

MEMORY AND EMOTION

INTERDISCIPLINARY PERSPECTIVES

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Why Memories May Become More Positive as People Age

Mara Mather

Abstract

Recent studies reveal a positivity effect in older adults' memories, in which they show a bias to enhance positive information and diminish negative information. In this chapter, I review findings of the positivity effect in memory for autobiographical events, choices, words, pictures, and faces. The effect does not appear to be the result of mood-congruent memory, age-related decline in physiological arousal mechanisms, or age-related decline in the amygdala. Instead, older adults' positivity effect appears to be the result of goal-directed processes that allocate attention and shape memory in ways that enhance well-being.

Because of their influence on emotions, memories have a utility that goes beyond the information they convey. Depending on their content, memories can either depress or enhance mood, and people often use memory in strategic ways to help them regulate emotion. For instance, when in a negative mood, people sometimes retrieve positive memories for mood repair and this memory retrieval strategy seems to help ward off depression (Josephson, Singer, & Salovey, 1996; Joormann & Siemer, 2004; Singer, this volume). The self-enhancing bias seen in autobiographical memory may benefit mental health (Taylor, 1991). People work hard at creating and maintaining happy memories, sometimes even at the cost of current experience (for example, bringing an attention-demanding videocamera on vacation).

Older adults are one population that is particularly effective at emotion regulation, and memory seems to play a role in this success (Carstensen, Mikels, & Mather, 2006; Mather, 2004). In this chapter I review evidence that older adults show a positivity effect in memory, favoring information that is emotionally gratifying in their memories and forgetting information that might increase negative affect. I also examine whether this positivity effect is simply the fortuitous by-product of age-related decline in emotional memory systems or whether it is the result of older adults' greater focus on regulating emotion.

Many studies suggest that motivations change with age and that, in particular, emotional goals become more salient as people approach the end of life. Carstensen's socioemotional selectivity theory posits that people's sense of the time they have left in life affects their goals and motivations (Carstensen, Isaacowitz, & Charles, 1999). Early in adulthood, an expansive future leads people to focus on knowledge seeking, whereas as time becomes more limited, goals related to emotional meaning and well-being gain precedence. One way that these shifts in goals have been examined is in studies giving people a hypothetical choice to spend time with a close friend or family member or meet someone new such as a famous author (Fung, Carstensen, & Lutz, 1999; Fung, Lai, & Ng, 2001). Older adults are more likely to select the emotionally close social partner whereas younger adults are more likely to select the social partner who may provide new information. Importantly, asking older adults to imagine that their lifespan has been expanded by new advances in medicine makes their preferences resemble those of younger adults, whereas asking younger adults to imagine they are about to move away from their current hometown, giving them a more limited time perspective, makes their preferences resemble those of older adults. Compared with younger adults, older adults are also more likely to emphasize emotional dimensions than other personal dimensions when categorizing people (Fredrickson & Carstensen, 1990), a pattern also seen among younger adults with a terminal illness (Carstensen & Fredrickson, 1998). Thus, the shift with age to give emotional goals greater priority seems to be linked to people's time perspective.

Prioritizing emotional goals should help everyday well-being. Indeed, older adults do seem to be more effective at maintaining positive affect and avoiding negative affect. An experience sampling study in which participants carried pagers that went off at random intervals throughout a week, signaling them to fill out an emotion rating scale based on their current affect, revealed that when older adults experience negative affect, it ends sooner than it does for younger adults (Carstensen et al., 2000). In addition, the study found that older adults are less likely than younger adults to experience negative affect. A longitudinal study revealed that negative affect decreases over time for individuals (Charles, Reynolds, & Gatz, 2001), ruling out the possibility that older adults' enhanced emotional experience is simply due to cohort effects. In addition, on questionnaire studies, older adults are more likely to report being good at regulating their emotions or focusing more on emotional control (Diehl, Coyle, & Labouvie-Vief, 1996; Gross et al., 1997; Lawton et al., 1992).

This increased focus on emotion regulation seems likely to have an impact on the way that controlled processes are deployed when people encounter emotional events. If the desire to optimize affect is chronically active among older adults, they may recruit cognitive control mechanisms in order to enhance

emotionally gratifying information and diminish negative information in attention and memory.

POSITIVITY EFFECTS IN MEMORY FOR VARIOUS TYPES OF INFORMATION

There are a number of studies across a wide variety of domains that reveal more emotionally gratifying memories among older adults than younger adults. The following overview describes findings from studies of memory for autobiographical information, choices, words, pictures, and faces.

