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Aging and the Intersection of Cognition, Motivation, and Emotion

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As in the mainstream of psychology, the field of psychology and aging has been parsed into subareas according to topical focus. Cognitive psychology concerns processing capacity, memory, and knowledge. Social and personality psychology address socioemotional aspects of aging, such as well-being and self-regulation. Historically, these subareas have operated relatively independently of one another. Admittedly, cognitive psychologists have often included measures of personality or mood in their studies, usually to ensure that age groups are comparable along these dimensions, and social psychologists have included gross measures of cognitive function in their studies in order to be sure that their findings are not simply artifacts of impaired intellectual functioning. However, until very recently, there has been little serious consideration of the interactions among cognition, emotion, and motivation. We maintain that a sea change is underway. Empirical findings from a number of laboratories are beginning to converge to suggest that the interplay of cognitive, emotional, and motivational processes may offer important insights into the

aging mind and, in doing so, point to ways to improve functioning.

The chapter is organized into four sections. The first two sections, respectively, provide broad overviews of cognitive and socioemotional aging, noting opposing aging trajectories. Next, we offer socioemotional selectivity theory—a life span model of motivation—as one conceptual framework within which to generate hypotheses about interactions between these functional domains. Finally, we review recent empirical evidence that memory and attention operate, in part, in the service of emotion regulation. We maintain that such age-related patterns are systematic and robust and conclude that consideration of the interplay of cognition, motivation, and emotion can provide a more complete and more nuanced understanding of the psychology of aging.

I. Cognitive Aging

The cognitive lives of older adults are characterized by stability, decline, and improvement; however, at the aggregate,

deterioration generally characterizes cognitive aging. In attempts to explain cognitive aging, much attention in the field has been paid to developing theories that postulate underlying basic mechanisms. Sensory function (Baltes & Lindenberger, 1997; Lindenberger & Baltes, 1994) and speed of processing (Salthouse, 1991, 1996) have been theorized to account for the myriad declines in cognitive ability. Equally compelling are theories positing that fundamental deficits in processing resources (Craik & Byrd, 1982), inhibitory control (Hasher & Zacks, 1988), or the ability to refresh recently activated information (Johnson et al., 2002) underlie the declines in cognitive performance. It is becoming increasingly clear that these theories are not necessarily mutually exclusive. Rather each mechanism appears to play a fundamental role in cognitive decline (Park, 2000).

Decades of research in cognitive aging have documented systematic deterioration in effortful cognitive functions, such as verbal and visuospatial working memory (Park et al., 2002; Park et al., 1996), free- and cued-recall long-term memory (Park et al., 1996, 2002), selective attention (Plude & Doussard-Roosevelt, 1989), divided attention (Madden, 1986; McDowd & Craik, 1988), mental imagery (Dror & Kosslyn, 1994), verbal fluency (Mathuranath et al., 2003; Phillips, 1999), reasoning and problem solving (Salthouse, 1996), language comprehension (for a review, see Carpenter, Miyake, & Just, 1995), and language production (Burke & Shafto, 2004; MacKay & James, 2004).

Decline is most pronounced in effortful and resource-intensive processing. Less decline is observed in relatively automatic processing, which requires fewer processing resources and does not require extensive deliberative processing (Craik & Salthouse, 2000; Hedden & Gabrieli, 2004; Johnson & Raye, 2000;

Park & Schwarz, 2000). For instance, implicit and procedural memory (Fleischman et al., 2004; Jacoby, 1991; Laver & Burke, 1993; Light & La Voie, 1993; Light & Singh, 1987; Mitchell, Brown, & Murphy, 1990; Park & Shaw, 1992) as well as picture recognition (Park, Puglisi, & Smith, 1986) are well maintained in old age.

In addition to the relative maintenance of performance on tasks involving automatic processing, general world knowledge and specified knowledge in areas of expertise increase across adulthood (Schaie, 2005). Such expertise can even offset cognitive decline (Mireles & Charness, 2002). Performance on tasks tapping expertise in matters of everyday life (e.g., wisdom and life management) remains stable (Baltes & Staudinger, 2000; Staudinger, 1999), whereas tasks that require solving interpersonal problems, older people show greater flexibility than younger people, especially when problems are emotionally charged (Blanchard-Fields, Jahnke, & Camp, 1995).

