The Role of Emotion and Motivation in Memory

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Abstract

Emotion has long been known to impact memory, with individuals generally showing heightened memory for emotional relative to neutral information. The mechanisms underlying this effect are still not clear, but the kinds of emotional material recalled by individuals may shed some light on this issue. The present investigation explored the type of emotional information recalled by younger and older adults across different contexts. The data suggest that younger adults tend to process negative information in an automatic, prioritized fashion across a variety of contexts, but that they can use incentive to attenuate this bias. Older adults also prioritize negative information, but are even more successful than young adults at shifting priority to positive material. The implications for theories regarding emotion and memory are discussed.

Emotion has been shown to have a strong impact on cognitive processing across a number of domains (Buchanan and Adolphs). Emotion seems to impact attention, as individuals fixate longer, and are faster to detect and respond to emotional relative to neutral items (Ohman, Flykt, and Esteves; Phelps, Ling, and Carrasco). We devote more attention to processing negative social traits, and focus our attention on emotional components of a scene while neglecting neutral items or events (e.g., Anderson and Phelps; Burke, Heuer, and Reisberg; Christianson and Loftus, 1987, 1990, 1991; Wessel and Merckelbach). Emotion has been postulated to affect visual processing, allowing

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people to see better when looking at items that are more emotionally salient (Phelps, Ling, and Carrasco). Emotion also impacts memory, such that participants often remember emotionally arousing items better than neutral items (Cahill et al.; Canli et al.; Christianson; Doerksen and Shimamura; Hamann et al.; LaBar and Phelps).

One question that continues to challenge researchers is what mechanisms are responsible for this emotional saliency effect. In addressing this question, some theories have focused on the finding that in many cases negative emotional information is remembered significantly better than neutral or positive information, particularly by young adults (Baumeister et al.; Dewhurst and Parry; Mather, Shafir, and Johnson; Rozin and Royzman; Kensinger, Piguet, Krendl, and Corkin). Even memory for everyday events is higher for negative relative to positive events (David et al.; but see Baumeister et al. for an exception). This finding of greater recall of negative relative to neutral information is typically referred to as the negativity bias.

It has been speculated that the negativity bias is prevalent because of a biological or evolutionary predisposition to focus on negative information (Kern et al.; Rozin and Royzman). Researchers have argued that humans need to be adept at evaluating an environment or situation as potentially threatening, and thus we automatically prioritize the processing of aversive stimuli (Dijksterhuis and Aarts; Ohman, Flykt, and Esteves; Pratto and John). Emotion may function to guide action and plan for future events. Consistent with this theory that negative items are processed in an automatic and differential fashion are findings from the neuroscience literature on emotion. In an effort to understand the mechanisms responsible for emotion's role in memory, researchers have begun to examine the underlying neural circuitry. This research has focused on the amygdala, a structure in the brain thought to enhance long-term memory for emotionally arousing events by modulating memory formation and storage in the hippocampus and neocortical areas (Anderson and Phelps). Functional brain imaging methods have shown that the amygdala is automatically activated when individuals look at emotional stimuli (LaBar and Phelps), particularly negative stimuli. Also, patients with amygdala damage show deficits in autobiographical emotion-related memories indicating that enhanced memory for details due to emotional arousal

depends at least partly on the amygdala (Adolphs et al.).

Not all findings are consistent, however, with the notion that negative information is automatically prioritized over neutral or positive material. Older adults, for example, tend to avoid negative stimuli and focus on positive items when given a choice. In addition, older adults elaborate more on positive relative to negative information (Knight and Mather). Furthermore, while older adults do show a negativity bias in some memory tasks (Cacioppo, Gardner, and Bernston, 1997, 1999), in other situations they fail to show a negativity bias or even show a bias for positive material (e.g., Berntsen; Berntsen and Rubin; Carstensen and Mikels; Charles, Mather, and Carstensen; Kennedy, Mather, and Carstensen).