Memory for autobiographical information

Autobiographical memories are powerful emotion elicitors. Indeed, one method that emotion researchers use to put people into positive or negative moods is to ask them to recall a happy or sad memory. Despite the greater weight given to negative than positive information in attention, impression formation, and judgment (Baumeister et al., 2001; Rozin & Royzman, 2001), negative autobiographical memories do not show an advantage in memory. In fact, if anything, people tend to be more likely to remember positive events (e.g., Matlin & Stang, 1978) and the intensity of the affect associated with an event fades faster when negative than positive (for a review, see Walker, Skowronski, & Thompson, 2003). This asymmetry in autobiographical memory may reflect healthy coping processes, in which people attempt to minimize the impact of negative events on their well-being (Taylor, 1991). Indeed, dysphoric undergraduates do not show the same fading in memory over time in the intensity of negative affect as non-dysphoric undergraduates do (Walker et al., 2003).

Various findings suggest that older adults are more likely than younger adults to forget negative autobiographical events and to underestimate the intensity of their past negative emotions. As time passes, mothers are more likely to recall their children as having had desirable traits when young, such as being cooperative and popular with peers (Yarrow, Campbell, & Burton, 1970). Moreover, as people get older, they rate their childhood as happier (Field, 1981). Of course, because as people get older their childhoods (or their children's childhoods) also becomes more distant, the increasingly rosy picture of childhood may be the result of fading memories over time rather than the age of the person remembering. But the link between positivity and age is supported by research showing that negative memories are more likely to fade for older adults than for younger adults. For younger adults, highly negative events seem

to be accessible for a longer time than highly positive events (Berntsen, 2001, 2002), but by age 60, the pattern reverses and memories for negative events seem to be accessible for a shorter time than for positive events (Berntsen & Rubin, 2002). Participants in these studies were asked to describe a memory for an extremely happy event or for an extremely sad or traumatic event and then asked when the event happened. For younger adults, the negative events tended to have happened a longer time ago than the positive events, whereas the opposite was the case for the older adults, suggesting an age difference in whether positive or negative memories tend to be more long lasting. Another study that had participants recall positive, negative, and neutral autobiographical memories suggests that older adults are more likely than younger adults to reappraise negative events in ways that make them seem more positive (Comblain, D'Argembeau, & Van der Linden, 2005). The study revealed that negative memories were associated with a less complex storyline and more intense positive feelings for older adults than for younger adults.

A study examining memory for reactions to a political event also provides evidence for greater fading of negative affect in memory for older adults than for younger adults (Levine & Bluck, 1997). In 1992, Ross Perot abruptly withdrew from the presidential race. Both his younger and older supporters expressed sadness at the withdrawal at the time. A few months later, among Perot's supporters who still wished he had been elected, memories of their negative reactions had faded more for older adults than for younger adults. In contrast, among people who had previously supported Perot but no longer wished he had been elected, there were no age differences – both younger and older adults underestimated how sad they had been. This study suggests that older adults who were still enthusiastic about Perot may have forgotten just how much they were saddened by his withdrawal from the race in order to help them avoid re-experiencing those emotions. Greater forgetting of negative events among older adults has also been seen in memory for traumatic events. Among a group of survivors of a World War II Nazi concentration camp who testified both shortly after the war and a couple of decades later, the oldest survivors were those who showed the most forgetting (Wagenaar & Groeneweg, 1990). Unfortunately, there was no control positive event in this study to test whether the older adults simply had worse memory overall.

When asked to remember their past selves, people often paint a picture of their past actions and characteristics that is more favorable than accurate (Greenwald, 1980; Ross & Wilson, 2003). For example, college students asked to recall their high school grades remember more A's than were actually on their transcripts (Bahrick, Hall, & Berger, 1996). Current goals also influence which personal experiences or characteristics are most likely to be remembered (Sanitioso, Kunda, & Fong, 1990).

A study with several hundred nuns examining the impact of emotional goals and age on autobiographical memory revealed that age and emotional focus are associated with more positive biases in autobiographical memory (Kennedy, Mather, & Carstensen, 2004). Fourteen years after completing a questionnaire about their demographic background, health practices, physical and mental illnesses, and family medical history, the nuns completed a retrospective version of the questionnaire and were randomly assigned to one of three focus conditions. In the emotion-focused condition, participants were told that it was very important that they focus on their feelings while answering the questions. In addition, after every few questions, they rated the extent to which they were currently feeling each of five emotions. In the accuracy-focused condition, participants were told that it was very important that they answer the questions as accurately as they could. These participants periodically rated the extent to which they used each of five memory strategies in recalling information in the questionnaire. In the control condition, participants did not receive any focusing instructions. In all three conditions, participants were asked to think back 14 years and answer the questions as they thought they answered them then.

A general index of participants' overall direction of memory bias across all dependent variables revealed that the oldest controls were more likely than the youngest controls to have a positive memory bias (for example, remembering having fewer headaches 14 years ago than indicated on the original survey). In addition, regardless of age, emotion-focused participants were likely to show a positive memory bias and accuracy-focused participants were likely to show a negative memory bias. No differences were found across age or condition for baseline levels of positive or negative mood. Nevertheless, mood ratings completed after the retrospective questionnaire revealed that the oldest controls experienced more positive emotion than the youngest controls after remembering themselves 14 years earlier. In addition, mood improved after the retrospective questionnaire for the emotion-focused participants but not the accuracy-focused participants. This suggests that positive memory biases exhibited by the oldest controls and the emotion-focused participants helped them regulate emotion.

