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Identity but not Expression Memory for Unfamiliar Faces is Affected by Ageing

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Abstract

We examined age-related differences in memory for identity and emotional expression of unfamiliar faces. Younger and older adults were presented with happy and angry faces and were later asked to recognise the same faces displaying a neutral expression. When a face was recognised, they also had to remember what the initial expression of the face had been. In addition, states of awareness associated with both identity and expression memory were assessed with the remember/know/guess paradigm. Older adults showed less recollective experience than younger adults for identity but not for emotional expressions of the faces. This evidence indicates that age-related differences in memory may depend on the nature of the to-be-remembered information, with emotional/social information being remembered as well in older as in younger adults.

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There is general agreement in the literature on cognitive ageing that episodic memory functioning declines with age. These age-related changes vary with the tasks that are used, with losses in performance more pronounced in some tasks than in others. For example, whereas age-related declines are slight in many recognition memory tasks, they are substantial in tasks involving free or cued recall (see Balota, Dolan, & Duchek, 2000; Zacks, Hasher, & Li, 2000 for reviews). In addition, old people seem to be disproportionately affected in their ability to consciously recollect events and the context in which they occurred. Indeed, there is evidence that age differences in context memory are reliably greater than those in memory for content (see Spencer & Raz, 1995 for a meta-analysis). Furthermore, it has been found that recognition memory was less often accompanied by a rich recollection of the encoding episode (as assessed by "remember" responses) in older than in younger adults (Clarys, Insingrini, & Gana, 2002; Mäntylä, 1993; Parkin & Walter, 1992; Perfect & Dasgupta, 1997; Perfect, Williams, & Anderson-Brown, 1995, Experiment 1 & 2B). Finally, Bartlett and his colleagues repeatedly found that older adults made more false alarms than younger adults during face recognition (e.g., Bartlett & Fulton, 1991; Bartlett, Strater, & Fulton, 1991; Searcy, Bartlett, & Memon, 1999; Searcy, Bartlett, Memon, & Swanson, 2001) and they reported evidence which suggests that this is due to a tendency for older individuals to rely relatively more on perceived familiarity, and less on recollection of context, in making recognition decisions (Bartlett & Fulton, 1991; Bartlett et al., 1991).

Most of these studies used emotionally neutral words or pictures and it is possible that this bias toward using nonemotional stimuli is responsible for the robust age-related decline in episodic memory that is typically observed. Indeed, the nature of the stimuli may be particularly important in ageing studies because there is evidence that cognitive processing goals shift with age, such that information processing becomes more emotion focused (see

Isaacowitz, Charles, & Carstensen, 2000). For instance, it has been found that younger and older adults tend to focus on different dimensions of the same event, with younger adults placing relatively more emphasis on perceptual details than older adults, and older adults focusing more on affective and value-based information than younger adults (Hashtroudi, Johnson, & Chrosniak, 1990; Hashtroudi, Johnson, Vnek, & Ferguson, 1994). In addition, other studies suggest that ageing is also associated with increased expertise in the social domain. For instance, the ability to discriminate between more or less informative aspects of behaviours in order to make inferences about other people seems to be enhanced in the elderly (Hess & Auman, 2001).

An enhanced motivation in older adults to process emotionally/socially significant information could make the age-related decline in episodic memory less pronounced or even eliminated for emotional compared to neutral stimuli. Consistent with this proposition, Carstensen and Turk-Charles (1994) found, in a study of prose recall, that although older adults remembered less neutral content than young adults, both age groups recalled equivalent amounts of emotional material. More recently, Kensinger, Brierley, Medford, Growdon, and Corkin (2002) also found that young and older adults showed similar memory enhancement effects for emotional words or pictures, as compared to neutral items. In addition, Davidson and Glisky (2002) found that memory for contextual information associated with important emotional news (flashbulb memories) was not affected by ageing. Finally, Rahhal, May, and Hasher (2002) reported two studies in which age differences in memory were robust for perceptual source material but were negligible for affective or value-based source information.