One theory that accounts for the finding that positive material receives greater attentional resources and if often recalled better than negative material by older adults is the Socioemotional Selectivity Theory (SST), which suggests that motivation plays a role in the type of information that is remembered (Carstensen, Isaacowitz, and Charles; Carstensen, Fung, Charles et al.). According to Carstensen and colleagues, older adults perceive time as limited, and therefore are highly motivated to optimize emotional state and meaningfulness (Charles et al.). In other words, people who believe that they do not have a long future ahead of them are motivated to remember positive information in order to maintain and reinforce a positive emotional state. Thus older adults tend to focus on positive information to enhance their current mood and maintain positive affect (Isaacowitz). Consistent with this theory are the findings that older adults fixate longer on, devote more resources to, and often show heightened recall for positive information. In addition, some studies have found that older adults report experiencing negative moods less than younger adults. Further support for this theory comes from the finding that the longer older participants believe that they have left to live, the smaller a positivity bias they show (Löckehoff and Carstensen). Thus the SST suggests that motivation and incentives play a major role in our memory for emotional material.

Incentives have long been known to play a role in younger adults' neutral information, as young adults in several studies have shown reliably greater recall for items they were instructed or motivated to

prioritize (e.g., Guynn and Roediger). In addition, other findings are suggestive that incentives may also play a role in younger adults' attention to and memory for emotional items. For example, young adults whose time is limited as a result of a terminal illness tend to focus more on positive social relationships (Carstensen and Fredrickson), and young individuals tend to recall more positive information when motivated to maintain a positive emotional state (e.g., Kennedy, Mather, and Carstensen).

The purpose of the present study was to examine the role of incentive on younger and older adults' memory for emotional information. Participants in this study viewed positive, neutral, and negative images and were instructed to remember them for a later test. In the Baseline (Equal-Incentive) condition, all items were weighted equally; participants were simply to recall all the images they could remember. To investigate the role of incentive in memory, we included two additional incentive conditions under which some items were designated as high-priority and were worth 10 points at recall, while others were low-priority and were worth 2 points at recall. In the Positive Incentive Condition (PIC), all positive items were designated as high-priority, while in the Negative Incentive Condition (NIC) all negative items were designated as high-priority. Our aim was to examine younger and older adults' recall of emotional items across the Equal-Incentive, Positive-Incentive, and Negative-Incentive in order to under the role of external (e.g., incentive) and internal (e.g., biological predisposition) priorities on memory.

Method

Participants

Seventy-two younger adults (ages 18-25) and seventy-two older adults (ages 60-80) participated in the experiment. The younger adults were all students at the College of Charleston who participated as one way of receiving class credit. The older adults were all healthy, community-dwelling volunteers who participated, received $10 compensation, as well as free parking.

Materials

Materials for the experiment included 44 pictures: 12 positive, 12

negative, 12 neutral, and 8 filler items, all selected from the International Affective Picture System (IAPS; see Ito, Cacioppo, and Lang), which provides norms for arousal and valence for each item. Negative images had an average valence rating of 2.7, neutral images had an average valence rating of 4.7, and positive items had an average valence of 7.5. Both negative and positive images had average arousal ratings of 5.83, while the neutral images had an average arousal rating of 2.4.

One-word labels (e.g., 'SHOES') were printed in the upper-left hand corner of each slide. All the labels had a blue rectangle as the background. These labels had either orange or white lettering. In the Equal Incentive Condition (EIC), all the labels were in white to signify equal incentive across items. The orange lettering was used to differentiate the high incentive pictures (orange lettering) from the low incentive pictures (white lettering) in the Positive Incentive Condition (PIC) and the Negative Incentive Condition (NIC). The participants were told that the labels in orange were worth ten points, while the pictures with the white labels were worth two points. The order of slide presentation was held constant across participants and was semi-random, with the constraint that no more than two items of any type (positive, negative, neutral) appeared consecutively.

Procedure

Before participating in the experiment, each participant filled out a consent form and general health/information questionnaire. All participants were then told that they would view a series of pictures on a slide show, with a label appearing in the upper left hand corner. They were told to remember the pictures and labels for a later memory test. In the PIC and NIC, participants were further instructed that some labels would appear in orange font, and others in white font. They were told that the orange labels were worth ten points, while those words in white were worth two points. They were then informed that the person with the most points at the end of the experiment would receive $10. Participants were shown an example slide of a butterfly accompanied by both white and orange lettering. After reviewing the instructions the slide show began.

Each photograph appeared on the screen for four seconds. Four

filler slides were placed at the beginning and end of the list of slides to reduce primacy and recency effects. At the conclusion of the slide show, participants completed a non-verbal distractor task for eight minutes.

At the conclusion of the distractor task, participants were given a recall test for the items. They were allotted as much time as needed for recall of items and informed to write as many as possible. Following the recall test, each participant completed the Extended Range Vocabulary Test (ERVT; Educational Testing Service, 1976). At the completion of the study, all participants were debriefed and allowed the opportunity to ask questions.