Thus, in summary, studies looking at autobiographical memory reveal that older adults are more likely to distort their memories in a positive direction, more likely to forget how negative events were, and more likely to have long-lasting positive memories than long-lasting negative memories.

Memory for choices

Memories of chosen as well as forgone alternatives can be a powerful influence on well-being. Studies with younger adults reveal that they tend to remember

their choices as being better than they actually were (Mather, Shafir, & Johnson, 2000, 2003). These younger participants were asked to make memory attributions about features from previously considered options (e.g., was “easily discouraged” associated with the first job candidate, the second job candidate, or is it a new feature?). They attributed more positive features to the option they had chosen and more negative features to the option they had rejected. A study in which participants were misinformed about which option they chose indicates that beliefs at the time of retrieval about which option was chosen are a key factor in generating these choice-supportive biases (Henkel & Mather, in preparation). In this study, participants made a series of choices and then returned a week later and were given a surprise memory test. For each choice scenario, the experimenters reminded the participants about which option they had selected. However, a randomly selected half of the reminders were false and half were correct (manipulation checks confirmed that most of the participants believed the reminders – those who did not were not included in the analyses). Participants showed strong choice-supportive biases both for the options they actually had chosen and for the options the experimenter told them they had chosen (but that they had actually rejected), with no differences in the magnitude of the biases. Thus, the biases seem to reflect the belief that “I chose this option and therefore it must be the better option.”

It is the contrast between a chosen option and the forgone alternatives that often leads to the sharpest pangs of regret or the most pleasure at having made the right choice (e.g., Kahneman & Miller, 1986). Choice-supportive memory distortion may help maintain positive affect and reduce negative affect. If so, older adults should be more likely to show choice-supportive biases in memory. In a study designed to address this question (Mather & Johnson, 2000) both older and younger adults made several hypothetical two-option choices. Each of the options was described by a list that included both positive and negative features. For example, “lots of sunlight” was a positive feature associated with one of the houses and “has a roach problem” was a negative feature. If older adults focus more on emotion regulation, they should engage in more choice-supportive memory distortion than younger adults. However, younger adults should be as choice-supportive as older adults if they focus on the emotional implications of making choices. To test this, a focus manipulation was included in the study. After making all four choices, one group of participants was asked to review how they felt about the options from each choice and another group was asked to review the features of the options. A third group was not asked to review the choices at all, and instead was asked to do an unrelated task. Participants completed source identification memory tests two days after making their choices. Overall, older adults were more choice-supportive in their memory attributions than younger adults. However, in the

affective review condition, younger participants were as choice-supportive as older adults. Asking younger adults to focus on how they felt about the choices made them more choice-supportive than asking them to review the features of the choice options or not to review the choices at all. In contrast, the review condition did not have a significant impact on older adults’ choice-supportiveness.

One possibility is that the age-related biases were simply a result of poorer memory. But another group of older participants who were tested after 30 minutes were just as choice-supportive as the older adults in the 2-day delay group – despite the fact that they had significantly more accurate memory than the 2-day older group and were as accurate as the 2-day younger group. Thus older adults’ greater degree of choice-supportive bias was not just a result of lower overall memory accuracy. Instead, they seemed to be more motivated than younger adults to avoid negative affect when remembering past choices.

A subsequent study replicated this finding of greater choice-supportiveness in older adults’ source attributions for choice option features than younger adults’ choice attributions (Mather & Carstensen, 2004). In addition, it revealed that compared with younger adults, older adults’ recall, recognition, and ratings of choice option features were also more positive. More of a positivity bias in older adults’ recognition memory for choice option features was also seen in another study looking at memory for choices (Mather, Knight, & McCaffrey, 2005).

Memory for words

Although words are not the most emotionally evocative type of stimuli, a couple of studies have found age differences in memory for positive versus negative words. A study comparing the effects of a sad mood induction on various memory tests for older and younger adults revealed two significant positivity effects in the neutral mood control condition (Knight, Maines, & Robinson, 2002). Older adults remembered a higher proportion of positive words and a lower proportion of negative words than younger adults on both immediate and delayed tests. In addition, older adults were less likely to spell the negatively valenced version of homophones than younger adults. The two other memory tasks (autobiographical recall and prose recall) did not reveal significant age differences by valence in the control condition.¹

Another study that looked at age differences in memory for emotional words had participants rate the valence of 27 positive, negative, and neutral words (Leigland, Schulz, & Janowsky, 2004). There were no age differences in the valence of the words recalled on an immediate or 30-minute delayed recall test. However, the authors reported a trend on a recognition test for the older adults to recognize more positive than negative words whereas the younger

adults showed no difference by valence on the recognition test. A similar procedure was used in another study, in which older and younger adults rated the valence of 27 positive, negative, and neutral words (Kensinger et al., 2002). This study included only an immediate recall test and there were no significant age differences by valence. Thus, age differences in whether positive or negative words are more likely to be remembered are not always found, but when they are, they reveal a positivity effect for older adults' memories.

