on mood-dependent memory (Bower, 1981; Eich, 1995) shows that people tend to retrieve ABMs congruent with their mood state (i.e. ABMs+ when feeling happy and ABMs- when feeling sad). Thus, where studies fail to control mood at retrieval results may vary depending on whether one group was higher in mood than the other. Finally, a number of studies did not control factors like years of education and cognitive function. This is problematic in studies placing demands on cognitive abilities like memory. In some studies positivity effects could have been obscured by reduced memory in OAs.

Internal validity was also lowered due to issues relating to experimental design. For example, several studies failed to control the age of ABMs. Still, in the current review positivity effects were observed both in studies which did and did not control ABM age. This finding appears consistent with SST. However, more research controlling age of ABMs is needed to support this suggestion.

Another factor which may impact on results is whether studies measured positivity effects in episodic or general ABMs. Since OAs retrieve fewer episodic ABMs than YAs (Piolino et al., 2002) positivity effects may more readily be observed in general ABMs. Unfortunately, because most studies failed to conceptualise ABMs as general or episodic conclusions regarding this cannot be drawn. Studies which did specifically assess positivity effects in episodic ABMs produced variable results. This may be explained by other methodological inconsistencies. Finally, there is an important point to be made about outcome measures. Some studies (Schlagman et al., 2009; Schulkind & Woldorf, 2005) made the questionable assumption that emotional cues will elicit emotionally congruent ABMs. In these studies, the measure "proportion of ABMs+ and ABMs-" actually reflects "proportion of ABMs retrieved to positive and negative cues". Thus, ABM valence is not necessarily known. This discussion highlights the importance of controlling confounding variables relating to both participant variables and experimental design. A failure to do so may impact on results.

5.4 Future Directions

The current review does suggest that the positivity effect is often observed in OAs' ABM. However, it is clear that further and better controlled research is needed in order to better understand the conditions under which it emerges. It follows from the discussion in section 5.3 that future research must attempt to control confounding variables relating to

participant characteristics and study design. In addition, it is suggested that studies conceptualise more clearly which component of ABM is under study (i.e. episodic or general). This may permit greater understanding of whether positivity effects are primarily observed in one of these components.

This review considered the possibilities that positivity effects arise during ABM retrieval or appraisal. However, it is worth considering that positivity effects may actually reflect OAs' life-experiences (i.e. they simply experience more positive life-events). Alternatively, OAs and YAs may experience the same number of objectively positive or negative life-events but appraise them differently when they occur (Schryer & Ross, 2014). This would support the Strength and Vulnerability Integration Theory (Charles, 2010) suggesting that positive appraisals of stressful life-events serve an adaptive function. As such, future research could explore if positivity effects are primarily the result of retroactive processes (re-appraisals or memory biases) or arise because OAs have more positive life-experiences or initially evaluate events more positively.

5.5 Limitations to the Review

There are a number of limitations to this review. For example, as only one reviewer assessed studies for inclusion and exclusion the reliability of this process cannot be ascertained. In addition, the review only included published peer-review articles. Although the purpose of this was to include only high quality research the review may be vulnerable to a publication bias.

The review also employed fairly stringent age based exclusion criteria. The aim of this was to ensure that potential positivity effects were not hidden as a result of very small age differences between OAs and YAs. In light of the findings from Reed et al. (2014) that

the positivity effect increases with increasing age differences it is acknowledged that criteria imposing fairly large age differences between groups may have biased the review towards finding evidence in favour of a positivity effect in ABM. In the future, it would be interesting to examine if the effect is observed also in studies with slightly wider age criteria.

In addition, as a result of the age based exclusion criterion a number of studies with continuous age criteria were not included. To date, such studies have provided mixed results (see Alea & Vick, 2010; Holland & Kensinger, 2012; Leist et al., 2010; Siedlecki, et al., 2015; Webster & Gould, 2007) and as such it is unclear if their inclusion in this review would have impacted significantly on its findings. However, it is important to bear in mind that the conclusions from the review are based on a fairly narrow age criteria and speak strictly to between group differences.

It should also be noted that this review does not speak to the related concept of a positivity bias. As such, there might be stronger evidence that OAs preferentially recall ABMs+ over ABMs- (i.e. a within group finding). Of course, such a bias may also support emotion regulation. Finally, it should be acknowledged that the present review included a fairly small number of papers. With an ever growing number of studies in this field, future systematic reviews are likely to be useful and may yield clearer patterns of findings.

5.6 Conclusion

The current review suggests that there is some evidence for a positivity effect in OAs' ABM. The majority of studies found evidence of a positivity effect in the proportion of ABMs+ and ABMs- retrieved. Nevertheless, there were still a number of studies which failed to replicate this finding. A similar pattern of results was found across studies

assessing emotional appraisals of ABMs. Although the majority of studies suggest that OAs positively re-appraise their ABMs (and in particular ABMs-) a significant minority failed to replicate this result. It is likely that the variable outcomes are explicable by significant methodological limitations and inconsistencies. To gain clarity about the conditions under which the positivity effect is likely to emerge in ABM further and better controlled research is needed. It is hoped that such research could explain discrepant results in a theoretically meaningful way.

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Part Two: Empirical Paper

The Effect of Emotion on Episodic Memory and Subjective Memory States in Older Adults With and Without Parkinson's Disease

This paper is written in the format ready for submission to Neuropsychologia

Please see Appendix H. for guidelines for authors.

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The Effect of Emotion on Episodic Memory and Subjective Memory States in Older Adults With and Without Parkinson's Disease

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1.0 Abstract

Research shows that individuals with Parkinson's Disease (PD) exhibit impairments in both memory and emotional processing. However, little is understood about the link between the two. The present research aimed to provide an initial exploratory investigation into the influence of emotion on memory in PD. Given the increasing evidence for a positivity bias in healthy older adults' memory, the study focussed specifically on emotion-memory links in older adults with PD. There were two primary aims. First, the study evaluated if older adults with PD and healthy older adults differed in the level to which emotion enhanced memory. Second, the study investigated whether the two groups differed in how emotion influenced two subjective memory states known as recollection and familiarity. To investigate group differences in emotional enhancements of memory the study employed a recognition task assessing retrieval of positive, negative and neutral images. To assess the influence of emotion on subjective memory states the study used the remember/know task. Results showed that here were no group differences in the influence of emotion on memory. Instead, negative affect enhanced recognition memory in both healthy older adults and older adults with PD. In addition, both groups showed an emotional enhancement of recollection and this enhancement was greatest for negative stimuli. Findings suggest that increased recognition of negative stimuli may be driven by recollection in older adults both with and without PD. However, the lack of group differences may be explicable by the number of methodological limitations in this study.

Key words: Emotion, Memory, Parkinson's disease, Recollection and Familiarity.

2.0 Introduction

Parkinson's Disease (PD) is a progressive and degenerative neurological condition. Usually, the disorder develops later in life primarily affecting individuals over 60 years of age (Grosset, Grosset, Okun, & Fernandez, 2009). The hallmark of PD is deficits in movement including resting tremor, rigidity, bradykinesia and gait impairments (Olanow, Stocchi, & Lang, 2011).

PD results from a reduction in the levels of dopamine secreting cells in the substantia nigra. As a result, dopamine depletion occurs in the nigrostriatal dopamine pathway projecting from the substantia nigra to the striatum. This leads to a dysregulation of neuronal activity in the basal ganglia and its neuro-circuits projecting to the cerebral cortex. Two other dopaminergic pathways, both originating in the ventral tegmental area, are implicated in PD. The first, the mesolimbic pathway, projects to brain structures including the nucleus accumbens, amygdala, olfactory nuclei, entorhinal cortex, and hippocampus. The second, the mesocortical pathway, projects to prefrontal and cingulate cortices (Blonder & Slevin, 2011; Oades & Halliday, 1987; Obeso, Rodríguez-Oroz, Rodríguez, Arbizu, & Giménez-Amaya, 2002; Postuma & Dagher, 2006).

Given the extent of neuropathology in PD it is perhaps not surprising that impairments extend beyond motor deficits to a range of cognitive and emotional functions. Studies now show that individuals with PD present with various difficulties in emotional processing (Bowers, et al., 2006; Gray & Tickle-Degnen, 2010; Hillier, Beversdorf, Raymer, Williamson, & Heilman, 2007) memory (Brønnick, Alves, Aarsland, Tysnes, & Larsen, 2011; Elgh, et al., 2009; Higginson, Wheelock, Carroll, & Sigvardt, 2005; Whittington, Podd, & Stewart-Williams, 2006) and executive functions (Azuma, Cruz, Bayles, Tomoeda, & Montgomery, 2003; Zgaljardic, et al., 2006).

2.1 Emotion and Episodic Memory

Declarative long term memory can be divided into episodic and semantic components. Semantic memory refers to our knowledge of the world and concepts. Episodic memory on the other hand refers to specific memories of personally experienced events that are associated with contextual, emotional and perceptual details (Tulving, 1985).

Research has shown that emotional arousal enhances encoding, consolidation and retrieval of episodic memories (Dolcos, Labar, & Cabeza, 2004; 2005; Hamann, Ely, Grafton, & Kilts 1999). According to the emotional modulation hypothesis the memory enhancing effect of emotion results from amygdala modulation of activity in medial temporal lobe memory structures such as the hippocampus and entorhinal cortex (Dolcos et al., 2005; McGaugh, 2004). In line with this, neuroimaging research shows that successful encoding and retrieval of emotional memories is associated with increased activity in the amygdala and hippocampus as well as increased connectivity strength between the two (Dolcos et al., 2004; 2005; Hamann et al., 1999; Smith, Stephan, Rugg, & Dolan, 2006).

To date, little research has investigated the link between emotion and memory in PD. This is somewhat surprising given the extensive body of literature documenting that PD is associated with impairments to both episodic memory (Whittington et al., 2006) and emotional processing (Péron, Dondaine, Le Jeune, Grandjean, & Vérin, 2012). Individuals with PD appear to exhibit impairments in episodic memory both when tested by free recall and recognition (Whitting, Podd, & Kan, 2000; Whittington et al., 2006). In addition, the disorder is associated with changes in recognition and experience of emotions and the physiological arousal which accompanies them (Bowers et al., 2006; Gray & Tickle-Degnen, 2010; Hillier et al., 2007). It has been suggested that emotional

impairments occur as a result of neuronal loss and dopamine depletion in the amygdala (Harding, Stimson, Henderson, & Halliday, 2002; Péron et al., 2012). Given that this structure mediates emotional enhancements of memory (Dolcos et al., 2004; 2005) there may be reason to predict reductions of emotional memory enhancements in PD.

To the author's knowledge, only one study (Hälbig et al., 2011) has investigated the influence of emotion on memory in individuals with and without PD. This study found no differences between healthy controls and people with PD (on medication) in the ability to recognise emotional images. However, this lack of group differences may be explained by methodological limitations. For example, a close look at results indicates that the study may have suffered from ceiling effects obscuring significant differences. In addition, recognition accuracy was measured only by correctly identified images ("hit rate"; Stanislaw & Todorov, 1999). The use of hit rate alone as an accuracy index is problematic in recognition memory paradigms because it fails to take into account the number of times an individual labels a new item as having been previously seen ("false alarm"; Stanislaw & Todorov, 1999). As such, a high hit rate is not necessarily indicative of high accuracy but may simply indicate a response bias.

2.2 The Positivity Effect of Memory

When researching emotional memory in PD it is essential to bear in mind that the disorder is primarily associated with old age (Grosset et al., 2009). This is important because the effect of emotion on memory appears to differ between young and old individuals (Carstensen, Fung, & Charles, 2003; Carstensen & Mikels, 2005). Although emotional memory enhancements are observed for positive stimuli in Young Adults (YAs), they tend to be more readily seen for negative stimuli (Hamann, 2001; Ochsner, 2000; Reed, Chan, & Mikels, 2014). However, over time, the relationship between age and valence

appears to reverse and in Older Adults (OAs) emotional enhancements are primarily seen for positive stimuli (Carstensen et al., 2003; Carstensen & Mikels, 2005; Charles, Mather, & Carstensen, 2003; Mather & Carstensen, 2005; Mather & Knight, 2005; Reed et al., 2014).

The finding of preferential memory for positive stimuli is known as the *'positivity effect'* or the *'positivity bias'*. Reed et al. (2014) have pointed out that although the positivity effect and positivity bias are related concepts there are important differences between the two. The positivity bias refers to the finding that OAs have better memory for positive compared to negative and neutral stimuli. In contrast, the positivity effect refers to the finding that OAs retrieve a relatively higher ratio of positive to negative memories compared to YAs. That is, OAs remember positive rather than negative information to a greater extent than YAs. As such, the positivity bias reflects a within group finding whereas the positivity effect refers to an interaction between age and valence. Both the positivity effect and the positivity bias have been replicated a number of times (for meta-analyses see Murphey & Isaacowitz, 2008; Reed et al., 2014). Failures to do so have been linked to methodological factors such as imposing controlled rather than incidental, naturalistic encoding conditions (Reed et al., 2014). The current study does not include a YA group and as such speaks only to the positivity bias.

2.3 Socio-emotional Selectivity or an Ageing Brain?

There are two main theories explaining OAs' preferential memory for positive over negative information. The first, the Ageing Brain Model (ABM; Cacioppo, Berntson, Bechara, Tranel, & Hawkley, 2011) proposes that a positive memory bias may arise as a result of an age-related degeneration of the amygdala. Cacioppo and colleagues have argued that because the amygdala is primarily associated with negative arousal, age

related changes in this region may impair memory for negative material. Indeed, research shows that when encountering and remembering negative information OAs do exhibit reduced amygdala activity (Nashiro, Sakaki, & Mather, 2011; Tessitore et al., 2005). As such the ABM appears able to account for age-related reductions in memory for negative information. However, studies have also found that OAs actually remember positive information to a greater extent than YAs (Reed et al., 2014). The ABM is less able to account for this finding.

A theory which may be able to account for both reduced memory for negative stimuli and increased memory for positive information is Socioemotional Selectivity Theory (SST; Carstensen et al., 2003). SST is a motivational theory which places the idea of goal-oriented cognition as a central tenet in explaining the positivity bias. According to this model, life goals are set within the context of time. In young adulthood, when people perceive their future as open-ended and time as expansive, goals are likely to be future oriented and knowledge focussed. Because of this, YAs may be willing to accept negative experiences in the hope that it will lead to future gains. However, mortality places a constraint on time and with age people may come to perceive time as less expansive. SST holds that this may shift a person's goals towards present moment life-satisfaction and emotional wellbeing. As such, the theory holds that it is an increased focus on emotionally meaningful goals which lead OAs to shift their information processing resources towards positive over negative information. This may serve the function of aiding emotion regulation which may increase positive affect and in turn emotional wellbeing. In line with this, negative emotions have been shown to decrease with age whilst the level of positive emotion remains stable or even increases (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Charles, Reynolds, & Gatz, 2001; Gross et al., 1997; Kunzmann,

Little, & Smith, 2000; Mroczek & Kolarz, 1998; Ready, Weinberger, & Jones, 2007; Scheibe & Carstensen, 2010).

Much evidence supports the motivational account of the positivity bias and positivity effect. For example, the positivity effect appears to be most pronounced when OAs have time to assert control over how they allocate cognitive resources (Petrican, Moscovitch, & Schimmack, 2008). In addition, highlighting the importance of goal oriented cognition, experimental manipulation of goals have been found to influence the effect (Löckenhoff & Carstensen, 2007). As the above findings extend beyond a reduction in memory for negative information they are difficult to explain purely by a reduction in amygdala activity. Therefore, Nashiro et al. (2011) have suggested that preferential memory for positive information observed in OAs may be primarily associated with the Prefrontal Cortex (PFC). The PFC has been found to be implicated in cognitive control of emotion (Ochsner et al., 2004; Urry, et al., 2006). As such, Nashiro and colleagues have suggested that OAs may recruit the PFC to down-regulate negative emotions as well as up-regulate positive ones. A number of fMRI studies have supported this idea. For example, it has been found that compared to YAs, OAs exhibit increased PFC activity and decreased amygdala activity when processing negative material. In addition, OAs show increased PFC activity in response to positive material (Murty et al., 2009; Nashiro et al., 2011; Tessitore et al., 2005).

2.4 The Positivity Bias and PD

As mentioned previously, only study (Hälbig et al., 2011) has investigated the effect of emotion on episodic memory in PD. Although the samples in that paper included OAs, YAs with PD were not excluded. Thus, the study does not speak specifically to the positivity bias. However, the question of whether or not OAs with PD (OAPDs) exhibit

a positivity bias is an important one given the links between the bias and emotional wellbeing (Carstensen et al., 2003; Scheibe & Carstensen, 2010). A consideration of neuropathology in PD in conjunction with SST (Carstensen et al., 2003) and the ABM (Cacioppo et al., 2011) suggests two possibilities. First, OAPDs may show a positivity bias as a result of amygdala degeneration. Both the ABM and SST postulate that the amygdala is primarily associated with negative affect (Nashiro et al., 2011) and research suggests that PD is associated with pathology in this region (Blonder & Slevin, 2011; Harding et al., 2002; Péron et al., 2012; Tessitore et al., 2002). As such, a positivity bias in PD may arise as a result of decreased memory for negative information. This could represent a similar (although possibly augmented) process to the reduced negativity bias seen in healthy OAs (HOAs).

However, it has been suggested that HOAs also show an increased memory for positive information which may be mediated by the PFC (Nashiro et al., 2011). In PD, such enhancements may be reduced as a result of PFC dysregulation (Azuma et al., 2003; Cools, Stefanova, Barker, Robins, & Owen, 2002; Owen, 2004). Such PFC impairments in PD are likely to occur as a result of a disruption in the neurocircuits projecting from the basal ganglia to the frontal lobes (Alexander, DeLong, & Strick, 1986; Owen, 2004).

2.5 Emotion and Subjective Memory States

In recent years there has been growing interest in how emotion impacts on factors beyond episodic memory accuracy. One area of research that has been receiving attention is the influence of emotion on subjective memory states. It is widely accepted that episodic memories can be supported by two different states of awareness (Davidson, Anaki, Saint-Cyr, Chow, & Moscovitch, 2006; Ochsner, 2000; Tulving, 1985; Yonelinas, 2002). The first, *recollection*, refers to a vivid and clear memory of an event and the contextual,

emotional and perceptual details surrounding it. Recollection is associated with a sense of 'being taken back' in time and re-living an original episode. For example, a person may recall when and where an event took place as well as their thoughts and feelings at the time. The second, *familiarity*, allows one to recognise that something has been encountered before without being able to bring to mind any contextual details. As such, a person might subjectively know that something has previously occurred whilst being unable to recall any specific details about the event.

As discussed at length previously, emotion enhances episodic memory. This emotional enhancement may be driven primarily by recollection. Research shows that feelings of recollection, but not familiarity, are increased for emotional material (Dolcos et al., 2005; Ochsner, 2000; Talarico, LaBar, & Rubin, 2004). This has led to the suggestion that emotional enhancements of memory occur because experiences that elicit emotion are more likely to later create a rich recollective experience (Dolcos et al., 2005; Ochsner, 2000). As such, recollection may support memory for emotional material. On a neural level, the selective effect of emotion on recollection appears mediated by increased activity in the hippocampus and amygdala (Dolcos et al., 2005).

