Neuropsychology
2007, Vol. 21, No. 3, 371–380

0894-4105/07/$12.00 DOI: 10.1037/0894-4105.21.3.371

The Effect of Age on Memory for Emotional Faces

Cheryl L. Grady
Rotman Research Institute at Baycrest and University of Toronto

Donaya Hongwanishkul
Rotman Research Institute at Baycrest

Michelle Keightley
University of Toronto

Wendy Lee
University of Toronto

Lynn Hasher
Rotman Research Institute at Baycrest and University of Toronto

Prior studies of emotion suggest that young adults should have enhanced memory for negative faces and that this enhancement should be reduced in older adults. Several studies have not shown these effects but were conducted with procedures different from those used with other emotional stimuli. In this study, researchers examined age differences in recognition of faces with emotional or neutral expressions, using trial-unique stimuli, as is typically done with other types of emotional stimuli. They also assessed the influence of personality traits and mood on memory. Enhanced recognition for negative faces was found in young adults but not in older adults. Recognition of faces was not influenced by mood or personality traits in young adults, but lower levels of extraversion and better emotional sensitivity predicted better negative face memory in older adults. These results suggest that negative expressions enhance memory for faces in young adults, as negative valence enhances memory for words and scenes. This enhancement is absent in older adults, but memory for emotional faces is modulated in older adults by personality traits that are relevant to emotional processing.

Keywords: emotion, face recognition, aging, amygdala, personality

Assessing, responding to, and remembering the emotional content of visual images in the environment, such as faces of friends and acquaintances, are abilities used on a daily basis. The past few years have seen a dramatic increase in the study of emotion and its influence on memory. Young adults consistently show better memory for emotional compared with nonemotional verbal material (B. P. Bradley & Baddeley, 1990; Carstensen & Turk-Charles, 1994; Dewhurst & Parry, 2000) and for scenes depicting emotional events (M. M. Bradley, Greenwald, Petry, & Lang, 1992; Charles, Mather, & Carstensen, 2003; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002; Ochsner, 2000). These studies were in agreement that young adults remember negatively valenced items better than neutral stimuli. With respect to positively valenced items, there have been discrepant findings in the literature, with some studies reporting better memory for negative than for positive materials (Charles et al., 2003; Ochsner, 2000) and others reporting equal performance (M. M. Bradley et al., 1992; Dewhurst & Parry, 2000; Ferre, 2003; Kensinger et al., 2002).

The effect of aging on the processing of emotional stimuli and the emotional enhancement of memory has been a topic of recent research as well. Although some have reported equivalent memory for emotional stimuli in young and older adults (Comblain, D'Argembeau, Van der Linden, & Aldenhoff, 2004; Denburg, Buchanan, Tranel, & Adolphs, 2003; Kensinger et al., 2002), a study of memory for emotional scenes (Charles et al., 2003) found that younger adults had better recall of positive and negative scenes, compared with neutral ones, whereas older adults had better recall of positive scenes, compared with both negative and neutral ones. These results were interpreted in the context of the socioemotional selectivity theory (Carstensen, Fung, & Charles, 2003; Gross et al., 1997), which proposes that older adults have better emotional regulation skills than young adults, allowing them to focus on positive rather than negative events.

Work on memory for faces and their depicted emotions has been far less common. Data from prior studies of labeling emotional expressions in faces and brain imaging studies suggest that memory for negative faces should be better than memory for neutral faces in young adults, as is the case with pictures or words, and that older adults should show a reduction in this effect. That is, young adults have increased activity in the amygdala when viewing negative emotional stimuli, including negative faces (Anderson, Christoff, Panitz, De Rosa, & Gabrieli, 2003; Canli, Zhao, Brewer, Gabrieli, & Cahill, 2000;

Cheryl L. Grady, Rotman Research Institute at Baycrest, Toronto, Ontario, Canada, and Departments of Psychology and Psychiatry, University of Toronto, Toronto, Ontario, Canada; Donaya Hongwanishkul, Rotman Research Institute at Baycrest; Michelle Keightley, Department of Occupational Science and Occupational Therapy, University of Toronto; Wendy Lee, Department of Psychology, University of Toronto; Lynn Hasher, Rotman Research Institute at Baycrest and Department of Psychology, University of Toronto.

This work was supported by Canadian Institutes of Health Research Grant MOP14036 and by National Institute on Aging Grant R37 AG04306.

Correspondence concerning this article should be addressed to Cheryl L. Grady, Rotman Research Institute at Baycrest, 3560 Bathurst Street, Toronto, Ontario M6A 2E1, Canada. E-mail: cgrady@rotman-baycrest.on.ca

Critchley et al., 2000; Morris et al., 1998), and this activity is related to later memory for this material (Cahill et al., 1996; Canli et al., 2000; Dolcos, LaBar, & Cabeza, 2004; Kensinger & Corkin, 2004). Activity in the amygdala during viewing of negative faces is lower in older adults (Gunning-Dixon et al., 2003; Iidaka et al., 2002), and they make more errors in labeling the specific negative emotions in faces compared with young adults (Calder et al., 2003; Keightley, Winocur, Burianova, Hongwanishkul, & Grady, 2006; MacPherson, Phillips, & Della Sala, 2002; McDowell, Harrison, & Demaree, 1994; Oscar-Berman, Hancock, Mildworf, Hutner, & Weber, 1990; Phillips, MacLean, & Allen, 2002). However, prior work has shown neither a clear memory enhancement for negative faces nor an age effect. Although one study (Mather & Carstensen, 2003) found that young adults recognized both positive and negative faces better than neutral faces, and that older adults showed poorer memory for negative faces, others have found better memory for positive faces in both young and older adults (D’Argembeau & Van der Linden, 2004; Leigland, Schulz, & Janowsky, 2004).

Some of the variability among studies of emotional face memory may be due to methodology. The two experiments reporting better memory for positive faces were conducted with a small number of faces that were shown repeatedly and with a variety of emotional expressions for each face, creating discriminability issues that may have overridden—or at least confused—the actual nature of emotional memory effects in young and older adults. For example, in the study by D’Argembeau and Van der Linden (2004), the stimuli were photographs of 12 individuals with happy or angry expressions, and participants were instructed to study and remember them for a later test. The recognition test was conducted with neutral versions of the same faces that had not been seen at study. Leigland et al. (2004) used photographs of only 6 different people expressing a variety of emotions, and each individual was seen multiple times during study. Some of the foils were pictures of these same 6 individuals with expressions not seen at study. These procedures are quite different from the one used in studies of emotional scenes and words, in which each stimulus during encoding is unique and expresses a single emotion. Hence, one of our goals was to examine memory for emotional faces using trial-unique stimuli, such that each face expressed only one emotion and was seen only once during encoding and then again during recognition. This approach should enable an evaluation of memory for faces that is comparable with the research on memory for words and scenes.