Memory for pictures

Several studies have used emotional pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1995). This widely used picture set consists of photographs of people, animals, objects, and scenes that have been normed for the emotional valence and arousal they convey. In two experiments (Charles, Mather, & Carstensen, 2003) participants were asked to watch a slide show with positive, negative, and neutral pictures. Participants were given recall or recognition tests after a 15-minute delay. In both experiments, there were equal numbers of European Americans in each age group and equal numbers of African Americans in each group, with gender and socioeconomic status stratified within each of these groups. Relative to other types of items, the number of negative items recalled decreased with age. Older adults' recognition accuracy for negative pictures was also diminished relative to their recognition accuracy for the other pictures. Including gender, ethnicity, and socioeconomic status revealed that these age-related positivity effects were not driven by any one group in particular but instead were seen broadly across the different categories of participants.

These findings have been replicated by some studies, whereas others have found no age differences in terms of the valence of memories. A study with younger adults and older adults (Kensinger et al., 2002) found no age by valence interaction when participants were asked to recall pictures that they had just rated for valence (older adults viewed the pictures twice, while younger adults viewed the pictures once). A study with younger, middle-aged, and older adults showed participants a slide show of pictures, each with a caption read by the experimenter. Participants were asked to try to feel the emotion that was being depicted (Denburg et al., 2003). Memory was tested in a variety of ways. For the first test, a 24-hour free recall test, there was a marginally significant age by valence interaction ($p = .08$), with younger adults showing a larger advantage in memory for the negative pictures than the other two age groups. The next test, a cued-recall test, showed no significant age by valence interaction, but the authors reported that while the younger adults remembered both neutral and negative pictures significantly better than the older adults, the

difference was not significant for the positive pictures. No significant age by valence effects were seen on a subsequent forced-choice recognition test or a long-term follow-up eight months later (however, the older adults were at floor in terms of their recall eight months later).

Mather and Knight (2005) replicated the positivity effect in three separate experiments. In the first experiment, younger and older adults viewed pictures and then were asked to recall as many of them as they could both 20 minutes and 48 hours later or were only asked to recall the pictures 48 hours later. Participants rated the valence of the pictures at the end of the experiment. The positivity effect for older adults increased with repeated testing, but did not increase with the passage of time if there was no intervening test. In both of the two subsequent experiments, participants recalled the pictures 20 minutes after viewing them. All three experiments revealed significant age by valence interactions that were stronger when participants' own valence ratings were used to categorize the pictures. As in Charles et al. (2003), in this series of experiments participants were simply asked to view a slide show of pictures, without any specific encoding task. In contrast, in studies showing weaker or no positivity effects (Comblain et al., 2004; Denburg et al., 2003; Kensinger et al., 2002), participants were given specific encoding tasks, such as rating the valence of the pictures (see Mathews, this volume). These encoding tasks may have reduced the likelihood that emotion regulation goals could affect the way in which the pictures were processed.

Memory for faces

Older adults also tend to have relatively worse memory for negative faces than for positive faces. Older adults asked to rate the valence of a series of emotional and neutral faces recognized fewer of the negative faces 30 minutes later than younger adults completing the same task, but showed no difference for neutral or positive faces (Leigland et al., 2004). In another study that examined memory for faces, the participants' task was to indicate whether a dot appeared on the left or right side of the screen (Mather & Carstensen, 2003). Before each dot appeared, two faces were shown, one on either side of the screen, for one second. Participants did not have to respond to the faces, but analyses of the reaction times revealed that older adults were faster to respond to dots that appeared "behind" positive faces than their neutral face pair and slower to respond to dots that appeared "behind" negative faces than their neutral face pair. Both recognition and forced-choice memory tests revealed that older adults remembered those faces that had appeared with positive expressions better than those that had appeared with negative expressions, whereas younger adults did not show this positivity bias.

I POSSIBLE MECHANISMS OF THE POSITIVITY EFFECT

Mood-congruent memory

Being in a certain mood can enhance the encoding or retrieval of memories that share the same valence (Blaney, 1986). It is possible that, when compared with younger adults, older adults show a bias against negative information in memory because they are less likely to be in negative moods than younger adults. However, age differences in the positivity of memories remains significant when current mood ratings or depression scale scores are used as covariates (Charles, Mather, & Carstensen, 2003; Kennedy et al., 2004; Mather & Carstensen, 2003; Mather & Knight, 2005). Thus, the effects do not appear to be the result of mood-congruent memory.

