

The Effects of Emotional Content on Reality-Monitoring Performance in Young and Older Adults

Elizabeth A. Kensinger
Boston College

Jacqueline L. O'Brien, Kelley Swanberg,
Rachel J. Garoff-Eaton, and Daniel L. Schacter
Harvard University

Reality monitoring refers to a person's ability to distinguish between perceived and imagined events. Prior research has demonstrated that young adults show a reality-monitoring advantage for negative arousing information as compared with neutral information. The present research examined whether this reality-monitoring benefit extends to positive information in young adults and whether older adults show a reality-monitoring advantage for emotional information of either valence. Two studies revealed no evidence for a reality-monitoring advantage for positive information; in both age groups, the reality-monitoring advantage existed only for negative information. Older adults were, however, more likely to remember that a positive item had been included on a study list than they were to remember that a nonemotional item had been studied. Young adults did not show this mnemonic enhancement for positive information. These results indicate that although older adults may show some mnemonic benefits for positive information (i.e., an enhanced ability to remember that a positive item was studied), they do not always show enhanced memory for source-specifying details of a positive item's presentation.

Keywords: aging, emotion, memory, reality monitoring, source

Individuals sometimes confuse actual events with those that they have only imagined. A person may wonder whether she locked the car or imagined herself locking it, or a person may return home because he is uncertain whether he turned off the coffeepot or only thought about performing the action. The ability to distinguish between externally derived and internally generated sources of information is referred to as reality monitoring (Johnson & Raye, 1981); breakdowns in this ability are called reality-monitoring errors.

While everyone is susceptible to reality-monitoring errors, older adults often perform more poorly than young adults on tasks requiring them to determine whether information was imagined or perceived. For example, Cohen and Faulkner (1989) asked young and older adults to perform an action, to imagine performing the action, or to watch an experimenter perform the action. Older adults were more likely than young adults to misremember whether the action had been performed, imagined, or watched.

Similarly, in a study by Hashtroudi, Johnson, and Chrosniak (1990), participants either performed or imagined complex events. When later asked to distinguish between events that were performed and events that were imagined, older adults had significantly greater difficulty distinguishing between the two sources of events. Rabinowitz (1989) also found that older adults had more trouble than young adults when judging whether an item was previously read or mentally generated.

It is likely that older adults' reality-monitoring deficits arise from age-related difficulties in remembering the contextual information associated with an item's presentation (see Adams, Labouvie-Vief, Hobart, & Dorosz, 1990; Bayen, Nakamura, Dupuis, & Yang, 2000; Gould, Trevithick, & Dixon, 1991; Mather, Johnson, & De Leonardis, 1999, for evidence that older adults process information in a less detailed fashion than young adults). According to the source-monitoring framework (Johnson, Hashtroudi, & Lindsay, 1993; Johnson & Raye, 1981), individuals typically can discriminate actual from imagined events because memories of real events have different qualities than memories that originate from their imaginations: Memories that originate from perception or experience are usually remembered with more perceptual detail (e.g., color, sound), more contextual information about time and place, and more personal affective qualities. In contrast, memories originating from introspection or imagination include more detail about the cognitive operations that contributed to the generation of the information (Johnson & Raye, 1981).

Much research has provided data to support this framework. Reality-monitoring accuracy increases when people encode perceptual and contextual details about experienced items and when they must use extensive cognitive operations to imagine events (Johnson & Raye, 1981). In contrast, errors occur when individuals imagine events vividly (thereby enhancing the sensory detail as-

Elizabeth A. Kensinger, Department of Psychology, Boston College; Jacqueline L. O'Brien, Kelley Swanberg, Rachel J. Garoff-Eaton, and Daniel L. Schacter, Department of Psychology, Harvard University.

This research was supported by National Institutes of Health Grant AG08411 to Daniel L. Schacter, by National Science Foundation (NSF) Grant BCS-0542694 to Elizabeth A. Kensinger, by an NSF Graduate Research Fellowship to Rachel J. Garoff-Eaton, and by a grant from the Harvard Cooperative Research Program. The first experiment was conducted as part of Jacqueline L. O'Brien's undergraduate honors thesis. Portions of this research were conducted while Elizabeth A. Kensinger was a fellow of the American Federation for Aging Research.

Correspondence concerning this article should be addressed to Elizabeth A. Kensinger, Boston College, Department of Psychology, McGuinn Hall, Room 510, 140 Commonwealth Avenue, Chestnut Hill, MA 02467. E-mail: elizabeth.kensinger@bc.edu

sociated with the imagined items) or effortlessly (thereby reducing the cognitive operations associated with the item's generation; e.g., Henkel, Johnson, & De Leonardis, 1998; Johnson, Foley, & Leach, 1988; Johnson, Raye, Foley, & Foley, 1981; Mammarella & Cornoldi, 2002). Recent neuroimaging evidence also has suggested that individuals tend to believe that an item was perceived if its retrieval is associated with enhanced activation in sensory cortices, whereas they are likely to attribute an item to imagination if the item's retrieval is associated with enhanced activity in regions thought to support self-generated reflection and self-referential processing (Kensinger & Schacter, 2006a).

If older adults are less able to encode source-specifying details (e.g., Ferguson, Hashtroudi, & Johnson, 1992; Spencer & Raz, 1995) or to use the retrieval of those details to support their memory decisions (e.g., Koutstaal, 2003; Naveh-Benjamin, Brav, & Levy, 2007), then it would follow that older adults would have difficulty on tasks requiring reality monitoring. What is less clear is whether there are situations in which older adults' reality-monitoring performance can be improved. In particular, the present study was designed to assess whether older adults are better able to distinguish imagined from seen items if those items have emotional meaning than if they do not. Prior research has demonstrated that older adults' ability to remember the details of an item's presentation can be boosted if those details have emotional meaning. For example, May, Rahhal, Berry, and Leighton (2005) found that older adults were good at remembering whether particular food items were safe to eat or were spoiled. This successful performance contrasted with their poor performance at remembering perceptual or nonemotional conceptual information about an item's presentation (see also Rahhal, May, & Hasher, 2002).

Although this prior study examined the influence of emotional context on memory, in young adults the emotional content of the to-be-remembered information also can influence memory for contextual detail. For instance, compared with performance with nonemotional items, young adults are more likely to remember the color of the font in which an emotional word was written (Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003), the spatial locations of emotional words (D'Argembeau & Van der Linden, 2004; MacKay & Ahmetzanov, 2005; MacKay et al., 2004), and whether negatively arousing words were imagined or perceived (Kensinger & Schacter, 2006b). The primary goal of the present experiment, therefore, was to examine whether older adults, like young adults, would show a reality-monitoring advantage for emotional stimuli relative to nonemotional ones.

As a corollary of this goal, we examined whether the effects of valence (i.e., whether a stimulus is positive or negative; see Lang, Greenwald, Bradley, & Hamm, 1993; Russell, 1980) would influence the magnitude of the emotion-related reality-monitoring benefit in young and older adults. Prior research examining the effects of emotional content on memory for source details either has focused exclusively on responses to negative items (Kensinger & Corkin, 2003; Kensinger & Schacter, 2006b) or has not reported results separately for positive and negative information (D'Argembeau & Van der Linden, 2004; Doerksen & Shimamura, 2001; MacKay & Ahmetzanov, 2005; MacKay et al., 2004). Therefore, it is not clear whether positive and negative stimuli confer equal advantages in memory for source-specifying details.

There is reason to believe that in young adults, negative (but not positive) stimuli may confer particular benefits on memory for source details. Young adults often remember negative information with exact detail: They are more likely to believe that they retain a vivid and detailed memory of a negative item's presentation than of a positive item's presentation (e.g., Dewhurst & Parry, 2000; Ochsner, 2000), and at least in some instances, information eliciting negative emotion appears to be less prone to distortion (Kensinger & Schacter, 2006c; Levine & Bluck, 2004; Storbeck & Clore, 2005). More broadly, studies in young adults have suggested that negative emotion is associated with detailed and analytic processing, promoting memory accuracy and memory specificity, whereas positive information often is processed in a heuristic or gist-based fashion, with individuals extracting the general theme of the presented information but not the exact details (e.g., Clore, Gasper, & Garvin, 2001; Fiedler, 2001; Gasper & Clore, 2002). Thus, young adults often claim that they know a positive item was presented but that they do not remember the details of its presentation (Ochsner, 2000), they are more likely to falsely or inconsistently remember positive information than negative information (e.g., Kensinger & Schacter, 2006c; Levine & Bluck, 2004), and they are more likely to rely on schemas when processing positive information (e.g., Storbeck & Clore, 2005).

