Response Bias in “Remembering” Emotional Stimuli: A New Perspective on Age Differences

Aycan Kapucu, Caren M. Rotello, Rebecca E. Ready, and Katharina N. Seidl
University of Massachusetts

Older adults sometimes show a recall advantage for emotionally positive, rather than neutral or negative, stimuli (S. T. Charles, M. Mather, & L. L. Carstensen, 2003). In contrast, younger adults respond “old” and “remember” more often to negative materials in recognition tests. For younger adults, both effects are due to response bias changes rather than to enhanced memory accuracy (S. Dougal & C. M. Rotello, 2007). We presented older and younger adults with emotional and neutral stimuli in a remember–know paradigm. Signal-detection and model-based analyses showed that memory accuracy did not differ for the neutral, negative, and positive stimuli, and that “remember” responses did not reflect the use of recollection. However, both age groups showed large and significant response bias effects of emotion: Younger adults tended to say “old” and “remember” more often in response to negative words than to positive and neutral words, whereas older adults responded “old” and “remember” more often to both positive and negative words than to neutral stimuli.

Keywords: response bias, remember–know judgments, emotional memory age

Memory for emotional events is often described as more accurate and more detailed than memory for neutral events. Younger adults are often reported to have memory that is specifically enhanced for negatively valenced materials (e.g., Ochsner, 2000). In contrast, older adults are often reported to have memory that is specifically enhanced for positively valenced stimuli (e.g., Charles et al., 2003; Thomas & Hasher, 2006), a finding attributed to the improved emotional regulation that occurs with aging (see Mather & Carstensen, 2005).

The enhanced and detailed memory for emotional stimuli may reflect the contribution of a recollection process, a claim often assessed with the remember–know paradigm (Tulving, 1985). In this paradigm, participants study some materials and are then given a recognition test during which they distinguish “old” responses that involve recollection (i.e., “remembered” stimuli) from those that do not (stimuli they “know” were studied). Research with younger adults indicates that the “remember” response rates for emotional stimuli are increased compared with those for neutral stimuli, suggesting increased use of recollection (e.g., Kensinger & Corkin, 2003; Ochsner, 2000). Similarly, the higher “remember” response rates observed in younger, compared with older, adults suggests a loss of recollection with normal aging (see Light, Prull, La Voie, & Healy, 2000).

Researchers have drawn similar conclusions using a source judgment task: Source memory is more accurate for negative than it is for neutral stimuli, which suggests that negative stimuli are better recollected (e.g., Kensinger & Corkin, 2003, Experiment 2). However, recent modeling work has shown that accurate source judgments do not require the use of recollection (Hautus, Macmillan, & Rotello, 2007). More convincing evidence comes from recognition tests of studied photos mixed with photos of different objects with the same name (i.e., two similar airplanes) and novel lures. Both older and younger participants were best able to distinguish negative, rather than neutral or positive, studied photos from similar lures (Kensinger, Garoff-Eaton, & Schacter, 2007), but they also showed a greater willingness to respond “old” to any negative stimulus than to the others.

The conclusion that emotional events lead to enhanced memory is not uniformly supported. Emotional stimuli are sometimes recognized no better than neutral stimuli, or are actually recognized more poorly, by both older and younger adults (e.g., Budson et al., 2006; Dougal & Rotello, 2007; Grady, Hongwanishkul, Keightley, Lee, & Hasher, 2007; Johansson, Mecklinger, & Treese, 2004; Maratos, Allan, & Rugg, 2000; Windmann & Kutas, 2001). Even in cases in which emotional stimuli are remembered better than neutral stimuli, older adults do not always show specific enhancement for positively valenced materials (e.g., Kensinger et al., 2007).

Emotional memories may also not be rich in recollected detail. Modeling work has shown that differences in the “remember” response rate merely reflect different response biases (Dougal & Rotello, 2007; Rotello, Macmillan, Hicks, & Hautus, 2006). Indeed, a number of researchers have argued that the effects of emotion on old–new response rates are also due to response bias (Budson et al., 2006; Dougal & Rotello, 2007; Windmann & Kutas, 2001).

One factor that may govern the experimental outcome is the adequacy of stimulus control. Talmi and Moscovitch (2004) showed that emotional words were recalled no better than neutral words when the neutral words were semantically interrelated like the emotional stimuli; Dougal and Rotello (2007) reported a sim-
ilar result in a recognition task. Analogously, Sharot, Delgado, and Phelps (2004) found that recognition of negative and neutral International Affective Picture System (IAPS) photos was equal when visual complexity was controlled.