2.6 The Positivity Bias and Subjective Memory States

A couple of studies have investigated how positive and negative emotion influences subjective memory states in HOAs. If HOAs direct their attention primarily to positive stimuli during encoding (Reed et al., 2014) this could enhance memory for the kind of details that support recollection. Comblain, D'Argembeau, Van der Linden, and Aldenhoff (2004) used the Remember/Know (R/K) paradigm (Gardiner, 1988; Tulving 1983; Yonelinas, 2002) to examine this. The R/K paradigm is a common method for assessing recollection and familiarity. It measures the subjective retrieval experience for

an item that is recognised as having been previously studied. A *Remember* judgement reflects recollection and a *Know* judgement reflects familiarity. Using this procedure Combalin et al. (2004) found that OAs actually gave more remember responses to negative than positive stimuli (indicating that negative material was more likely to give rise to a recollective experience). The authors also found that OAs showed greater memory accuracy for negative pictures (a finding discrepant with the large literature on the positivity bias; Reed et al., 2014). These findings were replicated by Kapucu, Rotello, Ready, and Seidl (2008).

A possible explanation for the lack of positivity bias in both memory accuracy and subjective awareness in these two studies is the encoding conditions. Reed et al. (2014) have highlighted that both of these studies constrained encoding in some fashion. The positivity bias is less likely to occur when studies do not employ naturalistic encoding conditions. As such, it is possible that increased recollection of positive stimuli would have been observed if the authors had not constrained encoding.

To date, no research has investigated the influence of emotion on subjective awareness states in PD. However, a number of studies have used the R/K procedure without considering the influence of emotion. Some of these have found impaired recollection but spared familiarity in PD (Edelstyn, Mayes, Condon, Tunnicliffe, & Ellis, 2007; Edelstyn, Shepherd, Mayes, Sherman, & Ellis, 2010) whereas others find the opposite pattern of spared recollection but impaired familiarity (Davidson et al., 2006; Weiermann, Stephan, Kaelin-Lang, & Meier, 2010). One suggestion to account for discrepant outcomes is that impairments in recollection may not present in very early PD. Instead, they may only occur in more moderate stages when frontal regions become increasingly impaired (Edelstyn et al., 2010). This is a plausible explanation given evidence suggesting that

recollection relies on frontal regions to a greater extent than familiarity (Yonelinas, Otten, Shaw, & Rugg, 2005).

2.7 Aims of the Current Study

Extensive research has documented that individuals with PD exhibit impairments in both memory and emotional processing. However, few have investigated the link between the two. The one existing study (Hälbig et al., 2011) suffers from methodological flaws limiting its interpretation. In addition, this study did not employ an age criterion and thus does not speak to whether there is reduction in the positivity bias in OAPDs. This is unfortunate given that the positivity bias may serve an emotion regulating function that is of clinical importance. In addition to the very limited research investigating links between emotion and memory, no study has to date investigated how emotion influences subjective memory states in OAPDs.

In order to evaluate how emotion influences memory accuracy in OAPDs the current study assessed recognition memory for positive, neutral and negative images in a group of HOAs and OAPDs. In addition the study used the R/K task to investigate the influence of emotion on recollection and familiarity in OAPDs.

There were two primary research questions as follows;

1. Do OAPDs and HOAs differ in the level to which emotion enhances the ability to correctly recognise previously seen stimuli? Here, it was of interest to evaluate whether potential group differences in emotional enhancements were mediated by the valence of emotional stimuli (i.e. are group differences greatest for positive material as a result of a positivity bias in HOAs but not OAPDs)?

2. Do OAPDs and HOAs differ in the level to which emotion promotes recollection (memory for contextual details) versus familiarity (no memory for contextual details) at the point of recognition? Again, it was of interest to assess whether potential group differences in the influence of emotion on recollection were mediated by the valence of emotion (i.e. positive or negative).

For research question one, the first hypothesis was that there would be a significant difference between the HOAs and OAPDs in the level to which emotion enhanced recognition accuracy. An interaction was predicted where increased recognition accuracy for emotional compared to neutral images was expected to be significantly greater in HOAs than OAPDs. A second hypothesis was that HOAs, but not OAPDs, would exhibit significantly better recognition accuracy for positive than negative images. As a result, group differences in emotional enhancements of memory accuracy were expected to be significantly greater for positive than negative images.

For research question two, the first hypothesis was that emotional enhancements of recollection would be significantly greater in HOAs than OAPDs. An interaction was predicted where emotional content of images was expected to significantly increase recollection in HOAs but not OAPDs. The second hypothesis for research question two concerned the influence of valence on recollection and familiarity. Here it was predicted that HOAs, but not OAPDs, would exhibit significantly larger rates of recollection for positive compared to negative images. As a result, positive images were expected to yield the greatest group differences in recollection.

3.0 Method

NHS Ethical approval for this study was obtained (see Appendix I).

3.1 Design

To test the research hypotheses this study employed a 2 (group) x 3 (stimuli valence) mixed design. The between subjects variable was group with two levels; OAPDs and HOAs. The within subjects variable was stimuli valence with three levels; positive, negative and neutral.

There were a number of dependent measures of interest. To investigate potential group differences in emotional enhancements of memory accuracy the study employed a recognition memory task. This permitted assessment of whether HOAs and OAPDs differed in their recognition accuracy for positive, negative and neutral images. To answer research question two, the study used the R/K task. This permitted assessment of potential group differences in the rates of recollection and familiarity at the point of recognition of positive, negative and neutral images.

3.2 Sample Size Calculation

Little and methodologically limited research has investigated emotion-memory links in PD. As such, sample size calculations were based on Edelstyn et al. (2010) who measured recognition memory as well as remembering and knowing. In Edelstyn et al. the hit rate for the PD group was 50.1% and the standard deviation (SD) was 23.96. For controls the hit rate was 67.4% (SD = 19.26). Based on these means and SDs, a standard α-level of 0.05 and a power of 0.80 a total sample size of 52 (26 in each group) would be needed to detect significant effects. However, in the current study the variable of emotion was predicted to increase hit rates for the HOAs but not OAPDs. As such, based on an estimated 75% hit rate for HOAs, an α-level of 0.05 and a power of 0.80 a total sample size of 30 (15 in each group) would be needed to detect significant effects. Taking both calculations into account a sample size of 40 (20 in each group) was deemed sufficient.

To calculate the sample size needed for the R/K task, remember and know rates from Edelstyn et al. (2010) were used. At an α-level of 0.05 and a power of 0.80 a total sample size of 6 (3 in each group) would be needed to detect significant effects.

3.3 Participants

A group of 18 OAPDs were recruited from Parkinson's outpatient clinics at the Department of Neurosciences at York Hospital and the Neurology Department at Hull Royal Infirmary. All patients were deemed by a clinician from their Parkinson's care team (specialist Parkinson's nurse or neurologist) to be in the early to moderate stages of the disease. The mean length of illness for OAPDs was 5.11 years (SD= 3.86). All patients were taking medication for their PD and continued on their normal medication regimen throughout their participation in this study. All patients were over 60 years of age (Mean (M) = 69.61, SD = 5.05, range = 60-79) and reported no psychiatric or neurological conditions apart from PD.

A group of 15 HOAs were recruited to serve as the control group. HOAs consisted primarily of partners to the patients with PD. However, as some patients did not have an eligible partner, volunteers were also recruited through Parkinson's UK. All HOAs were over 60 years of age (M = 67.00, SD = 5.03, range = 61-79) and reported no neurological or psychiatric conditions.

A screening phase was held to ensure participants met inclusion criteria for this study. All participants were screened for potential impairments in cognitive function using the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005, see Appendix J) and clinical levels of anxious and depressive symptomology using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983, see Appendix K). Participants with

a score of < 24 on the MoCA were excluded from the study (a cut-off score of 24-25 of 30 has been found to yield the highest sensitivity and specificity for detecting significant cognitive impairments in PD; Hoops, et al., 2009). Participants with a score of > 11 on the HADS depression scale and > 8 on the HADS anxiety scale were excluded (normal cut-off score is 8 but research suggests that a score of 11 on the depression scale may yield a higher sensitivity and specificity in PD; Mondolo et al., 2006).

No participants were taking memory enhancing or psychiatric medications and all had normal to corrected vision. Demographic characteristics for each group are show in Table 1. The two groups appeared matched for gender. Independent samples t-tests were conducted to assess for potential group differences in other demographic characteristics. This showed that the groups were matched on a number of variables such as age $t(31) = 1.48$, $p = .149$, years of education $t(31) = .84$, $p = .406$, premorbid function as assessed by TOPF-UK $t(31) = .55$, $p = .59$, scores on the HADS depression subscale $t(31) = 1.93$, $p = .063$, the HADS anxiety subscale $t(31) = 1.40$, $p = .170$, and the MoCA $t(31) = .66$, $p = .512$. All participants were native English speakers.

Table 1.

Demographic Characteristics of OAPDs and HOAs.

	Parkinson's disease (=18)		Healthy Control (=15)	
	Mean	Standard Deviation	Mean	Standard Deviation
Age	69.61	5.05	67.00	5.03
Female	9 (50.0%)	-	8 (53.3%)	-
Education (years)	12.72	2.85	13.53	2.64
	27.72	1.56	28.07	1.39
HADS-	4.78	1.83	1.567	1.45
HADS-	2.56	1.20	3.87	1.88
TOPF-	103.50	7.57	105.33	11.46
Years of illness	5.11	3.86	-	-

= Number [2] MOCA= Montreal Cognitive Assessment [3] HADS-A= Hospital Anxiety and Depression Scale- Anxiety [4] HADS-D = Hospital Anxiety and Depression Scale- Depression -UK= Test of Premorbid Functioning- UK version.

3.4 Materials

Stimuli consisted of 108 digitized images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999; 2008). The IAPS contains standardized emotional and neutral colour images which can be selected according to their normative ratings for arousal and valence. Emotional arousal ratings range from 1(low arousal) to 9 (high arousal) and emotional valence ratings range from 1 (unpleasant emotion) to 9 (pleasant emotion).

A total of 54 images (18 positive, 18 negative and 18 neutral) were selected as targets to be presented for study during the learning phase. Half of these images contained humans and half did not. A further 54 images (18 positive, 18 negative, and 18 neutral) were selected to serve as distractors during the recognition task. Again there was an equal split between images containing humans and those which did not. When selecting images, an effort was made not to duplicate images in the same category (i.e. two images of abstract art) within an image set. Targets and distractors were closely matched on emotional valence and arousal (see Appendix L for a detailed description of the stimuli selection process).

The mean emotional valence for positive images (as rated by the IAPS standardisation sample) was 7.45 (SD = .33), for negative images it was 2.66 (SD = .40) and for neutral images it was 4.98 (SD = .25). To ensure that the three image types differed significantly from each other in emotional valence a one way between subjects ANOVA was carried out. This showed that positive, negative and neutral images were significantly different in valence $F(2,105) = 1906.40$, $p < .001$. Post hoc comparisons using Tukeys HSD showed that the valence of all three image types was significantly different from each other ($p < .001$ for all comparisons). For the arousal variable, the mean rating of positive

images was 5.45 (SD = .74), for negative images it was 5.46 (SD = .72) and for neutral images it was 2.79 (SD = .48). A one way between subjects ANOVA was carried out to ensure that positive and negative images were matched on emotional arousal but that both differed significantly from neutral images. The ANOVA showed that the images were significantly different in arousal $F(2,105) = 196.23$, $p < .001$. Post hoc comparison using Tukeys HSD showed that positive and negative images were both higher in arousal than neutral images ($p < .001$ for both comparisons). However, negative and positive images did not differ significantly from each other ($p = .998$).

Stimuli were presented on a HP-pavilion laptop with a 15.6 inch screen. All pictures were 1024 x 768 pixels and covered almost the whole screen with a black border covering the remainder. Eprime version 2.0 was used for stimuli presentation and data collection.

3.5 Procedure

The study took place over two sessions. The first session was a screening session where relevant medical details and demographic information was collected. Participants were also screened for potential impairments to cognitive function and mood using the MoCA and HADS. This process took around 30 minutes. A total of 37 participants were seen for a screening session. Out of these, 33 participants were found eligible for the experimental phase. Of the four participants that were screened out two were ineligible due to low scores on the MoCA and two due to taking a psychiatric medication.

The second session (experimental phase) took part on a separate day to the screening session. Participants were seated in a comfortable manner in front of the computer screen which was adjusted to ensure they could read instructions clearly. Participants were informed that they would be presented with a number of images varying in emotional

content and asked to simply look at each picture. Participants were not instructed about the subsequent recognition task. The 54 target images were presented in a randomized order. Each image appeared on the screen for 5s followed by a blank black screen presented for 1s. Following the study phase a 20 minute retrieval interval was implemented. The TOPF-UK was administered immediately after stimuli presentation to prevent rehearsal. Following this, participants were given a comfort break.

Participants then completed the recognition and R/K tasks. The 54 target images were presented amongst 54 distractors (again at a rate of 5s per image in a randomized order). After each stimuli presentation, participants were asked to indicate whether the stimuli was an old image (previously seen in the study phase) or a new image (not previously seen). Responses were made using the "C" and "M" keys on a computer key-board. These keys had been labelled "O" for old image (i.e. previously seen) and "N" for new image (i.e. not previously seen). Correct identification of a target item was defined as a hit, whilst false recognition of a distractor was defined as a false alarm.

Following each endorsement of an image as having been previously seen (irrespective of whether this was correct) participants were asked to make a "remember" or "know" judgement. Instructions for the R/K task were based on those from Edelstyn et al. (2010) and Davidson et al. (2006). Briefly, participants were instructed to give a remember judgement if they were consciously aware of specific details associated with the time the image was presented in the study phase. They were instructed that know responses were to be given if they recognised the image without being able to recollect specific details about its occurrence during the study phase (instructions for making remember and know judgements can be found in Appendix M). This part of the study was not time-constrained. Remember responses were given by pressing the "X" key on a computer

key-board (labelled “R” for remember). Know responses were given by pressing the “N” button (labelled “K” for know). All participants were given written criteria for making remember and know judgements to refer to throughout the task (see Appendix M).

Before commencing the testing phase time was spent ensuring that participants understood the criteria for making remember and know judgements and practise trials were given. During this process the experimenter used a standardised example for explaining the distinction between the two judgments (see Appendix M). During the practise trials participants were also asked to justify their “remember” and “know” responses. If they struggled to understand the task adequately from this process the experimenter asked participants to justify remember and know responses during the experimental task until it was clear they understood what was required of them.

Finally, at the end of the study, participants rated the valence and emotional arousal of a selection of the target images. 30 target images (10 of each valence) were presented for 3s each. Following each image, participants were asked to rate their valence and arousal. They did so using the standard IAPS scales where valence ratings range from 1 (negative/unpleasant emotion) to 9 (positive/pleasant emotion) and arousal ratings range from 1 (lowest arousal) to 9 (highest arousal). This procedure was implemented because the standard ratings of IAPS images are based predominantly on responses from college-aged individuals. There is no guarantee that HOAs and OAPDs would rate either valence or arousal similarly to the standardisation sample. In this way, the rating process served as a control to ensure that the groups in the current study rated images consistent with their emotion category (i.e. positive, negative and neutral). However, it also permitted assessment of potential group differences in how HOAs and OAPDs rated the images. The full experimental procedure took between 1 hour and 1 hour and 15 minutes.

3.6 Measures and Data Analysis Procedure

For the recognition task, dependent variables were based on a signal detection theory framework (Macmillan & Creelman, 1991; Stanislaw & Todorov, 1999). This permitted assessment of the proportion of hits (correctly identifying an old image as previously seen) in the context of the proportion of false alarms (incorrectly identifying a new image as previously seen). In signal detection frameworks overall recognition accuracy is usually analysed using a d-prime (d') statistic (Macmillan & Creelman, 1991). This permits analysis of a person's ability to discriminate signal (target) from noise (distractor). However, d' rests on the assumption of normally distributed hit and false alarm rates across participants The current data set did not meet this assumption as clear ceiling effects were present (see Appendix N). Although a non-parametric equivalent of d' exists, this method has been deemed highly unreliable (Stanislaw & Todorov, 1999). As such, the decision was taken to measure overall recognition accuracy by a corrected recognition score calculated as hit rate-false alarm rate (Pr; Snodgrass & Corwin, 1988; Stark, 2006). As such, Pr takes into account both the probability of making a correct hit judgement and an incorrect false alarm judgement. For Pr, scores can range from +1 to -1 with scores of +1 indicating a 100% percent hit rate with no false alarms, scores of -1 indicating a 100% false alarm rate with no hits and scores of 0 indicating chance performance. As such, the dependent variables for the recognition task were hit rate, false alarm rate and Pr. To assess for significant group differences in hit rates, false alarm rates and Pr as a function of stimuli valence a 2 (group) x 3 (stimuli valence) ANOVA was conducted.

For the R/K task the dependent variables were the proportion of 'remember' and 'know' responses for neutral, positive and negative stimuli. For this variable, the average proportion of 'remember' and 'know' responses for each kind of stimuli (negative

positive and neutral) was calculated. A 2 (group) x 3 (stimuli valence) ANOVA was employed to evaluate if there were group differences in the proportion of 'remember' and 'know' responses for positive, negative and neutral stimuli.

Finally, the study measured the average valence (ranging from 1-9) and arousal (ranging from 1-9) ratings by participants to a selection of 30 target images. The average valence and arousal ratings as a function of group and stimuli valence was analysed using a 2 (group) x 3 (stimuli valence) ANOVA.

4.0 Results

Relevant statistical output for all analysis can be found in Appendix O.

4.1 Recognition Task; Do OAPDs Have Significantly Reduced Emotional Enhancements of Recognition Memory Compared to HOAs?

Because hit and false alarm rates were not normally distributed with clear ceiling effects being present across participants (see Appendix N) bootstrapping was performed on the ANOVA used to analyse data. As this method is not available in SPSS for repeated measures ANOVAs data was analysed using a mixed model ANOVA. The bootstrap technique does not rely on a normal distribution. Instead the existing data is taken as the population from which random samples are repeatedly drawn (bootstrap sample). Each sample gives an estimate of the parameter of interest and relevant statistics (e.g. means and standard deviations), and these values are accumulated into a bootstrap sampling distribution. This procedure is then repeated (usually 1000 times) to provide the needed information on the estimator variability (Efron, 1979). Below, the results from the mixed model ANOVAs performed on hit rates, false alarm rates and Pr are described followed by the bootstrap adjusted p-values and Confidence Intervals (CI). Means and standard

deviations for hit rates, false alarm rates and Pr across the two groups as a function of stimuli valence are presented in Table 2.

A 2 (group) x 3 (stimuli valence) mixed model ANOVA was performed on hit rates. This yielded a non-significant group x stimuli valence interaction $F(2, 63.57) < 1$, $p = .444$, and a main effect of group which approached but did not reach significance $F(1, 28.29) = 3.88$, $p = .059$. However, there was a significant main effect of stimuli valence $F(2, 63.57) = 4.01$, $p = .023$. Bootstrap adjusted analysis revealed that OAPDs had a lower hit rate (M = 0.92 SD = 0.09) than HOAs (M = 0.96 SD = 0.05), = -.04, 95% CI (-.07, -.02), p = .004. In addition, both participant groups had a lower hit rate for neutral (M = .92, SD = .09) than negative images (M = .96, SD = .05) = -.37, 95% CI (-.06, -.01), p = .031. Hit rates did not differ for any other stimuli type ($p > .05$ for all contrasts) and group differences in hit rates did not vary as a function of stimuli valence ($p > .05$ for all contrasts). As such, although OAPDs had an overall reduced hit rate compared to HOAs this reduction was not specific to emotional images of either valence.

A 2 (group) x 3 (stimuli valence) mixed model ANOVA on false alarm rates revealed no significant group x stimuli valence interaction $F(2, 62) = 1.40$, $p = .254$, no main effect of group $F(1, 31) = 1.47$, $p = .234$, and no main effect of valence $F(2, 62) < 1$, $p = .664$. However, bootstrap adjusted analysis for groups found that OAPDs had a slightly higher false alarm rate (M = .03, SD = .05) than HOAs (M = .02, SD = .04) and this small difference in means was significant = .01, 95% CI (.00, .03), p = .032. False alarm rates were not different for positive, negative and neutral stimuli ($p > .05$ for all contrasts) and group differences in false alarm rates were not mediated by stimuli valence ($p > .05$ for all contrasts). Therefore, although OAPDs exhibited a slight increase in false alarms

compared to HOAs, this group difference was not exclusively observed for emotional images.