As described earlier, according to the source-monitoring framework (Johnson & Raye, 1981), memories that include source-specifying details (e.g., sensory information or information about mental operations) are more likely to be attributed accurately to imagination or perception. In contrast, memories that lack those diagnostic features are more likely to be misattributed. Given the prior research suggesting that source-specifying details are more likely to be processed and remembered for negative information than for positive information, we hypothesized that, in young adults, negative emotional content might lead to a greater enhancement in reality-monitoring performance than would positive emotional content.

It is less clear whether these divergent effects of positive and negative valence are present in older adults. On the one hand, it is plausible that older adults may process emotional information in a similar fashion to young adults; older adults may attend to the details of negative information while being more likely to extract only the gist of positive information. On the other hand, it is possible that advancing age may change the way in which emotional information is processed. There have been a number of studies suggesting that older adults focus more on positive information than do young adults (see Mather & Carstensen, 2005, for review), and research also has revealed a shift in the valence of information remembered across the life span. In particular, whereas young adults generally remember more negative information than positive information, older adults sometimes show a memory shift toward the positive. In a couple of instances (e.g., Charles, Mather, & Carstensen, 2003, Experiment 1; Leigland, Schulz, & Janowsky, 2004), there has been evidence of a strong positivity bias in older adults: Whereas young adults have remembered more negative than positive information, older adults have remembered more positive than negative information. More commonly, studies have revealed a weak positivity bias: Young adults have shown greater memory benefits for negative compared with positive information, while older adults have shown equivalently large memory benefits for positive and negative information (e.g.,

Charles et al., 2003, Experiments 2 and 3; Comblain, D'Argembeau, Van der Linden, & Aldenhoff, 2004; Kennedy, Mather, & Carstensen, 2004). Although both the strong and weak instantiations have been referred to as a positivity bias, the latter pattern may be best characterized as an age-related broadening of the emotional memory enhancement effect: Older adults appear to have a broader mnemonic enhancement for emotional information—one that generalizes to positive and negative information—whereas young adults often show a recognition memory advantage that is more pronounced for one valence (negative) than the other (positive). Regardless of the exact characterization, the fact that there often are age differences in the mnemonic benefits conferred by positive and negative emotion suggests that aging may alter the way in which the two types of information are processed.

Even if we accept that aging may influence the way in which emotional information is processed, it is not clear whether that change in processing would affect reality-monitoring ability. Although it is possible that older adults' memory for source-specifying details could be enhanced for positive information as compared with neutral information, it also is plausible that older adults' mnemonic benefit for remembering these details could be restricted to negative information. This latter outcome may be particularly likely if there is something fundamentally different about the ways in which positive information and negative information are processed (i.e., with attention to heuristic aspects of positive information and to the details of negative information) and if this valence difference is preserved across the life span.

Thus, the present study investigated whether young and older adults would be better able to remember whether they had imagined or perceived items with emotional meaning (positive items like a sundae or a diamond ring and negative items like a snake or a grenade) as compared with items lacking emotional significance. We also examined whether young and older adults would be more likely to remember that items with emotional meaning had been studied (i.e., to know that emotional items had been seen or imagined and were not new—referred to as general recognition performance). Across two studies, we sought to replicate our prior finding of enhanced reality-monitoring performance for negative stimuli in young adults (Kensinger & Schacter, 2006b) and to examine whether young adults also would show a reality-monitoring advantage for positive stimuli. To address the issues considered above regarding aging and valence, we also investigated whether older adults would show a reality-monitoring (source memory) advantage or a general recognition memory advantage for positive or negative emotional information.

Experiment 1

In Experiment 1, we adapted a paradigm used by Gonsalves and Paller (2000) to examine participants' ability to distinguish objects that they had seen from objects that they had imagined. By presenting one-third positive objects, one-third negative objects, and one-third nonemotional objects to young and older adults, we were able to examine the effects of age and emotional valence on general recognition and reality-monitoring performance.

Method

Participants

Participants included 33 Harvard University or Boston College students or employees and 31 older adult participants recruited through the Harvard Cooperative on Aging and by posting advertisements in newsletters throughout the greater Boston area. The data from three young adults and one older adult were excluded from analyses: Two participants did not obey task instructions (one never made a response of a certain type, and another gave the same response to the last approximately 50 items), and upon completion of written debriefing forms, another two participants endorsed that they had anticipated that their memories would be tested (an exclusion criterion because of the incidental nature of the encoding task). The remaining 30 young adults (12 male and 18 female; age range = 18–35 years; mean age = 21.5 years) and 30 older adults (10 male and 20 female; age range = 65–80 years; mean age = 74.5 years) were all native English speakers without a history of head trauma, alcohol or drug abuse, or neurological or psychiatric disorders. No participants reported that they were taking any medications that would affect the central nervous system.

Older adults had an average of 16.7 years of education, and young adults had an average of 14.1 years of education; young adults all were enrolled in degree-granting programs or had completed their bachelor's degree. All older adults had Mini-Mental State Examination scores greater than 26 ($M = 28.4$; Folstein, Folstein, & McHugh, 1975), and they performed within the normal age-adjusted range on tasks of forward digit span ($M = 6.56$), backward digit span ($M = 4.62$), and letter (FAS) fluency (mean words generated = 15.3; mean perseveration = .77), and on the Wechsler Adult Intelligence Scale vocabulary assessment (90.2% correct; Wechsler, 1997).

Young adults received \$10 as compensation, and older adults were compensated at the rate of \$15/hr (young adults were paid a single amount because there was little variability in the time that it took them to complete the task; older adults were paid hourly because of variability in the time that it took them to complete the series of neuropsychological tasks administered during their delay interval). All participants provided informed consent in a manner approved by the Internal Review Boards of Harvard University and Boston College.

Materials

Stimuli consisted of 180 concrete words (60 positive—e.g., *sundae*, *money*, *bride*; 60 negative—e.g., *snake*, *grenade*, *cannon*; and 60 neutral—e.g., *barometer*, *napkin*, *avocado*) and 180 corresponding color photos of the named objects. All photo objects were set on a white background and were resized using PICStation X (available from <http://ancondia.com>) to have 300 pixels in their largest dimension. Images depicted photos of actual objects; no line drawings or artist renderings of objects were used. Negative and neutral images were obtained from a stimulus set used in a previous experiment (Kensinger, Garoff-Eaton, & Schacter, 2006). Positive images were obtained from a database on www.clipart.com as well as from Google Images.

To select images that were reliably rated as positive, negative, or neutral by both young and older adults, we gathered normative rating data from a separate group of 8 young adults (3 male and 5

female; age range = 20–22 years; mean age = 20.75 years) and 8 older adults (3 male and 5 female; age range = 63–75 years; mean age = 69.86 years). These participants viewed a series of positive, negative, and neutral photo objects and rated the objects for emotional valence on a scale of 1 to 9 (1 = *most negative*, 5 = *neutral*, and 9 = *most positive*). Participants also rated the objects for arousal (1 = *calming or soothing*, 5 = *neutral*, and 9 = *arousing or exciting*). Only those objects considered positive and arousing (valence > 6.2; arousal > 4), negative and arousing (valence < 3.8; arousal > 4), or neutral (valence between 4 and 6; arousal < 5) by both young and older adults were considered for inclusion in the final set of stimuli. From these potential stimuli, we selected 180 photo objects (60 negative, 60 positive, 60 neutral) so that the verbal labels corresponding to objects in each emotion category did not differ from one another in familiarity, word length, concreteness, imageability, or word frequency (according to values posted in the MRC psycholinguistic database; Coltheart, 1981; all $ps > .15$).

As expected, valence ratings for these three categories of stimuli differed significantly from one another (an analysis of variance [ANOVA] indicated a main effect of item type, with valence ratings highest for positive items and lowest for negative items; $p < .001$). Valence ratings did not differ between young and older adults (ANOVA indicated no effect of age, nor an interaction with age; see Table 1). Also as expected, arousal ratings were significantly higher for the positive and negative objects than they were for the neutral objects (an ANOVA indicated a main effect of item type; $p < .001$). Arousal ratings for the neutral items were quite comparable for the young and older adults (see Table 1). There were, however, unanticipated differences in the arousal ratings for positive and negative items. Both young and older adults rated the negative objects as more arousing than the positive objects ($p < .05$). This difference in arousal between the negative and positive objects was somewhat exaggerated in the older adults, as evidenced by a marginal interaction between item type and age ($p < .09$).

Procedure

The experiment involved an approximately 15-min study phase and an approximately 15-min test phase. For the young adults, these sessions were spaced 2 days apart. For the older adults, the two sessions were separated by a 2-to-3-hr delay. During this

delay, the older adults completed a battery of neuropsychological tests. The duration of the delay for young and older adults was chosen primarily to avoid ceiling or floor effects in each age group that could mask the influences of emotion on task performance. The exact delays were chosen both for logistical reasons and in an attempt to roughly equate the overall memory accuracy in the two age groups.