It also is possible that the way in which emotional faces are initially processed could influence memory. There is evidence that happy facial expressions are detected faster than any other expression (e.g., Kirita & Endo, 1995; Leppanen & Hietanen, 2004; Suzuki, Hoshino, & Shigemasu, 2006). This suggests that encoding tasks that allow rapid judgments of positive expressions, such as judging the emotional valence of the face or rating its emotion, might lead to impoverished encoding of these faces, which in turn could result in poor memory for positive faces. On the other hand, if the faces are viewed multiple times at study, or participants are encouraged to study them carefully for a later memory test, the influence of emotional expression on memory might be different. As we wanted to assess memory unbiased by potential rehearsal factors that may otherwise interact with emotion or influence memory in older adults (Rahhal, May, & Hasher, 2002), we tested recognition after an incidental encoding task. This task, requiring participants to judge whether the facial expression was positive, negative, or neutral, has been used in some of our earlier work and can be performed equally well by older and younger adults (Keightley et al., 2006). To determine the contribution of speed of identifying face valence to recognition accuracy, we assessed the impact of reaction time (RT) during the initial processing of the faces.

As well, we considered the role of personality traits and mood, as there is evidence for an interaction between these measures and emotional memory. With respect to personality, there is evidence that neuroticism is associated with memory for negative information, whereas extraversion is associated with memory for positive items (Rusting, 1999). Because evidence of age decreases in levels of neuroticism and extraversion has been reported across multiple cultures (McCrae et al., 1999; Zonderman, Siegler, Barefoot, Williams, & Costa, 1993), we assessed personality factors and considered the impact of these factors on age differences in emotional memory. Similarly, high scores on a test measuring alexithymia, a personality trait associated with difficulty in identifying and describing emotions, are related to reductions in the ability to accurately label emotional faces (Parker, Taylor, & Bagby, 1993). Increased levels of alexithymia with age have been reported (Pasini, Delle Chiaie, Seripa, & Ciani, 1992), but the influence of this trait on emotional memory is unknown. Keightley et al. (2006) have previously reported that extraversion and emotional sensitivity influence identification of emotional facial expressions in older but not younger adults, and these variables also could influence memory for emotional stimuli in older adults.

Mood is also known to affect memory for emotional material, such that negative mood is associated with better memory for negative stimuli or life events and positive mood is associated with better memory for positive material (Rusting, 1999; Yang & Rehm, 1993), the so-called mood congruence effect. Indeed, older adults sometimes have more reported positive affect or mood or less negative affect than younger adults (Barrick, Hutchinson, & Deckers, 1989; Gross et al., 1997; Mroczek & Kolarz, 1998), which could contribute to poorer memory for negative stimuli in this age group. Previous work has shown that the effect of mood on memory for emotional (Knight, Maines, & Robinson, 2002) and nonemotional material (Deptula, Singh, & Pomara, 1993) is larger in older adults than in young adults. Taken together, this work suggests that subjective emotional experience and personality traits may influence cognitive function to a greater degree in older adults than in young adults, consistent with the theory that emotional information is more salient as we age (Carstensen et al., 2003). We therefore thought it important to explore the influence of both mood and personality measures on age differences in memory for emotional faces. This is the first study to do so, to our knowledge.

In the experiment reported here, we tested incidental recognition for faces with emotional and neutral expressions in young and older adults using the sorts of trial-unique stimuli commonly used in studies with verbal or scene materials (e.g., Ochsner, 2000). We expected that young adults would show enhanced memory for negative faces, compared with neutral faces, similar to findings with other types of stimuli. We also expected that memory for positive faces would be worse than that for negative faces because of the rapid identification of positive faces when first encountered. On the basis of findings of less activity in the amygdala for negative faces in older adults, and age differences in labeling of negative facial expressions, we predicted that older adults would show less of a memory enhancement for negative faces compared with young adults. Finally, we expected that memory for emotional faces would be more strongly related to personality traits and measures of mood or emotional sensitivity in older adults, consistent with earlier work on personality and mood, as well as with a recent report of stronger relations between these measures and emotional face judgments in older adults (Keightley et al., 2006).

Method

Participants

A sample of 40 young adults (ages 18–29 years) and 40 older adults (ages 60–81 years) participated in the experiment. Participants were obtained either from the participant pool at the Rotman Research Institute at Baycrest (which includes adults of all ages recruited from the greater Toronto area) or from the University of Toronto, and all were right handed. An equal number of men and women were represented in both age groups. Participants were in good health and were screened for a history of neurological and psychiatric illness and current depression and anxiety disorders. Exclusion criteria included the use of psychotropic medication and uncorrected vision and hearing. All participants gave informed consent for the experiment, which was approved by the Research Ethics Board at Baycrest.

Participants were asked to complete several questionnaires, including measures of general intellectual function and measures of mood and personality. Mental status and intellectual function were assessed with the Mini-Mental Status Examination (Folstein, Folstein, & McHugh, 1975) and the Mill Hill Vocabulary Scale (Raven, 1982), respectively. Mood was assessed with the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), and emotional sensitivity was assessed with the 20-item Toronto Alexithymia Scale (TAS; Taylor, Bagby, Ryan, & Parker, 1990). Personality was assessed with the NEO Five-Factor Inventory (McCrae & Costa, 1987), which assigns scores on five personality traits: neuroticism, extraversion, agreeableness, conscientiousness, and openness.

Young and older groups had equivalent years of education (see Table 1). The young adults had slightly higher mental status scores on the Mini-Mental Status Examination, although all of the older adults scored in the normal range (≥26), $t(68) = 2.4$, $p < .05$. The older adults had significantly higher vocabulary scores, $t(68) = 3.1$, $p < .01$. There were no significant group differences on any of the personality scales, but the older adults scored higher on the measure of positive mood, $t(68) = 3.0$, $p < .01$, and the young adults scored higher on negative mood, t(61, unequal variances) $= 2.1$, $p < .05$.

