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Title: Effects of Emotion on Memory Specificity in Young and Older Adults

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The present study examined how an object's emotional content affects the amount of detail that young and older adults remember about the object. Participants studied neutral (e.g., an umbrella), negative arousing (e.g., a snake), and positive arousing objects (e.g., a trophy). They later were asked to distinguish *same* from *similar* exemplars of the objects. In both age groups, memory for visual details (e.g., the ability to distinguish the studied snake from another snake) was enhanced for negative but not for positive objects. Older, but not younger, adults were better able to remember that a particular type of object had been studied (e.g., that they had studied a trophy) if it was positive than if it was neutral. These data suggest that negative (but not positive) content enhances memory specificity in young and older adults, but that older adults also benefit from enhanced general memory for items with positive content.

Not all memories are equally detailed: We can remember seeing a car parked on the street but have no memory for its color or model, or we can remember seeing a blue Ford Taurus parked along a side street. The present study investigated whether the amount of visual detail that young and older adults remember about an object is influenced by the item's emotional content (whether it is positive or negative). In young adults, there is evidence to suggest that while both positive and negative items are more likely to be remembered than neutral ones, the memory boost for negative items often results from enhancements in the memory's vividness or level of detail (e.g., Dewhurst & Parry, 2000; Kensinger & Corkin, 2003, 2004; Kensinger, Garoff-Eaton, & Schacter, 2006; Kensinger & Schacter, in press a; Ochsner, 2000; Pesta et al., 2001). By contrast, the memory enhancement for positive information is more likely to result from an increased feeling of familiarity or from memory for general (nonspecific) information rather than from memory for specific details (e.g., Ochsner, 2000; Bless & Schwartz, 1999). Studies examining the effect of mood on young adults' memories have confirmed that positive mood seems to enhance reliance on gist-based information or on heuristics, while negative mood seems to increase a person's focus on the specific details of an item or situation. Thus, positive mood often is associated with an increased likelihood of memory distortion, while negative mood is associated with a decreased likelihood of memory distortion (e.g., Bless et al., 1996; Kensinger & Schacter, in press b; Levine & Bluck, 2004; Storbeck & Clore, 2005).

No prior study has examined whether positive and negative emotional content affect older adults' ability to remember the details of an item's presentation. This

question is of particular interest because recent evidence has suggested that older adults are more likely than young adults to focus attention on emotional information (Adams et al., 1997; Fung & Carstensen, 2001; Hashtroudi et al., 1990; May et al., 2005), and perhaps specifically on positive information (Mikels et al., 2005; Mather & Carstensen, 2005). While it is likely that enhanced attention toward emotional information would result in a memory benefit for that information (and see D'Argembeau & van der Linden, 2004), it is less clear whether it would lead to enhancements primarily in memory for the general theme of an item, or also would boost older adults' memory for detail. On the one hand, it is possible that older adults' "positivity bias" (see Mather & Carstensen, 2005) would result in a change in the effect of emotional valence on memory specificity: Perhaps negative emotion would enhance memory specificity more than positive emotion in young adults, but positive emotion would enhance memory specificity more than negative emotion in older adults. An alternate possibility is that older adults may show an enhancement in general memory for positive information, but no corresponding increase in memory specificity. This alternative is plausible given evidence that older adults are more likely than young adults to rely on general or gist information, rather than on item-specific or detailed information, when deciding whether or not they have previously encountered a nonemotional item (e.g., Kensinger & Schacter, 1999; Koutstaal, 2003; Koutstaal & Schacter, 1997; Schacter, Koutstaal, & Norman, 1997). Because memory for positive items in young adults can be differentially reliant on general information, older adults' reliance on such information may differentially benefit their memories for positive items.

The present study was designed to assess the effect of positive and negative emotion on the likelihood that participants remembered the general theme and the visual details of presented objects. Participants were shown a series of positive arousing, negative arousing, and neutral objects. At test, they were asked to distinguish objects identical to those they had studied (*same*) from different exemplars of studied objects (*similar*) and from novel objects (*new*). To preview the results, both age groups were better able to distinguish *same* from *similar* negative objects than they were to distinguish *same* from *similar* positive or neutral objects. Older adults, but not young adults, also were more likely to remember at least the general theme of positive items compared to neutral items. These data suggest that both age groups receive a boost in memory specificity for negative items, but that this benefit does not extend to positive items. Older adults did, however, show enhanced general memory for items with positive content, consistent with recent evidence for age-related enhancements in memory for positive information.