Arousal and the amygdala

Much of the enhancement seen in memory for emotional information can be attributed to the amygdala, a region of the brain that is closely connected to regions of the brain required for encoding new information, such as the hippocampus (see Dolcos, LaBar, & Cabeza, this volume). Patients with lesions in both amygdalae show no impairment in remembering neutral information, but do not show the typical enhancement for emotionally arousing information (Bechara et al., 1995; Phelps et al., 1998). Neuroimaging studies have also shown that amygdala activation at the time of encoding emotional information is correlated with its long-term recall (Cahill et al., 1996; Canli et al., 1999, 2000). The amygdala seems especially attuned to emotionally arousing (or emotionally intense) information and, when arousal levels have been equated, does not show differential activity for positive relative to negative stimuli (Anderson et al., 2003; Cunningham, Raye, & Johnson, in press; Kensinger, 2004; Kensinger & Corkin, 2004; see also Dolcos, LaBar, & Cabeza, this volume).

In general, negative stimuli tend to be more intense and emotionally arousing than positive stimuli (Baumeister et al., 2001; Bradley et al., 2001; Rozin & Royzman, 2001). If arousal is less likely to lead to memory enhancement for older adults and the most arousing stimuli tend to be negative, this could lead to a pattern in which the biggest declines in older adults' memory would be for negative stimuli.

Is it the case that arousal-based memory enhancements are less likely for older adults? The physiological arousal induced by emotional stimuli can be measured by changes in both cardiovascular and electrodermal responses. Several

studies have found that cardiovascular responses to emotionally arousing information decrease with age (Levenson, Carstensen, & Gottman, 1994; Levenson et al., 1991; Tsai, Levenson, & Carstensen, 2000), although this age-related decrease is not always seen (Kunzmann, Kupperbusch, & Levenson, 2005). This decrease in the responsiveness to emotional stimuli may have implications for memory; however, the cardiovascular system declines more generally with age (Cacioppo et al., 1998) and so it may be that older adults experience as much arousal but show fewer cardiovascular signs of that arousal. Indeed, despite the age differences in cardiovascular responses to emotional events, there were no age differences in the subjective ratings of those events (Levenson et al., 1991; Tsai, Levenson, & Carstensen, 2000). In addition, there typically are no age differences in electrodermal responses (as measured by skin conductance) while viewing emotionally arousing stimuli (Denburg et al., 2003; Levenson et al., 1991, 1994; Tsai, Levenson, & Carstensen, 2000). Among younger adults, skin conductance level during exposure to stimuli frequently predicts better memory for the stimuli later (Revelle & Loftus, 1992), but there is less information on whether cardiovascular responses are associated with later memory enhancement. Thus, the lack of age differences in skin conductance responses to emotional stimuli may be more important for the relationship between arousal and memory than the age differences seen in cardiovascular reactivity.

Indeed, behavioral studies that control for the arousal level of positive and negative pictures find that older and younger adults' memories benefit equally from arousal (Charles, Mather, & Carstensen, 2003; Denburg et al., 2003; Mather & Knight, 2005; see also Levine & Pizarro, this volume; Reisberg, this volume). In addition, neuroanatomical studies find relatively little decline in the amygdala compared with other brain regions (for a review, see Mather, 2004).

In one functional magnetic resonance imaging (fMRI) study, younger and older participants viewed emotional facial expressions consisting of mostly negative expressions and made judgments about the age or the emotional expression of the face (Gunning-Dixon et al., 2003). The most striking age difference was that younger adults showed amygdala activation when making emotion judgments, whereas the older adults did not. In contrast, the older adults showed anterior cingulate activation whereas the younger adults did not. The authors argued that the findings indicate "both structural and functional age-related changes on a cellular level" (p. 292). However, it is also possible that the age differences reflect differences in the cognitive strategies used when viewing the mostly negative faces (Knight & Mather, in press). The anterior cingulate is one region that plays an important role in emotion regulation (Ochsner & Gross, 2004; Ochsner et al., 2004). Older adults may have been attempting to down-regulate their emotional reactions to the negative faces, and in so doing may have shown greater anterior cingulate activation and less amygdala activation than younger adults. Younger adults instructed to up-regulate or down-regulate

their emotions when viewing aversive scenes showed amygdala activation that was modulated up or down in concordance with their regulatory goal (Ochsner et al., 2004).

In another fMRI study, younger and older participants saw pairs of faces and had to indicate which one was male or which one was female (Iidaka et al., 2002). In one block of trials, all the faces were negative, in another they were all positive, and in a third they were all neutral. Younger adults showed more activation than older adults in the amygdala during the negative face block, but not during the other two blocks. As in the Gunning-Dixon et al. (2003) study, older adults showed significant anterior cingulate activation while viewing the negative faces, whereas younger adults did not.

Another fMRI study examined age differences in amygdala activation in response to emotional pictures (Mather et al., 2004). Younger adults showed greater amygdala activation in response to both positive and negative pictures compared with neutral pictures, replicating a number of previous studies showing amygdala sensitivity to emotional stimuli in younger adults (for a review, see Phan et al., 2002). Older adults also showed an amygdala response that was greater for emotional pictures than for neutral pictures, but in contrast with the younger adults, they also showed greater amygdala activation for positive than for negative pictures. This study indicates that the amygdala still functions among older adults, but that the type of affective stimuli it is most responsive to changes.