Study phase. At study, 120 words (40 positive, 40 negative, 40 neutral) were presented on a computer screen, each for 3 s. While the word was on the screen, participants were asked to read the word. Half of the words (20 positive, 20 negative, 20 neutral) were followed by the presentation of a blank square for 3 s (word-only trials, or *imagined* condition), and half of the words were followed by their corresponding picture for 3 s (word-plus-picture trials, or *seen* condition). When a word was followed by a blank square, participants were asked to form a mental image of the object and to determine whether the object was bigger or smaller than a shoebox. Participants were instructed that the task was designed to test mental imagery ability and emotional processing and thus that they should make the size decision through use of mental imagery. For the word-plus-picture trials (*seen* condition), they were told to look at the picture and make the size judgment. Items from the three emotion categories (positive, negative, neutral) and from the two study conditions (*imagined*, *seen*) were pseudorandomly interspersed, with the constraint that no more than five items from a single emotion category or from a single study condition could occur in sequence. The items shown in the *imagined* versus *seen* conditions were counterbalanced across participants.

Test phase. Participants returned to the testing room for a surprise recognition test. Participants believed that they were returning to the room to perform a similar mental imagery task for the purpose of assessing how the perception of objects changes over time. During the self-paced test phase, participants saw all 120 words that had been presented at study as well as 60 new words (20 positive, 20 negative, 20 neutral). For each word, participants made a button press to indicate whether (a) they had seen the word at study with its corresponding picture (*seen* condition), (b) they had seen the word but had only imagined the object at study (*imagined* condition), or (c) they had never seen the word in the study phase (*new*). After the participants made this decision, they were asked to make another keypress to indicate their level of confidence (high or low). Because the distribution of

Table 1
Mean (SE) Valence and Arousal Ratings for the Items Used in Experiments 1 and 2

Age group	Valence			Arousal		
	Positive	Negative	Neutral	Positive	Negative	Neutral
Experiment 1						
Young	7.12 (.23)	2.49 (.24)	5.21 (.17)	6.04 (.27)	6.99 (.24)	4.61 (.13)
Older	7.23 (.18)	2.34 (.25)	5.58 (.24)	5.20 (.19)	7.38 (.30)	4.68 (.17)
Experiment 2						
Young	7.44 (.11)	2.63 (.23)	5.14 (.19)	5.95 (.31)	5.94 (.17)	3.99 (.24)
Older	7.13 (.23)	2.52 (.17)	5.27 (.26)	5.56 (.13)	6.02 (.11)	3.74 (.29)

Note. Valence and arousal were rated on 9-point scales (high values indicating positive valence and high arousal, respectively).

confidence scores did not differ based on the emotionality of the objects, we do not discuss the confidence data further.

Results

The proportions of “seen,” “imagined,” and “new” responses given to *seen*, *imagined*, and *new* items are reported in Table 2. We conducted analyses to examine two broad ways in which emotion could influence memory performance. First, emotion could affect participants’ ability to identify an object as having been on the study list (i.e., the likelihood that they knew that they had either seen or imagined the item). We refer to this ability to attribute an item to the study episode as *general recognition*. Second, emotion could affect the accuracy of young and older adults’ source attribution accuracy (i.e., their ability to correctly indicate whether an item had been seen or imagined). We refer to this second ability as *conditionalized source memory* (because the source memory measure is conditionalized for the likelihood of general recognition).

General Recognition Scores

To examine the effects of emotion on young and older adults’ ability to recognize that an item had been encountered before, we computed general recognition scores for each age group, collapsing across “seen” and “imagined” responses (not “new”) to *seen* items and collapsing across “seen” and “imagined” (not “new”) responses to *imagined* items. Separate general recognition scores were calculated for *seen* items and for *imagined* items, and scores were calculated separately for items of each valence (positive, negative, neutral). These scores included both correct and incorrect source attributions for the items but did not include any instances in which participants altogether forgot that the item had been studied. Thus, these scores measured participants’ ability to know that an item was studied regardless of whether they were able to remember if the item had been seen or imagined. In this way, the general recognition scores are similar to the concept of an “old” endorsement on an old–new recognition test (i.e., either a “seen” or an “imagined” response signifies that the participant believes the item was studied).

We analyzed the general recognition scores both as raw scores, uncorrected for false-alarm rates, and as corrected scores, controlling for false-alarm rates (i.e., corrected for the proportion of “seen” or “imagined” responses given to *new* items). The analyses revealed the same effects regardless of whether this correction for false alarms was applied (there were no effects of emotion or age

on the false-alarm rates), and so, here, we report the raw recognition scores (i.e., hit rates) uncorrected for false-alarm rates. The fact that the results remained qualitatively the same when scores were and were not corrected for false-alarm rate indicates that the results are not a reflection of participants’ biases to call items “new” (rather than “seen” or “imagined”); effects due to such response biases would have been eliminated when controlling for the false-alarm rates.

We first conducted an ANOVA with emotion type (positive, negative, neutral) and study condition (*seen*, *imagined*) as within-participants factors and age (young adults, older adults) as a between-participants factor. This ANOVA revealed a significant effect of emotion type, $F(2, 57) = 41.89, p < .001$, partial $\eta^2 = .60$, and a significant effect of study condition, $F(1, 58) = 37.59, p < .001$, partial $\eta^2 = .39$. These main effects were qualified by an interaction between study condition and age, $F(1, 58) = 17.22, p < .001$, partial $\eta^2 = .23$, and by an interaction between emotion type and age, $F(2, 57) = 9.42, p < .001$, partial $\eta^2 = .25$. No other main effects or interactions were significant (all other partial η^2 s $\leq .04$). Post hoc *t* tests (least significant difference pairwise comparisons among estimated marginal means) revealed that the interaction between study condition and age reflected the fact that young adults showed comparable general recognition for the items from the *seen* and *imagined* conditions ($p > .25$), whereas older adults had better general recognition of the items from the *seen* condition, $t(29) = 4.34, p < .001$. The interaction between emotion type and age emerged because, as shown in Figure 1, young adults were significantly more likely to recognize that negative items had been studied than they were to recognize that neutral, $t(29) = 4.7, p < .001$, or positive items, $t(29) = 3.9, p < .001$, had been studied. There was no difference between young adults’ ability to recognize positive and neutral items ($p > .25$; i.e., negative > positive = neutral). This finding is consistent with previous studies that have shown a greater memory enhancement in younger adults for negatively valenced stimuli than for positively valenced items (e.g., Dewhurst & Parry, 2000; Ochsner, 2000). In contrast, the older adults were equally likely to recognize negative and positive items ($p > .25$), and they were more likely to recognize either of these items than they were to recognize neutral items (i.e., negative = positive > neutral), $t(29) = 4.70, p < .001$, for positive as compared with neutral items; $t(29) = 6.41, p < .001$, for negative as compared with neutral items. This result is especially interesting given previous research suggesting that older adults tend to place more emphasis on positive infor-

Table 2
Mean (SE) Proportions of “Seen,” “Imagined,” and “New” Responses in Experiment 1 as a Function of Study Condition (*Seen*, *Imagined*, *New*), Valence (Positive, Negative, Neutral), and Age (Young Adult, Older Adult)

Age	Valence	<i>Seen</i> items			<i>Imagined</i> items			<i>New</i> items		
		“Seen”	“Imagined”	“New”	“Seen”	“Imagined”	“New”	“Seen”	“Imagined”	“New”
Young	Positive	.52 (.04)	.30 (.02)	.18 (.03)	.20 (.03)	.60 (.04)	.20 (.03)	.09 (.01)	.15 (.03)	.76 (.03)
	Negative	.73 (.03)	.18 (.02)	.09 (.02)	.12 (.02)	.77 (.03)	.11 (.02)	.09 (.02)	.15 (.02)	.77 (.02)
	Neutral	.51 (.03)	.30 (.02)	.19 (.02)	.20 (.03)	.60 (.05)	.21 (.03)	.07 (.02)	.14 (.02)	.78 (.03)
Older	Positive	.63 (.03)	.25 (.03)	.12 (.02)	.25 (.04)	.55 (.03)	.20 (.03)	.10 (.02)	.11 (.02)	.79 (.02)
	Negative	.68 (.03)	.22 (.02)	.10 (.02)	.17 (.02)	.64 (.03)	.19 (.02)	.11 (.02)	.11 (.03)	.79 (.03)
	Neutral	.57 (.04)	.20 (.03)	.24 (.02)	.15 (.02)	.47 (.03)	.38 (.03)	.12 (.02)	.11 (.02)	.77 (.03)