Results

Participants

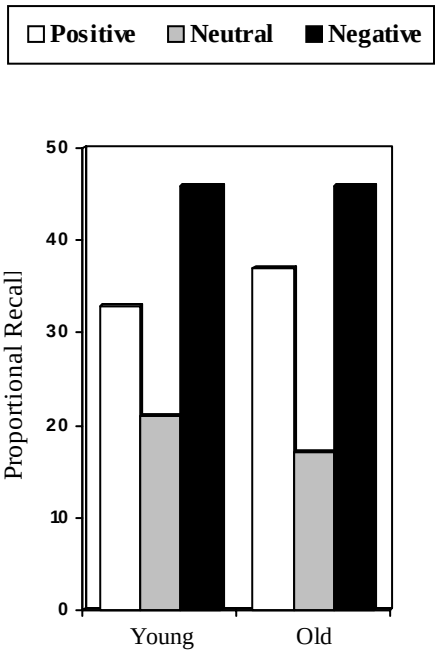
Younger adults (*M* age = 19.0) had on average 13.4 (*SD* = .9) years of education and a mean ERVT score of 14.9 (*SD* = 6.5). Older adults (*M* age = 72.6) had an average of 15.8 (*SD* = 3.1) years of education and ERVT score (*M* = 28.2, *SD* = 9.2).

Slide Recall

Data were analyzed with a 2 (Age) x 3 (Condition) x 3 (Emotion) mixed factorial analysis of variance (ANOVA). As expected, there was a main effect of Age, $\underline{F}(1,141) = 51.8$, with younger adults remembering more total information (35% of the images) than older adults (23% of images). Because of this age difference in total recall, we used a proportional recall measure to assess memory for positive, neutral, and negative slides across conditions. Proportional recall was calculated by dividing the number of items recalled for a given item type (positive, neutral, or negative) by the total items recalled. In this way we could assess the proportion of recall comprised by positive, neutral, and negative items for each age group and condition.

There was a main effect of Emotion, $\underline{F}(1,141) = 408.9$, which was qualified by two interactions, an Emotion x Age interaction, $\underline{F}(1,141) = 8.8$ and an Emotion x Condition interaction, $\underline{F}(2, 141) = 5.8$. There was no main effect of Condition, $\underline{F}(2,194) = 1.5$, and no Age x Condition interaction, $\underline{F}(2,141) = 1.2$, indicating that total recall was equivalent across conditions, regardless of age. The data showed

Figure 1: Proportional Recall for All Items in the Equal Incentive Condition (EIC)

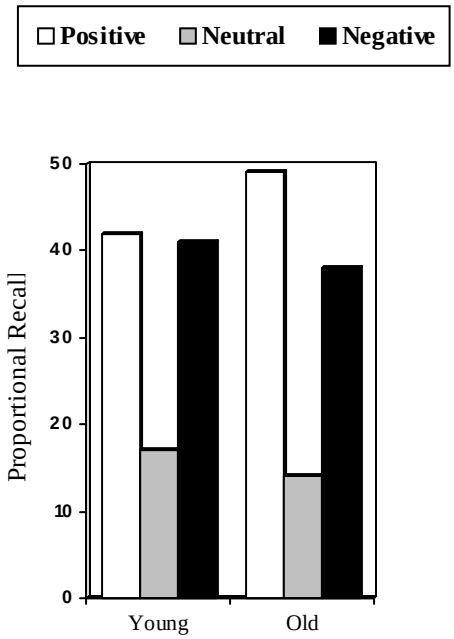


no three-way interaction between Emotion, Age, and Condition, $F<1$.

To examine the role of incentive on memory for emotional items, we evaluated younger and older adults' recall of positive, negative, and neutral items separately for each condition. As can be seen in Figure 1, the pattern of recall across positive, neutral, and negative items was identical for younger and older adults in the Equal Incentive Condition (EIC). Negative stimuli comprised a greater proportion of recall than neutral items, $t(46) = 10.43$, $p < .001$, confirming a negativity bias for both age groups. Negative items also comprised a greater proportion of recall than positive items, $t(46) = 6.15$, $p < .001$. Finally, positive items comprised a greater proportion of recall than neutral items, $t(46) = 4.52$, $p < .001$, confirming a reliable positivity bias for both age groups, though one that was less robust than the negativity bias.