Goal-directed selective processing

Older adults' positivity effects do not appear to be the result of mood-congruent processing, declines in the effects of physiological arousal, or deterioration in the amygdala. Socioemotional selectivity theory (Carstensen, Isaacowitz, & Charles, 1999) provides an explanation for this pattern of emotionally gratifying memory in its tenet that regulating emotion is a more central goal for older adults than for younger adults. Thus older adults should engage in more goal-directed processing in order to diminish the emotional impact of negative information. Strategies for regulating negative emotion include selecting situations based on their predicted emotional impact, changing existing situations to modify their emotional impact, directing attention to cues that should support desired emotions and ignoring cues that might support undesired emotions, reappraising a situation to decrease its emotional impact, and suppressing the outward signs of emotion (Gross, 2001). These strategies (especially the attention deployment and reappraisal strategies) are likely to require cognitive control mechanisms supported by prefrontal brain regions (Ochsner & Gross, 2004). Consistent with this link between emotion regula-

tion and resource-demanding cognitive processes are studies indicating that dividing attention or otherwise limiting cognitive resources reduces the ability to regulate emotion (Muraven, Tice, & Baumeister, 1998; Wegner, Erber, & Zanakos, 1993).

The idea that older adults use cognitive control processes to help them forget negative information may seem unlikely because many studies have shown that older adults are worse than younger adults at tasks requiring cognitive control (Hedden & Gabrieli, 2004; Johnson & Raye, 2000; Knight & Mather, in press; Zacks, Hasher, & Li, 2000). But even with less effective cognitive control processes, older adults may be more successful in regulating emotion if they devote a larger proportion of their resources to such goals. Findings that a larger proportion of what older adults remember is emotional information (Carstensen & Turk-Charles, 1994; Hashtroudi, Johnson, & Chrosniak, 1990), that the vividness of their memories depends on the strength of their emotional reactions more than it does for younger adults (Comblain et al., 2004), and that their source monitoring is more effective when it is framed in emotional terms (Rahhal, May, & Hasher, 2002) are consistent with the idea that older adults devote more cognitive resources to processing emotional information than to neutral information.

To test the idea that older adults recruit cognitive control processes to help them regulate emotions when encountering emotional stimuli, Mather & Knight (2005) had younger and older participants both watch a slide show of emotional pictures with a recall test 20 minutes later and complete a set of tasks requiring cognitive control. These tasks involved ignoring peripheral information (Fan et al., 2002), refreshing recently activated information (Johnson et al., 2002), and keeping information in mind while performing another task (Baddeley et al., 1985). Performance on the cognitive control tasks did not predict the valence of younger adults' memories, but did predict older adults' positivity effect. Older adults who performed highly on the cognitive control tasks were more likely to show a positivity effect than those who performed poorly.

As a further test of the role of cognitive resources in older adults' encoding of emotional information, a subsequent experiment (Mather & Knight, 2005) included a group of participants who performed a concurrent task (listening to rhythmic sounds and indicating how often they changed) while watching the picture slide show. Comparing the younger and older adults in the control condition replicated the age by valence interaction seen in previous studies (e.g., Charles, Mather, & Carstensen, 2003; Mather & Carstensen, 2003; Mather, Knight, & McCaffrey, 2005). Comparisons of participants in the divided attention group and the full attention control group revealed that, as expected, dividing attention reduced how many pictures people could recall later. Nevertheless, for younger adults, dividing attention did not affect the relative proportion of positive versus negative pictures recalled, consistent with the

hypothesis that younger adults do not have chronic emotion-regulation goals; thus, it doesn't matter whether younger adults have the cognitive resources to implement emotion regulation strategies. However, a striking reversal was seen in the divided attention condition for older adults. In contrast with the control condition, where they remembered more positive than negative pictures, in the divided attention condition the majority of what they remembered consisted of negative pictures. Thus, when older adults' cognitive resources are limited, they are no longer able to enhance positive and diminish negative information as effectively during encoding.

The fact that negative pictures had such a large advantage under divided attention is intriguing. One possibility is that older adults were experiencing an effect Wegner (1994) called the ironic process of mental control. Wegner argued that attempting to control the contents of one's thoughts involves both an effortful operating process that attempts to create the desired mental state and an automatic ironic process that searches the contents of thought for evidence of failure of mental control. The effortful operating process can be very successful, but it requires cognitive resources. If those resources are temporarily devoted elsewhere, the ironic process will continue to search for the undesired thoughts, leading to rebound of suppressed thoughts. Older adults' emotion regulation processes may involve both effortful processes that focus on information that should enhance mood and an automatic process that searches for information that might worsen mood in order to initiate regulation processes to diminish the impact of that information. Thus, under conditions of divided attention, older adults might be especially aware of negative information.