A second factor that may affect the results is the way in which recognition accuracy was measured. Some researchers report “corrected recognition” scores (hit rate minus false alarm rate) and others report d’. Unfortunately, neither correct recognition nor d’ is necessarily useful for measuring accuracy when there is also a change in response bias; in that case, response bias and the accuracy measures are confounded (Macmillan & Creelman, 2005; Rotello, Masson, & Verde, 2008). Receiver-operating characteristic (ROC) data allow us to avoid this confound.

Our purpose in the current study is to investigate changes in memory accuracy and response bias to emotional stimuli in younger and older adults using ROC analyses. We also evaluated the interpretation of “remember” responses by fitting quantitative models of memory to the data; these models assume either that “remember” responses reflect a high-threshold recollective process (Yonelinas, 1999; see Yonelinas, 2002, for a review) or that they merely reflect stronger memories (Donaldson, 1996; Wixted & Stretch, 2004). In other words, in our modeling work, we intend to distinguish whether “remember” and “know” responses reflect two qualitatively distinct types of information. We asked three specific questions. First, is memory enhanced for negative stimuli in younger adults and for positive stimuli in older adults? Second, are the response bias shifts to emotional stimuli different for younger and older adults? Finally, do “remember” responses indicate increased recollection for emotional items in older adults? We used ROC data to answer the first two questions and modeling work to answer the third.

Method

Participants

The younger adults (M age = 19.6 years, SD = 0.8; 77% women) were 22 University of Massachusetts undergraduates who participated in exchange for extra credit in their psychology courses. The older adults (M age = 71.9 years, SD = 7.5; M education = 15 years, SD = 2.5; 70% women) were 23 community-dwelling residents of the Amherst, Massachusetts, area; they were compensated with a modest cash payment. Two additional younger participants and six additional older adults participated but were excluded from the analyses because of near-chance memory performance (2 younger and 5 older adults) or failure to follow instructions (1 older adult).

The groups did not differ significantly on estimated verbal intelligence quotients measured with the American National Adult Reading Test (ANART; Gladsjo, Heaton, Palmer, Taylor, & Jeste, 1999; t(42) = 1.40, p > .15)\(^1\). Before they were enrolled in the study, older adults were screened for cognitive impairment with the modified Telephone Interview for Cognitive Impairment (TICS-m; Welsh, Breitner, & Magruder-Habib, 1993). All older adults scoring greater than 30 on the TICS-m were invited to participate in the current study.

Design

We used a 2 × 2 × 3 factorial design with two within-subjects factors: item status (studied, new) and emotionality of the words (negative and arousing, neutral, or positive and arousing), and one between-subjects factor (age).

Materials

The stimuli were the same as those used by Dougal and Rotello (2007, Experiment 1b). There were 96 negative arousing words (M valence = 2.24, M arousal = 6.63), 96 positive arousing words (M valence = 7.79, M arousal = 6.48), and 192 neutral nonarousing words (M valence = 5.16, M arousal = 4.15) taken from the Affective Norms for English Words (ANEW) pool (Bradley & Lang, 1999). Francis and Kučera (1982) word frequencies were equated across emotion, and the semantic interrelatedness among all classes of words was matched using latent semantic analysis (Landauer, Foltz, & Laham, 1998).

Older adults’ responses to these stimuli, for both arousal and judged valence, were strongly correlated with both Bradley and Lang’s (1999) data and a new sample of younger adults’ responses (Wurm, Labouve-Vief, Aycock, Rebucal, & Koch, 2004).

Procedure

All participants were instructed to study 192 words (96 neutral, 48 negative, and 48 positive) that were shown one at a time for 3 seconds each in the middle of the computer screen. Immediately following the presentation of the study list, participants made recognition judgments for 384 test words (half studied and half new) on a scale of 1 (sure new) to 6 (sure old). For each word participants called “old,” they were asked to make a remember–know judgment using Rajaram’s (1993) instructions. Study and test sequences were randomly ordered for each participant.

After the recognition test, participants completed the ANART. In total, the experiment took about 45 minutes for the younger adults and 60 minutes for the older adults.

Results and Discussion

We considered the data in three ways. First, we compared the overall hit and false-alarm rates, as well as remember–know proportions, with those in the literature. Next, we used the confidence ratings to generate ROC curves, which allow straightforward evaluation of memory sensitivity and response bias effects. Finally, we fit the data with three quantitative models based on different assumptions about the interpretation of “remember” and “know” judgments.