Method

Participants. Twenty-two young adults (6 men, 16 women, mean age = 20.5) and 24 older adults (8 men, 16 women, mean age = 72) took part in this experiment. All participants were native English speakers with normal or corrected to normal vision. No participant had a history of a neuropsychological or psychiatric disorder, and no participant listed taking any medications that affected the central nervous system. Informed consent was obtained from all participants in a method approved by the Harvard University Institutional Review Board.

Materials. Materials comprised 180 pairs of colored, nameable photo objects (Hemera Technologies Inc, 2002, Canada), sized to 300 pixels in their largest dimension. Pairs of objects were selected so that the two items of a pair shared the same verbal label (e.g., were both umbrellas) but differed in other perceptual features (e.g., color, shape, size, orientation). Object pairs included a subset of the negative and neutral pairs used in Kensinger et al. (2006) and were supplemented with additional pairs of positive objects. One-third of the objects were rated by a separate group of 8 young and 8 older adults as negative and arousing, one-third were rated as positive and arousing, and one-third were rated as neutral and nonarousing. Pairs also were selected to assure that the negative, positive, and neutral item pairs were matched for the overall similarity of the two items, the dimensions (color, size, shape, orientation) that differed between the two items, and the familiarity of the items.

Study Procedure. Participants were presented with 144 nameable, colored objects (48 negative, 48 positive, 48 neutral). Each object was presented for 1 sec, and following the object's presentation, participants were asked to indicate, by key press, whether the object would fit inside of a filing cabinet drawer.

Test Procedure. After approximately a 30-min delay for the older adults, and a 2-day delay for the young adults, participants performed a surprise object recognition task. These delays were chosen because pilot data indicated that neither ceiling nor floor effects existed for participants when tested after these delays, and because these delays resulted in approximate matching of performance for the young and older adults. On the recognition task, participants were presented with 180 objects: 72 objects (24 negative, 24 positive, 24 neutral) that were identical to those that had been studied (*same* objects),

72 objects (24 negative, 24 positive, 24 neutral) that shared the same verbal label as a studied item but that differed in color, size, shape, or orientation (*similar* objects), and 36 *new* objects (12 negative, 12 positive, 12 neutral; **Figure 1**). Each object appeared in the center of a computer screen, with a prompt below indicating that participants should indicate, by key press, whether the item was the “same,” “similar,” or “new.” The same object within the object pair was tested across all participants; the items presented at study were counterbalanced between subjects to manipulate the condition of each object shown at recognition.

Results

The data are presented in Table 1: The proportion of items given a “same,” “similar,” or “new” response are reported as a function of item type (*same*, *similar*, or *new*), emotion type (negative, positive, neutral) and age group (young, older adults). We examined the effects of emotional content and age on the three different types of items presented at recognition (*new* items, items that were *similar* to studied items, and items that were the *same* as studied items; **Figure 1**).

ANOVAs indicated no effects of emotion on participants’ responses to *similar* or *new* items. We therefore focus our analyses on participants’ responses to *same* items. In particular, we examined the effects of emotion on participants’ ability to remember the specific details of an item (i.e., the proportion of “same” responses to a *same* item, referred to as *specific recognition*), and to remember at least the general features of an item, regardless of whether the specific visual details were remembered (i.e., the proportion of “same” and “similar” [not “new”] responses given to a *same* item, referred

to as *general recognition*; see Kensinger et al., 2006 for further discussion of the task design and scoring).

An ANOVA conducted on the *specific recognition* scores (“same” responses to a *same* item) with emotion as a within-subject factor and age group as a between-subject factor revealed a significant effect of emotion ($F(2,41) = 6.07, p < .01$), with specific recognition scores highest for negative items but equal for positive and neutral items. Importantly, there was no interaction with age, as this effect was comparable in the young and older adults (see **Table 1**)¹. In contrast, an ANOVA conducted on the *general recognition* scores (“same” plus “similar” responses to *same* items) revealed a marginal effect of emotion ($F(2,41) = 2.46, p < .10$) and a significant interaction between emotion and age group ($F(2,41) = 3.15, p < .05$). This interaction reflected the fact that young adults showed an emotion-related benefit in general recognition for negative objects (76%) compared with neutral (70%) or positive (66%) objects. Older adults, in contrast, showed a boost in general recognition both for positive (87%) and for negative (85%) objects as compared to neutral objects (79%).