Finally, overall recognition accuracy (Pr) was also assessed by a 2 (group) by 3 (stimuli valence) mixed model ANOVA. There was no significant group x stimuli valence interaction $F(2, 62) = 1.68$, $p = .195$. The main effect of valence did not reach significance $F(2, 62) = 2.64$, $p = .080$. However, there was a significant main effect of group $F(1, 31) = 5.42$, $p = .027$. Bootstrapped contrasts analysis confirmed that Pr was lower for OAPDs ($M = .89$, $SD = .11$) than HOAs ($M = .94$, $SD = .05$) = -.06, 95% CI (-.08, -.03), $p = .001$. There was also a strong trend falling just short of significance for Pr in both groups to be higher for negative ($M = .93$, $SD = .08$) than positive ($M = .90$, $SD = .09$) images, = -.03. 95% CI (-.07, -.00), $p = .055$. Pr did not differ for any other stimuli type ($p > .05$ for all contrasts) and group differences in Pr did not vary as a function of stimuli valence ($p > .05$ for all contrasts). As such, OAPDs had a significantly reduced overall recognition accuracy. However, again, this group difference was observed across stimuli and not specific to emotional images.

Table 2.

Mean Hit Rate, False Alarm Rate and Pr Across the Two Groups for Each Stimuli Valence. SD Given in Brackets.

	Hit Rate	False Alarm Rate	
Positive	.95 (.05)	.01 (.03)	.94 (.05)
Negative	.97 (.04)	.03 (.04)	.95 (.06)
Neutral	.95 (.05)	.01 (.02)	.94 (.05)
Total	.96 (.05)	.02 (.03)	.94 (.05)
Positive	.91 (.10)	.04 (.06)	.87 (.11)
Negative	.95 (.06)	.02 (.05)	.92 (.09)
Neutral	.90 (.10)	.03 (.06)	.86 (.12)
Total	.92 (.09)	.03 (.05)	.89 (.11)

[1] HOAs = Healthy Older Adults. [2] OAPDs= Older Adults with Parkinson's Disease. [3] Pr = Overall recognition accuracy calculated as hits- false alarms.

4.2 R/K task; Do OAPDs Show Significantly Reduced Emotional Enhancements of Recollection Compared to HOAs?

The mean proportion of remember and know responses for hits and false alarms as a function of group and stimuli valence are presented in Table 3. As can be seen in this table, there were very few false alarms across groups. As such, conducting an ANOVA on the proportion of remember and know responses for this recognition judgement was not deemed valid (this approach is in line with that from Comblain et al. 2004 who also had very low false alarm rates across groups). As such, the ANOVAs represents remember and know proportions for hits only. Planned analysis for both remember and know proportions was a repeated measures 2 (group) x 3 (stimuli valence) ANOVA. However, Mauchly's test of sphericity indicated that the assumption of sphericity was violated for both remember (2) = 8.96, p = .011, and know data (2) = 6.02, p = .049. In addition, the assumption of normality was violated for both data sets (see Appendix N).

Therefore, data was analysed using a mixed model ANOVA as this permitted the use of bootstrap adjustments.

For remember responses the mixed model ANOVA showed that there was no group x stimuli valence interaction $F(2, 62) = 1.27$, $p = .287$. However, there was a significant main effect of group $F(1, 31) = 8.59$, $p = .006$ and a significant main effect of valence $F(2, 62) = 12.05$, $p < .001$. Bootstrap adjusted analysis showed that OAPDs had a lower proportion of remember responses for all stimuli types ($M = .65$, $SD = .23$) than did HOAs ($M = .84$, $SD = .18$), = -.19, 95% CI (-.24, -.13), $p = .001$. In terms of the effect of valence, both groups were found to give more remember responses for negative ($M = .80$, $SD = .18$) than positive stimuli ($M = .74$, $SD = .21$), = -.06, 95% CI (-12, -.01), $p = .050$. Participants also gave more remember responses for positive than neutral stimuli ($M = .66$, $SD = .27$), = .08, 95% CI (.02, .14), $p = .017$. There was no difference in remember responses to positive, negative and neutral stimuli as a function of group ($p > .05$ for all contrasts). As such, although OAPDs had an overall reduced rate of remember responses compared to HOAs this reduction was not specific to emotional images.

For know responses, the mixed model ANOVA found no significant group x stimuli valence interaction $F(2, 62) < 1$, $p = .429$. However, the main effect of group was significant $F(1, 31) = 6.28$, $p = .018$, as was the main effect of valence $F(2, 62) = 7.38$, $p = .001$. Bootstrap adjusted analysis showed that overall OAPDs gave more know responses ($M = .27$, $SD = .21$) than did HOAs ($M = .12$, $SD = .16$) = .14, 95% CI (.10, .19), $p = .001$. In addition, know responses were less common for all participants in response to positive ($M = .19$, $SD = .19$) than neutral stimuli ($M = .26$, $SD = .23$), = -.07, 95% CI (-.14, -.01), $p = .032$, and negative ($M = .16$, $SD = .18$) than neutral stimuli = .10, 95% CI (.04, .18), $p = .011$ There was no difference in the proportion of know responses

to negative and positive stimuli and group differences in know responses did not vary as a function of stimuli valence ($p > .05$ for all contrasts). Overall this shows that compared to HOAs, OAPDs had an increased rate of know responses. However, this increase was not significantly impacted on by stimuli valence as it was seen across positive, negative and neutral images.

Table 3.

Mean Proportion of Remember and Know Responses for Hits and False Alarms for Both Groups Across Stimuli Valence. SD in Brackets.

	Remember		Know		Total	
	Hits	False alarms	Hits	False alarms	Hits	False alarms
Positive	.83 (.16)	.01 (.02)	.13 (.15)	.01 (.02)	.95 (.05)	.01 (.03)
Negative	.89 (.14)	.01 (.02)	.08 (.12)	.02 (.03)	.97 (.04)	.03 (.04)
Neutral	.79 (.23)	.00 (.01)	.16 (.20)	.00 (.01)	.95 (.05)	.01 (.02)
Total	.84 (.18)	.01 (.02)	.12 (.16)	.01 (.02)	.96 (.05)	.02 (.03)
Positive	.67 (.22)	.01 (.03)	.24 (.20)	.03 (.05)	.91 (.10)	.04 (.06)
Negative	.73 (.19)	.00 (.01)	.22 (.19)	.02 (.05)	.95 (.06)	.02 (.05)
Neutral	.55 (.26)	.01 (.02)	.35 (.23)	.02 (.05)	.90 (.10)	.03 (.06)
Total	.65 (.23)	.01 (.02)	.27 (.21)	.02 (.05)	.92 (.09)	.03 (.05)

[1] HOAs = Healthy Older Adults. [2] OAPDs = Older Adults with Parkinson's Disease

4.3 Participant Ratings of Stimuli Valence and Arousal

Data from 1 OAPD was missing from this analysis due to a data entry error. As such, results are based on 17 OAPDs and 15 HOAs. Mean arousal and valence ratings for all stimuli types across groups can be seen in Table 4. Data for both arousal and valence ratings appeared to meet the assumption of normality (see Appendix N). In addition, Mauchly's test of sphericity indicated that the assumption of sphericity was met for both valence data (2) = 3.70, p = .157, and arousal data (2) = 3.95, p = .139. As such, both valence and arousal ratings were analysed using repeated measures 2 (group) x 3 (stimuli valence) ANOVAs.

For valence ratings, the group x stimuli valence interaction was not significant $F(2, 60) < 1$, $p = .561$ and there was no main effect of group $F(1, 30) < 1$, $p = .468$. As such, both groups rated the valence of the three stimuli types similarly. There was however a main effect of valence $F(2, 60) = 233.20$, $p < .001$. Bonferroni adjusted pairwise comparisons revealed that positive images ($M = 6.63$, $SD = .79$) were rated as more positive than neutral images ($M = 4.78$, $SD = .58$) which were in turn rated as higher in positive valence than negative images ($M = 2.58$, $SD = .82$) ($p < .001$ for all pairwise comparisons). This shows that both groups rated stimuli as consistent with the specified emotion category (i.e. positive, negative or neutral).

For arousal ratings the 2 (group) x 3 (stimuli valence) repeated measured ANOVA yielded a non-significant interaction $F(2,60) < 1$, $p = .517$, and a non-significant main effect of group $F(1, 30) < 1$, $p = .345$. As such, there were no differences in how the two groups rated the arousal of stimuli. However, a significant main effect of stimuli valence emerged $F(2, 60) = 75.24$, $p < .001$. Bonferroni adjusted pairwise comparisons revealed that negative images ($M = 6.78$, $SD = .1.33$) were rated as significantly higher in arousal than positive ($M = 5.68$, $SD = 1.34$) and neutral images ($M = 3.69$, $SD = 1.76$). Positive images were also rated as significantly higher in arousal than neutral images ($p < .001$ for all pairwise comparisons).

Table 4.

Mean Arousal and Valence Ratings (Min=1, Max=9) for All Stimuli Types Across Groups. SDs in Brackets.

	Positive stimuli	Negative stimuli	Neutral stimuli
Valence rating			
	6.67 (.75)	2.40 (.67)	4.75 (.59)
	6.61 (.84)	2.74 (.93)	4.80 (.60)
Arousal rating			
HOAs	5.98 (1.26)	6.83 (1.60)	4.02 (1.85)
OAPDs	5.42 (1.40)	6.74 (1.08)	3.39 (1.68)

[1] HOAs = Healthy Older Adults. [2] OAPDs = Older Adults with Parkinson's Disease.

5.0 Discussion

The present study had two overarching aims. First, it aimed to evaluate if OAPDs and HOAs differ in the level to which emotion enhances the ability to recognise previously seen stimuli. It was of particular interest to evaluate whether any group differences in emotional enhancements were greater for positive stimuli as a result of a positivity bias in HOAs but not OAPDs. A second purpose of the study was to investigate if OAPDs and HOAs differed in the level to which emotion promotes recollection (over familiarity) at the point of recognition. Again, it was of interest to assess whether any potential group differences were mediated by the valence of emotion and primarily observed for positive stimuli. To investigate group differences in emotional enhancements of recognition the study employed a recognition task assessing memory for positive, negative and neutral images. To assess the influence of emotion on recollection the study used the R/K task (Gardiner, 1988; Tulving, 1983; Yonelinas, 2002). This permitted assessment of group differences in how emotion influenced recollection (assessed by remember responses) and familiarity (assessed by know responses). The results from both the recognition and R/K tasks are discussed below.

5.1 Recognition task: Do OAPD Show Reduced Emotional Enhancements of Recognition compared to HOAs?

There were two hypotheses concerning the influence of emotion on recognition memory. The first predicted that compared to HOAs, OAPDs would show reduced recognition accuracy for positive and negative images (i.e. a reduced emotional enhancement). The second hypothesis built on this by predicting that group differences in emotional enhancements would be greater for positive stimuli as result of HOAs, but not OAPDs, showing a positivity bias.

The current study found no group differences in the extent to which emotion affected memory. Instead, the influence of emotion on recognition was similar for OAPDs and HOAs. First, a higher hit rate was observed for both groups in response to negative (over neutral) stimuli. This suggests that for both HOAs and OAPDs negative affect enhanced the ability to recognise previously seen stimuli. In addition, there was a strong trend (falling just short of significance) for overall recognition accuracy (Pr) to be higher for negative than positive stimuli in both groups. Such a strong trend observed with a small sample size like the one in this study could be meaningful. However, it is argued that not much can be made of it here because the confidence intervals for positive-negative Pr contained a value very close to zero (see Appendix O). The lack of group differences are contrary to the first hypothesis predicting that emotional enhancements of recognition would be larger for HOAs than OAPDs. The findings are also contrary to the second hypothesis predicting that group differences would be observed primarily for positive stimuli as a result of HOAs displaying a positivity bias. In fact, in the current study, no positivity bias was found. Instead both groups had higher hit rates for negative stimuli.

The absence of group differences in how emotion influenced recognition could be explicable by a number of factors. One possibility is that it is linked to the extent of degeneration in brain regions associated with emotional enhancements. Studies suggest that increased memory for negative stimuli is associated with amygdala activity (Dolcos et al., 2004; 2005; Dolcos & Denkova, 2008) whereas increased memory for positive stimuli may be mediated by the PFC (Nashiro et al., 2011). Although PD has been associated with neuropathology in both of these regions (Blonder & Slevin, 2011; Owen 2004) the extent to which these regions are compromised is likely to increase with disease progression. Although the current study included individuals with both early and moderate PD most appeared to be in the early stages of disease. It is possible therefore that the amygdala and PFC were fairly intact in the current sample. As a result, reduced emotional enhancements of memory may not have been observed. Another possibility is that the task employed in the current study was too easy. Indeed, performance on the recognition task was at ceiling for both HOAs and OAPDs (see Appendix N). It is possible that group differences in the effect of emotion would have been observed under more challenging conditions placing greater demands on the amygdala and PFC.

The lack of positivity bias in HOAs in the current study is also contrary to the common finding that ageing is associated with preferential memory for positive over negative stimuli (Mather & Knight, 2005; Murphy & Isaacowitz, 2008; Reed et al., 2014). Positivity effects and biases are primarily observed in incidental memory tasks which employ naturalistic encoding conditions (Reed et al., 2014). The current study aimed not to constrain encoding and participants were not told about the recognition task prior to the study phase. However, participants may still have guessed that their memory for the images presented to them would be tested. This seems possible since the study information given to participants before they decided to take part outlined that a memory

component was involved. As such, this study may be in line with those showing enhanced memory for negative information in HOAs in non-incidental memory tasks (Comblain et al., 2004; Kapucu et al., 2008).

However, informal conversations with participants following the experiment suggested that many of them had not guessed that their memory would be tested. An alternative account of higher hit rates for negative stimuli may as such be needed. A possible explanation lies in the valence and arousal ratings given by participants. Both HOAs and OAPDs rated the arousal of negative images as higher than the arousal of positive images. As such, although an effort was made to match positive and negative images on emotional arousal (as rated by the IAPS standardisation sample; Lang, Bradley, & Cuthbert, 2008) participants in the current study found negative images more arousing. This finding has some important implications. First, it suggests that the normative arousal ratings for IAPS images are not necessarily representative for age groups beyond the standardisation sample. More importantly for this study, the higher arousal for negative images opens the possibility that greater recognition of negative stimuli was driven by arousal. Indeed, studies on young adults show that emotional enhancements of memory are primarily driven by arousal rather than valence (Dolcos et al., 2004; 2005; Dolcos & Denkova, 2008; Ochsner, 2000). If arousal is the dominant affective dimension, a positivity bias (i.e. effect of valence) may primarily be observed when arousal is equated across positive and negative stimuli. This presents an interesting avenue of future research.

Finally, it is of note that the current study found that OAPDs had a lower overall recognition accuracy than HOAs (irrespective of stimuli valence). This suggests that OAPDs were characterised by a reduced ability to recognise previously seen stimuli. This outcome is consistent with previous literature showing a general reduction in episodic

memory in PD (Whittington et al., 2000; Whittington et al., 2006). As such, the finding of reduced recognition accuracy in OAPDs offers further support to the idea that PD is associated with impairments to episodic memory.

5.2 R/K task: Do OAPD Show Reduced Emotional Enhancements of Recollection compared to HOAs?

There were two related hypotheses concerning how emotion would influence recollection and familiarity. The first predicted that emotional enhancements of recollection would be greater in HOAs than OAPDs. The second predicted that these group differences would be greater for positive than negative stimuli as result of HOAs, but not OAPDs, showing a positivity bias in recollection.

Contrary to these predictions, the current study found no group differences in the extent to which emotion promoted recollection. Instead, both groups had a higher proportion of remember responses for positive and negative images than neutral images. Furthermore, for both groups, remember responses were more common for negative than positive images. In contrast, know responses were more commonly given for neutral than positive and negative images. Together, these findings suggest that emotion enhanced recollection for both HOAs and OAPDs. This emotion enhancing effect appeared greatest for negative stimuli. These findings are contrary to the hypothesis predicting that emotional enhancements of recollection would be larger for HOAs than OAPDs. In addition, the finding that negative affect enhanced recollection to a greater extent than positive affect does not support the prediction that group differences would be greatest for positive stimuli.

Research has suggested that emotional enhancements of recognition may primarily be driven by recollection. That is, emotional enhancements of memory may occur because experiences that elicit emotion are more likely to later create a rich recollective experience (Dolcos et al., 2005; Ochsner, 2000; Talarico et al., 2004). The current study did find that negative images yielded the highest hit rate and that recollection was most likely to occur for negative stimuli. As such, it is possible that the increase in hit rate was driven by an increase in recollection. Although contrary to the study hypotheses, this is consistent with previous research. For example, both Comblain et al. (2004) and Kapucu et al. (2008) found that negative affect promoted recollection in HOAs to a greater extent than positive affect. This study extends these results by showing that a similar effect of emotion on recognition may also be observed in OAPDs.

However, the lack of group differences in recollection could be explained by a number of factors. First, the prediction was that impairments to amygdala and PFC function in PD (Blonder & Slevin, 2011; Owen, 2004) would reduce recollection to both negative and positive material. However, as discussed in section 5.1, it is possible that the sample in the current study were mainly in the early stages of PD. As such, the amygdala and PFC may have been fairly intact and the way in which emotion influenced recollection may consequently not have differed from in HOAs. In addition, the finding that increased recollection was primarily observed for negative stimuli may again be explained by the higher arousal ratings for this type of stimuli. In their study of HOAs, Comblain et al. (2004) found that highly arousing images were more likely to be recollected than images that were lower in arousal. Similarly, research on young adult samples have suggested that emotional enhancements of recollection are primarily driven by arousal (Dolcos et al., 2005). As such, higher arousal for negative stimuli in the current study may have led to increased rates of recollection for this stimuli type in both groups.

Finally, the current study found that OAPDs gave fewer remember and more know responses for all stimuli compared to HOAs. This suggests that OAPDs were less likely (irrespective of stimuli valence) to experience recollection during recognition. This finding is interesting when considered in the context of reduced recognition accuracy in this group. It potentially suggests that impaired recognition in OPADs may have been driven by reduced recollection. The finding of reduced recollection in the current study is consistent with other research finding that individuals with PD are characterised by impaired recollection (Cohn, Moscovitch, & Davisson, 2010; Edelstyn et al., 2007; Edelstyn et al., 2010). Interestingly, one suggestion in the literature has been that impairments in recollection might primarily be seen in later stages of PD (Weiermann et al., 2010). However, the current study suggests that such deficits can also be seen early on in the disorder.

5.3 Limitations to the Present Study

This study provides an initial exploratory investigation into the links between emotion and memory in OAPDs. Although the study is novel and provided some initial insights into this area it suffers from a number of significant limitations. First, the recognition task was too easy and unfortunately this led to ceiling effects. It is possible that high performance for both groups across stimuli obscured group differences in the influence of emotion on recognition. The low demands of the task are unfortunate and may be explained both by the use of too few stimuli and too long stimuli presentation times. The presentation time in the current study was purposefully made somewhat longer as research shows that a positivity bias is more likely to be observed when HOAs have time to assert control over how they allocate cognitive resources (Petrican et al., 2008).). However, this manipulation may inadvertently have produced ceiling effects.