Behavioral Data

“Old” responses. Overall hit and false-alarm rates are shown in Figure 1 for both age groups. Both groups performed similarly: The hit rates are higher for negative stimuli than they are for positive stimuli, whose hit rates are higher than those for neutral items. The main effect of emotion on hit rates was highly reliable, F(2, 86) = 38.49, MSE = .006, p < .001, as were all pair-wise Bonferroni-corrected comparisons; there was no effect of age (F < 1), and the interaction of age and emotion was not significant (p > .18). The false-alarm rate was also affected by emotion, F(2, 86) =

\(^1\) Time constraints prevented the collection of screening data for 1 older adult.
29.36, $MSE = .006$, $p < .001$, but emotion interacted with age, $F(2, 86) = 3.93$, $MSE = .006$, $p < .05$. Older adults’ false alarms were increased for the emotional compared to neutral stimuli, whereas younger adults’ false alarms were particularly inflated for negative stimuli. The increased “old” response rate for negative stimuli, regardless of study status, is consistently observed in the literature (Budson et al., 2006; Dougal & Rotello, 2007; Windmann & Kutas, 2001).

“Remember” responses. The “remember” response rates are shown in Figure 2. Both older and younger participants claimed to remember more details of having studied negative stimuli than neutral or positive stimuli. The main effects of emotion were significant for both the studied items, $F(2, 86) = 19.32$, $MSE = .005$, $p < .001$, and lures, $F(2, 86) = 16.27$, $MSE = .002$, $p < .001$; there were no effects of age and no interactions.

The inflated “remember” response rate to negative stimuli (e.g., Dougal & Rotello, 2007; Kensinger & Corkin, 2003; Ochsner, 2000; Sharot et al., 2004) has sometimes been interpreted to mean that participants are actually retrieving more negative memories (e.g., Ochsner, 2000). However, the interpretation of remember–know judgments is a matter of debate: The issue is whether “remember” and “know” responses measure qualitatively distinct underlying processes (i.e., recollection and familiarity) or whether they measure quantitatively different values of the same underlying information (i.e., memory strength or, equivalently, the sum of recollection and familiarity; Wixted & Stretch, 2004). Only by fitting the data with models that implement these different assumptions can we adjudicate between these interpretations of the data; we adopt this approach in the Model-Based Analyses section. Before turning to models, however, we consider participants’ ROC data for the evaluation of memory sensitivity and bias to the three classes of stimuli.

ROC Analyses

Both hit and false-alarm rates, as well as “remember” responses, were increased for emotional stimuli. Thus, the primary consequence of emotion may be to shift participants’ response bias rather than to enhance their memory accuracy. We evaluated this hypothesis using ROC analyses that allowed us to measure accuracy and bias independently. We used participants’ confidence ratings in their old–new judgments to create ROC curves, which plot the hit rate against the false-alarm rate as a function of confidence. “Sure old” decisions constitute the leftmost point in ROC space; decreasing confidence is reflected in the points to the right. For a given false-alarm rate, a condition that yields a higher hit rate reflects greater memory accuracy. Therefore, ROC curves that fall higher in the space indicate better memory. In contrast, points that fall along the same theoretical curve reflect equal accuracy but different response biases. More liberal biases are indicated by points that are closer to (1,1) along a given ROC, because those points reflect higher hit and false-alarm rates.

Figure 3 shows the old–new ROCs for each stimulus type for both the younger (Figure 3A) and older participants (Figure 3C). The obvious effect of emotion is to produce a more liberal bias. For each confidence level, the negative stimuli yielded more liberal responses than the neutral stimuli: The operating points for negative stimuli are to the upper right of the corresponding points for neutral stimuli. The positive stimuli also yielded more liberal responses than the neutral stimuli, an effect that is stronger for the older participants.
We conclude that participants have equally good memory for all three types of stimuli (area under the ROC, $A_z$: $F(2, 86) = 2.11, p > .12, MSE = 0.007$), but are more willing to say “old” for emotional stimuli (bias, $c$: $F(2, 86) = 54.12, MSE = .046, p < .001$). Younger participants show a small response bias shift in response to positive stimuli and a much larger shift for negative stimuli. In contrast, older participants show a liberal response bias shift that is approximately the same magnitude for both negative and positive stimuli.