Moreover, even in areas that show reliable performance deficits, such as memory, there is considerable evidence for plasticity in performance. In a now classic study, reported by Baltes and Kliegl (1992; see also Kliegl & Baltes, 1991), older peoples' performance on a memory task benefited from practice so much so that after relatively few practice sessions, older people performed as well as younger people who had not practiced. Younger people also improved with practice such that younger people at all points in the study outperformed older people. Thus, the study elegantly demonstrated evidence for benefits of practice at the same time it demonstrated limits of such practice. More recently, Logan and colleagues (2002) have shown that the observed underrecruitment of frontal lobe regions can be eliminated when older adults

are explicitly provided strategies to use on a memory task.

In light of acknowledged malleability or plasticity of cognitive performance, researchers began to turn their attention to questions about social conditions that may enhance or impede performance. Rahhal, Hasher, and Colcombe (2001) documented performance differences as a function of experimental instructions. They reasoned that because there are widespread beliefs in the culture that memory declines with age, tests that explicitly feature memory may invoke performance deficits in older people. They compared memory performance under two conditions. In one condition, experimental instructions stressed that memory was being tested, with the experimenter stating repeatedly that participants should "remember" as many statements from a list as they could. In the other condition, experimental instructions were identical except that emphasis was placed instead on learning, i.e., participants were instructed to "learn" as many statements as they could. In this study, rather dramatic effects were obtained. Age differences were found when memory was emphasized, but were eliminated when learning was emphasized.

Hess and colleagues (2003) also documented deficits in performance when aging decline was emphasized to participants before the experiment. In their study, older participants read one of three simulated newspaper articles prior to completing a memory task. One article reaffirmed memory decline and stated that older people should rely on others to help them. Another article described research findings suggesting that memory may improve in some ways with age. The third article was memory neutral. In Hess's study, younger people outperformed older people in each condition, but the age difference was reduced significantly in participants who read the

positive account of memory. Most important, Hess's team identified a potential mediator of these performance differences. Participants had been required to write down as many words as they could remember. Those who had read the positive account about memory were more likely to use an effective memory strategy, called semantic clustering, in which similar words are grouped together. Thus, it appeared that strategic efforts were not recruited as skillfully in those participants who were reminded of age deficits.

Findings such as these begin to speak to the potential influence of emotion and motivation on cognitive performance. Interest in social and emotional influences on cognitive performance is all the more interesting in light of emerging evidence that socioemotional functioning is well maintained or even improved with age. The next section overviews key findings from this area and then offers socioemotional selectivity theory as one conceptual model that may help to inform interactions among motivation, cognition, and emotion.

II. Socioemotional Aging

The literature on socioemotional aging paints a very different picture than the literature on cognitive aging. Whereas emotional aging was initially characterized as a period of ubiquitous deterioration (Banham, 1951), it is becoming increasingly clear that this is not the case. Emotion regulation and emotional experience in old age are as good if not better than they are in younger years. Laboratory studies of emotional experience reveal that the emotional lives of older adults are very similar to those of younger adults or differ in ways that indicate improved emotion regulation (Carstensen, Fung, & Charles, 2003).