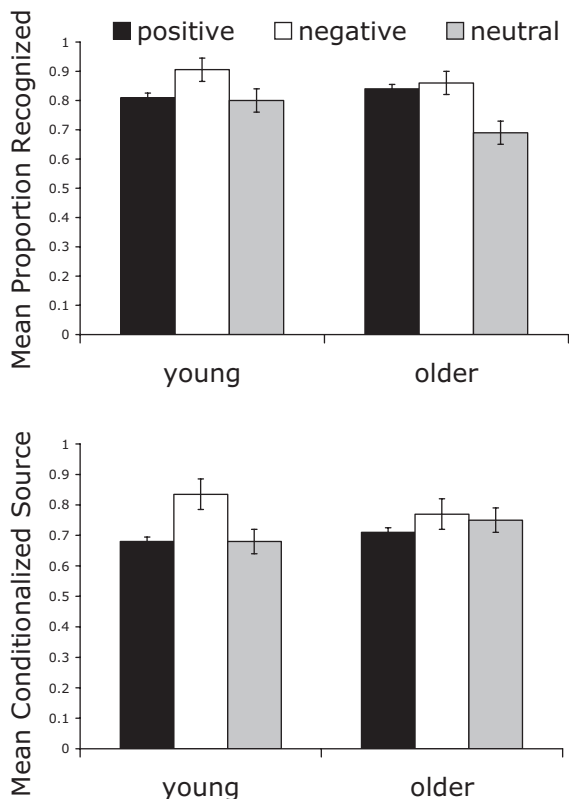


Figure 1. The effect of emotion type (positive, negative, neutral) and age on mean general recognition and conditionalized source scores in Experiment 1. General recognition was calculated as the proportion of *seen* or *imagined* items identified as either “seen” or “imagined.” Young adults showed a general recognition memory advantage for the negative items as compared with the neutral or positive items, while older adults showed a benefit for the positive and negative items as compared with the neutral ones. Conditionalized source memory scores were calculated by dividing the total number of items of a particular valence type correctly attributed to the appropriate source by the general recognition score for that valence. Young adults showed higher conditionalized source scores for the negative than for the positive or neutral items, while older adults showed no effect of emotion type on source scores. Bars represent $\pm 1 SE$.

mation in their memories than do young adults (reviewed by Mather & Carstensen, 2005).

Conditionalized Source Memory Scores

To examine the effects of emotion on source attribution accuracy, we conducted ANOVAs on conditionalized source scores for the *seen* and the *imagined* items. These scores, which control for valence-dependent differences in general recognition memory, were calculated by dividing the proportion of correctly attributed *seen* or *imagined* items by the general recognition score for the *seen* or *imagined* items (i.e., conditionalized source attribution accuracy for the *seen* items = [“seen” to *seen*]/[“seen” and “imagined” responses to *seen*]; conditionalized source accuracy for the *imagined* items = [“imagined” to *imagined*]/[“seen” and “imagined” to *imagined*]). The output of this equation corresponds with the conditional probability of an accurate source attribution given

the condition of general recognition, or P (accurate source attribution/“seen” or “imagined” response), for studied words. In other words, these conditionalized measures of source memory performance examine the ability of the participants to correctly identify an item as *seen* or *imagined* given that they recognize that the item has been studied. Because general recognition scores differed based upon the emotional valence of the items (as described above), it was necessary to conditionalize source memory scores. Without this conditionalization, source memory scores for the items that were more likely to be recognized could have been inflated. We conducted an ANOVA on these conditionalized scores with emotion type (positive, negative, neutral) and study condition (*seen*, *imagined*) as within-participants factors and age (young adults, older adults) as a between-participants factor. The ANOVA revealed significant main effects of emotion type, $F(2, 57) = 15.96, p < .001$, partial $\eta^2 = .36$, and study condition, $F(1, 58) = 7.63, p < .01$, partial $\eta^2 = .12$, as well as a marginal interaction between study condition and age, $F(1, 58) = 3.04, p < .09$, partial $\eta^2 = .05$, and a significant interaction between emotion type and age, $F(2, 57) = 5.36, p < .01$, partial $\eta^2 = .16$. No other main effects or interactions reached significance (all other partial η^2 s $\leq .02$). Post hoc t tests indicated that the marginal interaction between study condition and age reflected the fact that young adults had more difficulty correctly distinguishing the source of items in the *seen* condition than in the *imagined* condition,¹ $t(29) = 2.33, p < .05$, whereas the older adults showed no difference in performance between the two conditions ($p > .15$). The interaction between emotion type and age reflected the fact that young adults were more likely to correctly identify the study condition of a negative item than of a neutral one, $t(29) = 4.12, p < .001$, or a positive one, $t(29) = 3.92, p < .001$ (i.e., negative > positive = neutral). By contrast, older adults did not show a reality-monitoring benefit for the negative or the positive items compared with the neutral ones ($p > .25$; see Figure 1).

Discussion

Three central conclusions emerged from Experiment 1. First, with regard to general recognition scores, young adults showed a memory advantage for negative as compared with neutral stimuli, whereas older adults showed a memory advantage for both negative and positive as compared with neutral stimuli. This pattern is consistent with literature suggesting that although young adults’ emotional memory enhancement is sometimes stronger for negative than positive information, older adults often show a broader memory advantage that extends to positive and negative information (what we referred to in the introduction as a weak positivity bias; e.g., Charles et al., 2003; Comblain et al., 2004; Kennedy et al., 2004). Older adults also showed indications of a greater general recognition memory impairment (as compared with the young adults) for neutral items, whereas older adults’ memory for positive and negative items was closer to the level achieved by young

¹ Although this distribution of errors differs from the distribution commonly revealed in reality-monitoring paradigms (often, errors are more frequent for previously *imagined* items than for previously *seen* items), the error distribution revealed here is consistent with that demonstrated in a prior study using similar methods but including only negative and neutral stimuli (Kensinger & Schacter, 2006b).

adults (see Figure 1). We cannot draw strong conclusions based on this finding because young and older adults' memories were tested after different delay intervals. Nevertheless, the results provide suggestive evidence that memory for both positive and negative information may be relatively preserved in older adults as compared with memory for neutral information (see Kensinger, Krendl, & Corkin, 2006; Mather, 2004, for further discussion of a preservation of memory for emotional information with age). It may be that the way in which older adults tend to process information (e.g., with a particular focus on their affective response to the information; Comblain et al., 2004; Hashtroudi et al., 1990) leads to a specific preservation of memory for information with emotional relevance.

Second, with regard to the conditionalized source memory scores, young adults showed an emotion-related reality-monitoring advantage only for negative, and not for positive, information. Although the effect of negative emotion on reality-monitoring performance has been demonstrated previously in young adults (Kensinger & Schacter, 2006b), because that prior experiment included only negative arousing stimuli, it was not clear whether any arousing stimulus would be associated with enhanced reality-monitoring performance. The present results suggest that the reality-monitoring memory advantage is not ubiquitous across all emotional stimuli: Young adults showed no reality-monitoring benefit for positive arousing stimuli. This focal effect of negative (and not positive) emotion on memory accuracy is consistent with prior data suggesting that positive emotion may lead to less detailed processing, leaving memories more prone to distortion (e.g., Bless et al., 1996; Kensinger & Schacter, 2006c; Storbeck & Clore, 2005). In other words, consistent with the source-monitoring framework, young adults' memories for the negative items may have included additional details that allowed them to more accurately distinguish imagined objects from seen ones (see Kensinger, Garoff-Eaton, & Schacter, 2006; MacKay et al., 2004, for evidence that young adults' memories for negative information often are rich in perceptual detail). By contrast, their memories for positive items may have been void of the information that would boost their ability to accurately distinguish *imagined* from *seen* items.

We must be cautious in attributing the divergence in memory for positive and negative stimuli to valence differences, however. In this experiment, positive stimuli were rated as less arousing than negative stimuli (see Table 1); therefore, it is possible that the divergent effects stemmed from differences in arousal rather than from differences in valence. It has been argued previously that the arousal level of the stimuli, rather than their valence, may lead to differential binding of items to their context (MacKay & Ahmetzhanov, 2005; MacKay et al., 2004). Nevertheless, the positive items were rated as highly arousing relative to the nonemotional stimuli; thus, the results do make clear that the reality-monitoring advantage in young adults does not generalize to all emotional information or even to all arousing information.

The third finding from Experiment 1 is that, while young adults showed an emotion-mediated effect on reality-monitoring performance, older adults did not. One possible explanation for this lack of enhancement in the older adults may relate to the way in which older adults process emotional information: by focusing on their feelings in response to an emotional stimulus (Comblain et al., 2004; Hashtroudi et al., 1990; Hashtroudi, Johnson, Vnek, &

Ferguson, 1994). This affective processing may help them to remember that an item has been studied but may leave unaffected (or even hurt) their ability to distinguish *seen* from *imagined* items. In other words, the types of details that older adults encode and later retrieve about an emotional item's presentation may not be those details that contribute to accurate reality-monitoring performance. If older adults focus on their feelings toward particular items, this may help them to remember whether the item is good or bad (e.g., May et al., 2005), whereas it might not help them to distinguish whether they had imagined or perceived a particular object (e.g., remembering that one has felt afraid of a snake does not, on its own, allow one to decide whether one imagined the snake or saw it presented on the computer monitor).