We failed to observe a positivity effect: Older adults’ memory was not enhanced for positive stimuli. To be sure that our older adults were not too young to show a positivity effect, we identified 6 older adults who were 77 to 90 years of age and analyzed their data separately. The results did not differ.

The asymmetrical shape of the old–new ROC curves in Figure 3 is consistent with both the dual-process model (Yonelinas, 1994) and an unequal-variance signal-detection model (Wixted & Stretch, 2004). To determine which account of the data is more accurate, and to evaluate whether the increased “remember” response rates to emotional stimuli reflect a recollective process, we fit participants’ ROC data and their remember–know response rates at each confidence level with three distinction models.

Model-Based Analyses

A number of quantitative models of remember–know judgments have been proposed in recent years (see Macmillan & Rotello, 2006). These models make a variety of assumptions about the
nature of a “remember” response. For example, the dual-process model (Yonelinas, 1994) assumes that “remember” judgments reflect the use of a recollective process. On this view, remembering and knowing are qualitatively different responses, based on distinct types of information in memory. In contrast, in the one-dimensional model (Donaldson, 1996; Wixted & Stretch, 2004), it is assumed that “remember” responses simply reflect memories that differ quantitatively from “know” judgments: “Remember” responses are reserved for stronger memories. There are two versions of the basic one-dimensional model: the fixed criterion version (Donaldson, 1996), in which it is assumed that the decision criteria are stable across trials, and the variable-criterion version (Wixted & Stretch, 2004), in which it is assumed that the old–new confidence criteria are stable but that the remember–know criterion location varies from trial to trial.2

We fit these models to the data from each participant in our experiment using the same method as Dougal and Rotello (2007). Each condition in this experiment (negative, positive, or neutral stimuli) provided a matrix of 18 response frequencies, 6 confidence ratings × 2 types of items (old or new), where 3 of the ratings were followed by 2 types of judgment (“remember” or “know”), for each participant. For each model, we generated the predicted probability of a “remember,” “know,” or “new” response at each confidence level, and then found the parameter values that minimized the differences between these predicted response probabilities and the observed proportions, using maximum-likelihood estimation. The models differ in their number of free parameters and are not nested, so we used Akaike’s information criterion (AIC: Akaike, 1973) to compare the ability of the models to account for the data while adjusting for the number of parameters. We fit all conditions simultaneously (though all criteria, sensitivity, and other parameters were free to vary across conditions), which resulted in a single AIC value for each participant–model combination. Table 1 shows the mean AIC value for each model; smaller numbers reflect model predictions that correspond more closely to the observed pattern of data. On average, the one-dimensional model with variable criterion provides the best description of the data, meaning that the “remember” responses do not measure recollection.

Table 1 also shows the number of participants for whom each model yielded the best account of the data. Nineteen of the younger (86%) and 16 of the older (70%) participants’ data were best fit with a version of the one-dimensional model. These fits imply that for those 35 participants, “remember” responses merely reflected stronger memories than “know” judgments. A slight majority (57%) of these 35 individuals’ data were better described by the variable-criterion version of the model, which simply means that they were relatively uncertain of the strength at which to respond “remember” rather than “know.” The remaining participants’ data (3 younger and 7 older) were better fit by the dual-process model. For those 10 individuals, “remember” responses appear to reflect a recollective process that is a qualitatively different process than “knowing.” Examination of these participants’ characteristics did not reveal any factors (i.e., age or cognitive ability) that distinguished them from the participants whose data were better fit by the one-dimensional model. These results are consistent with Dougal and Rotello’s (2007) and Rotello et al.’s (2006): For the vast majority (78%) of participants, there was no evidence that “remember” responses reflected the retrieval of episodic details.

Table 2 shows the value of each parameter of the one-dimensional variable-criterion model averaged over participants. We analyzed the parameter values using two-way analyses of variance with factors of Emotion and Age. The results indicate that the model concurs with our interpretation of the ROCs in showing that there are no sensitivity effects of emotion or age but that the decision criteria are reliably more liberal for the emotional stimuli. In particular, the negative stimuli yield the most liberal response criteria. Analogous analyses for the parameter values of the other models led to the same conclusions. Thus, our conclusions are not model-bound: Memory accuracy is not affected by emotion, but response bias is.