The basic components of emotion, namely subjective experience, expression and physiological responsivity, change little with age. Older adults do not differ from younger adults in their self-reports of emotional intensity (Carstensen et al., 2000; Levenson et al., 1991; Malatesta et al., 1987; Mikels et al., 2005; Tsai, Levenson, & Carstensen, 2000), in emotion-specific patterns of physiological reactivity (Levenson et al., 1991; Levenson, Carstensen, & Gottman, 1994), or in the spontaneous production of emotional facial expressions, as well as other emotional expressive behavior [Levenson et al., 1991; Tsai et al., 2000; note, however, that Malatesta-Magai et al. (1992) found old adults to be more expressive]. Despite the lack of change in these aspects of emotional experience and expression, there are a few aspects of emotional experience in which there is decline. Older adults relative to their younger counterparts show overall decreases in the magnitude of their physiological reactions (Levenson et al., 1991, 1994; Tsai et al., 2000) and report fewer negative emotional experiences (Carstensen et al., 2000; Gross et al., 1997; Mroczek & Kolarz, 1998), especially reductions in anger (Lawton, Kleban, & Dean, 1993; Magai, 1999). Finally, in addition to the sustained and diminished aspects of emotional experience and expression in old age, there also appear to be gains in regulation. Older adults relative to younger adults report greater emotional control (Gross et al., 1997; Lawton et al., 1992), an increase in positive affect (Mroczek & Kolarz, 1998) or, at minimum, sustained levels of positive affect (Carstensen et al., 2000), and more complex emotional experiences, namely greater poignancy or the cooccurrence of positive and negative affects (Carstensen et al., 2000).

The pattern described earlier is also reflected at the evaluative level. Satisfaction with life increases or at least is

well maintained across adulthood (Diener & Lucas, 1999; Diener & Suh, 1997; however, see Mroczek & Spiro, 2005). Older adults report a greater sense of environmental mastery relative to their younger counterparts (Ryff, 1991; Ryff & Keyes, 1995). Relationships with family are described more positively by older adults (Fingerman, 2000). Even rates of depression and anxiety disorders are lower among older adults than their younger counterparts (George et al., 1988). Rather than heighten risk, advanced age appears to protect against psychopathology (Gatz et al., 1993).

Importantly, this patchwork pattern of sustained, diminished, and increased aspects of emotional experience and expression coalesce to indicate an overall pattern that suggests that age benefits emotion regulation (Carstensen et al., 2003). The sustained aspects of older adults' emotional lives make evident that the emotion system is as functional as it is in younger adults. The decreases in negative affect and increase in positive affect and emotional control indicate that the emotional lives of older adults are more pleasant and manageable relative to their younger counterparts. Thus, although distinct components of emotional processing show different trajectories, i.e., remaining the same, declining, or improving across the life span, at the aggregate emotional experience is enhanced.

III. Socioemotional Selectivity Theory

The juxtaposition of decline in cognitive and physical aging and the maintenance or improvement of well-being has been referred to as "the paradox of aging." How can it be that people suffer significant loss with age but experience life more positively? The socioemotional selectivity theory offers an explanation

based on motivation (Carstensen, 1993, 1995; Carstensen, Isaacowitz, & Charles, 1999). The theory is distinguished from other life span theories in that its principal focus concerns the motivational consequences of perceived time left in life. Instead of relying on the more traditional yardstick of age, namely time since birth (or chronological age), socioemotional selectivity theory considers the effects of a continually changing temporal horizon on human development. The theory holds that when time is perceived as open ended, as it typically is in youth, people are strongly motivated to pursue information. They attempt to expand their horizons, gain knowledge, and pursue relationships. Information is gathered relentlessly. In the face of a long and nebulous future, even information that is not immediately relevant may become so somewhere down the line.

In contrast, when time is perceived as constrained, as it typically is in later life, people are motivated to pursue emotional satisfaction. They invest in sure things, deepen existing relationships, and savor life. Under these conditions, people are less interested in banking information and instead invest resources in the regulation of emotion. In this way, the socioemotional selectivity theory specifies the direction of the age-related motivational shift and offers hypotheses about social preferences and goals as well as the types of material that people of different ages are most likely to attend to and remember. To be clear, the theory does not speak against experience-based change. Rather it postulates that some of the age differences long thought to reflect intractable, unidirectional change instead reflect changes in motivation, and as such the theory contributes to a more nuanced interpretation of age differences.

The theory leads to a number of postulates (for review, see Carstensen

et al., 1999). Among them is the assertion that heightened attention to emotion should lead to the allocation of more cognitive resources to emotional tasks. In other words, if greater priority is placed on the regulation of emotion states and emotional aspects of life, this motivational shift should have consequences for cognitive processing. Adding to the potential for such theoretical reasoning is the observation of different aging trajectories for effortful and automatic—also called deliberative and intuitive—processes. Although at times emotion regulation is effortful, much emotion regulation has become automatic. Thus, two factors may contribute to changes in cognitive processes: Priorities may change with age and/or temporal horizons such that more resources are allocated to emotion regulation, and to the extent that regulation has become relatively automatic it may be easier to engage such strategies than effortful strategies involving acquiring new information.