Despite the presence of ceiling effects, it is of note that group differences in overall recognition accuracy were still observed. However, an important point with regards to these differences lies in the issue of clinical vs. statistical significance. Although the study found overall reduced recognition memory for OAPDs both groups still performed very well. As such, although a reduction in recognition accuracy was observed for OAPDs they still achieved an 89% accuracy rate. Therefore, the observed reduction is unlikely to be of clinical importance. However, the finding of reduced memory performance during a simple task may suggest that OAPDs would struggle under conditions placing greater demands on memory. Of course, this may be the case in everyday life.

There are also a number of limitations to the way in which the R/K task was implemented. Firstly, the experiment could have been made stronger by asking participants to justify all remember and know judgements. This would have increased confidence in that participants were using these concepts appropriately throughout the task. In addition, the R/K procedure did not permit "guess" responses. Following identifications of an item as previously seen, some paradigms (Comblain et al., 2004; Wang et al., 2013) do not force participants to make a remember or know judgement but instead offer a "guess" option. This can be used if participants are uncertain about whether their endorsement of an item as previously seen is correct. When R/K paradigms do not include a guess response, know responses may not be a true estimate of familiarity (Yonelinas, 2002). Instead, a know response might be given (a) when a person truly experiences familiarity or (b) when a person experiences low confidence in their recognition judgement. Indeed, evidence suggests that remember responses are associated with higher confidence in recognition accuracy (Yonelinas, 2002). As such, although the R/K task in this study was designed to be comparable to other studies using this method in PD it could perhaps have been improved by permitting guess judgements.

Another limitation concerns the ecological validity of this study. It is important to acknowledge that experimental paradigms such as the one used here may be limited in their generalisability to real world memory. Of course, recalling a number of previously presented images is likely to be quite different to remembering personally experienced emotional events (i.e. emotional autobiographical memories). It is possible that differences between HOAs and OAPDs would be observed in emotional autobiographical memory where emotional content may be more salient. Finally, the R/K procedure as employed here in this study imposes a dichotomous judgement on the level to which memories can be re-experienced in detail. Again, for personally salient memories, such judgements are likely to be inevitability nuanced and perhaps less straight forward than that.

Related to the issue of personal memory is the issue of personal salience of the selected images. It is possible that different participants found different images more or less salient. Of course, images which held greater personal relevance for participants may have been better remembered. Although such individual differences could have affected results, the process of averaging memory performance across participants should have minimized any overall influence of this on the study outcome.

Finally, the study fell slightly short of the calculated sample size needed to detect significant effects. As such, the lack of group x valence interactions in the recognition or RK tasks could be explained by insufficient power to detect small effect sizes. In addition, the small sample size limits the generalisability of findings from the current study to the general population. Generalisability of findings are also limited by the fairly stringent inclusion criteria employed in this study.

5.4 Future Directions

As outlined above, the current study suffered a number of limitations and it is first and foremost in need of replication using a more robust design. In a replication study the number of stimuli should be increased and the stimuli presentation time decreased. It is also recommended that future studies permit a "guess" option to control for the possibility of know judgements reflecting low memory confidence. It would be interesting to assess if the delay between the study and recognition phase impacts on findings. The current study employed a fairly short retrieval interval (20 minutes) and it is possible that different results would be obtained after a longer delay. This would also have the benefit of increasing the difficulty of the recognition task.

Future research could also compare the influence of emotion on memory in a sample of individuals with early and more moderate/late PD. As discussed, reduced emotional enhancements may not be observed until later on in PD when the amygdala and PFC may be more affected. Including a group of individuals with moderate/late PD could permit testing of this hypothesis. Also related to sampling, the current study recruited mainly partners of individuals with PD to serve as the control group. Of course, this group of individuals may be a specific sample that differ in some ways from the general population of HOAs. For example, it could be argued that this group may be characterised by higher levels of stress or negative affect as a result of either having a partner with a degenerative condition or potential carer burdens. In the current study all participants were screened for affective disturbances in order to try and ensure this was not the case. In addition, OAPDs were mainly in the early stage of PD and as such carer strain is likely to have been low for the majority of individuals in the HOA group. Nevertheless, it would be of relevance of to compare emotional memory of OAPDs to a group of HOAs who are not partners of people with the disorder in order to control for this potential confound.

It may also be of interest to investigate in more detail the role of valence and arousal in emotional memory both in HOAs and OAPDs. In their meta-analysis, Murphy & Isaacowitz (2008) pointed out that many studies of the positivity bias focus exclusively on the dimension of valence. However, the current study indicates (as do studies from the young adult literature; Dolcos & Denkova, 2008) that enhancements of memory and recollection may actually be linked primarily to arousal. If arousal is the dominant affective dimension, a positivity bias (i.e. effect of valence) may primarily be observed when arousal is equated across positive and negative stimuli. This is an important avenue for future research to explore.

Finally, an important avenue for future research is to try and increase the ecological validity of findings on emotional memory in PD. As such, future studies cold investigate if there are differences between individuals with and without PDs (both young and old) in terms of how emotion influences autobiographical memories and the ability to relive these. This is likely to be of clinical importance as research shows that positive personal memories can reduce negative mood states as well as elicit positive ones (Joormann & Siemer, 2004; Parrot & Sabini, 1990).

5.5 Conclusion

The present study provides a novel investigation into the link between emotion and memory in PD. To date, this is an area of research that has received little attention. In summary, the study found no evidence of differences in the influence of emotion on recognition memory in HOAs and OAPDs. Instead, the influence of emotion on recognition was similar in both groups with higher hit rates being observed for negative stimuli. In addition, there were no group differences in the extent to which emotion

promoted recollection. Instead, both groups showed an emotional enhancement of recollection. Furthermore recollection was more likely for both HOAs and OAPDs in response to negative stimuli. These findings suggest that increased hit rates for negative stimuli may have been driven by an increase in recollection. The lack of group differences in the current study may be explicable by a number of methodological limitations relating to both study design (such as employing a too easy task) and participant characteristics (such as including individuals with primarily early PD). Unfortunately, these limitations significantly hamper firm conclusions regarding the influence of emotion on both recognition memory and subjective memory states in OAPDs. As such, further and better controlled research is needed to more fully understand the relationship between emotion and memory in individuals with this disorder.

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Part Three: Appendices

Appendix A- Guideline for Authors: Psychology and Ageing

Psychology and Aging ® publishes original articles on adult development and aging. Such original articles include reports of research that may be applied, biobehavioral, clinical, educational, experimental (laboratory, field, or naturalistic studies), methodological, or psychosocial. Although the emphasis is on original research investigations, occasional theoretical analyses of research issues, practical clinical problems, or policy may appear, as well as critical reviews of a content area in adult development and aging. Clinical case studies that have theoretical significance are also appropriate. Brief reports are acceptable with the author's agreement not to submit a full report to another journal.

Prior to submission, please carefully read and follow the submission guidelines detailed below. Manuscripts that do not conform to the submission guidelines may be returned without review.

Submission

Submit manuscripts electronically through the Manuscript Submission Portal (.rtf, .doc, or .pdf files).

Ulrich Mayr
Department of Psychology
University of Oregon
Eugene, OR

General correspondence may be directed to the Editor's Office.

In addition to addresses and phone numbers, please supply email addresses and fax numbers, if available, for potential use by the editorial office and later by the production office.

Masked Review Policy

Masked reviews are optional, and authors who wish masked reviews must specifically request them at submission. Authors requesting masked review should make every effort to see that the manuscript itself contains no clues to their identities. Authors' names, affiliations, and contact information should be included only in the cover letter.
If your manuscript was mask reviewed, please ensure that the final version for production includes a byline and full author note for typesetting.

Length

Manuscripts should not exceed 8,000 words (approximately 27 double-spaced pages in 12-point Times New Roman font). Shorter manuscripts are equally welcomed.The word count does not include references, tables, and figures. If you feel that you need extra space, please contact the editor. For example, you may have a complex methodology or statistical approach or a new theoretical framework that requires more text.

Please include the word count for the main text below the keywords.

Brief Reports

The Brief Report format is designated for particularly "crisp," theoretically noteworthy contributions that meet highest methodological standards. Use 12-point Times New Roman type and 1-inch (2.54-cm) margins; include an abstract of 75–100 words; do not exceed 265 lines of text, not including references; and typically include no more than two tables or figures.

Manuscript Preparation

Prepare manuscripts according to the *Publication Manual of the American Psychological Association* (edition). Manuscripts may be copyedited for bias-free language (see Chapter 3 of the *Publication Manual*).

Review APA's Checklist for Manuscript Submission before submitting your article.

Double-space all copy. Other formatting instructions, as well as instructions on preparing tables, figures, references, metrics, and abstracts, appear in the *Manual*.

Below are additional instructions regarding the preparation of display equations, computer code, and tables.

Display Equations

We strongly encourage you to use MathType (third-party software) or Equation Editor 3.0 (built into pre-2007 versions of Word) to construct your equations, rather than the equation support that is built into Word 2007 and Word 2010. Equations composed with the built-in Word 2007/Word 2010 equation support are converted to low-resolution graphics when they enter the production process and must be rekeyed by the typesetter, which may introduce errors.

To construct your equations with MathType or Equation Editor 3.0:

- Go to the Text section of the Insert tab and select Object.
- Select MathType or Equation Editor 3.0 in the drop-down menu.

If you have an equation that has already been produced using Microsoft Word 2007 or 2010 and you have access to the full version of MathType 6.5 or later, you can convert this equation to MathType by clicking on MathType Insert Equation. Copy the equation from Microsoft Word and paste it into the MathType box. Verify that your equation is correct, click File, and then click Update. Your equation has now been inserted into your Word file as a MathType Equation.

Use Equation Editor 3.0 or MathType only for equations or for formulas that cannot be produced as Word text using the Times or Symbol font.

Computer Code
Because altering computer code in any way (e.g., indents, line spacing, line breaks, page breaks) during the typesetting process could alter its meaning, we treat computer code differently from the rest of your article in our production process. To that end, we request separate files for computer code.

In Online Supplemental Material
We request that runnable source code be included as supplemental material to the article. For more information, visit Supplementing Your Article With Online Material.

In the Text of the Article
If you would like to include code in the text of your published manuscript, please submit a separate file with your code exactly as you want it to appear, using Courier New font with a type size of 8 points. We will make an image of each segment of code in your article that exceeds 40 characters in length. (Shorter snippets of code that appear in text will be typeset in Courier New and run in with the rest of the text.) If an appendix contains a mix of code and explanatory text, please submit a file that contains the entire appendix, with the code keyed in 8-point Courier New.

Tables
Use Word's Insert Table function when you create tables. Using spaces or tabs in your table will create problems when the table is typeset and may result in errors.

Submitting Supplemental Materials
APA can place supplemental materials online, available via the published article in the PsycARTICLES® database. Please see Supplementing Your Article With Online Material for more details.

Abstract and Keywords
All manuscripts must include an abstract containing a maximum of 250 words typed on a separate page. After the abstract, please supply up to five keywords or brief phrases.

References
List references in alphabetical order. Each listed reference should be cited in text, and each text citation should be listed in the References section.

Examples of basic reference formats:

- **Journal Article:**
  Hughes, G., Desantis, A., & Waszak, F. (2013). Mechanisms of intentional binding and sensory attenuation: The role of temporal prediction, temporal control, identity prediction, and motor prediction. *Psychological Bulletin, 139,* 133–151. http://dx.doi.org/10.1037/a0028566
- **Authored Book:**
  Rogers, T. T., & McClelland, J. L. (2004). *Semantic cognition: A parallel distributed processing approach.* Cambridge, MA: MIT Press.

- **Chapter in an Edited Book:**
  Gill, M. J., & Sypher, B. D. (2009). Workplace incivility and organizational trust. In P. Lutgen-Sandvik & B. D. Sypher (Eds.), *Destructive organizational communication: Processes, consequences, and constructive ways of organizing* (pp. 53–73). New York, NY: Taylor & Francis.

Figures
Graphics files are welcome if supplied as Tiff or EPS files. Multipanel figures (i.e., figures with parts labeled a, b, c, d, etc.) should be assembled into one file.

The minimum line weight for line art is 0.5 point for optimal printing.

For more information about acceptable resolutions, fonts, sizing, and other figure issues, please see the general guidelines.

When possible, please place symbol legends below the figure instead of to the side.

APA offers authors the option to publish their figures online in color without the costs associated with print publication of color figures.

The same caption will appear on both the online (color) and print (black and white) versions. To ensure that the figure can be understood in both formats, authors should add alternative wording (e.g., "the red (dark gray) bars represent") as needed.

For authors who prefer their figures to be published in color both in print and online, original color figures can be printed in color at the editor's and publisher's discretion provided the author agrees to pay:

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- An additional $600 for the second figure
- An additional $450 for each subsequent figure

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In addition, APA Ethical Principles specify that "after research results are published, psychologists do not withhold the data on which their conclusions are based from other competent professionals who seek to verify the substantive claims through reanalysis and who intend to use such data only for that purpose, provided that the confidentiality of the participants can be protected and unless legal rights concerning proprietary data preclude their release" (Standard 8.14).

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- Download Certification of Compliance With APA Ethical Principles Form (PDF, 26KB)

The APA Ethics Office provides the full Ethical Principles of Psychologists and Code of Conduct electronically on its website in HTML, PDF, and Word format. You may also request a copy by emailing or calling the APA Ethics Office (202-336-5930). You may also read "Ethical Principles," December 1992, *American Psychologist,* Vol. 47, pp. 1597–1611

Appendix B- Reference Lists of Excluded Papers.

Excluded Based on Criteria A:

Aizpurua, A., & Koutstaal, W. (2015). A matter of focus: Detailed memory in the intentional autobiographical recall of older and younger adults. *Consciousness and cognition*, *33*, 145-155.

Bohn, A. (2010). Generational differences in cultural life scripts and life story memories of younger and older adults. *Applied Cognitive Psychology*, *24*(9), 1324-1345.

Cohen, G., Conway, M. A., & Maylor, E. A. (1994). Flashbulb memories in older adults. *Psychology and Aging*, *9*(3), 454-563.

Ge, R., Fu, Y., Wang, D., Yao, L., & Long, Z. (2014). Age-related alterations of brain network underlying the retrieval of emotional autobiographical memories: an fMRI study using independent component analysis. *Frontiers in human neuroscience*, *8*, 1-17.

Gross, J. J., Carstensen, L. L., Pasupathi, M., Tsai, J., Götestam Skorpen, C., & Hsu, A. Y. (1997). Emotion and aging: experience, expression, and control. *Psychology and aging*, *12*(4), 590-599.

Janssen, S. M., & Murre, J. M. (2008). Reminiscence bump in autobiographical memory: Unexplained by novelty, emotionality, valence, or importance of personal events. *The Quarterly Journal of Experimental Psychology*, *61*(12), 1847-1860.

Levine, L. J., & Bluck, S. (1997). Experienced and remembered emotional intensity in older adults. *Psychology and aging*, *12*(3), 514-523.

Levine, B., Svoboda, E., Hay, J. F., Winocur, G., & Moscovitch, M. (2002). Aging and autobiographical memory: dissociating episodic from semantic retrieval. *Psychology and aging*, *17*(4), 677-698.

Maki, Y., Janssen, S. M., Uemiya, A., & Naka, M. (2013). The phenomenology and temporal distributions of autobiographical memories elicited with emotional and neutral cue words. *Memory*, *21*(3), 286-300.

Martinelli, P., Anssens, A., Sperduti, M., & Piolino, P. (2013). The influence of normal aging and Alzheimer's disease in autobiographical memory highly related to the self. *Neuropsychology*, *27*(1), 69-78.

McLean, K. C., & Lilgendahl, J. P. (2008). Why recall our highs and lows: Relations between memory functions, age, and well-being. *Memory*, *16*(7), 751-762.

Mickley, K. R., & Kensinger, E. A. (2009). Phenomenological characteristics of emotional memories in younger and older adults. *Memory*, *17*(5), 528-543.

Ready, R. E., Weinberger, M. I., & Jones, K. M. (2007). How happy have you felt lately? Two diary studies of emotion recall in older and younger adults. *Cognition and Emotion*, *21*(4), 728-757.

Robertson, S. M., & Hopko, D. R. (2013). Emotional Expression During Autobiographical Narratives as a Function of Aging: Support for the Socioemotional Selectivity Theory. *Journal of Adult Development*, *20*(2), 76-86.

Sasse, L. K., Gamer, M., Büchel, C., & Brassen, S. (2014). Selective Control of Attention Supports the Positivity Effect in Aging. *PloS one*, *9*(8), 1-12.

Schryer, E., Ross, M., St. Jacques, P., Levine, B., & Fernandes, M. (2012). Emotional expressivity in older and younger adults' descriptions of personal memories. *Experimental aging research*, *38*(4), 345-369.

Schulkind, M. D., Hennis, L. K., & Rubin, D. C. (1999). Music, emotion, and autobiographical memory: They're playing your song. *Memory & Cognition*, *27*(6), 948-955.

St. Jacques, P. L., & Levine, B. (2007). Ageing and autobiographical memory for emotional and neutral events. *Memory*, *15*(2), 129-144.

Uzer, T., & Gulgoz, S. (2014). Socioemotional selectivity in older adults: Evidence from the subjective experience of angry memories. *Memory*, (ahead-of-print), 1-13.

Excluded Based on Criteria B

Alea, N., & Vick, S. C. (2010). The first sight of love: Relationship-defining memories and marital satisfaction across adulthood. *Memory*, *18*(7), 730-742.

Alea, N., Arneaud, M. J., & Ali, S. (2013). The quality of self, social, and directive memories Are there adult age group differences?. *International Journal of Behavioral Development*, *1*, 1-12.

Alea, N., Bluck, S., & Semegon, A. B. (2004). Young and older adults' expression of emotional experience: do autobiographical narratives tell a different story?. *Journal of Adult Development*, *11*(4), 235-250.

Kennedy, Q., Mather, M., & Carstensen, L. L. (2004). The role of motivation in the age-related positivity effect in autobiographical memory. *Psychological Science*, *15*(3), 208-214.

Holland, A. C., & Kensinger, E. A. (2012). Younger, middle-aged, and older adults' memories for the 2008 US Presidential Election. *Journal of applied research in memory and cognition*, *1*(3), 163-170.

Leist, A. K., Ferring, D., & Filipp, S. H. (2010). Remembering positive and negative life events: Associations with future time perspective and functions of autobiographical memory. *GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry*, *23*(3), 137-147.

Petrican, R., Moscovitch, M., & Schimmack, U. (2008). Cognitive resources, valence, and memory retrieval of emotional events in older adults. *Psychology and aging*, *23*(3), 585-594.

Serrano, J. P., Latorre J. M., & Gatz, M. (2007). Autobiographical memory in older adults with and without depressive symptoms. *International Journal of Clinical and Health Psychology*, *7*(1), 41-57.

Siedlecki, K. L., Hicks, S., & Kornhauser, Z. G. (2015). Examining the Positivity Effect in Autobiographical Memory Across Adulthood. *The International Journal of Aging and Human Development*, 213-232.

Webster, J. D., & Gould, O. (2007). Reminiscence and vivid personal memories across adulthood. *The International Journal of Aging and Human Development*, *64*(2), 149-170.

Excluded based on Criteria C:

Ionicioiu, I., & Szamosckozi, I. Ş. (2013). The Relationship between the Positivity and Specificity of Autobiographical Memory and Well-being: Age-differences. *Transylvanian Journal of Psychology*, *14*(2), 195-209.

Excluded based on Criteria E:

Kensinger, E. A. (2009). How emotion affects older adults' memories for event details. *Memory*, *17*(2), 208-219.

Excluded based on Criteria F:

Manabu, A., & Shimizu, H. (2012). The characteristics of autobiographical memory for purchases: In terms of their temporal distribution and positive effects in younger and older adults. *The Japanese Journal of Cognitive Psychology, 10(1),* 67-79.

Appendix C- Key Authors Contacted for Relevant Publications and *'in press'* Articles.