Together, these findings strongly suggest that age-related decline in episodic memory may vary according to the emotional salience of the to-be-remembered information. In the present study, we examined the generalisability of this proposition by assessing memory for

two kinds of facial information which vary according to their social/emotional significance. The human face is a frequent, highly significant, social stimulus which provides various information that can be used to recognise familiar people and also to infer people's age, gender, or emotional state (Bruce & Young, 1986). The perception of invariant aspects of face structure underlies the recognition of individuals (identity recognition), whereas the perception of changeable aspects, such as eye gaze, expression, and lip movement, plays a more central role in social communication (Haxby, Hoffman, & Gobbini, 2002). A large body of studies have consistently found that identity recognition of unfamiliar faces is affected by ageing (e.g., Bartlett & Fulton, 1991; Grady, Bernstein, Beig, & Siegenthaler, 2002; Searcy et al., 1999, 2001). In contrast, memory for emotional expressions has received little interest by researchers and, to the best of our knowledge, no ageing studies were specifically designed to investigate expression memory. Nevertheless, there are a few studies which are relevant to this issue.

In two experiments reported by Bartlett and Leslie (1986), older and younger participants saw pictures of faces either in a single-view condition (in which each face was shown once) or in a multiple-view condition (in which each face was shown in four different poses). They were later presented with identical pictures of the faces, pictures of the same faces with a different expression, pictures of the same faces changed in both expression and pose, and pictures of new faces. For each picture, participants were asked to say if the picture was “exactly the same”, “old-but-different”, or “new”. It was found that, in the single-view condition, older adults performed worse than younger adults in discriminating identical from changed-expression faces, which suggests that their memory for emotional expression was reduced. However, this finding was not replicated in two subsequent experiments in which there were no age-related differences in discriminating identical from changed-expression items (Bartlett, Leslie, Tubbs, & Fulton, 1989). Finally, in a recent study by Thompson,

Aidinejad, and Ponte (2001), older adults were found to be more prone to reconstruct what people state verbally in a conversation to coincide with the meaning of the facial expressions people displayed during that conversation, which suggests that older adults pay more attention to the facial expressions of a speaker than do younger adults. However, expression memory itself was not assessed in this study.

It is difficult to draw clear conclusions about age-related differences in facial expression memory from these inconsistent findings. Yet, this is an important issue deserving further investigation because facial expressions are important social cues that enable us to infer intentions and emotions of others and consequently to regulate our behaviour adaptively. Furthermore, memory for expressions connoting approval or disapproval probably plays an important role in the retrospective evaluation of social situations and consequently influences the way one interprets and apprehends current and future interactions. From a methodological point of view, the use of a recognition task, as was the case in Bartlett and Leslie (1986)'s and Bartlett et al. (1989)'s studies, may not be the best way to assess expression memory. Indeed, in everyday life, we rarely try to remember what the expression of an individual was in a previous situation by seeing the same expression again and choosing it among distracters. Instead, we more probably try to retrieve and reconstruct a visual representation of what that expression was. Accordingly, recall or cued recall tasks might be more appropriate to assess expression memory.

The purpose of the present study was to examine age-related differences in memory for both identity and emotional expression of unfamiliar faces. Young and older participants were presented with happy and angry faces and were later asked to recognise neutral faces of the same individuals. When a face was recognised, expression memory was assessed by asking participants to decide whether this face had been presented earlier with a happy or an angry expression. In addition, states of awareness associated with both identity and expression

memory were assessed with the "remember/know/guess" procedure (Gardiner & Richardson-Klavhen, 2000). In line with previous findings (Bartlett & Fulton, 1991; Grady et al., 2002; Searcy et al., 1999, 2001), we thought that identity memory would be reduced in older adults. Furthermore, if, as it has been argued (Bartlett & Fulton, 1991; Bartlett et al., 1991; Searcy et al., 1999), this is the consequence of problems with recollection of context, identity recognition should be less often accompanied with "remember" responses in older than in younger adults. Such an age-related decline in recollection has been previously reported for word recognition (Clarys et al., 2002; Mäntylä, 1993; Parkin & Walter, 1992; Perfect & Dasgupta, 1997; Perfect et al., 1995, Experiment 1 & 2B), but, to the best of our knowledge, it has not been examined with face stimuli.

In addition, if, as is suggested by several lines of evidence (Isaacowitz et al., 2000), the processing of emotionally/socially significant information is less affected by ageing, we should observe two additional findings. First, there should be an influence of the type of expression displayed by the faces during presentation (happy vs. angry) on subsequent identity recognition for both younger and older adults. Indeed, we found in two previous studies with young participants that identity recognition is more often accompanied by "remember" responses for faces that had been previously seen with a happy expression than for faces previously seen with an angry expression (D'Argembeau, Van der Linden, Comblain, & Etienne, in press; D'Argembeau, Van der Linden, Etienne, & Comblain, 2002). This effect should also be observed for older adults in the present study. Second, memory for emotional expressions themselves should not differ between young and older participants.