IV. Emotion–Cognition Interactions with Age

From the socioemotional selectivity theory, we can derive two postulates about how motivation might affect attention and memory. The first is that, as people age, they allocate a larger proportion of their cognitive resources to all types of emotionally relevant information, as both negative and positive emotional information is relevant for emotion regulation. The second is that selective cognitive processing is a component of effective emotion regulation, and therefore older adults are likely to devote their attention and memory capacity to information that will enhance their current mood. A growing body of research supports this second postulate. Whereas younger people tend to favor

negative material in information processing, increasingly older groups favor positive material. We refer to the developmental trend as the positivity effect (see Carstensen & Mikels, 2005).

V. Memory for Emotion in General

Most of the initial research investigating emotion-cognition interactions and aging did not distinguish between negative and positive information. A number of these studies support the idea that with age, people allocate more of their cognitive resources to emotional information. As part of this, they seem to focus on their own internal thoughts and feelings more than younger adults. For example, in one study, younger and older adults participated in a series of "mini-events" in which they followed a script to complete actions such as packing a picnic basket or to imagine completing such actions (Hashtroudi, Johnson, & Chrosniak, 1990). When participants returned a day later and assessed the amount of perceptual and contextual detail and thoughts and feelings associated with their memories, older adults gave higher ratings for their thoughts and feelings than younger adults. In their recall of the events, younger adults recalled more spatial and contextual detail than older adults, whereas older adults recalled more associated thoughts and feelings than younger adults. Older adults not only were more likely to allocate their memory resources to thoughts and feelings, but they also seemed to base their confidence in their memories more on the strength of their associated thoughts and feelings than younger adults, as indicated by higher correlations between ratings of thoughts and feelings and memory confidence judgments than seen among younger adults (Johnson & Multhaup, 1992). Similar findings were seen in a study of

memory for pictures in which participants were asked to list reasons they indicated certain memories were vivid (Comblain et al., 2004). Older adults were more likely than younger adults to say that the memories seemed vivid because they recollected their emotional reactions.

This increased focus on internal emotional states with age seems to be one reason that older adults' memories tend to be more influenced by schemas than those of younger adults (for a review, see Mather, 2004). Focusing on one's own feelings enhances memory for semantic content but impairs memory for contextual details (Johnson, Nolde, & De Leonardis, 1996; Mather, Johnson, & De Leonardis, 1999), which may lead people to rely more on their general semantic knowledge about the event when reconstructing it later. Instructing younger adults to focus on their internal emotional states as they experience or review an event leads their memories to be more consistent with their schemas or general knowledge (Mather & Johnson, 2000, 2003). In fact, younger adults in emotion-focus conditions show the same biases in memory as older adults in control conditions, who presumably are more likely to focus on their feelings without being prompted to do so (Kennedy, Mather, & Carstensen, 2004; Mather & Johnson, 2000, 2003).

A few studies also suggest that, compared with younger adults, older adults allocate more resources to emotional information in the external world than to neutral information. One study had participants from four different age groups spanning from 20 to 83 years of age read and then recall a narrative that contained about the same amount of emotional and neutral information (Carstensen & Turk-Charles, 1994). The proportion of information recalled that was emotional increased linearly with age. Similar findings were found in

a study examining the recall of slogans and brand names from advertisements that were presented with a slogan that evoked either an emotionally meaningful goal (e.g., "Take flight ... your loved ones await" for an airline ad) or an information-seeking goal (e.g., "Take flight ... expand your horizons") (Fung & Carstensen, 2003). Older adults preferred the emotional versions of the ads and remembered the slogans and brand names better than in the knowledge-related versions, even though the two versions of the ads only differed in their slogans.