PUTTING THE PIECES TOGETHER: CRITERIA REQUIRED FOR POSITIVITY EFFECT

Figure 7.1 outlines a model of the conditions necessary to generate the positivity effect. The first criterion is whether emotion regulation goals are activated. Older adults report focusing more on regulating emotion (Diehl, Coyle, & Labouvie-Vief, 1996; Gross et al., 1997; Lawton et al., 1992). The fact that older adults' positivity biases occur even without any explicit reminder of their emotional goals suggests that older adults' emotional goals are automatically activated. As such, they fall into the category of "chronic" goals that can influence information processing at unconscious as well as conscious levels (Bargh, Gollwitzer et al., 2001; Fitzsimons & Bargh, 2004; Higgins, 1996). Thus, for older adults, the answer to the first question in figure 7.1 ("Are emotion regulation goals activated?") is most likely to be "yes." In contrast, for younger adults, emotion regulation is not a chronically active goal and so they are most likely to fall into the "no" category for the first criterion, leading them not to

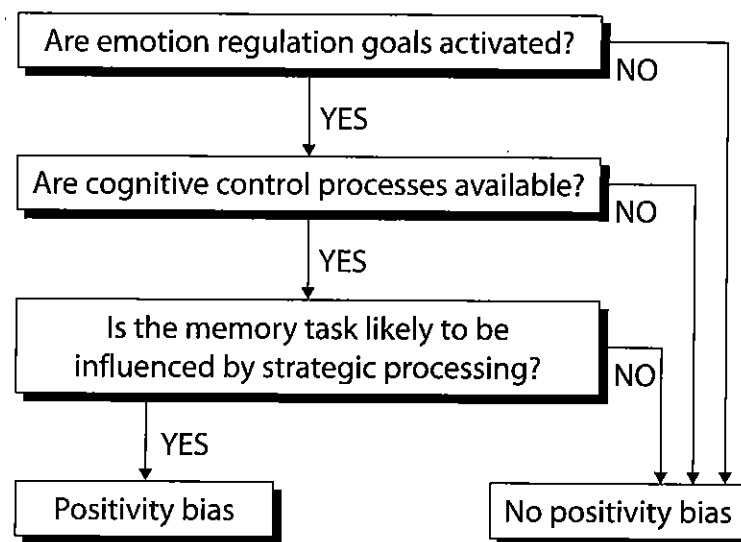


Figure 7.1 Conditions necessary to generate the positivity effect.

show positivity effects in memory. However, if asked to focus on their own feelings, younger adults can be reminded of the desire to regulate emotion and show memory biases that are just as emotionally gratifying as those of older adults in control conditions (Kennedy, Mather, & Carstensen, 2004; Mather & Johnson, 2000).

The second criterion is the availability of cognitive control processes. Executive or strategic processes are necessary to enhance goal-consistent information and diminish goal-inconsistent information. Thus, older adults with decline in executive processes or anyone whose cognitive resources are consumed by another task will be unlikely to be able to implement emotion regulation goals (e.g., Mather & Knight, 2005). The integral role of cognitive control in enhancing positive and diminishing negative information in this model distinguishes it from Labouvie-Vief and Medler's (2002) proposal that the type of affect optimization that increases across the life span is based on automatic processing that is "relatively effortless and efficient, making it ideal for rapid action in emergency situations" (p. 573). The need for cognitive control to regulate emotion may also help explain findings that older adults with cerebrovascular risk factors are prone to late-life onset of depression with a different symptom profile than those with nonvascular depression (Kales, Maixner, & Mellow, 2005). Cerebrovascular risk factors are often associated with undetected strokes, and a key factor linking them with depression seems to be whether

strokes have occurred in frontal regions of the brain, impairing executive processes (Firbank et al., 2004; Mast et al., 2004; Thomas et al., 2002).

The final criterion is whether the memory task is likely to be influenced by cognitive control processes. The more that the task is constrained by external circumstances, the less room there will be for goal-directed processes to have an impact. For example, positivity effects should be less likely to occur when the focus of attention or thought is constrained by rating tasks during encoding.

THE BIG PICTURE: SIMILARITIES AND DIFFERENCES IN YOUNGER AND OLDER ADULTS' EMOTIONAL MEMORY

When comparing younger and older adults' emotional memories, a useful organizing principle may be that of automatic and controlled processes (e.g., Jennings & Jacoby, 1993).

Automatic and controlled processes in emotional memory

Both automatic and controlled processes can lead to enhancement of emotional events in memory. First, consider the role of controlled processes – in other words, self-initiated, strategic processing that requires cognitive control. Because emotional events are quite often of special interest and importance, they are more likely to be attended to, told to others, and thought about frequently. Emotional events are also more likely to elicit elaborative processing, as people think about their meaning and relationship to other events and themselves (see Reisberg, this volume). Personal goals and motivations help direct controlled processes and can lead to biases in memory (Levine & Safer, 2000; Ross & Wilson, 2000; Walker, Skowronski, & Thompson, 2003). These goal-directed cognitive control processes that can enhance (or diminish) memory for emotional events are likely to be implemented in the same prefrontal brain regions that support cognitive control more generally.