Method

Participants

Thirty-two young adults (range = 20-25 years, *M* = 24 years) and thirty-two older adults (range = 60-70 years, *M* = 67 years) participated in this study. Both groups consisted of

half males and half females. The older adults came from the general community and lived in their own homes. All participants were volunteers and reported themselves to be in good physical and mental health. Years of education were equivalent in the two age groups (*M*s = 13.84 and 14.53, for the old and young groups, respectively), $t(62) = 1.41$, $p = .16$. Vocabulary performances, as assessed by the Mill Hill (French translation by Deltour, 1993), tended to be higher for older ($M = 25.97$) than for younger ($M = 23.41$) adults, $t(62) = 1.89$, $p = .062$, a finding which is frequently reported in ageing studies. Scores at the Beck Depression Inventory (Beck, Rush, Shaw, & Emery, 1979) were equivalent in both groups ($M = 6.47$ for the young and $M = 8.13$ for the elderly), $t(62) = 1.30$, $p = .20$.

Materials

Black and white pictures of 24 different faces (12 males and 12 females), each displaying a neutral, a happy, and an angry expression were used. These pictures were selected from four different databases (Beaupré, Cheung, & Hess, 2000; Bégin, Kirouac, & Doré, 1984; Ekman & Friesen, 1976; Martinez & Benavente, 1998). Stimuli with unusual features (e.g., beards, glasses) were not used. All the photos were retouched with Adobe Photoshop software to standardise their frame, size, background colour, and, whenever possible, luminosity and contrast.

Two sets (A and B) of 12 faces (6 male and 6 female) were made. Whenever possible, faces in sets A and B were matched for physical similarity (e.g., hair size and colour, complexion). Six happy faces (three male, three female) and six angry faces (three male, three female) were presented during the inspection phase. The use of sets A and B as studied or nonstudied items was counterbalanced across participants. Also, within each set, each face was seen with a happy expression by half the participants and with an angry expression by the other half. This made it possible to look for the effect of face expression on memory unconfounded with differences in the memorability of particular people's faces. Stimuli were

placed in a pseudorandom but fixed order in such a manner that no more than two faces with the same expression occurred in succession. To counterbalance for order effects, the photos were presented in one order for half the participants and in the reverse order for the other half. Two test lists were constructed using the 24 neutral faces. Stimuli were placed in a pseudorandom but fixed order so that no more than three “old” or “new” faces, and no more than two “old” faces that had the same expression at study should occur in succession. The second list presented the photos in reverse order.

Procedure

Participants were tested individually. Each face was shown for 5 s on a computer screen approximately 60 cm in front of them. They were asked to look carefully at the faces in order to be able to recognise them later. After a 5-min retention interval, participants were presented with the recognition test. They were told that they would be shown a series of faces some of which represented people they had been shown initially, though the expression of the faces had changed (all the faces were neutral). When each item appeared, they had to decide whether they had seen it before. Furthermore, they had to report whether their recognition was of the remember (R), the know (K) or the guess (G) variety. The instructions we used to explain the R, K, and G responses were inspired from those used by Gardiner and colleagues (see Gardiner & Richardson-Klavehn, 2000). Briefly, participants were told that an R response should be given to any face which, at the time it was recognized, brought back to mind something they had consciously experienced (e.g., an association, a thought, a feeling, etc.) at the time it was presented. In contrast, they were asked to make a K response if the face felt familiar but they were unable to recollect details of its prior exposure. Finally, they were asked to make a G response if they were unsure whether or not the face had been presented in the study phase.

Participants were also asked to remember the initial expression of the faces they claimed to recognise. They were told that some of the faces they had seen in the study phase had a happy expression and other faces an angry expression. When they classified a face as old, they were asked to decide whether this face had had a happy or angry expression when they first saw it in the study phase, and they also had to classify their responses according to the R/K/G paradigm. They were asked to make an R response if they could consciously recall seeing the expression of the face, if they could remember what the expression looked like. They were asked to make a K response if they believed that the face had a particular expression but they could not consciously recollect what the expression looked like. They were asked to make a G response if they had no idea of the expression and they had guessed. Participants were asked to repeat the instructions concerning the R/K/G classification for identity and for emotional expression of the faces and also to explain the rationale for some of their responses to ensure that they had understood the classification correctly. All the responses were made orally and each face remained on the screen until participants indicated their responses.