Discussion

For both young and older adults, items with negative emotional content, but not positive emotional content, were remembered with additional visual detail: Specific recognition for both young and older adults was enhanced only for the negative items,

¹ We also examined how emotion affected the proportion of recognized items that were remembered with specific visual detail (i.e., “specific recognition” / “general recognition”). An ANOVA conducted on these proportional scores, with emotion as a within-subject factor and age as a between-subject factor, also revealed a main effect of emotion (with negative items having higher proportional scores than positive or neutral items; $F(2,41) = 3.73, p < .05$) but no interaction between emotion and age.

whereas memory specificity was no greater for positive items than for neutral ones. The fact that young and older adults were able to remember the details of negative items better than those of neutral items is broadly consistent with a couple of prior studies indicating that both age groups are more likely to form vivid memories of negative experiences than of neutral ones (Comblain et al., 2003; Davidson & Glisky, 2002; Kensinger, Krendl, & Corkin, 2006; Wolters & Goudsmit, 2005), and are less likely to falsely recall or recognize negative lures (Kensinger & Corkin, 2004). Taken together, these results suggest that negative emotion can facilitate memory for detailed information throughout the adult lifespan.

The fact that negative items also were remembered with more detail than positive items is consistent with prior research demonstrating that, in young adults, positive emotion leads to more gist-based or heuristic processing, whereas negative emotion leads to more detailed processing (Bless et al., 1996; Kensinger & Schacter, in press b; Levine & Bluck, 2004; Storbeck & Clore, 2006). Critically, these data suggest that these divergent effects of positive and negative emotion remain consistent across the lifespan. Despite age-related increases in the prioritization of processing for positive emotion-eliciting information (see Mather & Carstensen, 2005), older adults do not show enhanced memory specificity for positive information.

Although emotional content has similar influences on memory specificity in young and older adults, emotion does appear to have divergent effects on general recognition in the two age groups. Young adults showed a general recognition benefit only for negative objects as compared to neutral ones; they showed no comparable mnemonic boost for general recognition of positive objects. Older adults, in contrast,

showed equivalently elevated general recognition for the negative and positive objects. These results are broadly consistent with data indicating that positive emotion has more of an enhancing effect on older adults' memories than on young adults' memories (Charles et al., 2003; Hill et al., 2005; Leigland et al., 2003). Importantly, these results suggest that there are instances in which older adults' mnemonic benefit for positive information is limited to extraction of general features of an item, and does not extend to memory for the specific visual details of the previously-encountered information. This observation fits well with previous research on false recognition of nonemotional items, which highlights that older adults sometimes rely more on general than specific information when making recognition decisions (e.g., Koutstaal & Schacter, 1997; Kensinger & Schacter, 1999). Age-related increases in reliance on general information thus appear to have significant consequences for the performance of older adults in multiple aspects of memory.

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Table 1. Proportion of “same,” “similar,” and “new” responses (mean, SE) as a function of item type (*same*, *similar*, or *new*), emotion type (negative, positive, neutral) and age (young, older adults).

Response Type	Same	Similar	New
YOUNG ADULTS			
Negative objects			
“same”	.53 (.06)	.27 (.05)	.11 (.03)
“similar”	.23 (.04)	.43 (.04)	.26 (.04)
“new”	.24 (.06)	.30 (.04)	.63 (.05)
Positive objects			
“same”	.40 (.06)	.23 (.04)	.06 (.02)
“similar”	.26 (.03)	.40 (.04)	.24 (.04)
“new”	.34 (.07)	.37 (.03)	.70 (.05)
Neutral objects			
“same”	.40 (.05)	.23 (.04)	.09 (.02)
“similar”	.30 (.03)	.36 (.04)	.26 (.03)
“new”	.30 (.05)	.41 (.05)	.65 (.04)
OLDER ADULTS			
Negative objects			
“same”	.68 (.04)	.30 (.04)	.10 (.02)
“similar”	.17 (.02)	.41 (.05)	.21 (.03)
“new”	.15 (.03)	.30 (.05)	.69 (.04)

Positive objects			
“same”	.57 (.06)	.27 (.03)	.07 (.02)
“similar”	.31 (.06)	.36 (.04)	.18 (.03)
“new”	.13 (.02)	.37 (.04)	.74 (.04)
Neutral objects			
“same”	.59 (.06)	.28 (.04)	.12 (.03)
“similar”	.19 (.04)	.38 (.06)	.19 (.03)
“new”	.21 (.05)	.34 (.05)	.69 (.04)

Figure 1. Task design: At study, young and older adults viewed objects for 1000ms. One-third of the objects were negative and arousing (e.g., tarantula), one-third were positive and arousing (e.g., diamond ring), and the other third were neutral (e.g., barometer). At test, participants were presented with objects that were the *same* as a studied item (identical), *similar* to a studied item (sharing the same verbal label but not an identical picture), or *new* (not studied). Participants indicated whether the item was “same,” “similar,” or “new.”