Stimuli

To create a set of 180 faces that ranged in age and ethnicity, we collected photographs with positive (happy and surprised), negative (angry, sad, disgusted, fearful), and neutral expressions from magazines, websites, and databases (including the Japanese and Caucasian Facial Expressions of Emotion and Neutral Faces, Biehl et al., 1997). All photographs were shown in black and white and adjusted so they measured approximately 150 mm × 185 mm on the computer screen. Initial ratings for the emotional valence of the stimuli were obtained from 12 young volunteers ($M = 23.6$ years, $SD = 4.4$ years) who did not participate in the memory testing session. The emotional valence of each face was rated on an 11-point scale ranging from *highly negative* (−5) to *highly positive* (5). The responses were categorized as highly negative (ratings of −4 or −5), negative (−2 or −3), neutral (−1, 0, or 1), positive (2 or 3), or highly positive (4 or 5). Only stimuli that were consistently rated in one of the above five categories by the majority of individuals (i.e., 10 out of 12) were retained. The raters were also asked to indicate any familiarity with the stimuli, and only unfamiliar faces were used.

As a further check on the reliability of the valence of these stimuli in older as well as young adults, we obtained ratings of valence and arousal for the resulting stimulus set (180 faces) from separate groups of young, middle-aged, and older adults, none of whom participated in the memory experiment (see Appendix A). Volunteers made these ratings on 5-point scales for both valence (ranging from 1 = *highly negative* to 5 = *highly positive*, with 3 = *neutral*) and arousal (ranging from 1 = *no arousal* to 5 = *highly arousing*) using self-assessment mannequins (M. M. Bradley et al., 1992). Positive faces were rated highest on valence and negative faces were rated lowest, with neutral faces receiving intermediate ratings. Positive and negative faces were rated equivalently for arousal, and both were rated as more arousing than neutral faces. Neither valence nor arousal ratings differed with age (see Appendix A).

Two presentation lists were created from this set of materials, each with 20 stimuli per valence (positive, negative, and neutral) and with an equal number of male and female faces (lists were counterbalanced across participants). The recognition task con-

Table 1
Demographic, Personality, and Mood Measures

Measure	Young adults *M*	Young adults *SD*	Older adults *M*	Older adults *SD*
Age (years)	21.8	2.1	70.0	5.7
Education (years)	15.6	1.2	15.9	3.4
Mental status	29.7	0.4	29.2	1.3*
Vocabulary	20.1	3.0	23.1	4.8*
PANAS positive	28.0	6.6	33.2	7.5*
PANAS negative	12.0	2.7	10.9	1.4*
Alexithymia scale	42.1	9.8	43.3	11.1
Neuroticism	45.8	11.6	45.1	9.0
Extraversion	49.1	12.1	51.5	13.3
Openness	50.9	9.9	49.5	8.8
Agreeableness	52.5	14.8	54.2	13.9
Conscientiousness	49.2	8.4	49.6	12.4

Note. Young $n = 40$; older $n = 30$ (10 older adults were excluded from analyses). PANAS = Positive and Negative Affect Schedule.
* $p < .05$, older differ from young.

Table 2
Face Encoding and Recognition Measures

	Young adults						Older adults					
	Negative		Positive		Neutral		Negative		Positive		Neutral	
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Encoding	0.88	0.12	0.96	0.07	0.85	0.13	0.78	0.21	0.95	0.09	0.75	0.22
Hits	0.76	0.17	0.60	0.20	0.69	0.19	0.71	0.21	0.62	0.24	0.70	0.18
False alarms	0.20	0.15	0.25	0.17	0.26	0.15	0.39	0.19	0.41	0.26	0.39	0.16

Note. The measure for encoding is proportion correct.

sisted of 60 “old” faces (i.e., those presented during the encoding tasks) and 60 “new” faces (20 of each valence), with 10 of each gender per valence. As much as possible, across encoding and recognition sets, we matched old and new faces for their general characteristics (e.g., age and ethnicity) to reduce the possibility that any unique visual or semantic aspect of a face would act as a memory cue during the recognition phase.

Experimental Procedure

Participants saw a series of faces and judged the expression of each as positive, negative, or neutral by pressing the appropriate response key. They were not told that there would be a memory test. RTs were measured during the valence judgment so we could assess the influence of this variable on recognition accuracy. The study phase was followed by administration of the questionnaires described above. Participants were given 15–20 min to finish these measures. Following completion of the questionnaires, the face-recognition memory task was administered.

Stimuli were presented on a laptop computer with a 17-in. screen (Toshiba Satellite Pro, 4200 series). During the encoding tasks, each stimulus was presented for 2.5 s, followed by an interstimulus interval of 1 s, in which a fixation cross was displayed in the center of the screen. For the recognition task, which was subject paced, stimuli were presented one at a time and participants made old or new judgments. During all tasks, instructions (i.e., the appropriate keys for each response) were presented on every trial at the bottom of the screen.

Data Analysis

Prior to analysis, we examined overall recognition scores to ensure inclusion of data from participants who demonstrated above-chance performance. For this purpose we used a corrected accuracy score (proportion of hits minus proportion of false alarms) of $\geq$0.10, which resulted in the elimination of 10 older adults (leaving 14 men and 16 women) and of no young adults.[1] Corrected recognition accuracy was analyzed with a repeated measures analysis of variance, in which emotional valence was the within-subject factor and age group was the between-subjects factor. For the repeated measures, we used within-subject contrasts designed to test our hypotheses that memory for negative faces would be enhanced relative to positive and neutral faces and that age differences would be largest for negative faces. These consisted of Helmert contrasts that compared scores for negative faces with the mean of positive and neutral faces and then contrasted scores for positive and neutral faces. Thus, for the main effect of valence and the interaction of Age $\times$ Valence, there were two contrasts per analysis of variance. Encoding data were analyzed in the same way, although on the basis of our earlier work (Keightley et al., 2006), we did not expect any age differences in encoding accuracy.

To assess the influence of the mood and personality measures on emotional face processing and memory, we carried out a series of backward regression analyses on the encoding accuracy and corrected recognition accuracy measures for positive and negative faces separately in young and older adults. These regression models included as predictors the following variables: the five personality measures from the NEO, mood scores from the Positive and Negative Affect Schedule, and the score on the emotional sensitivity scale (TAS).

Results

The means for encoding accuracy and the hits and false alarms from the recognition test are shown in Table 2. The corrected recognition scores (hits minus false alarms) are shown in Figure 1. Contrary to our expectations, there was a significant effect of age on encoding accuracy, $F(1, 68) = 7.3$, $p < .01$, $\eta^2 = .10$. In addition, there was a significant difference between encoding accuracy for negative faces and encoding of positive and neutral faces, $F(1, 68) = 6.2$, $p < .02$, $\eta^2 = .08$, as well as a difference between positive and neutral faces, $F(1, 68) = 50.0$, $p < .001$, $\eta^2 = .42$. It is important, however, that neither of the contrasts for the interaction of age and encoding accuracy was significant, indicating that the encoding of negative faces was not disproportionately lower in the older group.