Results

Identity Recognition

Overall identity recognition performances were examined by analysing total hit scores and false alarms (see Table 1 for mean proportions), as well as discrimination and bias measures derived from signal detection theory (*d'* and *C*; see MacMillan & Creelman, 1991). Total hit scores tended to be higher for young (M = .734) than for older (M = .648) adults, $F(1, 62) = 3.68$, p = .059. Although total hit scores tended to be higher for faces that were previously seen with a happy expression (M = .714) than faces previously seen with an angry expression (M = .669), this difference failed to reach statistical significance, $F(1, 62) = 2.81$, p = .099. There was no age by expression type interaction, $F < 1$. An analysis of false alarm

rates indicated that the elderly (M = .344) made more false alarms than the young (M = .214), $F(1, 62) = 13.35$, $p < .001$. In addition, signal detection analyses revealed that the sensitivity parameter *d'* was higher for young (*d'* = 1.99) than for older (*d'* = 0.96) adults, $F(1, 62) = 8.37$, $p < .01$, whereas response bias measure (C) was not different between the two groups (C = .029 for the young and C = .042 for the elderly), $F < 1$.

-INSERT TABLE 1 APPROXIMATELY HERE-

We also examined the influence of ageing and expression type (happy vs. angry) on states of awareness associated with identity recognition by decomposing overall recognition scores into R, K, and G responses. Table 1 shows the mean proportions of R, K, and G responses for identity recognition as a function of age and expression type.

Separate 2 (age: young vs. old) X 2 (expression type: happy vs. angry) analyses of variance (ANOVAs) were performed on R, K, and G responses. For R responses, there was a significant main effect of expression type, $F(1, 62) = 5.42$, $p < .05$, indicating that recognition of faces that were previously seen with a happy expression was more often associated with an R response (M = .484) than recognition of faces previously seen with an angry expression (M = .406). Furthermore, young adults (M = .492) tended to report more R responses than older adults (M = .398), $F(1, 62) = 3.78$, $p = .056$, and there was no age by expression type interaction, $F < 1$.

The proportion of K responses did not differ between young and older adults, $F < 1$, nor between faces that were previously seen with a happy expression and faces previously seen with an angry expression, $F(1, 62) = 2.47$, $p = .12$. Furthermore, age did not interact with expression type, $F < 1$. Similarly, there were no main effects of age, $F < 1$, or expression type, $F(1, 62) = 1.92$, $p = .17$, nor age by expression type interaction, $F < 1$, for G responses.

Finally, we examined states of awareness associated with false alarms. Table 1 shows the proportions of false alarms associated with R, K, and G responses for young and older

adults. Older adults reported more R and K, but not G, responses than younger adults, $F(1, 62) = 5.18$, $p < .05$, $F(1, 62) = 4.74$, $p < .05$, and $F < 1$, respectively.

Memory for Emotional Expressions

Memory for emotional expressions was assessed by determining the probability that a participant correctly recalled expression conditionalized upon correct identity recognition. For each participant, proportions of correct and incorrect responses for expression memory were calculated separately for each type of expression (happy vs. angry). This was made by dividing the number of correct or incorrect R, K, and G responses for each type of expression by the number of correct identity recognitions (hits) for that type of expression. Data from one older adult were dropped because he did not recognise any faces previously presented with a happy expression. Table 2 shows mean proportions of R, K, and G responses for expression memory as a function of age and expression type.

-INSERT TABLE 2 APPROXIMATELY HERE-

Separate 2 (age: young vs. old) X 2 (expression type: happy vs. angry) ANOVAs were performed on total correct responses, and on correct R, K, and G responses. For total correct responses, there was no significant effect of age, $F(1, 61) = 2.07$, $p = .16$, nor of expression type, $F(1, 61) = 1.09$, $p = .30$, and the age by expression type interaction was also not significant, $F < 1$. Although the proportion of total correct responses of young ($M = .643$) and older ($M = .582$) adults was somewhat low, it was significantly higher than chance for both groups, $t(31) = 5.10$, $p < .01$, and $t(30) = 2.55$, $p < .01$, respectively.