Older adults also remember the source of information better when the sources are framed in emotional terms than when they are framed in nonemotional terms (Rahhal, May, & Hasher, 2002). In one such experiment, older adults listened to tape of a female and a male speaker each saying some trivia statements. The experimenters told them that all of the statements made by the female were true and all of the statements made by the male were false (or vice versa). After a delay, they were given a source memory test consisting of a list of the statements they had heard. In the emotional source task condition, participants were asked whether each statement was true or false. In the perceptual source task condition, participants were asked whether each statement was said by the male or by the female. As found in many previous studies, older adults were worse than younger adults at identifying who said each statement. However, there were no age differences in memory for which statements were true or false, even though that affective information was originally indicated by which speaker said the statement. Hess, Rosenberg, and Waters (2001) reported similar findings on an impression formation task. When the task was made personally relevant (e.g., participants were told that they would share their impressions with another person), they were more

likely to remember inconsistencies in the behavior of the target they were asked to describe.

Thus, these studies suggest that older adults allocate relatively more resources to encoding and retrieving relevant information. We go one step further and argue that "relevance" is systematic. Information that is related to older peoples' own internal emotional states or represents emotional aspects of the external environment assumes greater relevance. Given that experimental instructions reliably elicit and diminish such effects, we contend that motivation appears to be the key factor in creating these age differences. We note, however, that relatively well-maintained brain regions associated with emotional processing among older adults (Mather, 2004) may be an important precondition allowing older adults to effectively focus on and manage emotional information and reactions.

Because the studies reviewed earlier do not distinguish between negative and positive emotional information, they do not indicate whether older adults use attention and memory as an emotional regulation tool by focusing on the information that should make them feel best or whether they are especially attuned to all emotional information.

VI. Positivity Effects in Memory

Studies that distinguish positive and negative information reveal a positivity effect in older adults' memories that manifests itself in a number of different contexts and testing paradigms. We define the positivity effect as a developmental pattern in which a disproportionate preference for negative material in youth shifts across adulthood to disproportionate preference for positive information in later life. Operationally, the positivity effect is the age difference in the ratio

of positive to negative material in information processing. For example, older adults show positivity effects in both recall and recognition of pictures (Charles, Mather, & Carstensen, 2003). Charles et al. (2003) asked 48 younger (18–29 years), 48 middle-aged (41–53 years), and 48 older (65–80 years) adults to watch a slide show consisting of positive, negative, and neutral pictures and to complete a 15-min filler task before recalling as many pictures as they could. Following the recall test, participants also completed a recognition test. Across each successive age group, memory recall increasingly consisted of positive pictures. Recognition also showed a shift in emotional memory, but on this measure, younger adults were most accurate for negative pictures, an advantage that disappeared in middle and old age.

Charles et al. (2003) controlled for a number of possible influencing variables. Half of the pictures from each emotional category depicted people and half did not. The numbers of men and women, white- and blue-collar workers, and European and African Americans were the same across each age group. None of these factors moderated the age by valence interactions. In addition, in a second study, including mood ratings as a covariate did not eliminate the age differences. Thus, the increase with age in the relative advantage of positive information over negative information in memory occurs across socioeconomic status, gender, and race and is not driven by age differences in mood.

Not only is the positivity effect present in long-term memory, but also in working memory. Mikels and colleagues (2005) examined working memory for visual and emotional information in older and younger adults. As expected from the pervasive declines in working memory described earlier, an age deficit in working memory for visual

information emerged in that older adults performed significantly worse than younger adults. However, no age deficit emerged in working memory for emotional information; older and younger adults performed equivalently. Further, whereas younger adults showed superior working memory for negative relative to positive emotional stimuli, older adults exhibited superior working memory for positive relative to negative emotional stimuli. Thus, even within a fundamental component of the information processing system, a positivity effect is evident.