In terms of recognition, negative faces were recognized better than neutral and positive faces, $F(1, 68) = 25.2$, $p < .001$, $\eta^2 = .27$ (see Figure 1). In addition, neutral faces were better recognized

[1] The 10 omitted older adults did not differ from the remaining older participants in age, education, Mini-Mental Status Examination, vocabulary, or any of the personality or mood scores. The results of the analyses of variance with the entire sample of older adults were the same as those reported here.

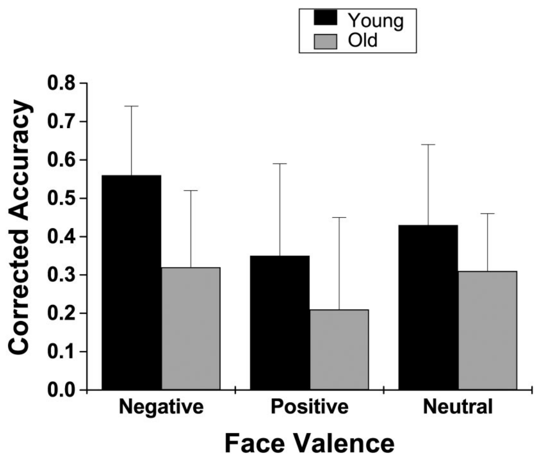

Figure 1. Mean recognition scores (hits minus false alarms) are shown for positive, negative, and neutral faces in young and older adults. Error bars are standard deviations.

than positive faces, $F(1, 68) = 8.1$, $p < .01$, $\eta^2 = .11$. There also was a significant main effect of age, with older adults performing more poorly than young adults, $F(1, 68) = 22.0$, $p < .001$, $\eta^2 = .24$. The age difference in accuracy for negative faces was significantly larger than that for positive and neutral faces, $F(1, 68) = 5.3$, $p < .05$, $\eta^2 = .07$. The difference in performance between young and older groups was equivalent for neutral and positive faces ($F < 1$).

To determine whether the effects of valence were reliable in both young and older adults, we analyzed performance in the two groups separately. Young adults recognized negative faces better than neutral and positive faces, $F(1, 39) = 46.6$, $p < .001$, $\eta^2 = .54$, and neutral faces better than positive faces, $F(1, 39) = 4.0$, $p = .05$, $\eta^2 = .09$. For older adults, recognition of negative faces was not reliably different from recognition of positive and neutral faces, $F(1, 29) = 2.2$, $p > .05$, $\eta^2 = .07$. However, the older adults had better memory for neutral compared with positive faces, $F(1, 29) = 4.2$, $p = .05$, $\eta^2 = .13$.

Because the older adults were less accurate overall at encoding the faces, we wanted to rule out the possibility that their lower recognition scores for negative faces were simply a function of their ability to judge the emotional valence of these faces. To do this, we recalculated the corrected accuracy scores in both groups on the basis of the proportion of hits for those faces that were accurately judged during the encoding task. Using the same cutoff of 0.10 for overall recognition accuracy (see the Method section), we dropped 9 older adults from this analysis. The results of the analysis of variance on these recognition measures were unchanged from those reported above. Critically, there was still a bigger age difference in recognition of negative faces compared with positive and neutral faces, $F(1, 69) = 4.6$, $p < .05$, $\eta^2 = .06$.

Both young and older adults showed poor recognition memory for positive faces, consistent with the idea that positive faces are encoded more quickly and less effectively than faces with negative or neutral expressions. To test this idea further, we examined whether encoding speed, as indexed by the time taken to make the emotional judgment, accounted for the difference in recognition across valence. An RT difference measure was calculated for each participant by averaging the RT to judge the valence of negative and neutral faces and subtracting from this average the RT for positive faces (young adults, $M = 263$ ms, $SD = 146$ ms; older adults, $M = 396$ ms, $SD = 205$ ms).[2] This RT difference measure was then entered as a covariate into an analysis of covariance of corrected accuracy with age group and face valence as factors. The rationale for this analysis was that if memory for positive faces was influenced by poor encoding associated with more rapid responses to these faces, then covarying out the difference in encoding time between positive faces and those with other expressions should reduce the difference between positive face memory and memory for negative or neutral faces.

These analyses of covariance were done separately on young and older adults, as the effects of valence differed between the groups. For young adults, the superior recognition of negative faces remained after controlling for encoding RT differences, $F(1, 38) = 12.3$, $p = .001$, $\eta^2 = .24$; the positive versus neutral difference was no longer significant ($F < 1$). For older adults, the difference in recognition of neutral and positive faces was no longer significant ($F < 1$), and the contrast between negative faces and those with other expressions remained nonsignificant. These analyses suggest the possibility that the poor memory for positive faces, relative to neutral faces, may be associated with differences in time spent judging the valence of the facial expressions. However, encoding time had little impact on the memory enhancement for negative faces shown by young adults.

The remaining question was whether any of the mood or personality variables influenced encoding or memory for emotional faces in either the young or older adults (the correlations between all the personality and mood variables are included in Appendixes B and C). None of these measures significantly predicted either the encoding or the recognition scores in the young adults (all r^2s $<$ .10). In the older group, encoding of positive faces was significantly predicted by negative mood scores from the Positive and Negative Affect Schedule, $F(1, 26) = 9.9$, $p < .005$, $r^2 = .28$. Lower scores on the negative mood scale in older adults were associated with more accurate encoding of positive faces ($\beta = -0.52$), $t(25) = -3.1$, $p < .01$. None of the personality measures significantly predicted encoding of negative faces in older adults, although there was a trend for greater emotional sensitivity (i.e., lower scores on the TAS) to predict better encoding, $F(1, 26) = 3.1$, $p = .09$, $r^2 = .11$. In terms of recognition in older adults, none of the personality measures significantly predicted recognition of positive faces, although there was a trend for lower scores on negative mood and extraversion to predict better memory for positive faces, $F(1, 26) = 3.1$, $p = .06$, $r^2 = .20$. Finally, more accurate recognition of negative faces in older adults was significantly predicted by several of the personality measures, $F(4, 27) = 3.9$, $p < .02$, $r^2 = .41$. Better memory for negative faces was

[2] The mean encoding RTs for each valence were as follows: positive (young adults, $M = 879$ ms $\pm$ 196 ms; older adults, $M = 1{,}047$ ms $\pm$ 208 ms); negative (younger adults, $M = 1{,}119$ ms $\pm$ 240 ms; older adults, $M = 1{,}397$ ms $\pm$ 224 ms); neutral (younger adults, $M = 1{,}164$ ms $\pm$ 245 ms; older adults, $M = 1{,}489$ ms $\pm$ 297 ms).

predicted by lower scores on extraversion ($\beta = -.48$), $t(25) = -2.4$, $p < .05$; openness ($\beta = -.44$), $t(25) = -2.4$, $p < .05$; and the TAS ($\beta = -.53$), $t(25) = -2.6$, $p < .02$. That is, older adults who rated themselves as less outgoing and less open to new experiences, but who showed greater sensitivity to their emotions, had better memory for faces with negative expressions. There also was a trend for an association between better memory for negative faces and lower negative mood in older adults ($\beta = -.34$), $t(25) = -1.9$, $p = .07$.