It also is possible, however, that the lack of reality-monitoring enhancement for the older adults stemmed from the fact that they were performing the task in a different way from young adults. In particular, the task had two methodological aspects that may have contributed to the age differences in reality-monitoring performance. First, the size decision task did not require vivid imagery on every trial. Although young and older adults were instructed to form a mental image every time that the blank square was presented, it is possible that participants made at least some of their size decisions without relying on mental imagery (i.e., on the basis of semantic knowledge alone). If older adults did not form mental images successfully on every trial, this could have dramatically influenced the pattern of results revealed with regard to the effect of emotion on reality-monitoring performance. Second, it is possible that participants mentally imagined items even when it was not an imagery trial. Because the word preceded the presentation of either the box (on the mental imagery trials) or the image (on the picture trials), it is possible that participants occasionally imagined the referent while the word was presented on the screen rather than only on trials where the box followed the word. If this type of task-inappropriate use of mental imagery was more common in the older adults, this could have adversely impacted their reality-monitoring performance. Although, upon debriefing, participants indicated compliance with task instructions (i.e., performing mental imagery on the imagery trials and not on the picture trials), we felt that it was important to attempt to replicate these findings in an experiment in which we could be certain that mental images were created on each imagery trial and were unlikely to be generated on visual presentation trials. Experiment 2 was conducted with these goals in mind.²

² It is important to note that the arousal differences between the positive and the negative items, as well as the potential difficulties with task instruction compliance, cannot explain the pattern of age differences revealed in general recognition memory scores. Young and older adults both rated the positive stimuli as less arousing than the negative stimuli, and the magnitude of the arousal difference was greater in older adults than in young adults; thus, arousal differences cannot explain why older adults would show an equivalent enhancement for negative and positive items while young adults would show a greater enhancement for negative items. Moreover, because general recognition requires only the ability to remember that an item has been studied (and not accurate assignment to imagery or visual presentation), age differences in task compliance with regard to mental imagery should not significantly impact the effects of emotion on general recognition performance.

Experiment 2

Experiment 2 differed from Experiment 1 in three critical ways. First, in Experiment 2, reality-monitoring performance was assessed for positive and negative words that had been rated as equally arousing by both young and older adults. Second, the delay interval was kept constant for young and older adults, allowing us to examine whether there were differences in the magnitude of the age-related mnemonic changes based on item valence. Third, the task was designed so that participants were required to form mental images on every imagery trial (the task could not be performed without successful formation of mental images) but were unlikely to form mental images on visual presentation trials. Thus, the design increased the likelihood that young and older adults would successfully imagine the information on the imagery trials and would not imagine the information on the visual presentation trials.

Method

Participants

Participants were 33 young adults and 32 older adults who met the same criteria as outlined in Experiment 1. Data from two young adults were excluded due to technical difficulties in presenting the auditory stimuli, and data from a third young adult and two older adults were excluded due to failure to comply with task instructions: Upon debriefing, one young and one older adult noted confusion regarding the seen–imagined distinction, and the other older adult never made a response of a particular type. The remaining 30 young adults (17 female, 13 male) were 18–28 years of age (mean age = 20.6 years). The 30 older adults (18 female, 12 male) were ages 62–81 years (mean age = 69.7 years). Participation required 30–45 min and included a compensation of \$10/hr or course credit. Informed consent was provided by participants in a manner approved by Harvard University and Boston College's Committees on the Use of Human Subjects.

Older adults had an average of 16.9 years of education, and young adults had an average of 15.1 years of education. Young adults all were enrolled in bachelor's degree programs or had completed their bachelor's degree. All older adults had Mini-Mental State Examination scores greater than 26 ($M = 29.2$; Folstein et al., 1975), and they performed within the normal age-adjusted range on tasks of forward digit span ($M = 6.58$), backward digit span ($M = 5.41$), and letter (FAS) fluency (mean words generated = 14.3; mean perseveration = .67), and on the Wechsler Adult Intelligence Scale vocabulary assessment (85.1% correct; Wechsler, 1997).

Materials

A separate group of 10 young adults (5 female, 5 male; ages 18–35 years) and 10 older adults (5 female, 5 male; ages 62–78 years) viewed a large number of words from the Affective Norms for English Words database (Bradley & Lang, 1999) and from a list of words used in a prior investigation (Kensinger & Corkin, 2003). Participants rated these words for their valence and arousal on scales ranging from 1 (*very negative* on the valence scale; *low arousal*) to 9 (*very positive*; *very arousing*). On the basis of these ratings, 108 four- or five-letter words (36 arousing and positive—

e.g., *love*, *sexy*, *jewel*; 36 arousing and negative—e.g., *devil*, *tumor*, *wasp*; and 36 nonemotional—e.g., *hand*, *quart*, *salt*) were selected so that the negative and positive words did not differ significantly in arousal or in magnitude of valence (i.e., distance from neutral valence; all $ps > .2$). Negative and positive words differed significantly from the neutral words in arousal ($p < .001$) and valence ($p < .001$). Critically, words also were included in the experiment only if young and older adults gave them comparable valence and arousal ratings (all effects of age, $p > .2$; see Table 1). Words also were chosen so that items of the three emotion types did not differ significantly in word frequency, familiarity, or concreteness (Coltheart, 1981). Because participants were to make letter-height decisions about the items (see procedure below), the heights of the first and fourth letters were matched across positive, negative, and neutral words: Half of the words in each emotion category had a shorter first letter than last letter (requiring a “yes” response in the letter-height decision task), and half had first letters of similar or greater height than the last (requiring a “no” response in the task).

Procedure

The procedure consisted of a study phase followed immediately by an unexpected memory test (no participant anticipated that his or her memory would be tested).

Study phase. In the study phase, participants were presented with 72 words pulled from the collection of 108 words; 24 words were positive, 24 were negative, and 24 were neutral. All words were pronounced over a headset. The aural presentation of each term was immediately followed by either an onscreen visual counterpart written in lowercase letters (*seen* condition) or an onscreen fixation cross (*imagined* condition). Half of the items from each emotion category were presented in the former manner, half in the latter. Items from each emotion category and from each study condition (*seen* or *imagined*) were pseudorandomly interspersed, with the constraint that no more than five items of a particular emotion category or study condition could occur in sequence. Whether a given word was presented in the *seen* or *imagined* condition (or was not studied) was counterbalanced across participants. The visual stimulus was presented for a maximum of 6 s and was removed from the screen when the participant made a key response.

Participants engaged in a letter-height decision task (adapted from Brown, Kosslyn, Breiter, Baer, & Jenike, 1994) for which they reported via keypresses whether the first letter of each word was shorter than the last letter if all letters were lowercase (if yes, participants pressed *I*; if no, they pressed *O*). For the trials on which the aural presentation of the word was coupled with the visual presentation of the word (*seen* condition), participants could simply look at the word to make their response. In contrast, participants were required to visualize the words whose aural presentations were accompanied with only the fixation cross (*imagined* condition). This paradigm resulted in a category of internally generated word images distinct from those that were externally presented. Five buffer items were placed at the beginning of the task and five at the end to control for primacy and recency memory effects. Buffer items were drawn from the same three emotional categories as the other words. Half of the buffer items required a “yes” response, and half required a “no” response.

All participants performed the letter-height decision task with high accuracy (less than 3% incorrect responses), and there were no effects of emotion (nor any interactions with emotion) on the accuracy or response time related to performance of the letter-height task.

Test phase. Immediately after the study phase, participants performed a surprise recognition task similar in design to that given in Experiment 1. Participants were presented with all 108 words via headset; studied and novel items were intermixed randomly. Participants were instructed to report via keypress whether each word had been seen, had been imagined, or had not been studied during the study phase. As in the study phase, participants had a maximum of 6 s to make their decision; after participants' keypress, the next word was pronounced over the headset.

Results

The proportions of “seen,” “imagined,” and “new” responses given to *seen*, *imagined*, and *new* items are reported in Table 3. As in Experiment 1, we examined the effects of emotion on the likelihood that participants were able to recognize an item as having been studied (general recognition) and on the probability that participants correctly attributed those items that they had recognized (conditionalized source memory).