Automatic processes also play a role in enhancing memories for emotional events. Threatening stimuli tend to pop out and get noticed automatically (MacLeod, Mathews, & Tata, 1986; Mather & Knight, 2006; Öhman, Flykt, & Esteves, 2001). Even when attention is divided when seeing pictures, people later show an advantage in memory for the most emotionally arousing pictures (Kensinger & Corkin, 2004). Even when not attended to at encoding and showing no advantage on an immediate test, emotional stimuli end up being those most likely to survive the longer-term consolidation process (Sharot &

Phelps, 2004). These automatic advantages for emotional stimuli seem primarily due to the amygdala and its interactions with the hippocampus (Dolcos, LaBar, and Cabeza, this volume; McGaugh, 2000; Phelps, 2004). For instance, although under conditions of limited attention normal people are more likely to perceive aversive words than neutral words, a patient with bilateral amygdala damage showed no enhanced perception for the aversive words (Anderson & Phelps, 2001). Moreover, another case study revealed that bilateral damage to the amygdala eliminated the memory benefits seen for arousal, but not those seen for valence (Phelps et al., 1998). The authors suggest that the enhancement in memory for valenced words may be the result of cognitive processes such as schemas and categories that do not require the amygdala.

Automatic and controlled processes in aging and emotional memory

Generally, age differences are most pronounced when the memory task requires self-initiated, controlled processing that could be characterized as involving strategic processes (Balota, Dolan, & Duchek, 2000; Craik & Byrd, 1982; Zacks, Hasher, & Li, 2000). Strategic memory processes rely on prefrontal regions of the brain, which are disproportionately affected with aging (e.g., Johnson & Raye, 2000; Stuss, Alexander, & Benson, 1997). However, there are significant individual differences in how much decline is seen in strategic processes (e.g., Park & Gutchess, 2005). Thus, as seen in Mather and Knight's (2005) study, older adults' ability to implement their emotional goals will depend in part on whether their cognitive control processes have declined significantly or not. In contrast, older adults show little decline in automatic processes of memory. For example, Jacoby (2001) exposed younger and older adults to pairs of associatively related words in a training phase (e.g., knee bend might appear multiple times) and then gave them short lists of to-be-remembered pairs (e.g., knee bone) followed by a cued-recall test for the pairs (e.g., knee b_n_). When the correct response from the study list and the more accessible response from the previous training were placed in opposition, older adults were less likely to recollect the correct response, but showed no decrease in accessibility of the more automatic response.

This pattern of age differences for controlled but not automatic processes of memory also seems to hold true for emotional memory, but for somewhat different reasons. Age differences in emotional memory should be most pronounced when the process of encoding and retrieval permits the influence of goal-directed processing, because it is then that older adults' chronically activated emotional goals can influence what will be remembered. In contrast, automatic processes of emotional memory should show little change, because

there is relatively little decline in the amygdala with age (Mather, 2004) and emotional goals should have little influence on automatic processes.

1 OVERVIEW

Older adults tend to remember in ways that help them regulate affect. These positivity effects show up in memory for a variety of types of information and cannot be accounted for by age differences in mood or arousal. Instead, they seem to be the result of goal-directed processes and provide an example of an age-related change where it is critical to take into account the interaction of motivation and cognition. Neither one alone can account for the pattern of findings, as it is those older adults who have the best cognitive ability to implement their goals that show the biggest effects of motivated remembering.

AUTHOR NOTES

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NOTE

- 1 The results from the sad mood induction are also of interest, but they were mixed and therefore hard to interpret, with older adults showing significantly less of a mood induction effect than younger adults for one measure and more of a mood induction effect for another two measures.

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8

Age-Related Changes in the Encoding and Retrieval of Emotional and Non-Emotional Information

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Abstract

According to theoretical claims, memory for emotional events and experiences seems to show either no decline or even improvements with age. This chapter presents a meta-analysis and critical review of previous research on age-related changes in memory for emotional events and experiences. The review highlights a number of serious methodological problems that limit interpretation of the results from previous investigations. Next, the chapter reports a new study on age-related changes in the encoding and retrieval of emotional versus non-emotional information. The results provide strong evidence that memory for emotional information shows no age declines, at least under some circumstances. Moreover, the findings reveal that the presence or absence of age declines occurs at the time of memory encoding rather than during retrieval.

According to popular belief, declines in memory are an inevitable consequence of aging. This belief is universally accepted, propagated, and buttressed by a large body of scientific research showing that when assessed by means of standardized tests, older adults remember fewer words, pictures, or designs than younger adults. The textbook explanation for this decline is discouraging and blames it on brain changes that are an inevitable consequence of physical aging. However, a comprehensive reading of the relevant literature paints a different and more encouraging picture. It reveals that while some aspects of memory inevitably decline with aging, other aspects show no evidence of decline and some show improvements well into late adulthood.

Research on memory for emotional events and experiences seems to show the latter pattern – either no decline or even improvements with age – and this finding has sparked unique theoretical claims about age-related changes