Discussion

There are three novel findings from our experiment. First, we found that using a procedure that shows enhanced memory for negative pictures and words in young adults also resulted in better recognition of faces with negative expressions, compared with both positive and neutral faces. Positive faces were remembered most poorly, an effect associated with spending less time on the faces during the emotion judgment task. Second, the memory enhancement for negative faces compared with neutral and positive faces was absent in older adults, who also showed lower overall recognition. Finally, we found support for the hypothesis that personality traits and mood have a greater influence on both encoding and recognition of emotional faces in older than in young adults. Greater accuracy on the emotional judgment task and on face recognition was predicted by a number of the personality measures and by negative mood scores, whereas none of the personality or mood measures predicted performance in young adults.

Enhanced Memory for Negative Faces

Our initial hypothesis was that young adults would show better memory for negative faces compared with both positive and neutral faces. We found support for this hypothesis, indicating that negative valence enhances memory for faces, just as it enhances memory for words and scenes (e.g., Kensinger et al., 2002; Ochsner, 2000). However, our findings differ from those of several studies reporting better memory for positive than for neutral or negative faces, as we did not find this effect for either young or older adults. Methodological differences between experiments and differences in encoding across face valence likely account for this variability in results. As mentioned in the introduction, two previous studies of emotional face memory (D'Argembeau & Van der Linden, 2004; Leigland et al., 2004) used only a few individual faces that were shown at test with different emotional expressions; alternatively, the same person's face, with an expression not seen at study, was used as both a target and a foil. In contrast, we had participants recognize the same face with the same emotional expression, and each face was seen with only one emotional expression. That is, each face seen during encoding in our experiment was unique and was not repeated, except as an "old" face during the recognition tests. Both the D'Argembeau and Van der Linden (2004) and the Leigland et al. (2004) studies may thus have tapped memory for the different emotions expressed by the same individual, rather than memory of emotional faces per se. Because our experiment was designed to be more like studies done with words and scenes, which also use trial-unique stimuli at study and test (e.g., Ferre, 2003; Ochsner, 2000), it is not surprising that our finding of better memory for negative faces is in line with results from these other experiments, which also found better memory for negative stimuli. Our results, taken together with previous work, suggest that the familiarity of the face interacts with emotional expression and may influence the salience of this expression and memory for the emotional content of the face. In line with this idea, a recent neuroimaging study reported that activity in the amygdala in response to emotional face expressions was greater when different faces were used than when the same face was used repeatedly (Glascher, Tuscher, Weiller, & Buchel, 2004).

A notable aspect of our results is how poorly the positive faces were recognized. We had hypothesized that positive faces might be encoded to a lesser degree than negative faces and that this might result in poorer memory, which is indeed what we found. The fact that controlling for encoding time removed any differences in recognition between positive and neutral faces, but did not affect enhanced memory for negative faces, indicates that the time spent encoding the faces leads to poor memory for positive faces but does not account for the superior memory for negative ones. Similarly, it is unlikely that differences in arousal can account for our results. The negative and positive faces used in this study were rated by both young and older adults as equally arousing (see Appendix A), yet the young adults' memory was better for the negative faces. Similarly, both positive and negative faces were rated as more arousing than neutral faces, yet memory for neutral faces did not differ from that for positive faces, once encoding RT was taken into account. Thus, the pattern of memory results does not parallel the differences in arousal ratings. It is interesting that the apparent lack of influence of arousal on emotional face memory is in contrast to evidence that arousal plays a role in memory for emotional scenes (Canli et al., 2000) and words (Kensinger & Corkin, 2004). This could be due to differences in levels of arousal elicited by various emotional stimuli, or it could indicate differences in how these stimuli are processed by the amygdala or by other brain areas mediating emotion.

Age Differences in Emotional Face Memory

The older adults in these experiments showed lower memory overall compared with young adults. This finding is consistent with earlier reports of age-related differences in face memory (Bartlett, Leslie, Tubbs, & Fulton, 1989; Crook & Larrabee, 1992; Grady et al., 1995; Smith & Winograd, 1978). As well, the older adults showed no enhancement of recognition for negative faces relative to positive and neutral faces. This finding is similar to the lower accuracy shown by older adults in labeling specific negative expressions, such as fear and anger (Calder et al., 2003; Keightley et al., 2006; MacPherson et al., 2002; McDowell et al., 1994; Oscar-Berman et al., 1990; Phillips et al., 2002), although we ruled out the possibility that a deficit in encoding negative expressions was responsible for the memory deficit. Differentially poorer memory for negative faces in our older adults is consistent with lower amygdala activity in elderly persons when viewing negative stimuli (Gunning-Dixon et al., 2003; Iidaka et al., 2002; Mather et al., 2004) and with the deficits in negative face identification and memory for negative stimuli seen in patients with damage to the amygdala (e.g., Adolphs, Cahill, Schul, & Babinsky, 1997; Adolphs et al., 1999; Anderson & Phelps, 2000; Phelps & Anderson, 1997). Thus, it is possible that lower memory scores for negative faces in older adults could be due to less intense responses to these stimuli in the amygdala, which would reduce the influence of amygdala activity on other medial temporal lobe structures that is thought to underlie memory enhancement for negative emotional material (e.g., Cahill & McGaugh, 1998; Dolcos et al., 2004).