General Recognition Scores

As in Experiment 1, an ANOVA with emotion type (negative, positive, neutral) and study condition (*seen*, *imagined*) as within-participants factors and age (young adults, older adults) as a between-participants factor was run on participants' general recognition scores. This ANOVA revealed significant main effects of emotion type, $F(2, 57) = 9.881, p < .001$, partial $\eta^2 = .26$, and age, $F(1, 58) = 13.23, p < .01$, partial $\eta^2 = .19$. There also was an interaction between study condition and age, $F(1, 58) = 4.31, p < .05$, partial $\eta^2 = .07$, and an interaction between emotion type and age, $F(2, 57) = 5.17, p < .01$, partial $\eta^2 = .15$. No other main effects or interactions reached significance (all other partial η^2 s $\leq .03$). Post hoc *t* tests clarified that the interaction between study condition and age emerged because young adults showed no difference in general recognition for the items from the *seen* and *imagined* conditions, whereas older adults showed higher general recognition of the items from the *imagined* condition than from the *seen* condition (see Figure 2). The interaction between emotion type and age reflected the fact that young adults showed enhanced general recognition of negative words compared with neutral

words, $t(29) = 2.57, p < .05$, or positive words, $t(29) = 4.94, p < .001$, but showed comparable general recognition for positive and neutral words ($p > .25$; i.e., negative > positive = neutral). In contrast, older adults showed enhanced recognition of both positive and negative words as compared with neutral words—for negative compared with neutral words, $t(29) = 2.2, p = <.05$; for positive compared with neutral words, $t(29) = 3.1, p < .01$ —and showed comparable general recognition for negative and positive words ($p > .25$; i.e., negative = positive > neutral; see Figure 2). Because the delay rates were equivalent for the young and older adults in this experiment, another way of interpreting this interaction is to note that the age-associated general recognition reduction was mitigated for the positive items ($p > .25$) but was pronounced for the negative and neutral items ($p < .05$; see Figure 2).

Conditionalized Source Memory Scores

To examine the effects of emotion on the accuracy of source memory attributions, we computed conditionalized source memory scores as described in the *Results* section of Experiment 1. An ANOVA conducted on these source memory scores with emotion type (negative, positive, neutral) and study condition (*seen*, *imagined*) as within-participants factors and age (young adults, older adults) as a between-participants factor revealed only a main effect of emotion type, $F(2, 57) = 9.72, p < .001$, partial $\eta^2 = .25$. No other main effects or interactions reached significance (all other partial η^2 s $\leq .01$). Post hoc *t* tests confirmed that both age groups had better source attribution accuracy for negative words than for neutral words—for young adults, $t(29) = 2.38, p < .05$; for older adults, $t(29) = 2.09, p < .05$ (see Figure 2)—but showed no corresponding source memory benefit for positive as compared with neutral words (all $ps > .25$).

Discussion

The general recognition results of Experiment 2 paralleled those of Experiment 1. Most notably, young adults showed a general recognition advantage only for negative as compared with neutral items (and not for positive as compared with neutral items), whereas older adults showed a broader general recognition advantage for both positive and negative items as compared with neutral items. Also as in Experiment 1, older adults appeared to show the greatest general recognition memory impairment (as compared with the young adults) for neutral items, whereas their memory for positive items was relatively preserved. In fact, in this experiment,

Table 3
Mean (SE) Proportions of “Seen,” “Imagined,” and “New” Responses in Experiment 2 as a Function of Study Condition (Seen, Imagined, New), Valence (Positive, Negative, Neutral), and Age (Young Adult, Older Adult)

Age	Valence	Seen items			Imagined items			New items		
		“Seen”	“Imagined”	“New”	“Seen”	“Imagined”	“New”	“Seen”	“Imagined”	“New”
Young	Positive	.39 (.03)	.30 (.04)	.31 (.03)	.26 (.03)	.46 (.03)	.28 (.03)	.07 (.02)	.12 (.02)	.81 (.03)
	Negative	.62 (.04)	.21 (.03)	.17 (.02)	.21 (.03)	.60 (.03)	.19 (.03)	.05 (.02)	.11 (.03)	.84 (.03)
	Neutral	.43 (.04)	.32 (.03)	.26 (.03)	.27 (.03)	.38 (.04)	.35 (.03)	.05 (.02)	.17 (.03)	.79 (.03)
Older	Positive	.36 (.03)	.29 (.03)	.35 (.04)	.29 (.04)	.38 (.04)	.33 (.04)	.11 (.03)	.13 (.02)	.75 (.03)
	Negative	.45 (.04)	.18 (.02)	.37 (.04)	.19 (.03)	.49 (.04)	.32 (.04)	.11 (.03)	.14 (.02)	.74 (.04)
	Neutral	.28 (.03)	.23 (.04)	.49 (.05)	.26 (.03)	.31 (.03)	.43 (.04)	.11 (.02)	.16 (.03)	.74 (.04)

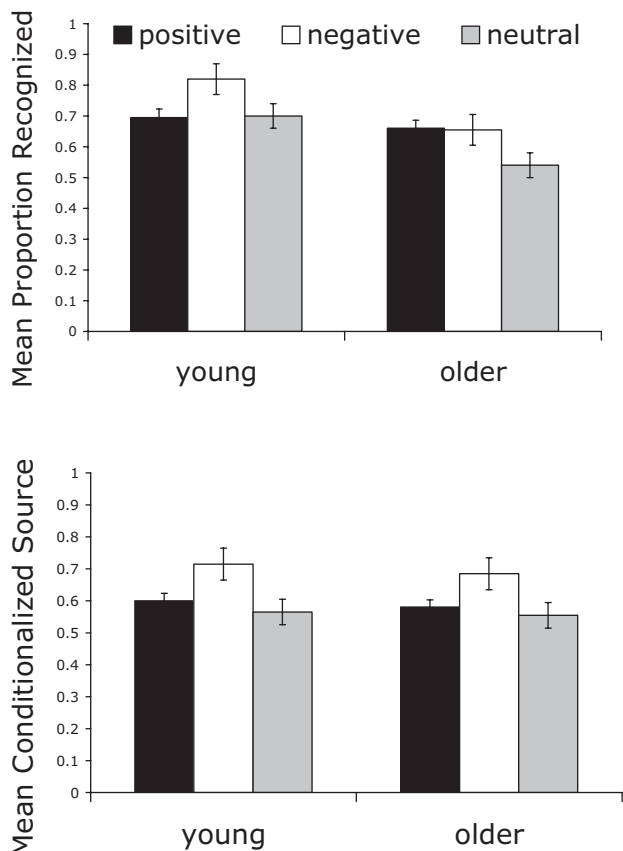


Figure 2. The effect of item type (positive, negative, neutral) and age on mean general recognition and conditionalized source scores in Experiment 2. General recognition was calculated as the proportion of *seen* or *imagined* items identified as either “seen” or “imagined.” Young adults showed a general recognition memory advantage for the negative items as compared with the neutral or positive items, whereas older adults showed a benefit for the positive and negative items as compared with the neutral ones. Conditionalized source memory scores were calculated by dividing the total number of items of a particular valence type correctly attributed to the appropriate source by the general recognition score for that valence. Young and older adults showed higher source scores for the negative items than for the positive or neutral items. Bars represent ± 1 SE.

older adults’ general recognition memory for the positive items did not differ significantly from the young adults’ performance. This finding is consistent with a couple of prior studies suggesting that memory for positive information may be relatively well maintained across the adult life span, while memory for neutral information may show more pronounced age-related decline (Charles et al., 2003; Kensinger, Garoff-Eaton, & Schacter, 2007a).

The young adults’ reality-monitoring performance also replicated the pattern revealed in Experiment 1. Once again, young adults showed a reality-monitoring advantage only for the negative, and not for the positive, items. However, although the young adults’ reality-monitoring performance was comparable across the two experiments, the older adults’ performance was not. In particular, in Experiment 2, the older adults, like the young adults, demonstrated a reality-monitoring advantage for the negative stimuli. Because the positive and negative stimuli in Experiment 2

were carefully matched on arousal, we are confident that the differences in memory attribution accuracy for the negative and positive stimuli do not reflect differences in the subjective arousal of the stimuli. Rather, these differences may arise because of the divergent ways in which positive information and negative information are processed (i.e., with negative information being processed in a more detailed fashion than positive; see Clore, Wyer, et al., 2001, for further discussion). Thus, these results suggest that older adults can show mnemonic benefits similar to those of young adults when remembering the source from which negative information was presented. It will be interesting for further research to examine the types of sources for which this finding holds; recent research has made clear that the effects of emotion on memory may depend on the type of detail assessed (see Kensinger, 2007; Mather, 2007, for further discussion).