When considering qualitative aspects of expression memory, the proportions of R responses were equivalent in young ($M = .327$) and older ($M = .304$) adults, $F < 1$. Similarly, there were no significant effects of age on K and G responses, $F(1, 61) = 1.48$, $p = .23$, and $F < 1$, respectively. Furthermore, the proportions of R, K, and G responses were not different for happy and angry expressions, all Fs < 1. Finally, there was no age by expression type

interaction on either R, K, or G responses, $F(1, 61) = 3.17$, $p = .08$ for R responses, and Fs < 1 for K and G responses.

Discussion

We investigated the influence of ageing on both identity recognition and memory for emotional expression of unfamiliar faces. We found that identity recognition (as indexed by *d'*) was better for young than older adults. Total hit scores tended to be higher for young than older adults and older adults made more false alarms than younger adults, a finding that is consistent with previous studies which examined the influence of ageing on face recognition (e.g., Bartlett & Fulton, 1991; Grady et al., 2002; Searcy et al., 2001). Identity recognition was also less often associated with an R response in older than in younger adults. This finding extends previous studies that found a decrease in R responses associated with word recognition in the elderly (Clarys et al., 2002; Mäntylä, 1993; Parkin & Walter, 1992; Perfect & Dasgupta, 1997; Perfect et al., 1995, Experiment 1 & 2B) by showing that such an age-related decline in recollection is not restricted to verbal material. We also found that young and older adults did not differ with regard to K and G responses. Finally, false alarms were more often associated with R and K, but not G, responses for older than for younger adults. Overall, these findings indicate that identity of unfamiliar faces is less richly recollected in older than in younger adults.

Although identity recognition was affected by ageing, the influence of happy and angry expressions on identity recognition was the same in both young and older adults, with faces that were previously seen with a happy expression receiving more R responses than faces previously seen with an angry expression. Such an influence of expression type on identity memory was also found in two previous studies with young adults and we argued that it can be explained by the social meaning of emotional expressions for the self (D'Argembeau et al., in press, 2002). Indeed, it has been found that the degree of elaboration and attention

during encoding affected the proportion of R responses (see Gardiner & Richardson-Klavehn, 2000 for a review). For instance, when attentional resources are engaged in a concurrent task during face encoding, the R component of recognition memory tends to be reduced while the proportion of K responses remains unaffected (Parkin, Gardiner, & Rosser, 1995). In addition, there is evidence that most people tend to process preferentially positive rather than negative social information that is self-relevant such as feedback provided by other people (see Baumeister, 1998 for a review). Facial expressions of emotions are highly significant social stimuli that play an important role in the regulation of social interactions by providing feedback about attitudes, intentions, and emotional states. A happy expression denotes approval and satisfaction with our current behaviour or attitude whereas an angry expression denotes disapproval. A greater motivation to process positive rather than negative face stimuli should therefore make positive faces to be more richly recollected in memory, which is consistent with our previous findings with young adults (D'Argembeau et al., in press, 2002). The present study extends these findings by showing that, although identity memory is affected by ageing, the memory bias for faces with positive expressions is similar in young and older adults. Therefore, it seems that the modulation of memory performances by motivational factors, such as the relevance of information to processing goals of the self, is not affected by ageing.

Another important finding of the present study is that older adults were not impaired in memory for emotional expressions of the faces. Most interesting was the finding that, contrary to identity memory, the proportion of R responses associated with expression memory was not different between younger and older adults. Therefore, there was no age-related reduction in recollective experience for information with important emotional/social value. This finding is consistent with others showing that the typical age-related decline in episodic memory is, at least in part, dependent on the stimuli that are used (Carstensen &

Turk-Charles, 1994; Davidson & Glisky, 2002; Kensinger et al., 2002; Rahhal et al., 2002). With age, information processing goals shift, leading older adults to be more motivated to process emotionally-significant information (Isaacowitz et al., 2000). This differential importance of emotional/social stimuli could make older people devote preferentially their limited information-processing resources to this kind of information, thus limiting their memory difficulties for emotional relative to neutral stimuli. Such a focus on emotional stimuli would be adaptive because emotion often signals that an event has important implications for the goals of an individual and, consequently, memory for this information is important in making decisions and in regulating present and future behaviour (Ochsner & Schacter, 2000).