We also found that older adults, as well as young adults, showed no difference in recognition of positive and neutral faces (after controlling for encoding RT). Our results are not consistent with the idea that older adults have a bias toward positive emotions and will therefore remember positive better than negative stimuli (Carstensen et al., 2003). However, our results are consistent with an attentional or motivational bias away from or suppression of negatively valenced information. On the other hand, our data could also be explained by a change in brain function with age, which would be in line with the idea that older adults have less modulation of memory structures by the amygdala when negative stimuli are encountered, without invoking a motivational mechanism. It is not currently possible to determine from the results of previous studies, and our own, whether age differences in emotional memory are because of alterations of brain activity, which lead to behavioral differences, or whether age differences in motivation and emotional regulation alter behavioral strategies that in turn are reflected in brain activity. Nevertheless, our results add to the evidence that memory for negatively valenced information is more vulnerable to the effects of age than memory for positive material. In addition, our finding of the influence of initial processing of positive faces on later recognition of these faces in older adults, as well as in young adults, suggests that theories attempting to explain the effect of aging on emotion will need to consider this aspect of face processing as it relates to a hypothesized "positivity bias."

The regression analyses showed that personality traits influenced memory for faces in only the older adults. Better encoding and recognition of positive faces were predicted by lower negative mood, although this effect was more robust for encoding. We also found a weak association between mood and negative face recognition, such that decreased negative mood predicted increased memory for negative faces in the older adults. Neither of these findings is what would be expected from the idea of mood congruency, which predicts that memory for positive or negative material is associated with higher positive or negative mood, respectively (Rusting, 1999). Although an association between low negative mood and better memory for positive items is not entirely inconsistent with this notion, our data support an alternative interpretation. That is, our finding of better memory for both positive and negative faces in those older adults with lower negative mood suggests that increased negative mood may adversely affect judging and remembering emotional faces in older adults regardless of the valence of the emotional expression. This suggests that some effects of negative mood are nonspecific in older adults and that negative mood in general has a larger influence on emotional memory in older adults than positive mood. On the other hand, the relation between negative mood and negative face memory in older adults was only a trend, and not significant, so this effect will need to be replicated.

In addition to the mood effects, scores on the personality measures also predicted face memory in older adults. We did not find an association between neuroticism and negative face memory, as might have been expected (Rusting, 1999; Yang & Rehm, 1993). Instead, higher scores on the positive personality traits of extraversion and openness predicted lower recognition accuracy for negative faces in older adults. One explanation of this result could be that it is due to a negative correlation between extraversion and neuroticism in the older group ($r = -.62$; see Appendix C). This might indicate that our finding of higher extraversion and poorer memory for negative faces is consistent with the opposite side of the coin (i.e., higher neuroticism and better negative memory). On the other hand, positivity and negativity of both mood and personality measures are thought to represent independent dimensions and typically are not highly correlated (Watson, Wiese, Vaidya, & Tellegen, 1999). So, a more likely explanation for our regression results is that negative stimuli may be less salient for those older adults who are more open and extraverted, or may even be avoided by them (consistent with socioemotional selectivity theory; Carstensen et al., 2003), and therefore are remembered more poorly. It is of interest that a measure of emotional sensitivity was predictive of negative face memory in older adults. Those with higher scores on this measure, and hence less insight into their own and others' emotional behavior, had worse memory for negative faces and tended to judge the emotional valence of these faces less accurately as well. This finding, in conjunction with those of studies showing a reduction in emotional sensitivity with age (Pasini et al., 1992), suggests that older age influences the response of individuals to emotion in general, which in turn affects their ability to remember emotional information. Our results therefore suggest that the influence of personality traits and mood on memory for emotional material increases with age, as we have found for perception of emotional stimuli (Keightley et al., 2006).

The ability of personality to predict emotional memory in older adults was found even though we did not find the age differences in personality that have been described by others (McCrae et al., 1999). This raises the interesting possibility that some of the variability across experiments in whether an age difference in emotional memory is found could result from unassessed differences in personality traits in the older participants. That is, the older participants sampled in studies that have not found an age difference in emotional memory might differ in terms of personality traits from the participants sampled in studies finding such an effect. This would indicate that assessment of personality, and perhaps affect as well, should be a component of future studies looking at age effects on emotional memory regardless of what type of stimuli are used.

Conclusion

Young adults showed better recognition of faces with negative expressions than of faces with either positive or neutral expressions. This enhancement for negative face recognition was not seen in older adults. The age reduction in memory enhancement for negative faces, together with evidence of a greater influence of personality on emotional memory in older adults, suggests that the complex interplay of emotion and cognitive processes may change over the life span. This age difference in memory for negative emotional faces is likely to be related to the brain mechanisms responsible for processing different emotions and how these mechanisms are altered or spared by the aging process.

References

Adolphs, R., Cahill, L., Schul, R., & Babinsky, R. (1997). Impaired declarative memory for emotional material following bilateral amygdala damage in humans. *Learning and Memory, 4,* 291–300.

Adolphs, R., Tranel, D., Hamann, S., Young, A. W., Calder, A. J., Phelps, E. A., et al. (1999). Recognition of facial emotion in nine individuals with bilateral amygdala damage. *Neuropsychologia, 37,* 1111–1117.

Anderson, A. K., Christoff, K., Panitz, D., De Rosa, E., & Gabrieli, J. D. (2003). Neural correlates of the automatic processing of threat facial signals. *Journal of Neuroscience, 23,* 5627–5633.

Anderson, A. K., & Phelps, E. A. (2000). Expression without recognition: Contributions of the human amygdala to emotional communication. *Psychological Science, 11,* 106–111.

Barrick, A. L., Hutchinson, R. L., & Deckers, L. H. (1989). Age effects on positive and negative emotions. *Journal of Social Behavior and Personality, 4,* 421–429.

Bartlett, J. C., Leslie, J. E., Tubbs, A., & Fulton, A. (1989). Aging and memory for pictures of faces. *Psychology and Aging, 4,* 276–283.

Biehl, M., Matsumoto, D., Ekman, P., Hearn, V., Heider, K., Kudoh, T., & Ton, V. (1997). Matsumoto and Ekman's Japanese and Caucasian Facial Expressions of Emotion (JACFEE): Reliability Data and Cross-National Differences. *Journal of Nonverbal Behavior, 21,* 3–21.

Bradley, B. P., & Baddeley, A. D. (1990). Emotional factors in forgetting. *Psychological Medicine, 20,* 351–355.

Bradley, M. M., Greenwald, M. K., Petry, M. C., & Lang, P. J. (1992). Remembering pictures: Pleasure and arousal in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 379–390.

Cahill, L., Haier, R. J., Fallon, J., Alkire, M. T., Tang, C., Keator, D., et al. (1996). Amygdala activity at encoding correlated with long-term, free recall of emotional information. *Proceedings of the National Academy of Sciences, USA, 93,* 8016–8021.

Cahill, L., & McGaugh, J. L. (1998). Mechanisms of emotional arousal and lasting declarative memory. *Trends in Neuroscience, 21,* 294–299.