It is unclear what led to the divergent results of Experiments 1 and 2 with regard to older adults’ reality-monitoring performance. It is possible that older adults’ failure to demonstrate a reality-monitoring advantage for the negative items in Experiment 1 resulted because they were not successfully imaging all imagery trial items and only imagery trial items. In contrast, the letter-height decision task used in Experiment 2 required successful mental imagery for accurate performance on the imagery trials, and mental imagery was unlikely to occur on the visual presentation trials. Thus, the similarity in young and older adults’ performance in Experiment 2 may have reflected each groups’ compliance with the task instructions. It also is possible that differences in the two encoding tasks led to the different patterns of results. The shallower processing (i.e., letter-height decision) invoked in Experiment 2 may have allowed the beneficial effects of emotion to be more apparent than did the deeper processing task (i.e., size decision) required in Experiment 1. In particular, the task in Experiment 2 likely drew participants’ attention to perceptual features of the stimuli that would allow them to make an accurate reality-monitoring decision. Of course, we also cannot rule out the possibility that there may simply be more variability with regard to older adult’s reality-monitoring benefit for the negative information: Older adults may not show as reliable a reality-monitoring advantage for negative information as young adults do. Regardless of the exact reasons for the reality-monitoring benefit in Experiment 2 but not Experiment 1, the results of Experiment 2 make clear that when older adults do show a reality-monitoring advantage for emotional information, that benefit is restricted to negative information and does not extend to positive information.

General Discussion

Three primary conclusions are suggested by the results of the present study. First, young adults’ emotion-related reality-monitoring advantage is restricted to negative information and does not extend to positive information. Second, although older adults may not always show an emotion-related reality-monitoring advantage, when they do show such an advantage, it also is restricted to negative information and does not extend to positive information. Third, whereas young and older adults show similar, valence-specific effects on their reality-monitoring performance, the two age groups show disparate effects of valence on their ability to remember that an item was studied (i.e., on their general recognition memory). Young adults show a general recognition

memory enhancement only for negative, and not for positive, information; by contrast, older adults show an equivalently large enhancement for negative and for positive information. Thus, older adults seem to show a broader influence of emotion on the ability to remember whether or not an item was studied. The implications of each of these conclusions are expanded upon below.

The fact that young adults demonstrate a reliable reality-monitoring benefit for negative information but no parallel benefit for positive information is consistent with a growing body of evidence suggesting that positive information and negative information are processed in different ways by young adults. Whereas negative information is processed in a detail-oriented and analytical fashion (e.g., Bless et al., 1996; Gasper & Clore, 2002) and often is remembered with vividness and contextual detail (e.g., Kensinger & Corkin, 2003; Ochsner, 2000), positive information is processed in a more heuristic fashion. This difference in processing seems to have broad effects on the likelihood of memory distortions; not only is positive emotion associated with more gist-based memory errors than negative emotion (e.g., Kensinger et al., 2007a; Storbeck & Clore, 2005), it also is associated with more reality-monitoring errors. This link between the types of processing engaged during encoding and the likelihood of accurately attributing items to imagination or perception fits well with extensive behavioral and neuroimaging data indicating that individuals tend to rely on the amount of sensory information retrieved to determine whether information was presented or imagined. Thus, memories rich in sensory detail are more likely to be attributed to perception, whereas memories that include information about the cognitive operations used to generate an item are attributed to imagination (Gonsalves & Paller, 2000; Johnson & Raye, 1981; Kensinger & Schacter, 2006a). Within this source-monitoring framework (Johnson et al., 1993), it makes good sense that items—such as negative ones—that are more likely to be bound to source-specifying details (see Kensinger, 2007, for more discussion) would be more likely to be accurately attributed than other types of items.

The fact that, when older adults show an emotion-related reality-monitoring advantage, it is restricted to negative items and does not extend to positive ones suggests that these differences in the processing of positively and negatively valenced information are maintained across the adult life span. It is important to note, however, that older adults did show a less consistent reality-monitoring benefit for negative information than young adults (i.e., older adults showed the benefit in Experiment 2 but not in Experiment 1). As discussed in more detail following Experiment 2, this difference in outcome between the two experiments may be related to participants' compliance with task instructions, to differences in the types of processing engaged on the two tasks, or simply to increased variability in whether older adults show reality-monitoring enhancements for negative information. Although further research is needed to adjudicate between these alternatives, the present results make clear that despite evidence that older adults are more likely than young adults to focus on positive information in the environment (see Mather & Carstensen, 2005), older adults nevertheless do not show an advantage for extracting details of positive items' presentations. This finding makes sense within the context of the source-monitoring framework. Accurate reality-monitoring performance requires an ability to remember source-specifying details of an item's presentation. However, pos-

itive information appears to be processed in a heuristic fashion, without attention to those details. Therefore, even if older adults devote more attention to positive items than do young adults, this enhanced attention would not be expected to confer a reality-monitoring benefit.

In contrast, age-related changes in the processing of positive information do appear to be sufficient to elicit changes in the likelihood of remembering that an item was studied (i.e., in general recognition performance). In particular, whereas young adults showed a general recognition enhancement only for negative, and not for positive, information, older adults showed an equivalently large mnemonic boost for negative and positive information. This age-related broadening of the emotional memory enhancement has been noted previously (e.g., Charles et al., 2003; Comblain D'Argembeau, & Van der Linden, 2005) and often has been referred to as a positivity bias (what we referred to in the introduction as a weak bias). However, this broadening has not always been shown (e.g., Denburg, Buchanan, Tranel, & Adolphs, 2003; Gruhn, Smith, & Baltes, 2005; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002), and it has been difficult to pinpoint why the effect occurs in some situations and not in others. The results of the present study suggest that age-related changes regarding the effects of valence on emotional memory enhancement may be most prominent when memory decisions can be supported by global information about an item's presentation and do not require the retrieval of source-specifying details.

In summary, the results of the present study replicate our prior finding of enhanced reality-monitoring performance for negative stimuli in young adults (Kensinger & Schacter, 2006b) and further demonstrate that this enhancement does not generalize to all high-arousal stimuli: Young adults showed a reality-monitoring advantage for the negative stimuli but not for the positive stimuli. Moreover, the distinct effect of negative content on reality-monitoring performance was consistent in young and older adults: In both age groups, when there were emotion-related enhancements in reality-monitoring performance, these benefits were restricted to items with negative content. These findings suggest that both age groups may process positively and negatively valenced information differently, such that only negative information is remembered with additional source-specifying details. Older adults were, however, better able to remember that positive items had been studied than they were to remember that neutral items had been studied. Young adults showed no mnemonic benefit for the positive items. Older adults' unique recognition advantage for positive information appeared in both experiments despite the use of different types of stimuli and different types of encoding tasks. These findings emphasize that age-related changes in the processing of emotional information can have divergent mnemonic effects depending on the memory demands of the task. Although older adults showed a broader emotional memory enhancement in terms of general item recognition, this broadening did not extend to reality-monitoring performance.

References

- Adams, C., Labouvie-Vief, G., Hobart, C. J., & Dorosz, M. (1990). Adult age group differences in story recall style. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *45*, P17–P27.
- Bayen, U. J., Nakamura, G. V., Dupuis, S. E., & Yang, C. L. (2000). The