All Authors contacted before of March. A response was obtained from all authors.

1. Professor Michael Ross. Email: mross@uwaterloo.ca. No further relevant studies obtained.
2. Professor Myra Fernandes: Email: mafernan@uwaterloo.ca. No further relevant studies obtained.
3. Dr Emily Schryer: Email: ecschrye@uwaterloo.ca. No further relevant studies obtained.
4. Dr Nicole Alea Albada: Email: Nicole.Albada@sta.uwi.edu. No further relevant studies
5. Professor Laura Carstensen: Email: laura.carstensen@stanford.edu. No further relevant studies
6. Professor Mara Mather: Email: Mara.Mather@usc.edu. No further relevant studies

Appendix D- Data Extraction Form.

General information	
Title	
Author/Year	
Type of Publication/Peer review status	
Aim of study	
Participants	
Population (OA/YA)	
Mean age of groups	OA= YA=
Sample size	YA= OA=
Gender	YA Female= OA Female=
Research design/paradigm	
Method for eliciting ABMs (1) Cue word paradigm (2) Category Cuing paradigm (3) Autobiographical interview (4) Autobiographical memory interview (5) Famous event (6) Valence based: Ask for positive/ negative ABMs (7) Autobiographical memory task (8) Not retrospective (i.e. diary)	
N and Valence of ABMS (positive/negative/neutral)	
Age of ABMs (controlled?)	
Control the specificity of the event (episodic or general?)	
Outcome measures: 1) N ABMs as function of emotion and age 2) Appraisal of ABM as function of age (Self rated valence scale of memory affect content). 3) Appraisal of emotional valence during the event (valence scale).	

4) Coding by experimenter on a valence rating scale	
Results	
Main findings	
Limitations highlighted	
Conclusion	

Appendix E- Quality Assessment Checklist

The development of this checklist was based in part on the well-established quality assessment protocol from Downs and Black (1998) and the EBL critical appraisal checklist (Glynn, 2006). Items from these two checklists that appeared primarily appropriate for the evaluation of clinical interventions were removed as were items which did not appear directly relevant to evaluate the quality of studies included in this review. In addition, some items were modified and adapted in order to suit the content of studies included in the present SLR (see item 8, 9, 13). Finally, some items were added specifically to assess quality of studies investigating the positivity effect in ABM (notably item 7, 10, 11 and 14). These factors related primarily to the conceptualisation of ABM and the quality of ABM paradigms and measures. It is acknowledged that the adaptation of standardised quality assessment tools may inadvertently introduce bias in the quality assessment protocol. However, the benefit of a less generic checklist in developing a more tailored and in depth understanding of study quality was deemed to outweigh this potential drawback. Overall quality of papers was quantified in line with standards from Downs and Black (1998) where scores of > 20 = good quality, scores of 15-19 = fair quality and scores < 14 = poor quality. As the checklist in this study contained fewer items (max score = 18) the scoring scale was adjusted. Studies with scores of =>12 = good quality, scores of 7-11= fair quality and scores <7 = poor quality.

Authors				
Study title				
Publication type				
Peer review status				
Reporting of relevant information	**Yes (1 or 2 for Q3)**	**No (0)**	**U/D**	
1. Is the hypothesis/aim/objective of the study clearly described?				
2. Is the experimental methodology described in sufficient detail to permit replication?				
3. Are the distributions of principal confounders for each group of participants to be compared clearly measured and described? (age, gender, YoE, a measure of IQ,				

cognitive imp, mental health,)? 3-5=1				
4. Are the main findings of the study clearly described?				
				Subsection score:
External validity (generalizability to population)				
5. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?				
6. Were the screening criteria for study eligibility specified? (Is it clear what inclusion criteria were?)				
7. Does the experimental paradigm represent an ecologically valid measure of ABM (i.e. does experimental procedures resemble "real-world" conditions)				
				Subsection score:
Internal validity (bias)				
8. Was an attempt made to blind those measuring the main outcomes to experimental group from which data was derived and study hypotheses?				
9. Was there adequate adjustment for confounding variables in the analyses from which the main findings were drawn? (pt charateristics)				
10. Was the time-period from which ABMs were retrieved controlled by the experimental procedure or were any such differences statistically accounted for?				
11. Was the level of Specificity of ABM controlled or measured?				
12. Were the statistical tests used to assess the main outcomes appropriate?				
				Subsection score:

Construct validity				
13. Is the data collection tool a valid and reliable measure of emotional ABM? (I.e. was a validated standardised used?)				
14. Does the study appear to convincingly measure the concept of emotional ABM? (can still be awarded even if study obtained 0 for item 13)				
	Subsection score:			
Power				
15. Did the study mention having conducted a power analysis to determine the sample size needed to detect a significant differences in one or more outcome measures?				
16. Did the study appear to have sufficient power to detect significant effects (sample <20 with near sign. Effects)?				
Results				
17. Do the conclusions accurately reflect the analysis?				
	Subsection score:			
	Total score (Max=18):			

Table 1.

Overview of Scores on All Items on Quality Checklist. 1= Yes, 0= No or Unable to Determine.

	Reporting				External validity				Internal validity				Construct validity		Power		Results	Total
Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Max=18
Bluck & Alea (2009)	1	1	1	1	0	1	0	0	0	0	1	1	0	1	0	1	1	10/18
Boals, Hayslip, & Banks (2014)	1	1	0	1	0	0	0	0	0	1	1	1	1	1	0	1	1	10/18
Chessel et al. (2014)	1	1	0	1	0	1	0	0	0	0	0	1	0	1	0	1	1	8/18
Comblain et al. (2005)	0	1	1	1	0	1	0	0	0	1	1	1	1	1	1	1	1	12/18
Dijkstra & Kaup (2005;study)	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	6/18
Dijkstra & Kaup (2005;study 2)	1	1	0	1	0	0	0	0	0	1	0	1	0	1	0	1	1	8/18
Fernandes et al. (2008)	1	1	1	1	0	1	0	0	0	1	0	1	0	1	0	1	1	10/18
Gallo et al. (2011)	1	1	1	1	0	0	0	0	0	0	1	1	0	1	0	1	1	9/18
Holland et al. (2012)	1	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1	12/18
Rice & Pasupathi (2010)	1	1	1	1	0	0	0	0	0	1	0	1	0	1	0	1	1	9/18
Ros & Latorre (2012)	1	1	1	1	0	1	0	0	0	0	1	1	1	1	0	1	1	11/18
Rubin & Schulkind (1997)	0	1	1	1	0	0	0	0	0	0	1	1	0	1	0	1	1	8/18
Schlagman et al. (2006)	1	1	1	1	0	1	1	0	0	0	0	1	0	1	0	1	1	10/18

Schlagman et al. (2009)	1	0	1	1	0	1	1	0	0	0	1	1	0	0	0	1	1	9/18
Schryer & Ross (2012)	1	1	1	1	0	0	0	0	0	1	0	1	0	1	0	1	1	9/18
Schryer & Ross (2014)	1	1	1	1	0	1	1	1	0	1	0	1	0	1	0	1	1	12/18
Schulkind & Woldorf (2005)	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	5/18
Tomaszczyk & Fernandes (2012)	1	1	2	1	0	1	0	0	1	0	0	1	0	1	0	1	1	11/18

Appendix F- SPSS Output for Inter-rater Reliability

Percentage agreement between the two raters:

Difference

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1.00	7	5.9	5.9	5.9
	.00	99	83.2	83.2	89.1
	1.00	13	10.9	10.9	100.0
	Total	119	100.0	100.0	

Cohen's Kappa Correlation:

Symmetric Measures

		Value	Asymp. Std.	Approx.	Approx. Sig.
Measure of Agreement	Kappa	.656	.070	7.194	.000
N of Valid Cases		119			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Intraclass Correlation

Intraclass Correlation Coefficient

	Intraclass	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.	-.126	.934	4.500	6	6	.045
Average Measures	.	-.289	.966	4.500	6	6	.045

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type A intraclass correlation coefficients using an absolute agreement definition.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Appendix G- Narrative Synthesis

The preliminary step of the narrative synthesis involved developing a data extraction table for summarising relevant variables relating to participant demographics, the design and primary outcomes of studies (see Table 1 in main text of the systematic review). Following this, studies were categorised according to their primary outcome measures as follows;

a) Studies measuring proportion of ABMs+ and ABMs-
b) Studies measuring valence based appraisals of ABMs
c) Both a and b.

Studies Measuring Proportion of ABMs

Studies were categorised according to their findings. In order to provide an overview of findings a table was created (see Table 2, main text of the systematic review). This table grouped findings from studies according to whether or not they found evidence of a positivity effect. In a final step those studies which found evidence of a positivity effect were further grouped according to whether the observed positivity effect arose from OAs retrieving fewer ABMs-, more ABMs+ or both.

Following this, it was investigated how methodological variations and study limitations may have impacted on study outcomes. In order to do this in a systematic manner, a table including a number of methodological factors which may have produced different outcomes was created (see Table 2 in this appendix). The following variables were deemed important:

1. The method for cuing ABMs. It was possible that different cuing methodologies and whether or not a study aimed to cue emotional ABMs impacted on study outcomes.

2. Outcome measure. Studies varied according to what was reflected in outcome measures. It was of specific interest to assess whether study results differed depending on whether a study measured participant classified ABM valence or not.
3. Controlling age of ABMs. Research has shown that negative affect fades quicker than positive affect (the fading affect bias; Walker & Skowronski, 2009). As such, in studies which do not control the time-period from which ABMs can be retrieved OAs may be more likely to retrieve less negative ABMs. As such, positivity effects may primarily arise in those studies failing to control age of ABMs.
4. Specificity of ABMs. Research shows that OAs retrieve fewer episodic ABMs than do YAs (Piolino et al., 2002). Therefore, a positivity effect might be more readily observed in studies permitting the retrieval of general as opposed to only episodic ABMs.
5. Mood. Substantial evidence points to mood congruency effects in ABM (Bower, 1981; Eich 1995). As such, if people feel more positive they may retrieve more positive ABMs. Therefore, study outcomes may vary depending on whether or not a study controlled mood.
6. Gender differences. Women and men differ in the retrieval of emotional memories (Ros & Latorre, 2010). As such, not controlling gender distribution could impact on study outcomes.
7. Studies risking being underpowered. A possible reason for lack of positivity effects is that a study did not have sufficient power to detect effects. As such, it was assessed if studies failing to find effects generally had a smaller sample size than studies finding significant positivity effects.

As can be seen in Table 2 in this Appendix, there was great study heterogeneity. This made it difficult to establish any clear pattern of methodological differences which reliably appeared to explain differences in study outcomes. It was also not the case that studies differed in outcomes depending on whether or not they achieved a high or low quality rating.

Table 2.

Table Used to Support The Synthesis Process for Studies Measuring Proportion of ABMs.

	Positivity effect?	Cue Method	Age ABM	Specific ABMs only?	Mood/ depression	Gender differences <10% or significant	Control ABM consistent with cues?	Possibly underpowered?	Quality rating
Schlagman et al. (2009; exp. 2)	No	Cue word (+/-/+-)	Uncontrolled	No (but measured)	No mood differences	YA more female	No	No	9
Fernandes et al. (2008; exp. 2*)	No	2 week recall	Controlled	No	Mood differences did not predict effects	No	N/A	No	10
Holland et al. (2012)	No	Cue word (+/-/-+)	Uncontrolled	Yes	Depression difference did not affect result. Mood state uncontrolled	U/D	Yes	Yes	12
Schryer & Ross (2014 exp. 2)	No	1 week recall	Controlled	No	Uncontrolled	YA more female	N/A	No	12
Chessel et al. (2014)	No	IAM	Uncontrolled	No	Uncontrolled	OA more female	N/A	Yes	8
Djikstra & Kaup (2005; exp. 1)	Yes	Category/cue word	Uncontrolled	No	Uncontrolled	No	N/A	No	6
Ros & Latorre (2010)	Yes	Cue word (+/-)	Uncontrolled	Yes	Not depression. Mood state uncontrolled	OA more female-controlled	Yes	No	11

Fernandes et al. (2008 exp. 1[*)]	Yes	Valence cued	Controlled	No	Mood differences did not predict effects	No	Yes (valence cued)	No	10
Schlagman et al. (2006)	Yes	Diary	Uncontrolled	No	Mood at time of recall was related to valence of memory retrieved	OA more female	N/A	Yes	10
Schryer & Ross (2014; exp. 1)	Yes	Diary	Controlled	No	Uncontrolled	YA more female	N/A	No	12
Schulkind &Woldorf (2005)	Yes	Music cued	Uncontrolled	No	Uncontrolled	U/D	No	Yes	5
Djikstra & Kaup (2005 exp. 2)	Yes	Category/cue word	Controlled	No	Uncontrolled	YA more female	N/A	No	8
Tomaczyk & Fernandes, (2012)	Yes	Cue word (+/-)	Uncontrolled	No	Mod differences did not predict effects	No	Yes	No	11

Studies Measuring Appraisal of ABMs

Studies were categorised according to their findings. To provide an overview of findings from studies a table was created (see Table 3 main text of systematic review). This table grouped studies into those finding that OAs appraised their ABMs more positively than YAs and those which did not. The second step was to consider if those studies which did find evidence of a positive re-appraisal did so because OAs re-appraised their ABMs- or ABMs+ more positively. During this process it became clear that although some studies has specifically analysed appraisals of positive and negative ABMs other studies did not specifically investigate appraisals of differently valenced ABMs. Studies not paying attention to ABM valence were grouped together and analysed separately. After this, studies examining appraisals of differently valenced ABMs were grouped according to outcome into (a) those finding that OAs positively re-appraised ABMs- (b) those finding that OAs positively re-appraised both ABMs+ and ABMs- (c) studies finding no evidence of positive re-appraisals.

Following this, study characteristics and study quality was used to attempt to understand potential reasons for variable outcomes. In order to do this in a systematic manner a table including a number of methodological variables which may have produced different outcomes was created (see Table 3 in this appendix). This involved many of the same variables considered relevant during the synthesis of studies measuring proportion of ABMs. However, one additional factor was considered, namely whether participants rated the valence they experienced at the time of the event or the valence of the actual retrospective ABM itself. As can be seen in Table 3 below, there was no clear patterns of methodological differences which reliably explained variations in study outcomes. Instead, there was great study heterogeneity. It was also not the case that studies differed in outcomes depending on whether they achieved a high or low quality rating.

Table 3.

Table Used to Support the Synthesis Process of Appraisal Studies.

	Positivity effect?	Cue method	Participant classify ABMs as +/-	Valence then or now?	Age of ABM	Mood/ Depression	Gender differences <10% or significant	Control ABM consistent with cues?	Possibly underpowered?	Quality rating
Alea & Bluck (2009)	N	Category (+)	No	Now	No	Uncontrolled	No	No	No	10
Holland et al. (2012)	N	Cue word +- +-	Yes	Now	No	Depression difference did not affect result. Mood state uncontrolled	U/D	Yes	Yes	12
Fernandes et al. (2008)	N	Valence cued	Yes	U/D	Yes	Controlled: did not affect results	No	Yes	No	10
Schlagman et al. (2009; exp. 2)	N	Cue word +- +-	No	Both	No	Controlled: No mood differences	YA more female	No	No	9
Schlagman et al. (2006)	Y:ABMs-	Diary	No	Now: rate valence of memory	No	Mood at time of recall was related to valence of memory retrieved	OA more female	N/A	Yes	10
Boals et al. (2014)	Y:AMs-	Category (negative)	Yes	U/D	Yes	Uncontrolled	No	Yes	No	10

Comblain et al., (2005)	Y:ABMs-	Valence cued	Yes	Then: intensity of emotion when event occurred	Yes	OA higher in depression. Mood not controlled.	No	Yes	No	12
Gallo et al., (2011)	Y:both	Cue word +- +-	Match cue word	Now: Emotion associated with ABM	No	Uncontrolled: OA higher in mood	No	Yes	Yes	9
Schulkind & Woldorf (2005)	Y:both	Music cued	Yes	U/D	No	Uncontrolled	U/D	No	Yes	5
Schryer & Ross (2012)	Y:both	Valence cued	Yes	Now	Yes	Uncontrolled	No	Yes	Yes	9
Tomaczyk & Fernandes (2012)	Y:both	Cue word +- +-	Yes	Now	No	Mod differences did not predict effects	No	Yes	No	11
Rice & Pasupathi (2010)	Y	Category	N/A	Then: how felt when event occurred	Yes	Uncontrolled	OA more female	N/A	No	9
Rubin & Schulkind (1997)	Y	Cue words/ category	N/A	Now: equal to pleasant/unpleasant memory	No	Uncontrolled	No	N/A	No	8
Schlagman et al. (2009; exp. 1)	Y	Diary	N/A	Both	No	Controlled: No mood differences	YA more female	N/A	No	9

Appendix H- Guideline for Authors; Neuropsychologia

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Reference to a book:

Strunk, W., Jr., & White, E. B. (2000). The elements of style. (4th ed.). New York: Longman, (Chapter 4).

Reference to a chapter in an edited book:

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Appendix I- Letter of Ethical Approval

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Appendix J- Montreal Cognitive Assessment (MoCA)

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Appendix K- Hospital Anxiety and Depression Scale

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Appendix L- Stimuli Selection Process

IAPs Images were selected according to a variety of criteria. To start with, all images which were erotic in nature were removed based on the great gender differences in ratings for these images and their heterosexual nature. Following this all images were sorted into negative, positive and neutral categories. Table 4 in this appendix provides the identification number of the IAPS images included in this study.

Neutral images were classified as those with an arousal rating below 4.00 and a valence rating between 4.25 and 5.75. In the IAPS data set, there were 184 images meeting this criteria (mean arousal = 3.25 SD = 0.54, mean valence = 5.08, SD = 0.35). Images were then separated into those depicting human subjects in clear focus and those which did not. Out of these 184 images, 18 were selected for study in the learning phase (targets) and 18 were selected to serve as distractors during the recognition task. Half of the targets and distractors contained humans and half did not. When selecting the images an effort was made not duplicate images in the same category (i.e. two images of abstract art) within an image set. Mean valence for the neutral targets was 4.98 (SD = .24) and for neutral distractors it was 4.99 (SD = .26). Mean arousal for neutral targets was 2.78 (SD = .54) and for distractors it was 2.80 (SD = .41). As such, targets and distractors were closely matched on both of these dimensions. The overall mean valence rating (for target and distractors) was 4.98 (SD = .25). Mean overall arousal rating was 2.79 (SD = .48).

Negative images were classified as those with a valence rating of between 2.00 and 3.50 and arousal ratings over 4.00 (images with valence ratings below 2 were not selected due to ethical concerns about the disturbing nature of some of these images). Images of mutilation were also deemed too disturbing and removed. There were a total of 209 images classified as negative (mean valence = 2.74 SD= 0.41, mean arousal= 5.58, SD=

0.72). Images were separated into those depicting human subjects and those which did not. Out of these images, 18 were selected as targets and 18 as distractors. Half contained humans, and half did not. An effort was made to ensure images were sufficiently different. As such duplicating images in the same category (i.e. two images of similar assaults) within the same image set was avoided. The mean valence for negative targets was 2.65 (SD = .42) and for distractors it was 2.67 (SD =. 39). Mean arousal rating for targets was 5.48 (SD = .69) and for distractors it was 5.45 (SD =.78). As such, targets and distractors were closely matched on both of these dimensions. The overall mean valence rating (for target and distractors) was 2.66 (SD = .40). Mean overall arousal rating was 5.46 (SD = .72)

Positive images were classified as those with a valence rating of between 6.50 and 8.00 and arousal ratings over 4.00. Images with valence ratings over 8 were excluded as part of ensuring that positive and negative stimuli sets were comparable (the images with the most extreme valence ratings had been removed from negative stimuli due to ethical concerns). There were 189 images classified as positive (mean valence = 7.15, SD = .39, mean arousal = 5.17, SD = .79). Images were separated into those depicting human subjects and those which did not. An effort was made to ensure images were sufficiently different. As such duplicating images in the same category (i.e. two images puppies) within the same image set was avoided. The mean valence for positive targets was 7.46 (SD = .33) and for distractors it was 7.45 (SD =. 34). Mean arousal rating for targets was 5.47 (SD = .66) and for distractors it was 5.44 (SD = .84). As such, targets and distractors were closely matched on both of these dimensions. The overall mean valence rating (for target and distractors) was 7.45 (SD = .33). Mean overall arousal rating of positive images was 5.45 (SD = .74).