Calder, A. J., Keane, J., Manly, T., Sprengelmeyer, R., Scott, S., Nimmo-Smith, I., et al. (2003). Facial expression recognition across the adult life span. *Neuropsychologia, 41,* 195–202.

Canli, T., Zhao, Z., Brewer, J., Gabrieli, J. D. E., & Cahill, L. (2000). Event-related activation in the human amygdala associates with later memory for individual emotional experience. *Journal of Neuroscience, 20,* 1–5.

Carstensen, L. L., Fung, H. F., & Charles, S. T. (2003). Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motivation and Emotion, 27,* 103–123.

Carstensen, L. L., & Turk-Charles, S. (1994). The salience of emotion across the adult life span. *Psychology and Aging, 9,* 259–264.

Charles, S. T., Mather, M., & Carstensen, L. L. (2003). Aging and emotional memory: The forgettable nature of negative images for older adults. *Journal of Experimental Psychology: General, 132,* 310–324.

Comblain, C., D'Argembeau, A., Van der Linden, M., & Aldenhoff, L. (2004). The effect of ageing on the recollection of emotional and neutral pictures. *Memory, 12,* 673–684.

Critchley, H., Daly, E., Phillips, M., Brammer, M., Bullmore, E., Williams, S., et al. (2000). Explicit and implicit neural mechanisms for processing of social information from facial expressions: A functional magnetic resonance imaging study. *Human Brain Mapping, 9,* 93–105.

Crook, T. H., & Larrabee, G. J. (1992). Changes in facial recognition memory across the adult life span. *Journal of Gerontology, 47,* 138–141.

D'Argembeau, A., & Van der Linden, M. (2004). Identity but not expression memory for unfamiliar faces is affected by ageing. *Memory, 12,* 644–654.

Denburg, N. L., Buchanan, T. W., Tranel, D., & Adolphs, R. (2003). Evidence for preserved emotional memory in normal older persons. *Emotion, 3,* 239–253.

Deptula, D., Singh, R., & Pomara, N. (1993). Aging, emotional states, and memory. *American Journal of Psychiatry, 150,* 429–434.

Dewhurst, S. A., & Parry, L. A. (2000). Emotionality, distinctiveness, and recollective experience. *European Journal of Cognitive Psychology, 12,* 541–551.

Dolcos, F., LaBar, K. S., & Cabeza, R. (2004). Interaction between the amygdala and the medial temporal lobe memory system predicts better memory for emotional events. *Neuron, 42,* 855–863.

Ferre, P. (2003). Effects of level of processing on memory for affectively valenced words. *Cognition and Emotion, 17,* 859–880.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-Mental State": A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12,* 189–198.

Glascher, J., Tuscher, O., Weiller, C., & Buchel, C. (2004). Elevated responses to constant facial emotions in different faces in the human amygdala: An fMRI study of facial identity and expression. *BMC Neuroscience, 5,* 45.

Grady, C. L., McIntosh, A. R., Horwitz, B., Maisog, J. M., Ungerleider, L. G., Mentis, M. J., et al. (1995, July 14). Age-related reductions in human recognition memory due to impaired encoding. *Science, 269,* 218–221.

Gross, J. J., Carstensen, L. L., Pasupathi, M., Tsai, J., Skorpen, C. G., & Hsu, A. Y. (1997). Emotion and aging: Experience, expression, and control. *Psychology and Aging, 12,* 590–599.

Gunning-Dixon, F. M., Gur, R. C., Perkins, A. C., Schroeder, L., Turner, T., Turetsky, B. I., et al. (2003). Age-related differences in brain activation during emotional face processing. *Neurobiology of Aging, 24,* 285–295.

Iidaka, T., Okada, T., Murata, T., Omori, M., Kosaka, H., Sadato, N., et al. (2002). Age-related differences in the medial temporal lobe responses to emotional faces as revealed by fMRI. *Hippocampus, 12,* 352–362.

Keightley, M. L., Winocur, G., Burianova, H., Hongwanishkul, D., & Grady, C. (2006). Age effects on social cognition: Faces tell a different story. *Psychology and Aging.*

Kensinger, E. A., Brierley, B., Medford, N., Growdon, J. H., & Corkin, S. (2002). Effects of normal aging and Alzheimer's disease on emotional memory. *Emotion, 2,* 118–134.

Kensinger, E. A., & Corkin, S. (2004). Two routes to emotional memory: Distinct neural processes for valence and arousal. *Proceedings of the National Academy of Sciences, USA, 10,* 3310–3315.

Kirita, T., & Endo, M. (1995). Happy face advantage in recognizing facial expressions. *Acta Psychologica, 89,* 149–163.

Knight, B. G., Maines, M. L., & Robinson, G. S. (2002). The effects of sad mood on memory in older adults: A test of the mood congruence effect. *Psychology and Aging, 17,* 653–661.

Leigland, L. A., Schulz, L. E., & Janowsky, J. S. (2004). Age related changes in emotional memory. *Neurobiology of Aging, 25,* 1117–1124.

Leppanen, J. M., & Hietanen, J. K. (2004). Positive facial expressions are recognized faster than negative facial expressions, but why? *Psychological Research, 69,* 22–29.

MacPherson, S. E., Phillips, L. H., & Della Sala, S. (2002). Age, executive function, and social decision making: A dorsolateral prefrontal theory of cognitive aging. *Psychology and Aging, 17,* 598–609.

Mather, M., Canli, T., English, T., Whitfield, S., Wais, P., Ochsner, K., et al. (2004). Amygdala responses to emotionally valenced stimuli in older and younger adults. *Psychological Science, 15,* 259–263.

Mather, M., & Carstensen, L. L. (2003). Aging and attentional biases for emotional faces. *Psychological Science, 14,* 409–415.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology, 52,* 81–90.

McCrae, R. R., Costa, P. T., Pedroso de Lima, M., Simoes, A., Ostendorf, F., Angleitner, A., et al. (1999). Age differences in personality across the adult life span: Parallels in five cultures. *Developmental Psychology, 35,* 466–477.

McDowell, C. L., Harrison, D. W., & Demaree, H. A. (1994). Is right hemisphere decline in the perception of emotion a function of aging? *International Journal of Neuroscience, 79,* 1–11.

Morris, J. S., Friston, K. J., Buchel, C., Frith, C. D., Young, A. W., Calder, A. J., et al. (1998). A neuromodulatory role for the human amygdala in processing emotional facial expressions. *Brain, 121,* 47–57.

Mroczek, D. K., & Kolarz, C. M. (1998). The effect of age on positive and negative affect: A developmental perspective on happiness. *Journal of Personality and Social Psychology, 75,* 1333–1349.