- use of schematic knowledge about sources in source monitoring. *Memory & Cognition*, 28, 480–500.
- Bless, H., Clore, G. L., Schwarz, N., Golisano, V., Rabe, C., & Wolk, M. (1996). Mood and the use of scripts: Does a happy mood really lead to mindlessness? *Journal of Personality and Social Psychology*, 71, 665–679.
- Bradley, M. M., & Lang, P. J. (1999). *Affective norms for English words* [CD-ROM]. Gainesville: University of Florida, The NIMH Center for the Study of Emotion and Attention.
- Brown, H. D., Kosslyn, S. M., Breiter, H. C., Baer, L., & Jenike, M. A. (1994). Can patients with obsessive-compulsive disorder discriminate between percepts and mental images? A signal detection analysis. *Journal of Abnormal Psychology*, 103, 445–454.
- 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.
- Clore, G. L., Gasper, K., & Garvin, E. (2001). Affect as information. In J. P. Forgas (Ed.), *Handbook of affect and social cognition* (pp. 121–144). Mahwah, NJ: Erlbaum.
- Clore, G. L., Wyer, R. S., Dienes, B., Gasper, K., Gohm, C., & Isbell, L. (2001). Affective feelings as feedback: Some cognitive consequences. In L. L. Martin & G. L. Clore (Eds.), *Theories of mood and cognition: A user's guidebook* (pp. 27–62). Mahwah, NJ: Erlbaum.
- Cohen, G., & Faulkner, D. (1989). Age differences in source forgetting: Effects on reality monitoring and on eyewitness testimony. *Psychology and Aging*, 4, 10–17.
- Coltheart, M. (1981). The MRC psycholinguistic database. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, 33(A), 497–505.
- Comblain, C., D'Argembeau, A., & Van der Linden, M. (2005). Phenomenal characteristics of autobiographical memories for emotional and neutral events in older and younger adults. *Experimental Aging Research*, 31, 173–189.
- 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.
- D'Argembeau, A., & Van der Linden, M. (2004). Influence of affective meaning on memory for contextual information. *Emotion*, 4, 173–188.
- Denburg, N. L., Buchanan, T. W., Tranel, D., & Adolphs, R. (2003). Evidence for preserved emotional memory in normal older persons. *Emotion*, 3, 239–253.
- Dewhurst, S. A., & Parry, L. A. (2000). Emotionality, distinctiveness, and recollective experience. *European Journal of Cognitive Psychology*, 12, 541–551.
- Doerksen, S., & Shimamura, A. (2001). Source memory enhancement for emotional words. *Emotion*, 1, 5–11.
- Ferguson, S. A., Hashtroudi, S., & Johnson, M. K. (1992). Age differences in using source-relevant cues. *Psychology and Aging*, 7, 443–452.
- Fiedler, K. (2001). Affective states trigger processes of assimilation and accommodation. In L. L. Martin & G. L. Clore (Eds.), *Theories of mood and cognition: A user's guidebook* (pp. 86–98). Mahwah, NJ: Erlbaum.
- 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.
- Gasper, K., & Clore, G. L. (2002). Attending to the big picture: Mood and global versus local processing of visual information. *Psychological Science*, 13, 34–40.
- Gonsalves, B., & Paller, K. A. (2000). Neural events that underlie remembering something that never happened. *Nature Neuroscience*, 3, 1316–1321.
- Gould, O. N., Trevithick, L., & Dixon, R. A. (1991). Adult age differences in elaborations produced during prose recall. *Psychology and Aging*, 6, 93–99.
- Gruhn, D., Smith, J., & Baltes, P. B. (2005). No aging bias favoring memory for positive material: Evidence from a heterogeneity-homogeneity list paradigm using emotionally toned words. *Psychology and Aging*, 20, 579–588.
- 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.
- Henkel, L. A., Johnson, M. K., & De Leonardis, D. M. (1998). Aging and source monitoring: Cognitive processes and neuropsychological correlates. *Journal of Experimental Psychology: General*, 127, 251–268.
- Johnson, M. K., Foley, M. A., & Leach, K. (1988). The consequences for memory of imagining in another person's voice. *Memory & Cognition*, 16, 337–342.
- Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, 114, 3–28.
- Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review*, 88, 67–85.
- Johnson, M. K., Raye, C. L., Foley, H. J., & Foley, M. A. (1981). Cognitive operations and decision bias in reality monitoring. *American Journal of Psychology*, 94, 37–64.
- Kennedy, Q., Mather, M., & Carstensen, L. L. (2004). The role of motivation in the age-related positivity effect in autobiographical memory. *Psychological Science*, 15, 208–214.
- Kensinger, E. A. (2007). How negative emotion affects memory accuracy: Behavioral and neuroimaging evidence. *Current Directions in Psychological Science*, 16, 213–218.
- Kensinger, E. A., Brierley, B., Medford, N., Growdon, J. H., & Corkin, S. (2002). The effect of normal aging and Alzheimer's disease on emotional memory. *Emotion*, 2, 118–134.
- Kensinger, E. A., & Corkin, S. (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory & Cognition*, 31, 1169–1180.
- Kensinger, E. A., Garoff-Eaton, R. J., & Schacter, D. L. (2006). Memory for specific visual details can be enhanced by negative arousing content. *Journal of Memory and Language*, 54, 99–112.
- Kensinger, E. A., Garoff-Eaton, R. J., & Schacter, D. L. (2007a). Effects of emotion on memory specificity in young and older adults. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 62, P208–P215.
- Kensinger, E. A., Krendl, A. C., & Corkin, S. (2006). Memories of an emotional and a nonemotional event: Effects of aging and delay interval. *Experimental Aging Research*, 32, 23–45.
- Kensinger, E. A., & Schacter, D. L. (2006a). Neural processes underlying memory attribution on a reality-monitoring task. *Cerebral Cortex*, 16, 1126–1133.
- Kensinger, E. A., & Schacter, D. L. (2006b). Reality monitoring and memory distortion: Effects of negative, arousing content. *Memory & Cognition*, 34, 251–260.
- Kensinger, E. A., & Schacter, D. L. (2006c). When the Red Sox shocked the Yankees: Comparing negative and positive memories. *Psychonomic Bulletin & Review*, 13, 757–763.
- Koutstaal, W. (2003). Older adults encode—but do not always use—perceptual details: Intentional versus unintentional effects of detail on memory judgments. *Psychological Science*, 14, 189–193.
- Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology*, 30, 261–273.
- Leigland, L. A., Schulz, L. E., & Janowsky, J. S. (2004). Age related changes in emotional memory. *Neurobiology of Aging*, 25, 1117–1124.
- Levine, L. J., & Bluck, S. (2004). Painting with broad strokes: Happiness and the malleability of event memory. *Cognition and Emotion*, 18, 559–574.
- MacKay, D. G., & Ahmetzanov, M. V. (2005). Emotion, memory and attention in the taboo Stroop paradigm: An experimental analogue of flashbulb memories. *Psychological Science*, 16, 25–32.

- MacKay, D. G., Shafto, M., Taylor, J. K., Marian, D. E., Abrams, L., & Dyer, J. R. (2004). Relations between emotion, memory, and attention: Evidence from taboo Stroop, lexical decision, and immediate memory tasks. *Memory & Cognition, 32*, 474–488.
- Mammarella, N., & Cornoldi, C. (2002). Aging and the effect of predictability on reality monitoring. *American Journal of Psychology, 115*, 331–350.
- Mather, M. (2004). Aging and emotional memory. In D. Reisberg & P. Hertel (Eds.), *Memory and emotion* (pp. 272–307). London: Oxford University Press.
- Mather, M. (2007). Emotional arousal and memory binding: An object-based framework. *Perspectives on Psychological Science, 2*, 33–52.
- Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences, 9*, 496–502.
- Mather, M., Johnson, M. K., & De Leonardis, D. M. (1999). Stereotype reliance in source monitoring: Age differences and neuropsychological test correlates. *Cognitive Neuropsychology, 16*, 437–458.
- May, C. P., Rahhal, T., Berry, E. M., & Leighton, E. A. (2005). Aging, source memory, and emotion. *Psychology and Aging, 20*, 571–578.
- Naveh-Benjamin, M., Brav, T. K., & Levy, O. (2007). The associative memory deficit of older adults: The role of strategy utilization. *Psychology and Aging, 22*, 202–208.
- Ochsner, K. N. (2000). Are affective events richly “remembered” or simply familiar? The experience and process of recognizing feelings past. *Journal of Experimental Psychology: General, 129*, 242–261.
- Rabinowitz, J. C. (1989). Age deficits in recall under optimal study conditions. *Psychology and Aging, 4*, 378–380.
- Rahhal, T. A., May, C. P., & Hasher, L. (2002). Truth and character: Sources that older adults can remember. *Psychological Science, 13*, 101–105.
- Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39*, 1161–1178.
- 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.
- Storbeck, J., & Clore, G. L. (2005). With sadness comes accuracy; with happiness, false memory: Mood and the false memory effect. *Psychological Science, 16*, 785–791.
- Wechsler, D. (1997). *Technical manual for the Wechsler Adult Intelligence and Memory Scale—Third Edition*. New York: Psychological Corporation.

Received August 14, 2006

Revision received April 30, 2007

Accepted May 25, 2007 ■

Members of Underrepresented Groups: Reviewers for Journal Manuscripts Wanted

If you are interested in reviewing manuscripts for APA journals, the APA Publications and Communications Board would like to invite your participation. Manuscript reviewers are vital to the publications process. As a reviewer, you would gain valuable experience in publishing. The P&C Board is particularly interested in encouraging members of underrepresented groups to participate more in this process.

If you are interested in reviewing manuscripts, please write to the address below. Please note the following important points:

- To be selected as a reviewer, you must have published articles in peer-reviewed journals. The experience of publishing provides a reviewer with the basis for preparing a thorough, objective review.
- To be selected, it is critical to be a regular reader of the five to six empirical journals that are most central to the area or journal for which you would like to review. Current knowledge of recently published research provides a reviewer with the knowledge base to evaluate a new submission within the context of existing research.
- To select the appropriate reviewers for each manuscript, the editor needs detailed information. Please include with your letter your vita. In the letter, please identify which APA journal(s) you are interested in, and describe your area of expertise. Be as specific as possible. For example, “social psychology” is not sufficient—you would need to specify “social cognition” or “attitude change” as well.
- Reviewing a manuscript takes time (1–4 hours per manuscript reviewed). If you are selected to review a manuscript, be prepared to invest the necessary time to evaluate the manuscript thoroughly.

Write to Journals Office, American Psychological Association, 750 First Street, NE, Washington, DC 20002-4242.