Table 4.

Identification Number of IAPS Images Included in Study.

Negative Targets	**Negative distractors**	**Neutral Targets**	**Neutral distractors**	**Positive Targets**	**Positive distractors**	**Practise trials**
2141	1111	2190	2038	1722	1463	1304
2170	1271	2191	2221	1811	1630	7140
6312	2900	2383	2273	2045	1920	8163
6560	3230	2396	2377	2091	2075	1202
6821	6510	2440	2393	2151	2347	7205
9041	7135	2484	2480	2311	4603	5215
9181	7359	2745.1	2499	5270	4626	
9186	9000	2850	2840	5829	5260	
9291	9050	2890	7000	5849	5700	
9470	9250	5510	7020	5910	5830	
9560	9280	5740	7035	7270	5836	
9584	9332	7006	7059	7405	7200	
9622	9430	7031	7150	7502	7451	
9180	9561	7050	7187	8170	8030	
9830	9621	7080	7217	8370	8210	
9911	9630	7175	7233	8461	8350	
9922	9800	7179	7513	8496	8490	
9927	9900	7950	7705	8500	8501	

Appendix M- R/K Task Instructions and Example

On screen instructions for participants regarding criteria for making remember and know judgements. (Participants were given a copy to use throughout the task):

When you recognise a picture as an "old picture" you will be asked to make a **"REMEMBER"** or **"KNOW"** judgement. This is a judgement of whether or not you can remember specific details about when the picture was presented to you.

To **"REMEMBER"** is to be consciously aware of specific aspects of what was experienced at the time you studied the picture. For example, you may recall aspects of the physical appearance of the picture or what happened in the room when you saw it. You might also recall what you were thinking or doing when you studied the picture (including mental images or memories that entered your mind). Equally, you might remember an emotional reaction triggered by the picture. Therefore, to "REMEMBER" a picture, you must be able to bring to mind some particular experience associated with the time the picture was initially presented.

To **"KNOW"** is to recognize that the picture was studied without being able to consciously recall any details about its actual occurrence. Instead, you just "know" that you have seen the picture before. The picture may be familiar, "pop-out" or you may just have a feeling that you have seen it before.

Example used to explain remembering and knowing during practise trials:

I am going to give you an example of what "REMEMBERING" and "KNOWING" means in this study because it is a bit different to how we use these words in everyday life. Imagine that you have met a person one time before. You then bump into this person

again in the supermarket 2 weeks later and you recognise them. If you “REMEMBER” them you would be able to recall specific details about the first time you met the person. You might remember what they were wearing, what you talked about and how you felt about them (did you like them, didn’t you like them etc.).

However, you might also recognise the person without being able to recall any details about where or when you have seen them before. Most of us have had that feeling where we recognise a face but we can’t remember specific details about where a person has been encountered previously. This is what knowing refers to. You just have a feeling that the person is familiar and you know you have seen them before, but you cannot access specific details about the time you met the person.

It is similar for the pictures in this study. You might recognise a picture and “REMEMBER” lots of details about when it was presented to you the first time. You might remember specifics about how it looked, how you felt about it or what you were thinking the first time you saw it. Or, you might recognise the picture and “just know” that you have seen it before without being able to recall any details like that.

Do you have any questions about making these two judgements?

Appendix N- SPPS Output: Assessment of Normality of Data

Appendix provides Histograms and information of Kurtosis and Skewness for dependent variables.

Hit and false alarm rates

Descriptives

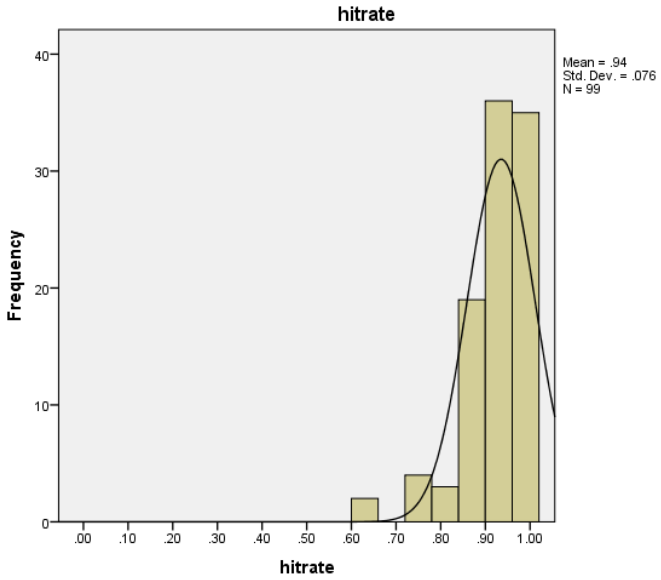
			Statistic	Std. Error
hitrate	Mean		.9352	.00768
	95% Confidence Interval for Mean	Lower Bound	.9199	
		Upper Bound	.9504	
	5% Trimmed Mean		.9453	
	Median		.9440	
	Variance		.006	
	Std. Deviation		.07639	
	Minimum		.61	
	Maximum		1.00	
	Range		.39	
	Interquartile Range		.11	
	Skewness		-2.120	.243
	Kurtosis		5.974	.481
falsealarmrate	Mean		.0242	.00446
	95% Confidence Interval for Mean	Lower Bound	.0154	
		Upper Bound	.0331	
	5% Trimmed Mean		.0176	
	Median		.0000	
	Variance		.002	
	Std. Deviation		.04441	
	Minimum		.00	
	Maximum		.17	
	Range		.17	
	Interquartile Range		.06	
	Skewness		1.998	.243
	Kurtosis		3.453	.481

Pr

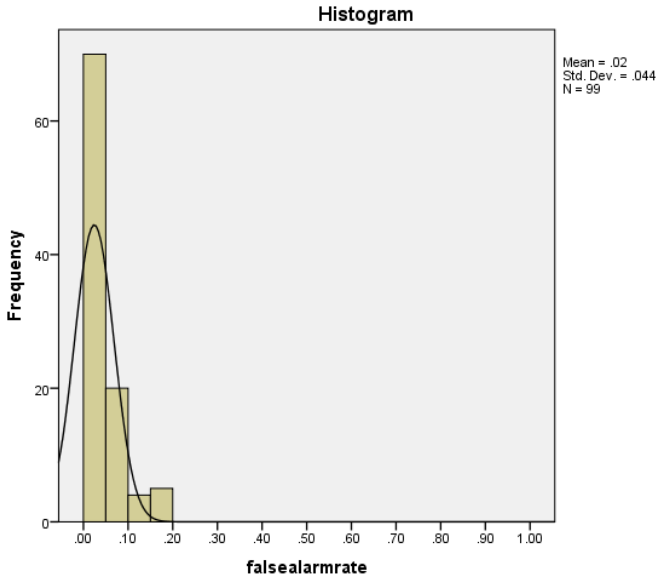
Descriptives

			Statistic	Std. Error
Pr	Mean		.9105	.00920
	95% Confidence Interval for Mean	Lower Bound	.8922	
		Upper Bound	.9288	
	5% Trimmed Mean		.9203	
	Median		.9400	
	Variance		.008	
	Std. Deviation		.09157	
	Minimum		.56	
	Maximum		1.00	
	Range		.44	
	Interquartile Range		.11	
	Skewness		-1.518	.243
	Kurtosis		2.651	.481

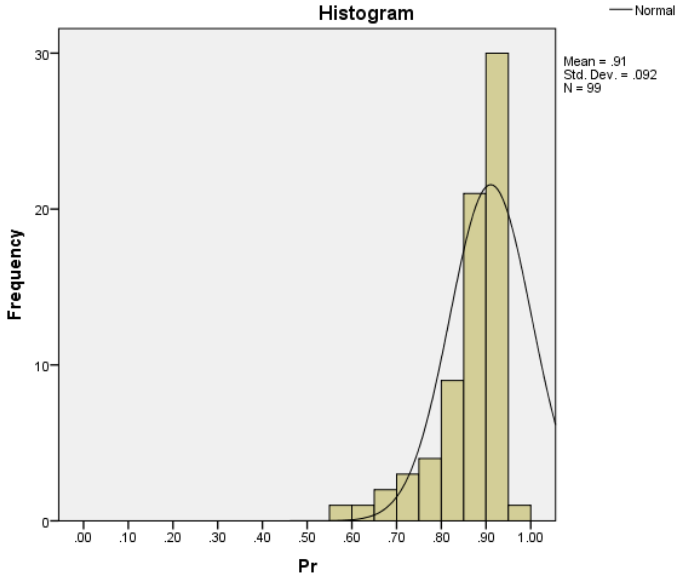
Histogram Hit Rates



Histogram False Alarm Rates



Histogram Pr

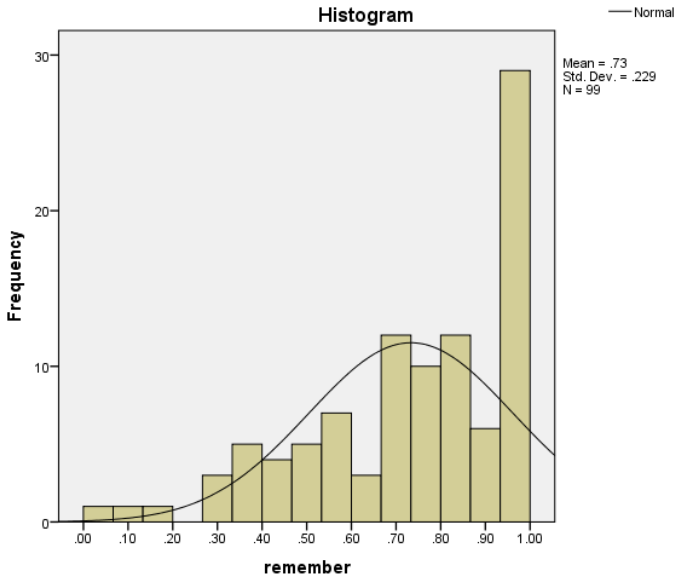


Remember know data

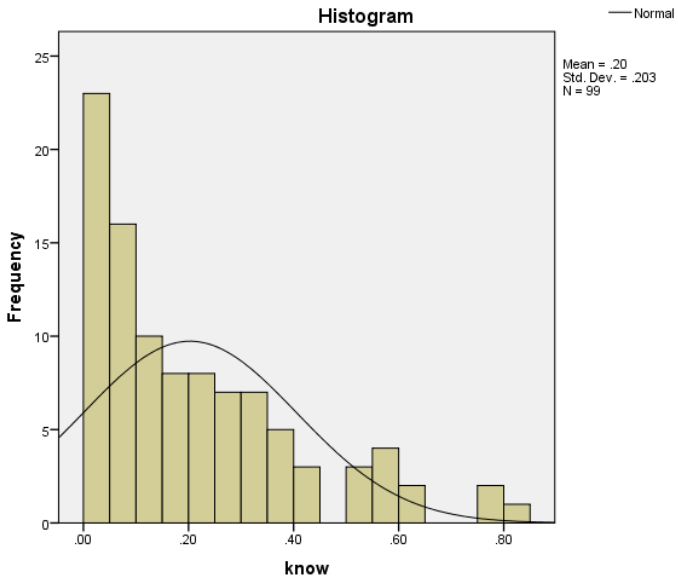
Descriptives

			Statistic	Std. Error
remember	Mean		.7333	.02298
	95% Confidence Interval for Mean	Lower Bound	.6877	
		Upper Bound	.7789	
	5% Trimmed Mean		.7495	
	Median		.7800	
	Variance		.052	
	Std. Deviation		.22862	
	Minimum		.00	
	Maximum		1.00	
	Range		1.00	
	Interquartile Range		.38	
	Skewness		-.904	.243
	Kurtosis		.295	.481
know	Mean		.2027	.02039
	95% Confidence Interval for Mean	Lower Bound	.1623	
		Upper Bound	.2432	
	5% Trimmed Mean		.1851	
	Median		.1700	
	Variance		.041	
	Std. Deviation		.20291	
	Minimum		.00	
	Maximum		.83	
	Range		.83	
	Interquartile Range		.27	
	Skewness		1.087	.243
	Kurtosis		.647	.481

Histogram Remember data



Histogram Know data

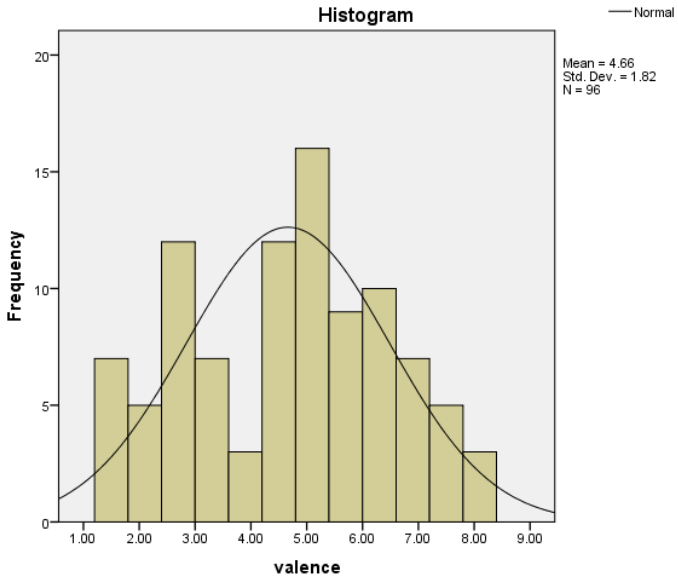


Arousal and valence ratings

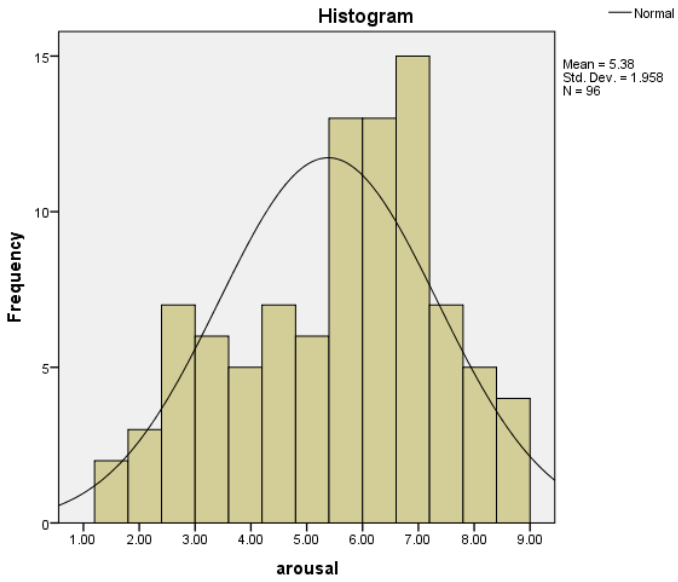
Descriptives

			Statistic	Std. Error
valence	Mean		4.6625	.18574
	95% Confidence Interval for Mean	Lower Bound	4.2938	
		Upper Bound	5.0312	
	5% Trimmed Mean		4.6688	
	Median		4.8500	
	Variance		3.312	
	Std. Deviation		1.81990	
	Minimum		1.20	
	Maximum		8.30	
	Range		7.10	
	Interquartile Range		3.15	
	Skewness		-.100	.246
	Kurtosis		-.897	.488
arousal	Mean		5.3844	.19988
	95% Confidence Interval for Mean	Lower Bound	4.9876	
		Upper Bound	5.7812	
	5% Trimmed Mean		5.4382	
	Median		5.8000	
	Variance		3.835	
	Std. Deviation		1.95843	
	Minimum		1.00	
	Maximum		8.80	
	Range		7.80	
	Interquartile Range		3.03	
	Skewness		-.488	.246
	Kurtosis		-.592	.488

Histogram Valence Ratings



Histogram Arousal Ratings



Appendix O- Relevant ANOVA output.

Throughout this appendix, Group 1= OAPDs and Group 2= HOAs

Mixed model ANOVA hit rate

Type III Tests of Fixed

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	28.293	7513.423	.000
group	1	28.293	3.877	.059
valence	2	63.567	4.009	.023
group * valence	2	63.567	.821	.444

a. Dependent Variable: hitrate.

Bootstrap contrast analysis interaction: valence 1= positive, valence 2= neutral, valence 3=negative

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[group=1.00] * [valence=1]	-.021078	.001186	.027807	.477	-.076478	.033900
[group=1.00] * [valence=2]	-.033911	.000203	.027366	.264	-.088053	.017999
[group=1.00] * [valence=3]	0	0	0		0	0
[group=2.00] * [valence=1]	0	0	0		0	0
[group=2.00] * [valence=2]	0	0	0		0	0
[group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis for hit rate main effects (valence 1= positive, valence 2= neutral, valence 3= negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.981209	-9.331987E-5	.010741	.001	.961788	1.003759
[group=1.00]	-.042596	-.000192	.011731	.004	-.066188	-.019296
[group=2.00]	0	0	0		0	0
[valence=1]	-.030030	.000208	.015207	.075	-.060056	-.000703
[valence=2]	-.037030	.000746	.014551	.031	-.063494	-.008209
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis for hit rate interaction (1= positive, 2=negative, 3= neutral) allowing positive-neutral comparison

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[group=1.00] * [valence=1]	.012833	.000983	.029297	.679	-.042135	.072213
[group=1.00] * [valence=2]	.033911	-.000203	.027366	.264	-.017999	.088053
[group=1.00] * [valence=3]	0	0	0		0	0
[group=2.00] * [valence=1]	0	0	0		0	0
[group=2.00] * [valence=2]	0	0	0		0	0
[group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis main effects (1= positive, 2=negative, 3= neutral) allowing positive-neutral comparison

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.944178	.000328	.011017	.001	.921914	.965526
[group=1.00]	-.042596	.000309	.011225	.004	-.063901	-.017724
[group=2.00]	0	0	0		0	0
[valence=1]	.007000	-.000743	.014657	.659	-.020393	.035679
[valence=2]	.037030	-.001005	.014075	.025	.010687	.064558
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Mixed model ANOVA False alarms

Type III Tests of Fixed

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	31	14.900	.001
Group	1	31	1.472	.234
Valence	2	62.000	.412	.664
Group * valence	2	62.000	1.400	.254

a. Dependent Variable: falsealarmrate.