Finally, one could speculate about the reasons why older adults sometimes show reduced recollective experience and sometimes do not. Previous studies suggest that the often reported age-related decline in recollective experience is the consequence of a reduced ability for older people to spontaneously initiate adequate (elaborative) encoding strategies. Indeed, Perfect and Dasgupta (1997) asked older and younger participants to say everything they were thinking about when encoding words and nonwords. They found that older adults used encoding strategies less often than younger adults. However, once these encoding differences had been taken into account (by focusing exclusively on those items that received elaborative encoding), there were no age effects on reported recollective experience. Furthermore, Perfect et al. (1995, Experiment 2) found that after depth-of-processing instructions were given to constrain the nature of encoding, the age difference in recollective experience was reduced. From these findings, Perfect and Dasgupta (1997) concluded that “older adults show reduced recollective experience because of poorer encoding rather than because of a failure to reintegrate item and context at retrieval” (p. 856). The present findings further suggest that not all information is poorly encoded by older adults. Information that is highly relevant to

their processing goals may trigger elaborate encoding strategies in older people, thereby ensuring that this important information can be richly recollected subsequently.

In summary, we sought to investigate age-related differences in memory for two kinds of facial information that vary according to their emotional/social value. We found that ageing was associated with a decline in memory for identity but not for emotional expressions of unfamiliar faces. This evidence indicates that age-related differences in memory may depend on the nature of the to-be-remembered information, with emotional/social information being remembered just as well by older as by younger adults.

References

Balota, D. A., Dolan, P. O., & Duchek, J. M. (2000). Memory changes in healthy older adults. In E. Tulving & F. I. M. Craik (Eds.), *The oxford handbook of memory* (pp. 395-409). Oxford: Oxford University Press.

Bartlett, J. C., & Fulton, A. (1991). Familiarity and recognition of faces in old age. *Memory & Cognition, 19,* 229-238.

Bartlett, J. C., & Leslie, J. E. (1986). Aging and memory for faces versus single views of faces. *Memory & Cognition, 14,* 371-381.

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

Bartlett, J. C., Strater, L., & Fulton, A. (1991). False recency and false fame of faces in young adulthood and old age. *Memory & Cognition, 19,* 177-188.

Baumeister, R. F. (1998). The self. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed., vol. 1, pp. 680-740). New-York: McGraw-hill.

Beaupré, M., Cheung, N., & Hess, U. (2000, october). *La reconnaissance des expressions émotionnelles faciales par des décodeurs africains, asiatiques, et caucasiens*. Poster presented at the XXIIIe Congrès annuel de la Société Québécoise pour la Recherche en Psychologie, Hull, Qc.

Beck, A. T., Rush, A. J., Shaw, B. F., & Emery, G. (1979). *Cognitive therapy for depression.* New York: Guilford Press.

Bégin, C., Kirouac, G., & Doré, F. (1984). *Collection de stimuli faciaux émotionnels élaborée à partir du FACS.* Unpublished document.

Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology, 77,* 305-327.

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

Clarys, D., Isingrini, M., Gana, K. (2002). Mediators of age-related differences in recollective experience in recognition memory. *Acta Psychologica, 109*, 315-329.

D'Argembeau, A., Van der Linden, M., Comblain, C., & Etienne, A-M. (in press). The effects of happy and angry expressions on identity and expression memory for unfamiliar faces. *Cognition & Emotion.*

D'Argembeau, A., Van der Linden, M., Etienne, A-M., & Comblain, C. (2002). *Identity and expression memory for happy and angry faces in social anxiety.* Manuscript submitted for publication.

Davidson, P. S. R., & Glisky, E. L. (2002). Is flashbulb memory a special instance of source memory? Evidence from older adults. *Memory, 10*, 99-111.

Deltour, J. J. (1993). *Echelle de vocabulaire de Mill Hill de J. C. Raven : Adaptation française et normes comparées du Mill Hill et du Standard Progressive Matrices (PM 38).* Braine-le-Château, Belgique :Editions L'application des Techniques Modernes.

Ekman, P., & Friesen, W. V. (1976). *Pictures of facial affect.* Palo Alto, CA: Consulting Psychologists Press.

Gardiner, J. M., & Richardson-Klavehn, A. (2000). Remembering and knowing. In E. Tulving & F. I. M. Craik (Eds.), *The oxford handbook of memory* (pp. 229-244). Oxford: Oxford University Press.

Grady, C. L., Bernstein, L. J., Beig, S., & Siegenthaler, A. L. (2002). The effects of encoding task on age-elated differences in the functional neuroanatomy of face memory. *Psychology and Aging, 17,* 7-23.