Ochsner, K. N. (2000). Are affective events richly recollected or simply familiar? The experience and process of recognizing feelings past. *Journal of Experimental Psychology: General, 129,* 242–261.

Oscar-Berman, M., Hancock, M., Mildworf, B., Hutner, N., & Weber, D. A. (1990). Emotional perception and memory in alcholism and aging. *Alcoholism: Clinical and Experimental Research, 14,* 383–393.

Parker, J. D., Taylor, G. J., & Bagby, R. M. (1993). Alexithymia and the recognition of facial expressions of emotion. *Psychotherapy and Psychosomatics, 59,* 197–202.

Pasini, A., Delle Chiaie, R., Seripa, S., & Ciani, N. (1992). Alexithymia as related to sex, age, and educational level: Results of the Toronto Alexithymia Scale in 417 normal subjects. *Comprehensive Psychiatry, 33,* 42–46.

Phelps, E. A., & Anderson, A. K. (1997). Emotional memory: What does the amygdala do? *Current Biology, 7,* 311–314.

Phillips, L. H., MacLean, R. D., & Allen, R. (2002). Age and the understanding of emotions: Neuropsychological and sociocognitive perspectives. *Journal of Gerontology Series B: Psychological Science and Social Science, 57,* 526–530.

Rahhal, T. A., May, C. P., & Hasher, L. (2002). Truth and character: Sources that older adults can remember. *Psychological Science, 13,* 101–105.

Raven, J. C. (1982). *Revised manual for Raven's Progressive Matrices and Vocabulary Scale.* Windsor, United Kingdom: nferNelson.

Rusting, C. L. (1999). Interactive effects of personality and mood on emotion-congruent memory and judgment. *Journal of Personality and Social Psychology, 77,* 1073–1086.

Smith, A. D., & Winograd, E. (1978). Adult age differences in remembering faces. *Developmental Psychology, 14,* 443–444.

Suzuki, A., Hoshino, T., & Shigemasu, K. (2006). Measuring individual differences in sensitivities to basic emotions in faces. *Cognition, 99,* 327–353.

Taylor, G. J., Bagby, R. M., Ryan, D. P., & Parker, J. D. (1990). Validation of the alexithymia construct: A measurement-based approach. *Canadian Journal of Psychiatry, 35,* 290–297.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070.

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology, 76,* 820–838.

Yang, J. A., & Rehm, L. P. (1993). A study of autobiographical memories in depressed and nondepressed elderly individuals. *International Journal of Aging and Human Development, 36,* 39–55.

Zonderman, A. B., Siegler, I. C., Barefoot, J. C., Williams, R. B., & Costa, P. T., Jr. (1993). Age and gender differences in the content scales of the Minnesota Multiphasic Personality Inventory. *Experimental Aging Research, 19,* 241–257.

(*Appendixes follow*)

Appendix A

Valence and Arousal Ratings for Faces

Sample	Negative		Positive		Neutral	
	M	*SD*	*M*	*SD*	*M*	*SD*
Valence						
Young	2.01	0.38	4.11	0.39	2.98	0.08
Middle	2.17	0.52	3.92	0.37	2.94	0.11
Older	2.15	0.42	3.88	0.81	3.00	0.14
Arousal						
Young	2.35	0.88	2.27	0.80	1.67	0.73
Middle	2.52	0.88	2.57	0.98	2.00	0.76
Older	2.71	1.08	2.82	1.18	2.19	0.83

Note. These ratings were obtained from 16 young adults (M = 24.5 years, SD = 4.9 years), 16 middle-aged adults (M = 50.8 years, SD = 6.5 years), and 16 older adults (M = 75.6 years, SD = 5.7 years). The young and middle-aged groups had similar years of education (young, M = 16.0, SD = 1.3; middle-aged, M = 16.6, SD = 2.8), but the older group had significantly fewer years of education relative to the younger groups (M = 13.3, SD = 3.3, $p < .02$). For valence ratings, the main effect of valence was significant, $F(2, 90) = 205.3$, $p < .001$. Bonferroni t tests indicated that all three valence ratings differed from one another ($p < .001$). Neither the main effect of age on valence ratings nor the Age × Valence interaction was significant (Fs < 1). The arousal ratings showed a similar pattern in that there was a significant effect of valence, $F(2, 90) = 32.5$, $p < .001$. Bonferroni t tests indicated that arousal ratings were higher for both positive and negative faces, compared with neutral faces ($p < .001$), but there was no difference between arousal ratings for positive and negative faces. Neither the main effect of age on arousal ratings, $F(2, 45) = 1.3$, $p > .10$, nor the Age × Valence interaction was significant ($F < 1$).

Appendix B

Correlations Among Personality and Mood Scores in Young Adults

Measure	P-pos	P-neg	TAS	Neurot	Extrav	Open	Agree
PANAS negative	0.01						
TAS	−0.16	0.21					
Neuroticism	−0.07	0.25	0.49*				
Extraversion	0.35*	−0.07	−0.25	−0.37*			
Openness	0.08	0.04	−0.38*	0.16	0.00		
Agreeableness	0.01	−0.32*	−0.44*	−0.19	0.20	0.05	
Conscientiousness	0.21	−0.21	−0.24	−0.33*	0.34*	−0.25	0.31

Note. PANAS = Positive and Negative Affect Schedule; P-pos = PANAS positive mood score; P-neg = PANAS negative mood score; TAS = emotional sensitivity scale; Neurot = neuroticism; Extrav = extraversion; Open = openness; Agree = agreeableness.
* $p < .05$.

Appendix C

Correlations Among Personality and Mood Scores in Older Adults

Measure	P-pos	P-neg	TAS	Neurot	Extrav	Open	Agree
PANAS negative	−0.06						
TAS	−0.35	0.23					
Neuroticism	−0.28	0.56*	0.54*				
Extraversion	0.46*	−0.37*	−0.51*	−0.62*			
Openness	−0.04	0.04	−0.37*	0.00	0.06		
Agreeableness	0.14	−0.31	−0.20	−0.37*	−0.04	−0.28	
Conscientiousness	0.21	−0.33	−0.57*	−0.56*	0.35	0.02	0.47*

Note. PANAS = Positive and Negative Affect Schedule; P-pos = PANAS positive mood score; P-neg = PANAS negative mood score; TAS = emotional sensitivity scale; Neurot = neuroticism; Extrav = extraversion; Open = openness; Agree = agreeableness.
* $p < .05$.

Received March 24, 2006
Revision received October 31, 2006
Accepted November 20, 2006 ■