Bootstrap analysis for false alarm rate interaction (1= positive, 2=neutral, 3= negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[Group=1.00] * [valence=1]	.023522	-.000430	.018050	.244	-.011332	.059099
[Group=1.00] * [valence=2]	.024767	-.000412	.017868	.197	-.008594	.061379
[Group=1.00] * [valence=3]	0	0	0		0	0
[Group=2.00] * [valence=1]	0	0	0		0	0
[Group=2.00] * [valence=2]	0	0	0		0	0
[Group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis for False alarm rate main effects (1= positive, 2=neutral, 3= negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.017287	.000522	.007114	.008	.002297	.030583
[Group=1.00]	.014807	-.000134	.007033	.032	.000449	.028896
[Group=2.00]	0	0	0		0	0
[valence=1]	.001697	-.000847	.009510	.891	-.016401	.020734
[valence=2]	-.005091	-.000560	.008931	.610	-.022436	.013066
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis interaction: valence (1= positive, valence 2= negative, valence 3=neutral)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[Group=1.00] * [valence=1]	-.001244	-.000675	.016967	.948	-.034549	.031982
[Group=1.00] * [valence=2]	-.024767	-.000599	.017466	.202	-.060468	.007692
[Group=1.00] * [valence=3]	0	0	0		0	0
[Group=2.00] * [valence=1]	0	0	0		0	0
[Group=2.00] * [valence=2]	0	0	0		0	0
[Group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis for false alarm rate main effect (1= positive, 2=negative, 3= neutral)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.012196	-8.155671E-5	.006041	.027	.000452	.023567
[Group=1.00]	.014807	.000157	.006707	.024	.000772	.027868
[Group=2.00]	0	0	0		0	0
[valence=1]	.006788	.000133	.008776	.458	-.009491	.025112
[valence=2]	.005091	-.000354	.008620	.583	-.012256	.022864
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Pr Mixed model ANOVA

Type III Tests of Fixed

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	31	5654.771	.000
Group	1	31	5.417	.027
Valence	2	62.000	2.637	.080
Group * valence	2	62.000	1.678	.195

a. Dependent Variable: Pr.

Bootstrap analysis for Pr interaction (1= positive, 2=neutral, 3=negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[Group=1.00] * [valence=1]	-.042667	.001531	.034021	.251	-.109644	.026639
[Group=1.00] * [valence=2]	-.055556	-.000640	.034069	.142	-.124511	.009654
[Group=1.00] * [valence=3]	0	0	0		0	0
[Group=2.00] * [valence=1]	0	0	0		0	0
[Group=2.00] * [valence=2]	0	0	0		0	0
[Group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis for Pr main effect (1= positive, 2=neutral 3= negative).

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.963859	-.000246	.012492	.001	.940773	.988777
[Group=1.00]	-.056519	.000698	.013086	.001	-.080550	-.029723
[Group=2.00]	0	0	0		0	0
[valence=1]	-.033939	.000243	.016435	.055	-.065100	-.000492
[valence=2]	-.033636	.000234	.017195	.082	-.068792	-.000581
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrap analysis for Pr (1= positive, 2=negative, 3= neutral) allowing positive-neutral comparison

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.930222	-.000212	.012962	.001	.903702	.956463
[Group=1.00]	-.056519	-.000341	.013407	.002	-.083974	-.030339
[Group=2.00]	0	0	0		0	0
[valence=1]	-.000303	-5.848773E-5	.017224	.993	-.032962	.034339
[valence=2]	.033636	6.727158E-5	.017600	.083	-.001007	.066565
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Remember and know data

Mauchly's test of sphericity for remember and know repeated measures ANOVA

Remember data

Mauchly's Test of

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Valence	.742	8.956	2	.011	.795	.858	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group

Within Subjects Design: Valence

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Know data

Mauchly's Test of

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
know	.818	6.024	2	.049	.846	.919	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group

Within Subjects Design: know

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Mixed model ANOVA Remember for hits

Type III Tests of Fixed

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	31	547.879	.000
Group	1	31	8.591	.006
valence	2	62	12.054	.000
Group * valence	2	62	1.275	.287

a. Dependent Variable: remember.

Bootstrapped analysis remember with interaction (1= positive, 2=neutral, 3=negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[Group=1.00] * [valence=1]	.008333	-.000388	.054672	.877	-.095944	.120171
[Group=1.00] * [valence=2]	-.075000	-.001883	.072820	.338	-.218597	.065187
[Group=1.00] * [valence=3]	0	0	0		0	0
[Group=2.00] * [valence=1]	0	0	0		0	0
[Group=2.00] * [valence=2]	0	0	0		0	0
[Group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrapped contrast analysis remember main effects (1= positive, 2=neutral, 3=negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.903455	-.000286	.025385	.001	.854323	.956001
[Group=1.00]	-.185778	.000299	.026852	.001	-.239297	-.131639
[Group=2.00]	0	0	0		0	0
[valence=1]	-.062121	-.000207	.028763	.050	-.120646	-.008198
[valence=2]	-.144242	.001484	.036899	.002	-.215250	-.074769
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrapped contrast analysis remember interaction (1= positive, 2=negative 3=neutral)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[Group=1.00] * [valence=1]	.083333	-.002458	.065588	.229	-.052709	.202573
[Group=1.00] * [valence=2]	.075000	-.000413	.074531	.348	-.068401	.213569
[Group=1.00] * [valence=3]	0	0	0		0	0
[Group=2.00] * [valence=1]	0	0	0		0	0
[Group=2.00] * [valence=2]	0	0	0		0	0
[Group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrapped contrast analysis remember main effects (1= positive, 2=negative 3=neutral)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.759212	.000442	.030315	.001	.698918	.818548
[Group=1.00]	-.185778	.000226	.026843	.001	-.236963	-.132247
[Group=2.00]	0	0	0		0	0
[valence=1]	.082121	-.001131	.031168	.017	.018195	.144625
[valence=2]	.144242	.000630	.036600	.001	.071887	.217125
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Mixed model ANOVA Know for hits

Type III Tests of Fixed

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	31	46.133	.000
Group	1	31	6.280	.018
Valence	2	62.000	7.378	.001
Group * valence	2	62.000	.857	.429

a. Dependent Variable: know.

Bootstrapped contrast analysis mixed model know interaction (1= positive, 2=neutral 3=negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval Lower	95% Confidence Interval Upper
[Group=1.00] * [valence=1]	-.026333	-.000724	.055805	.666	-.138262	.081220
[Group=1.00] * [valence=2]	.044889	.000630	.069987	.543	-.098244	.185107
[Group=1.00] * [valence=3]	0	0	0		0	0
[Group=2.00] * [valence=1]	0	0	0		0	0
[Group=2.00] * [valence=2]	0	0	0		0	0
[Group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrapped contrast analysis mixed model know main effects (1= positive, 2=neutral, 3=negative)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval Lower	95% Confidence Interval Upper
Intercept	.078626	-.000159	.023684	.002	.034520	.124782
[Group=1.00]	.144741	-.000201	.024145	.001	.098083	.189687
[Group=2.00]	0	0	0		0	0
[valence=1]	.030303	.000347	.028238	.318	-.027433	.084008
[valence=2]	.105152	.000414	.035626	.011	.039877	.175895
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrapped contrast analysis mixed model know interaction (1= positive, 2=negative 3=neutral)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
[Group=1.00] * [valence=1]	-.071222	.001645	.062567	.289	-.190789	.050210
[Group=1.00] * [valence=2]	-.044889	.003332	.071063	.560	-.177997	.093340
[Group=1.00] * [valence=3]	0	0	0		0	0
[Group=2.00] * [valence=1]	0	0	0		0	0
[Group=2.00] * [valence=2]	0	0	0		0	0
[Group=2.00] * [valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Bootstrapped contrast analysis mixed model know main effects (1= positive, 2=negative 3=neutral)

Bootstrap for Estimates of Fixed Effects

Parameter	Estimate	Bias	Std. Error	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Intercept	.183778	-.000550	.028164	.001	.128731	.237196
[Group=1.00]	.144741	-8.308475E-5	.024201	.001	.098344	.192042
[Group=2.00]	0	0	0		0	0
[valence=1]	-.074848	8.333427E-5	.031720	.032	-.138612	-.014099
[valence=2]	-.105152	.001086	.034530	.009	-.172242	-.035500
[valence=3]	0	0	0		0	0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Repeated measures ANOVA- valence ratings by participants (valence 1 =positive, 2= negative, 3 = neutral)

Mauchly's Test of

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Valence	.880	3.700	2	.157	.893	.977	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: Valence

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Valence	Sphericity Assumed	264.449	2	132.225	233.204	.000	.886
	Greenhouse-Geisser	264.449	1.786	148.062	233.204	.000	.886
	Huynh-Feldt	264.449	1.955	135.277	233.204	.000	.886
	Lower-bound	264.449	1.000	264.449	233.204	.000	.886
Valence * Group	Sphericity Assumed	.662	2	.331	.584	.561	.019
	Greenhouse-Geisser	.662	1.786	.371	.584	.542	.019
	Huynh-Feldt	.662	1.955	.339	.584	.557	.019
	Lower-bound	.662	1.000	.662	.584	.451	.019
Error(Valence)	Sphericity Assumed	34.019	60	.567			
	Greenhouse-Geisser	34.019	53.582	.635			
	Huynh-Feldt	34.019	58.646	.580			
	Lower-bound	34.019	30.000	1.134			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	2075.739	1	2075.739	3936.417	.000	.992
Group	.285	1	.285	.541	.468	.018
Error	15.820	30	.527			

Pairwise Comparisons

Measure: MEASURE_1

(I) Valence	(J) Valence	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for	
					Lower Bound	Upper Bound
1	2	4.069*	.216	.000	3.520	4.617
	3	1.863*	.160	.000	1.458	2.268
2	1	-4.069*	.216	.000	-4.617	-3.520
	3	-2.206*	.186	.000	-2.677	-1.735
3	1	-1.863*	.160	.000	-2.268	-1.458
	2	2.206*	.186	.000	1.735	2.677

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Repeated measures ANOVA- Arousal ratings (Valence 1 =positive, 2= negative, 3 = neutral)

Mauchly's Test of

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Arousal	.873	3.948	2	.139	.887	.970	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group

Within Subjects Design: Stimuli valence

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Stimuli valence	Sphericity Assumed	155.306	2	77.653	75.235	.000	.715
	Greenhouse-Geisser	155.306	1.774	87.537	75.235	.000	.715
	Huynh-Feldt	155.306	1.941	80.032	75.235	.000	.715
	Lower-bound	155.306	1.000	155.306	75.235	.000	.715
Stimuli valence * Group	Sphericity Assumed	1.378	2	.689	.667	.517	.022
	Greenhouse-Geisser	1.378	1.774	.777	.667	.500	.022
	Huynh-Feldt	1.378	1.941	.710	.667	.513	.022
	Lower-bound	1.378	1.000	1.378	.667	.420	.022
Error(Arousal)	Sphericity Assumed	61.928	60	1.032			
	Greenhouse-Geisser	61.928	53.225	1.164			
	Huynh-Feldt	61.928	58.216	1.064			
	Lower-bound	61.928	30.000	2.064			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	2785.928	1	2785.928	599.855	.000	.952
Group	4.270	1	4.270	.919	.345	.030
Error	139.330	30	4.644			

Pairwise Comparisons

Measure: MEASURE_1

(I) Arousal	(J) Arousal	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for	
					Lower Bound	Upper Bound
1	2	-1.082*	.204	.000	-1.601	-.564
	3	1.995*	.272	.000	1.305	2.684
2	1	1.082*	.204	.000	.564	1.601
	3	3.077*	.280	.000	2.366	3.788
3	1	-1.995*	.272	.000	-2.684	-1.305
	2	-3.077*	.280	.000	-3.788	-2.366

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Appendix P- Participant Information Sheets

Information sheet for participants recruited through NHS sites.

Participant information sheet

PROJECT TITLE

The Retrieval of Episodic Memories in Parkinson's disease: The Role of Emotion and Subjective Memory States.

INVITATION

I would like to invite you take part in a research study on emotion and memory in Parkinson's disease. Before deciding if you want to take part I would like you to understand why the research is being done and what it would involve for you. I would therefore ask that you read the following information carefully before making your decision.

PURPOSE OF STUDY

We know very little about the links between emotion and memory in Parkinson's disease. Therefore this research aims to investigate if individuals with Parkinson's disease differ from individuals without Parkinson's disease in their ability to retrieve and relive emotional memories. In order to do this the study requires comparison of individuals with and without Parkinson's disease.

WHY HAVE YOU BEEN INVITED TO PARTICIPATE?

This study requires the comparison of individuals with or without Parkinson's disease. You have been invited to take part in this research because you are over 60 years of age and have a diagnosis of Parkinson's disease or because you are over 60 years of age and a relative or family member of a person with Parkinson's disease. Staff members at the clinic give this information sheet to people who may fulfil the criteria to take part in the study as they may be interested in participating.

DO I HAVE TO PART?

No. Participation is completely voluntary and it is up to you to decide to join this study. You will be free to withdraw from this study up to the point where the study results are analysed and written up and you do not have to give a reason for this. Your decision will not affect your medical care or your legal rights.

WHAT WILL PARTICIPATING INVOLVE?

The study consists of two stages. In the first stage you will be asked to provide general information. You will also be asked to complete some questionnaires to assess your mood and a short screening test of your cognitive function (for example your thinking skills, memory, language etc.). This process will take around 30 minutes. These tests will be used to decide if you are eligible to take part in the second part of the study. If these tests reveal any potential

mood problems or potential problems with cognitive function you will be informed as will your Parkinson's care team or your GP.

Following this stage, participants who are eligible to take part will be invited to continue to the second phase of the study lasting just over 1 hour. In this phase you will be asked to view emotional and non-emotional pictures on a computer screen and to rate how emotional you find the images and if you find them positive, negative or neutral. Following a small delay, you will then be asked to try to identify the images you have already seen amongst a larger set of images. You will also be asked to specify the level of detail you experience when you recognise an image. Please note that not everyone will be invited to complete this second part of the study.

WHERE WILL THE RESEARCH TAKE PART?

It is up to where you wish to take part in this study. You can choose to come to the University of Hull for your participation or I can come to your home and you can do the study there.

EXPENSES AND PAYMENTS

Your participation in this study is voluntary. However, you will be reimbursed for any travel expenses should you wish to come to the university to take part in the study.

WHAT ARE THE BENEFITS AND RISKS OF TAKING PART?

This study involves little risk. However, you may experience mild emotional distress when viewing some of the emotional images. Should this be the case, you are free to discontinue your participation at any point. The researcher will also offer support and help you to gain access to further help from your clinical care team or your GP, if needed.

Although there are no known benefits for taking part in this study, your participation may help improve knowledge about Parkinson's disease and therefor help professionals working with people that have the disorder.

ANONYMITY AND CONFIDENTIALITY

Information obtained in the study will be used only for this study. All information is stored securely for 10 years and will then be destroyed. Information is collected by myself only and all information will be anonymised and participants will not be identified by name at any point. We will follow ethical and legal practice and all information about you will be handled in confidence

WHAT WILL HAPPEN WITH THE RESULTS OF THE STUDY?

The results of this study will be presented in a doctoral thesis, submitted for publication in an academic journal and may be presented at conferences. No individual participant details will be identified in the presentation of data.

WHO IS ORGANISING THIS STUDY?

This research is carried out as part of a doctorate level training program in clinical psychology with approval of Humber NHS foundation trust.

WHAT IF THERE IS A PROBLEM?

If you have concerns about any aspects of this study you can contact Dr Tim Alexander at the University of Hull (T.Alexander@Hull.ac.uk/ 01482 464008). You can also contact the local NHS Patient and Advice and Liaison Service (PALS) on telephone number 01482 303 966 or via email: pals@humber.nhs.uk.

WHAT SHOULD I DO NEXT?

If you wish to take part please inform the member of staff, they will then be able to advise you about what to do next.

FOR FURTHER INFORMATION

Miss Matilda Ohlsson and Dr Tim Alexander will be happy to answer any questions about this study at any time:

Email: M.J.Ohlsson@2012.hull.ac.uk/ T.Alexander@Hull.ac.uk

Address: Miss Matilda Ohlsson/ Dr Tim Alexander, Department of Psychological Health and Wellbeing, University of Hull, Cottingham road, Hull, HU6 7RX

Thank you for taking the time to read this letter!

Yours Sincerely

Matilda Ohlsson
Trainee Clinical Psychologist

Supervised by

Dr Miles Rogish
Clinical Psychologist

Dr Tim Alexander
Research psychologist

Information sheet for participants recruited through Parkinson's UK

Participant information sheet

PROJECT TITLE

The Retrieval of Episodic Memories in Parkinson's disease: The Role of Emotion and Subjective Memory States.

INVITATION

I would like to invite you take part in a research study on emotion and memory in Parkinson's disease. Before deciding if you want to take part I would like you to understand why the research is being done and what it would involve for you. I would therefore ask that you read the following information carefully before making your decision.

PURPOSE OF STUDY

We know very little about the links between emotion and memory in Parkinson's disease. Therefore this research aims to investigate if individuals with Parkinson's disease differ from individuals without Parkinson's disease in their ability to retrieve and relive emotional memories. In order to do this the study requires comparison of individuals with and without Parkinson's disease.

WHO CAN TAKE PART?

We are currently looking for participants without Parkinson's disease who are over 60 years of age to take part in the study.

DO I HAVE TO PART?

No. Participation is completely voluntary and it is up to you to decide to join this study. You will be free to withdraw from this study up to the point where the study results are analysed and written up and you do not have to give a reason for this. Your decision will not affect your medical care or your legal rights.

WHAT WILL PARTICIPATING INVOLVE?

The study consists of two stages. In the first stage you will be asked to provide some general information. You will also be asked to complete a questionnaire to assess your mood and a short screening test of your cognitive function (for example your thinking skills, memory, language etc.). This process will take around 30 minutes. These tests will be used to decide if you are eligible to take part in the second part of the study. If these tests reveal any potential mood problems or potential problems with cognitive function you will be informed as will your GP.

Following this stage, participants who are eligible to take part will be invited to continue to the second phase of the study lasting just over 1 hour. In this phase you will be asked to view emotional and non-emotional pictures on a computer screen and to rate how emotional you find the images and if you find them positive, negative or neutral. Following a small delay, you will then be asked to try to identify the images you have already seen amongst a larger set of

images. You will also be asked to specify the level of detail you experience when you recognise an image. Please note that not everyone will be invited to complete this second part of the study.

WHERE WILL THE RESEARCH TAKE PART?

It is up to where you wish to take part in this study. You can choose to come to the University of Hull for your participation or I can come to your home and you can do the study there.

EXPENSES AND PAYMENTS

Your participation in this study is voluntary. However, you will be reimbursed for any travel expenses should you wish to come to the university to take part in the study.

WHAT ARE THE BENEFITS AND RISKS OF TAKING PART?

This study involves little risk. However, you may experience mild emotional distress when viewing some of the emotional images. Should this be the case, you are free to discontinue your participation at any point. The researcher will also offer support and help you to gain access to further help from your GP if needed. Although taking part in this study may not benefit you directly, your participation may help improve knowledge about Parkinson's disease and may therefore help professionals working with people that have the disorder.

ANONYMITY AND CONFIDENTIALITY

Information obtained in the study will be used only for this study. All information is stored securely for 10 years and will then be destroyed. Information is collected by myself only and all information will be anonymised and participants will not be identified by name at any point. We will follow ethical and legal practice and all information about you will be handled in confidence

WHAT WILL HAPPEN WITH THE RESULTS OF THE STUDY?

The results of this study will be presented in a doctoral thesis, submitted for publication in an academic journal and may be presented at conferences. No individual participant details will be identified in the presentation of data. You may also receive a summary of the research outcome should you wish to do so.

WHO IS ORGANISING THIS STUDY?

This research is carried out as part of a doctorate level training program in clinical psychology with approval of Humber NHS foundation trust.

WHAT IF THERE IS A PROBLEM?

If you have concerns about any aspects of this study you can contact Dr Tim Alexander at the University of Hull (T.Alexander@Hull.ac.uk/ 01482 464008).

WHAT SHOULD I DO NEXT?

If you wish to take part please contact the researcher using the contact details below

Email: M.J.Ohlsson@2012.hull.ac.uk

Telephone: 07565 773 711

FOR FURTHER INFORMATION

Miss Matilda Ohlsson and Dr Tim Alexander will be happy to answer any questions about this study at any time:

Email: M.J.Ohlsson@2012.hull.ac.uk/ T.Alexander@Hull.ac.uk

Address: Miss Matilda Ohlsson/ Dr Tim Alexander, Department of Psychological Health and Wellbeing, University of Hull, Cottingham road, Hull, HU6 7RX

Thank you for taking the time to read this letter!