Hashtroudi, S., Johnson, M. K., & Chrosniak, L. D. (1990). Aging and qualitative characteristics of memories for perceived and imagined complex events. *Psychology and Aging, 5*, 119-126.

Hashtroudi, S., Johnson, M. K., Vnek, N., & Ferguson, S. A. (1994). Aging and the effects of affective and factual focus on source monitoring and recall. Psychology and Aging, 9, 160-170.

Haxby, J. V., Hoffman, E. A., & Gobbini, M. I. (2002). Human neural systems for face recognition and social communication. *Biological Psychiatry, 51*, 59-67.

Hess, T. M., & Auman, C. (2001). Aging and social expertise: The impact of trait-diagnostic information on impressions of others. *Psychology and Aging, 16*, 497-510.

Isaacowitz, D. M., Turk-Charles, S., & Carstensen, L. L. (2000). Emotion and cognition. In F. I. M. Craik & T. A. Salthouse (Eds.), The handbook of aging and cognition (2nd ed., pp. 593-631). Mahwah, NJ: Erlbaum.

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.

MacMillan, N. A., & Creelman, C. D. (1991). *Detection theory: A user's guide*. Cambridge, UK: Cambridge University Press

Mäntylä, T. 1993). Knowing but not remembering: Adult age differences in recollective experience. *Memory & Cognition, 21*, 379-388.

Martinez, A. M, & Benavente, R. (1998). *The AR Face Database.* CVC Technical Report #24, http://rvl1.ecn.purdue.edu/~aleix/aleix_face_DB.html.

Ochsner, K. N., & Schacter, D. L. (2000). A social cognitive neuroscience approach to emotion and memory. In J. C. Borod (Ed.), *The neuropsychology of emotion* (pp. 163-193). New York: Oxford University Press.

Parkin, A. J., Gardiner, J. M., & Rosser, R. (1995). Functional aspects of recollective experience in face recognition. *Consciousness and Cognition, 4*, 387-398.

Parkin, A. J., & Walter, B. M. (1992). Recollective experience, normal aging, and frontal dysfunction. *Psychology and Aging, 7*, 290-298.

Perfect, T. J., & Dasgupta, Z. R. R. (1997). What underlies the deficit in reported recollective experience in old age? *Memory & Cognition, 25*, 849-858.

Perfect, T. J., Williams, R. B., & Anderton-Brown, C. (1995). Age differences in reported recollective experience are due to encoding effects, not response bias. *Memory, 3*, 169-186.

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

Searcy, J. H., Bartlett, J. C., & Memon, A. (1999). Age differences in accuracy and choosing in eyewitness identification and face recognition. *Memory & Cognition, 27*, 538-552.

Searcy, J. H., Bartlett, J. C., Memon, A., & Swanson, K. (2001). Aging and lineup performance at long retention intervals: Effects of metamemory and context reinstatement. *Journal of Applied Psychology, 86*, 207-214.

Spencer, W. D., & Raz, N. (1995). Differential effects of aging on memory for content and context: A meta-analysis. *Psychology and Aging, 10*, 527-539.

Thompson, L. A., Aidinejad, M. R., & Ponte, J. (2001). Aging and the effects of facial and prosodic cues on emotional intensity ratings and memory reconstructions. *Journal of Nonverbal Behavior, 25*, 101-125.

Zacks, R. T., Hasher, L., & Li, K. Z. H. (2000). Human memory. In F. I. M. Craik & T. A. Salthouse (Eds.), The handbook of aging and cognition (2nd ed., pp. 293-357). Mahwah, NJ: Erlbaum.

Table 1

Mean Proportions of R, K, and G Responses for Identity Recognition as a Function of Age and Expression Type

	Young			Old		
Response	Happy	Angry	False alarms	Happy	Angry	False alarms
R	.542	.443	.081	.427	.370	.146
K	.198	.250	.109	.203	.245	.167
G	.026	.010	.024	.031	.021	.031
Total	.766	.703	.214	.661	.636	.344

Table 2

Mean Proportions of R, K, and G Responses for Expression Memory as a Function of Age and Expression Type

	Young				Old			
	Hits		Errors		Hits		Errors	
Response	Happy	Angry	Happy	Angry	Happy	Angry	Happy	Angry
R	.384	.269	.106	.153	.282	.326	.156	.159
K	.204	.200	.142	.160	.177	.140	.174	.151
G	.106	.123	.058	.095	.125	.113	.086	.111
Total	.694	.592	.306	.408	.584	.579	.416	.421