As can be seen in Figure 2, in the Positive Incentive Condition

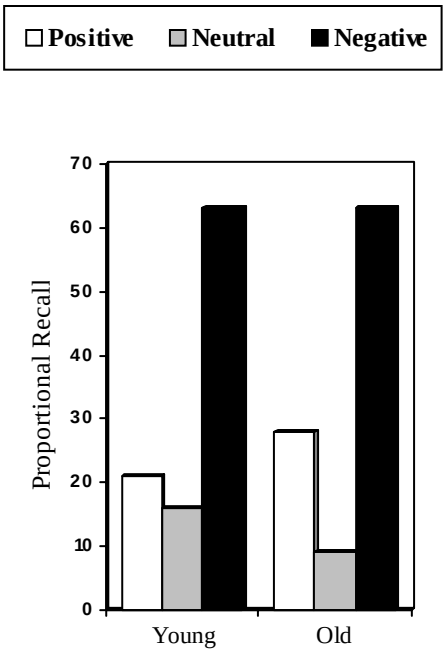
Figure 2: Proportional Recall for All Items in the Positive Incentive Condition (PIC)



(PIC) we found that negative items once again comprised a greater proportion of recall than neutral items, $t(46) = 9.8$, $p < .001$, confirming a negativity bias in recall. We also observed a robust positivity bias, with positive items comprising a greater proportion of recall than neutral items, $t(46) = 10.4$, $p < .001$. In contrast with the Equal Incentive Condition, however, negative items in the PIC comprised a slightly *smaller* proportion of recall than positive items, $t(46) = 1.6$, $p = .055$, though this advantage was driven by older adults' robust memory for positive items. Younger adults showed no difference in recall between negative and positive items, $t < 1$.

In the Negative Incentive Condition (NIC), both age groups showed a negativity bias, with negative items comprising a greater proportion of recall than neutral items, $t(46) = 12.78$, $p < .001$. Recall of negative items was also significantly greater than the recall of

Figure 3: Proportional Recall for All Items in the Negative Incentive Condition (NIC)



positive items, $t(46) = 9.13$, $p < .001$. Recall of positive items was still greater than the recall of neutral, $t(46) = 3.92$, $p < .001$, though again this effect was reliable only for older adults.

Discussion

Our goal was to investigate the role of emotion on memory across different age groups and attempt to understand why young adults tend to show a negativity bias in memory while older adults often show a positivity bias. To do this we tested younger and older adults across three conditions, two of which contained motivation and incentive elements in an effort to shift the participants' memory toward one particular type of stimuli.

When positive, neutral, and negative items were all weighted equally, there was a negativity bias across age groups, with older and

younger adults recalling a greater proportion of negative items than neutral items. Indeed, this negativity bias was found across all three conditions, regardless of incentive. Furthermore, in both the EIC and the NIC, negative items also comprised a greater proportion of recall than positive items. These findings are consistent with the biological theory that negative items may be processed in an automatic, obligatory fashion, even by older adults (Dijksterhuis and Aarts; Kern et al.; Ohman, Flykt, and Esteves; Phelps, Ling, and Carrasco; Rosler et al.; Rozin and Royzman).

However, our results confirmed that motivation also plays a significant role in memory, as the pattern of recall changed for both age groups when participants were presented an incentive to remember positive or negative images. In the NIC, both age groups showed an enormous negativity bias that was greater than that found in the EIC condition, suggesting that the negativity bias can be further enhanced by motivation or incentive. In the PIC, younger adults eliminated the advantage of negative over positive items. Older adults were actually able to reverse the negativity bias in the PIC and show reliably greater of positive relative to negative items. Together, these data are consistent with other findings demonstrating the powerful role of incentives in memory (e.g., Guynn and Roediger; Lustig and Witryol), and suggest that both age groups can shift processing priorities to some extent.

We also found evidence consistent with the notion that older adults are generally more motivated than young to show a positivity bias. For young adults, the positivity bias disappeared in the NIC, whereas the effect remained reliable for older adults. In addition, in the PIC, recall of positive and negative items was equivalent for young, but for old recall of positive items was greater than that of negative items. This pattern of findings is consistent with the Socioemotional Selectivity Theory, and suggests that older adults more readily emphasize positive material over negative or neutral information (Carstensen, Isaacowitz, and Charles; Carstensen, Fung, and Charles). Thus our data indicate that memory for emotional information is not driven exclusively by automatic, obligatory processes; incentive or intention also plays a significant role.

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