Our interpretation of the remember–know judgments depends on the fits of the models to individual participants’ data. However, we have superimposed the models’ predictions for the best-fitting parameter values on the group ROC data in Figure 3 and on the “remember” response rates in Figure 4. As is apparent in Figures 3A and 3C, the dual-process model systematically overpredicts the higher confidence (leftward) points on the ROCs. In contrast, the one-dimensional model’s predictions are quite close to the observed data (see Figures 3B and 3D). Similarly, the predicted “remember” response rates are mispredicted by the dual-process model (see Figures 4A and 4C) and better fit by the one-dimensional model (see Figures 4B and 4D). The reason for this failing is that in the dual-process model, it is assumed that essentially all “remember” responses are made with highest confidence, because recollection of an episodic memory should result in high-confidence “old” judgments. In contrast, in the variable-criterion one-dimensional model, it is assumed that “remember” and “know” judgments reflect a continuum of memory strengths, so that both responses may be made at several confidence levels.

General Discussion

We investigated recognition memory for emotional words in younger and older adults. Younger and older adults did not differ in their memory accuracy. Although this outcome seems surprising, other studies have also failed to observe age-related changes in memory accuracy, particularly on recognition tasks (e.g., Bunce & Macready, 2005; Siedlecki, 2007; see Zacks & Hasher, 2006, for a review). ROC analyses showed that accuracy was no better
Table 2  
Mean Parameter Values for the Best-Fitting (One-Dimensional, Variable-Criterion) Model for Younger and Older Adults

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Younger adults</th>
<th>Older adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>zROC slope</td>
<td>0.64 0.74</td>
<td>0.73 0.73</td>
</tr>
<tr>
<td>d′&lt;sub&gt;f&lt;/sub&gt;</td>
<td>1.29 1.21</td>
<td>1.28 1.70</td>
</tr>
<tr>
<td>c&lt;sub&gt;1&lt;/sub&gt; (“probably new”)</td>
<td>−0.65 −0.67</td>
<td>−0.68 −0.19</td>
</tr>
<tr>
<td>c&lt;sub&gt;2&lt;/sub&gt; (“maybe new”)</td>
<td>0.32 −0.04</td>
<td>0.24 0.54</td>
</tr>
<tr>
<td>c&lt;sub&gt;3&lt;/sub&gt; (“maybe old”)</td>
<td>1.11 0.60</td>
<td>0.95 1.02</td>
</tr>
<tr>
<td>c&lt;sub&gt;4&lt;/sub&gt; (“probably old”)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.64 1.19</td>
<td>1.50 1.40</td>
</tr>
<tr>
<td>c&lt;sub&gt;5&lt;/sub&gt; (“sure old”)&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>2.15 1.73</td>
<td>2.07 1.83</td>
</tr>
<tr>
<td>t&lt;sub&gt;1&lt;/sub&gt;&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.71 1.22</td>
<td>1.54 20.0</td>
</tr>
<tr>
<td>t&lt;sub&gt;2&lt;/sub&gt;&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.51 6.54</td>
<td>6.72 11.8</td>
</tr>
</tbody>
</table>

Note. d′<sub>f</sub> is the distance between the old and new distributions measured in units of the new distribution; zROC slope is the ratio of the standard deviation of the new distribution to that of the old distribution; c<sub>1</sub>—c<sub>5</sub> are old-new decision criteria; c<sub>1</sub> is the mean location of the remember-know criterion; 1/σ is the standard deviation of the remember-know criterion criterion.

<sup>a</sup> Statistically reliable main effects of emotion.  
<sup>b</sup> Main effects of age.  
<sup>c</sup> Interactions of emotion and age.  
<sup>d</sup> This negative value was caused by 1 participant, for whom c<sub>1</sub> was estimated to be −615. Elimination of that participant increased the mean c<sub>1</sub> value to 7.05 and did not affect any statistical conclusions.

for emotional stimuli than it was for neutral stimuli, but participants employed more liberal response biases for emotional items. Younger adults tended to say “old” more often to negative words than they did to positive words and also more often to positive words than to neutral words. Similarly, older adults tended to say “old” more often to both negative and positive words than they did to neutral words. Thus, the criterion shifts observed in younger and older adults are similar but not identical.

The finding that the effect of emotion on recognition memory can be attributed to response bias shifts rather than to enhanced accuracy is consistent with previous recognition studies of words (Dougal & Rotello, 2007; Windmann & Kutas, 2001) and well-controlled IAPS pictures (Sharot et al., 2004) with younger adults and healthy older adults (Budson et al., 2006). It is interesting to note that Budson et al. (2006) found that older adults with Alzheimer’s disease (AD) showed a significant shift to a more conservative response bias for emotional than for neutral stimuli, suggesting that the amygdala (which is affected by AD) might be responsible for the bias shifts. Indeed, there is some evidence for an age-related change in the neural systems responsible for emotional processing from amygdala to more frontal and parietal structures (Leigland, Schulz, & Janowsky, 2004). Similarly, Mather et al. (2004) found that amygdala activation during viewing of negative images was diminished in older, as compared with younger, adults.