Yours Sincerely

Matilda Ohlsson
Trainee Clinical Psychologist

Supervised by

Dr Miles Rogish
Clinical Psychologist

Dr Tim Alexander
Research psychologist

Appendix Q- Consent forms

Consent for participants without Parkinson's disease.

Participant Identification number for this study:

CONSENT FORM

Title of Project: **The Retrieval of Episodic Memories in Parkinson's disease: The Role of Emotion and Subjective Memory States.**

Name of Researcher: **Matilda Ohlsson**

	Please initial all boxes
1. I confirm that I have read and understand the information sheet dated 11/06/2014 (version 1.2) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time up to the point where the study results are analysed and written up without giving any reason and without my medical care or legal rights being affected.	☐
3. I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from the University of Hull from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	☐
4. I agree to my GP being informed about my scores on the mood questionnaires and cognitive screening tool if the researcher deems this to be appropriate.	☐
5. I agree to take part in the above study.	☐

Name of Participant	Date	Signature
Name of Person taking consent.	Date	Signature

Consent form for Participants with Parkinson's disease

Participant Identification number for this study:

CONSENT FORM

Title of Project: **The Retrieval of Episodic Memories in Parkinson's disease: The Role of Emotion and Subjective Memory States.**

Name of Researcher: **Matilda Ohlsson**

	Please initial all boxes
1. I confirm that I have read and understand the information sheet dated 11/06/2014 (version 1.2) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time up to the point where the study results are analysed and written up without giving any reason and without my medical care or legal rights being affected.	☐
3. I understand that relevant sections of my medical notes and data collected during the study may be looked at by individuals from the University of Hull from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	☐
4. I agree to my GP informed about my scores on the mood questionnaires and cognitive screening tool if the researcher deems this to be appropriate.	☐
5. I agree to members from my Parkinson's care team being informed about my scores on the mood questionnaires and cognitive screening tool.	☐
6. I agree to take part in the above study.	☐

Name of Participant	Date	Signature
Name of Person taking consent.	Date	Signature

Appendix R- Form for Collecting Demographic Details

Demographic details to be collected

Participant ID:

Gender:

DOB:

Uncorrected visual impairment: Y/N

Memory medication Y/N

Mood medication Y/N

Native English: Y/N

On PD medication: Y/N

Length of PD diagnosis:

Years in education:

Medications:

Current or previous neurological condition or psychiatric diagnosis:

GP details:

Appendix S- Debrief for all participants

Debrief: The Retrieval of Episodic Memories in Parkinson's disease: The Role of Emotion and Subjective Memory States

Thank you for taking the time to take part in this study. The aim of this study is to investigate if older adults with Parkinson's disease differ from healthy older adults in their ability to recognise emotional material. Healthy older adults have been found to have better memory for positive than negative material. As such, this study is interested in finding out if older adults with Parkinson's disease also remember emotional material better than neutral material and if so whether this effect is greater for positive than negative emotional content. We are also interested in finding out if Parkinson's disease influences a process whereby emotion enhances the ability to recall a lot of details about material which has been previously seen.

For this purpose I showed you a number of emotional pictures and asked you to rate how positive and negative you found them as well as how emotionally arousing the pictures were to you. After a delay I asked you to try to identify the pictures you had seen before amongst a number of new images. When you identified a picture as old you were asked to judge if you experienced a feeling of "remembering" or "knowing" when you saw the picture. These remember and know judgements will help us assess the level of details you recalled when you recognised a previously seen picture.

The results of this study will be written up in a doctorate thesis before June 2015. They will also be submitted for publication in a scientific journal and may be presented at potential conferences. You will also receive a summary of the research and research findings.

Should you have any questions regarding your participation in this research please do not hesitate to contact me or my research supervisor:

Email: M.J.Ohlsson@2012.hull.ac.uk/ T.Alexander@Hull.ac.uk

Address: Miss Matilda Ohlsson/ Dr Tim Alexander, Department of Psychological Health and Wellbeing, University of Hull, Cottingham road, Hull, HU6 7RX

Phone number: 01482 464101/01482 464030

Again, many thanks for taking the time to take part in this research!

Yours Sincerely

Matilda Ohlsson
Trainee Clinical Psychologist

Supervised by

Dr Tim Alexander
Research Psychologist

Dr Miles Rogish
Clinical psychologist

Appendix T- Epistemological Statement

This research, by its quantitative nature, is grounded in the idea that there is an objective truth which can be measured and understood. It rests on positivistic assumptions (Barker, Pistrang, & Elliott, 2002) regarding the importance of employing rigorous empirical methods like measurements and observations in order to learn the truth about various phenomena. Furthermore, it sits within a hypothetico-deductive approach to research (Barker et al., 2002). As such, the project is grounded in and driven by a number of falsifiable hypotheses which were in turn grounded in existing theory and scientific literature.

In taking this approach it is acknowledged that more subjective aspects of the concepts under study have been lost. For example, this research does not speak in any detail to people's more subjective experiences of emotional remembering. Instead, the research is grounded in the idea that emotional memory can be quantified in an objective manner and measured in a way which reflects reality. This has clearly shaped the design of the project which quantifies memory through measures of recognition accuracy, and memory detail through the R/K procedure.

Although the process of quantifying these concepts in this manner can be criticised, it was deemed appropriate for a number of reasons. First, old/new recognition memory paradigms such as that employed here are commonly used in psychology as a method for quantifying episodic memory. Furthermore, these paradigms have a long tradition of being combined with the R/K procedure in order to measure more subjective aspects of the retrieval experience as well as the memory processes underlying recognition (Tulving, 1985; Yonelinas, 2002). In this way, using these two paradigms provided a means for making the current research comparable to existing literature. In addition, the quantitative

method has been suggested as most appropriate when the aim of a study is, as it was here, to compare two groups (Barker et al., 2002).

A further idea springing from the positivistic stance underpinning this study is that statistical analysis provides a means through which findings can be generalised and applied to the wider population (Barker et al., 2002). Such ideas of generalisation of data from this study to the general population (and the limitations of such generalisations based on sampling) are discussed at length in the discussion section of the empirical paper. A further assumption is that statistical analysis provides a means for the researcher to remain objective and avoid a purely subjective interpretation of findings. In this way, findings may more accurately reflect objective reality which can be generalised than would a study where data is analysed through other means. However, it is acknowledged again that a drawback of quantifying human experience in this way is that it ultimately means that one loses some of the richness of personal experience.

References:

Barker, C., Pistrang, N., & Elliott, R. (2002). Research methods in clinical psychology. London: Wiley.

Tulving, E. (1985). Memory and consciousness. Canadian Psychology 26(1), 1.

Yonelinas, A. P. (2002). The nature of recollection and familiarity: A review of 30 years of research. Journal of memory and language, 46(3), 441-517.

Appendix U- Reflective statement

Choosing a project

I remember the early days of choosing this project. I was only months out of having finished my Master's degree at Leeds University. This had been focussed specifically around neuropsychology, memory and memory disorders and this was an area that I was (and still am) truly interested in. It felt like a natural progression of this interest to do my thesis on something linked to this area and I felt very excited about this idea. I have also always loved research and I was really looking forward to doing a big research project.

I grappled for some time with the exact area I wanted to focus on. Linked to this, I felt that there was a big decision to make with regards to the research method I wanted to use (qualitative vs. quantitative). Initially I came up with a number of topics that I was interested in doing. However, these all fitted a qualitative method of study best and I felt that this method would not suit me as well as a quantitative style of research. I worried that I would struggle with the more subjective nature of qualitative research and it just didn't feel right for me. At times this led to me trying to turn a "qualitative topic" into a quantitative one and this was at times a very frustrating process. I asked myself many times what felt more important to me- the topic or the method. The answer was usually the same- the topic is most important but I will struggle with qualitative research in the long run.

As such, I decided to keep developing my research ideas until I found a topic that would suit a quantitative method. Interestingly, when I think back to this time now I do think I would have actually enjoyed a qualitative project. I have learnt through doing this thesis that no form research (qualitative or quantitative) is inherently free from subjectivity, fully correct and accurate. Interestingly, I think this mirrors my clinical journey

somewhat. I came into clinical training thinking that there would be hard, fast, non-subjective truths to guide my clinical work. However, over time I have realised that this is not the case and that clinical psychology is often subjective and that this is okay. As such, in the future I would really like to try my hand at a qualitative study.

After having spent a lot of time grappling with these issues I decided to really sit down and think back to my masters and what had interested me the most. The thing which stood out to me was a module we did on emotion and cognition. I started reading around this area, specifically looking at memory and emotion in clinical populations. I realised that there was very little research in this area for people with Parkinson's Disease (PD). Whilst lots of studies had looked at emotional memory in dementia and other disorders associated with memory, PD appeared to have been somewhat forgotten. It appeared that the motor deficits and the medical side of this disorder had received significant attention and there was also lots of work on emotion and cognition as isolated functions. To me, this felt somewhat unsatisfactory as I don't really subscribe to the idea of cognitive and emotional functions as wholly separate. As such, I became really curious about the link between the two in general and especially in relation to PD. When I was reading around the neuropathology in PD it also seemed like emotion and cognition might interact in some very interesting ways. As such, I finally settled on a topic.

Designing the project

Once I had decided to look at emotion and memory in PD I started thinking about exactly what I wanted to do. I was very interested not just in how emotion and memory might be linked but also how emotion affects more subjective memory states. During this time I had many really helpful research supervision meetings which were invaluable in exploring different ideas and thinking about what would and wouldn't be feasible. I spent

a lot of time reflecting on how best to study subjective memory states and I had started thinking about using the remember-know paradigm. My supervisor was not familiar with this procedure and during our conversations it became clear that these two concepts were difficult to understand and explain clearly. I was very concerned that my participants would not understand how to use these concepts and we decided that service user input to explore this would be really helpful. The conversations with people who had PD gave me lots of opportunities for developing ideas on how I could use and explain the paradigm well and it gave me renewed confidence.

The service user input was also invaluable for assessing the relevance of this project to people with PD themselves. Upon until this point I had felt very torn between my own (perhaps too academic) interests and the actual clinical relevance of the research. Many times I wondered if the research I wanted to do would really genuinely benefit people with PD and I wanted this to be the case. Conversations with people who had the diagnosis confirmed that many of them had noticed changes to memory and emotional reactions and they appeared genuinely interested in my project. This helped with my own anxiety somewhat. However, to be honest, the doubt around the clinical relevance of my study has stayed with me throughout the process.

By the time I was preparing my final research proposal I had gotten myself incredibly caught up in the design of the project thinking about all sorts of ways to make it "well controlled". I have a number of friends who are doing PhDs and I had been listening to them thinking about all the ways they were trying to control their research and "ensure experimental rigour". When I thought about my own project, I felt overwhelmed with the sheer volume of factors that could potentially confound my research and how to control for these. I felt very strongly that a project on emotion and memory must control for mood

disorders and memory impairments. However, I also realised that any number of other differences in cognitive profiles between people with and without PD could affect the study. I ended up thinking about controlling a very large number of variables. Research supervision was again so important at this time. My supervisor pointed out that it would be infeasible to control for everything and that there is no perfect research. We discussed at length the idea of "good enough" and what that meant given our time constraints. This process was challenging for me and I often struggled to accept this idea of good enough. It was helpful to spend time really thinking about why it was difficult for me to accept this idea and letting go of the wish to do an ideal piece of work. If it is one thing this process has taught me it is that there is no such thing. In the end, I went back to basics; control only the factors that are principally confounding; memory and mood.

I submitted my research proposal and received the feedback that screening people out on the basis of depression and cognitive impairments would possibly make my project infeasible. This was really difficult since I felt that I had already gone a long way in terms of reducing experimental control at the possible expense of study quality. However, the feedback I received pointed out that having separate screening and testing sessions would mean a very heavy time investment. The decision about whether to implement a screening phase or not felt like a choice between good research quality and making my life easier. In the end, I decided that if I was going to invest a lot of time in time in this project I wanted it to be something I could be truly proud of. As such, I decided to go ahead with the screening session (at this time I had definitely not fully accepted the idea of "good enough"). I also wasn't very compassionate to myself thinking that if a big project meant I didn't have much free time for the next year so be it. This was hands down one of the biggest decisions I made for my thesis and since then I have wished many times that I had gone with the reviewer's feedback. As predicted the project ended up being incredibly

time-consuming (with around 70 screening/testing session and far more meetings with potential participants). This whole process taught me two key things. First, listen to other people's feedback when those people have your best interest in mind. Sometimes it can be really hard to be compassionate to yourself and then it is very important to listen out for other people trying be just that. Second, believe that what you are doing can be worthwhile even if it is not perfect.

There was also a really positive new direction of my research as a result of the reviewer feedback. I had mentioned in my proposal ideas around the positivity effect in ageing but I hadn't specified it further. The feedback I received made this feel like a truly valuable idea to pursue and I decided to tweak my proposal to include only older adults to allow me to look into this effect. This came to shape my whole thesis and I have been so interested in reading about this phenomenon. It really challenged my views on ageing which had perhaps until this point been more in line with the general (and stereotypical view) of old age as an emotionally difficult time. I also felt that focussing my research around this effect increased the clinical relevance of my project given the links between the positivity effect and emotion regulation.

Data collection

The data collection phase was both anxiety provoking and very enjoyable for me. Because I knew I needed quite a few people I felt stressed throughout the process. I also felt anxious about handing over control of recruitment to the Parkinson's clinicians and I had a sense that I wanted to be more involved in this process myself. Handing over control is something that I can at times find difficult in general and it definitely wasn't easy to do with something as important as my thesis. I also worried that the PD clinicians would feel like I was just expecting them to do my work. However, during the first few months of

this process there were very few study days where I could recruit so I did not have a choice. Looking back, I actually think this was a very useful exercise in learning to trust a team that you are working with and ensuring that you maintain good relationships where people feel supported and appreciated even if you are not there in person.

Recruitment did feel easier once I had time to attend clinics although it was a steady process over 7 months to achieve the numbers. Many times I doubted I would ever get there and it has been a very useful exercise in tolerating uncertainty. Something quite unexpected during these process was that I was able to share some of my psychology knowledge with the medical recruitment staff. For example, one member of staff reflected on how he now will use a depression and anxiety screening tool as part of their routine practise because he realised how often people with PD present with these issues. I hope this will carry some benefits to patients.

One of the issues I came up against during screening and testing was detecting a potential diagnosis of dementia. I knew from the start that this would be a possibility and having done a placement in a memory clinic I was hoping to be able to deal with this as well as possible. My clinical knowledge was actually very useful when I did come across people who scored low on my cognitive screening tool. I feel that my training helped me to have these anxiety provoking conversations with people in a good way and to manage any distress experienced on their part. However, I hadn't anticipated how difficult I would find it myself on an emotional level when I suspected that a person might have dementia. I ended up feeling very guilty because people had volunteered to do my research just wanting to help out and contribute to the knowledge around PD. It felt very difficult to then say that something had been picked up that would need investigation. Although there may be many reasons to why they scored low on a cognitive screening test (which participants were of course told) it still left me feeling uncomfortable. I felt like I had

brought something on people which they hadn't asked for. Again, research supervision became useful here in thinking about how to manage my own reactions. It also made me realise how important all those hours spent planning the project and preparing for different scenarios had been. It felt very re-assuring to have a clear pathway to offer the patients so they knew exactly what would happen next in terms of follow-ups.

Although there were some difficult issues around this time I also really enjoyed data collection in many ways. It was very interesting and often touching to listen to people's stories about how they cope with PD. Some people were very positive and expressing how they won't let PD stop them from living their life. Other people were finding it hard to get to terms with their diagnosis and managing day to day life. Many people spoke at length about changes they had noticed both to memory and emotions and it was very interesting to hear all of their stories. I think this re-affirmed to me that I would like to do some qualitative work in the future to capture some of those issues for people. Unfortunately, I feel that none of those very important stories are captured in my data.

The Afterthought- Systematic Literature Review (SLR)

As am I writing this reflective statement I realise that so far there has been no mention of my SLR. This very much mirrors my research process. For a long time I simply didn't think about it and I was just focussed on the empirical paper. Every now and then in teaching somebody would mention the SLR always saying that this piece of work was half the thesis and equally important as the empirical paper. Still, I was left feeling that it was somehow an added extra. At times, it even felt like a huge inconvenience to have to think about doing this piece of work when my empirical study was taking so much time.

Nevertheless, at some point in the autumn I started to listen to everybody saying not to leave the SLR to the last minute because it takes a long time. So in November I decided it was time to start thinking about this piece of work in a serious manner. In December I had realised just how long it was going to take and I found this very stressful. Doing the searching, data extraction and quality assessment was an incredibly slow process for me. I became a bit obsessive with the process and again I was struggling with the idea of "good enough". I did and re-did my search so many times and was still left feeling like I must have missed something. The same happened with my data extraction, and then again with my quality assessment. I actually surprised myself with how difficult I was finding it to leave each of these steps behind and deciding that I had done a "good enough" job. As such, the SLR process ended up being one of the most valuable experiences in the thesis process for me. It taught me to have some faith in the work I have done and that it would be correct and at an acceptable standard. It also gave me practise in leaving things behind and accepting that I had done as well as I could.

Writing Up

It felt quite odd when the time to write up finally came and it felt like a time of wanting to do all the hard-work over the last few years justice. I started by writing up my SLR and found this really quite hard. The area of research was very "messy" and I had not been able to find any clear patterns of results or any variables that appeared consistently linked to differing outcomes. I found it difficult to be clear in what various studies were showing and organising my results in an easy to follow manner. I ended up structuring and-restructuring my results a number of times. In the end, I decided that there was no great way of doing it and I chose the structure which I felt was most useful. Since then I have had the urge many times to think about alternative ways to do it but managed to stick to what I had agreed on with myself. This felt like some evidence of the learning process

throughout the project where I have come to accept that there may not be a best and perfect way to do things.

Writing up my empirical paper felt like a nicer and easier process. I had spent a lot of time on my previous research proposals reviewing the literature and that was definitely a big benefit when it came to writing up. During the write-up of the paper it has been really nice to reflect back on the entire process. The introduction made me remember back to the early days when I was doing all the reading and trying to build up an idea of what research was needed and which predictions I could make. The method very much reminded me of my struggles during the design process and about all the decision that needed to be made back then. I remembered writing all the research proposals planning what I was going to do and wondering if I would ever be able to do it. It felt really satisfying to be writing the method as something I had done and not as something I was going to do.

Analysing the results was not as straight forward of an exercise as we had predicted it to be. My data wasn't parametric and it was clear that my task had been too easy. Initially, I was disappointed and felt that I had designed my project really poorly despite all the effort. However, I was actually able to think quite quickly that I had done the best I could and that the decisions I had made I had made because I thought they were the best option given existing research. I felt able to be compassionate to myself rather than irritated. Again, I genuinely think this reflects a lot of what I have learnt throughout the research project. Also, the data was not at all in line with my predictions. Interestingly, this didn't actually concern me too much. It almost felt like a challenge to try and figure out why the results were the way they were. I think this is a big change from my undergraduate days of doing research when the aim often felt like it was to support your hypotheses. I think

that now, I'm more of the opinion that good research doesn't set out to support a hypothesis but to answer the research question (regardless of whether it supports a hypothesis or not).

Final Thoughts

I have always really liked research and although this process has been really difficult at times I have also enjoyed it. I think I have learnt so much throughout this project both about myself and about research and in that way it has really been very rewarding. I hope and think that working on this project has broadened the way I look at research and I know that it has given me lots of interesting ideas for the future. I hope that I will get the chance to actually do some of them.