When remembering choices, older adults also remember in a way that is more emotionally gratifying than younger adults. They are more accurate at recognizing positive features (e.g., “spacious kitchen” for an apartment) than negative features (e.g., “low ceilings”) from choices in contexts in which younger adults are about equally accurate for both types of features (Mather, Knight, & McCaffrey, 2005). In addition, when asked “which choice option was this feature associated with?” older adults are more likely than younger adults to attribute features from choices in a way that supports the option they chose (Mather & Johnson, 2000), attributing more positive features to chosen options and more negative features to rejected options than younger adults. Older adults show a stronger choice-supportive bias even when their overall source-monitoring accuracy is equated with that of younger adults. Supporting the idea that older adults remember in a more choice-supportive way than younger adults because of age differences in motivation is an additional condition in which younger adults were asked to think about how they felt about their choices after they made them. In this condition, younger adults were as choice supportive as older adults in the control condition, indicating that when

emotional goals are made more salient for them, they are as likely as older adults to remember in ways that are emotionally gratifying.

Positivity effects are also seen more among older adults than younger adults in autobiographical memory (see Chapter 21). For example, when interviewed repeatedly throughout their lifetime, participants in a longitudinal study reported their childhood as being happier the older they were (Field, 1981). When recalling the 1992 election, older supporters of Ross Perot were more likely to underestimate how sad they had been than younger supporters (Levine & Bluck, 1997). This age difference was only present among those supporters who still wished Perot had been elected. Presumably, among those supporters who no longer wished he had been elected, memory for emotions when he withdrew from the race did not have as much relevance for current emotion regulation. In another study, nuns were asked to recall personal information from 14 years earlier when they had filled out a questionnaire about their health and personal habits (Kennedy et al., 2004). In the control condition in which participants simply filled out the questionnaire with questions about themselves 14 years ago, the oldest nuns distorted their memories in a positive direction more than the youngest nuns did. However, the youngest nuns had as strong a positivity bias as the oldest nuns in an emotion-focus condition in which they were asked to complete a brief emotion rating scale every so often during the questionnaire. Thus, this study, like Mather and Johnson (2000), demonstrates that age differences can be eliminated by making emotional goals more salient for younger adults.

In addition, the nuns in the Kennedy et al. (2004) study completed mood rating scales both before and after completing the memory questionnaire.

Both the oldest nuns in the control condition and the nuns in the emotion-focus condition were in better moods after completing the memory questionnaire than when they started, an indication that the positivity biases in their memories helped improve their moods. In contrast, the youngest nuns and the nuns in an accuracy-focus condition did not show this improvement in mood, consistent with their lack of positivity bias in memory. The idea that older adults use memory as an emotion regulation tool is consistent with a study that examined emotions during various everyday activities (Pasupathi & Carstensen, 2003). Age was correlated with improved emotional experience only during episodes of reminiscing; no effects of age on mood were seen during other daily activities.

VII. Positivity Effects in Initial Attention

Initial indications of older adults' positivity biases can be seen in the way they first process information. When two faces appear on a computer screen side by side for 1, followed by a dot in the same location as one of the faces, older adults are slower to indicate which side of the screen the dot is on if it appeared behind a negative face than a neutral or a positive face (Mather & Carstensen, 2003). Thus, older adults appeared to have detected the negative face and then avoided attending to it.

The ability to downregulate initial responses to negative stimuli was also found in a study that monitored participants' brain activity using fMRI while they viewed emotional pictures (Mather et al., 2004). The study focused on the amygdala, a region of the brain that has been found to enhance memory for emotionally arousing information (e.g., Cahill et al., 1996; Canli et al., 2000;

Phelps et al., 1998). Both older and younger adults showed greater amygdala activation while viewing emotional pictures than while viewing neutral pictures, but for older adults the amygdala activity was greater for the positive than the negative pictures, whereas this was not the case for younger adults. Thus, when left to their own devices, older adults are more likely than younger adults to downregulate responses to negative stimuli. Interestingly, younger adults also show decreased amygdala activation in response to negative pictures when given an explicit regulatory goal by experimenters (Ochsner et al., 2004).