The absence of enhanced emotional memory in the present study might not seem surprising given our use of word stimuli rather than more arousing IAPS pictures and the evidence suggesting that the effects of emotion on memory usually develop after some delay (e.g., Kensinger & Corkin, 2003). However, enhanced emotional memory has also been reported in studies using immediate testing (e.g., Charles et al., 2003; Leigland et al., 2004; Thomas & Hasher, 2006); understanding the psychological basis of those immediate effects was the goal of the present study. Moreover, enhanced effects of emotion are not consistently observed in experiments that employ a study–test delay with well-controlled stimuli (e.g., Sharot et al., 2004; Talini & Moscovitch, 2004). Our results suggest that immediate memory effects from emotional stimuli might actually be due to changes in response bias. Whether bias changes could also account for emotional effects observed after a delay or with IAPS stimuli, are worthy questions.

One may also wonder whether response bias effects could account for the enhanced recall of emotional materials that has been reported. Although our recognition results are suggestive, answering this question directly requires intrusion rate data for emotional and neutral stimuli (i.e., analogs to the false alarm rates), which are rarely reported.

Implications for Theories of Emotional Processing and Aging

Socioemotional Selectivity Theory (SST; Charles et al., 2003) suggests that a “positivity effect” will occur in memory for emotional materials: Memory for positive stimuli should be enhanced in older adults due to the advanced emotion regulation brought about by aging. In contrast to the predictions of SST, our older participants showed equally good memory for all three types of stimuli. Perhaps the positivity effect should be construed more broadly to include the possibility of older adults’ greater receptiveness to positive stimuli (i.e., response bias changes) rather than memory enhancement.

Implications for Interpreting Remember–Know Data

A typical finding is that older adults make fewer “remember” responses than do younger adults (e.g., Parkin & Walter, 1992). One interpretation is that the use of recollection declines with age (see Light et al., 2000, for a review). In our study, similar “remember” rates were observed in each age group, perhaps because recognition accuracy was also similar.

Both younger and older adults claimed to remember more details of the negative stimuli than they did of the neutral or positive stimuli, replicating the results of prior studies (e.g., Dougal & Rotello, 2007; Kensinger & Corkin, 2003; Ochsner, 2000; Sharot et al., 2004). As with age differences in “remember” rates, increased “remember” response rates to emotional stimuli have been interpreted as evidence for enhanced recollection of those items (e.g., Kensinger & Corkin, 2003; Ochsner, 2000). However, our model-based analyses showed little support for the view that “remember” responses measure the contribution of recollection to the recognition judgments. For the vast majority of our participants, the increased “remember” responses to emotional stimuli simply reflected a liberal response bias that is analogous to the liberal bias to say “old.” These results are consistent with previous model-based studies suggesting that “remember” and “know” responses do not reflect qualitatively distinct processes (Dougal & Rotello, 2007; Rotello et al., 2006; Rotello, Macmillan, Reeder, & Wong, 2005).

Conclusions

Studies of recognition memory for emotional materials have yielded inconsistent results; some have found enhanced memory
Figure 4. “Remember” response rates, averaged over participants, for each stimulus type and both age groups. Model predictions for the best-fitting parameter values are superimposed on the data. A: younger adults, dual-process fit; B: younger adults, one-dimensional variable-criterion fit; C: older adults, dual-process fit; D: older adults, one-dimensional variable-criterion fit. Data are indicated with plus signs for positive items, minus signs for negative items, and filled circles for neutral items; model predictions are shown as dashed lines for positive items, dotted lines for negative items, and solid lines for neutral stimuli.
sensitivity for negative compared with neutral stimuli, whereas others have found the opposite pattern or no sensitivity difference at all. These conflicting outcomes may be attributable to differences in methodology, stimulus control, or measurement of memory accuracy across experiments. A striking consistency in the literature is the liberal response bias shift that occurs for emotional, particularly negatively valenced, materials. Our data extend that basic effect to older adults and contribute to the growing evidence that “remember” responses should not be interpreted as measuring the use of a recollective process.

References


Received October 31, 2007
Revision received January 18, 2008
Accepted January 20, 2008