In addition, studies examining age difference in information search during choices reveal differences in attention allocation. When allowed to search through a comparison chart about different cars available to purchase, older adults spend a larger proportion of their time looking at the positive features (e.g., a good safety rating feature) than the negative features (e.g., a bad safety rating feature) than younger adults (Mather et al., 2005). A study examining an information search during health-related decisions found that, as in memory retrieval contexts (Kennedy et al., 2004; Mather & Johnson, 2000), this age difference in the positivity effect can be eliminated by explicitly focusing both younger and older adults on the details of the situation (Löckenhoff & Carstensen, 2005).

In contrast with the studies reviewed earlier, several studies have found no evidence for age-related positivity effects in memory (Comblain et al., 2004; Kensinger et al., 2002) or have found only marginally significant positivity effects (Denburg et al., 2003). One potential reason for the failure of these studies to replicate the positivity effect may be a lack of statistical power. The positivity effect is typically manifested in age by

valence interactions with medium effect sizes (e.g., Charles et al., 2003; Mather & Knight, 2005). According to Cohen (1988), an N of 20 in each group, as used in Comblain et al. (2004) and Kensinger et al. (2002), only provides 34% power to detect a medium effect size. Another important and potentially meaningful methodological difference is that Charles et al. (2003) and Mather and Knight (2005) showed participants the picture slide shows without any encoding task; participants were simply asked to watch a slide show. In contrast, studies that have found no positivity effects have had participants either make valence/arousal ratings or asked them to try to feel the emotion being depicted in each picture. Including specific encoding instructions may equate performance across subgroups by limiting the implementation of more typical strategies. Another potential difference between the studies that do find a positivity effect and those that do not may be the cognitive abilities of the older participants. Higher executive functioning appears to be related to greater positivity, a point to which we return later.

VIII. Mechanisms Underlying the Positivity Effect

Given what we know about the numerous declines seen with age in various types of memory, one obvious possible explanation for the positivity effect is that it results from some sort of declining ability. As mentioned previously, older adults show diminished physiological responses to emotional stimuli (Levenson et al., 1991, 1994; Tsai et al., 2000). This diminished level of physiological responding occurs despite the lack of age differences in subjective emotional experience in the same studies, thus it is not clear how they might be associated with memory. Many studies

with younger adults indicate that memory is enhanced for emotionally arousing elements of a scene but impaired for peripheral details of arousing scenes (for reviews, see Cahill & McGaugh, 1998; McGaugh, 2000; Reisberg & Heuer, 2004). Highly arousing stimuli are more likely to be negative (Lang, 1995), thus if arousal no longer affects memory as much for older adults, they may show less vivid memories for negative stimuli.

However, there is growing evidence that older adults gain the same benefits and suffer the same costs of emotional arousal as younger adults. Like younger adults, they recall the gist of emotionally arousing pictures better than neutral pictures (Denburg et al., 2003), but recognize the details of emotionally arousing scenes less well than details from neutral scenes (Denburg et al., 2003; Kensinger et al., 2005). The maintained effect of arousal among older adults is consistent with neurological evidence that the amygdala shows relatively little decline with age (for a review, see Mather, 2004). Thus, older adults' bias to forget negative information more quickly than positive information does not seem to be the result of declines in the influence of emotional arousal on memory.

As reviewed earlier, one of the most consistent themes in cognitive aging research is the decline in effortful and resource-intensive processes versus the stability of more automatic processes. From this perspective, one likely account of the positivity effect is that it somehow results from declines in the ability to engage in more resource-intensive processes. However, it has been shown that positivity effects rely on resource-intensive executive processes (Mather & Knight, 2005). In one experiment in this study, older and younger adults were shown a slide show of emotional pictures, like the ones seen in

Charles et al. (2003), and were asked to remember them 20 min later. In addition, they completed several tasks associated with executive function and were split in to low and high groups based on their performance on these tasks. Older adults who performed well on the ability to ignore goal-irrelevant information while performing a task (Fan et al., 2002) or well on the ability to refresh just-activated information in memory (Johnson et al., 2002) had larger positivity biases in memory than older adults who performed poorly on these tasks. In contrast, performing well on the executive tasks had little relation with the positivity of younger adults' memories.

In another experiment, distracting older adults while they viewed the picture slide show eliminated their positivity effect in a later memory test, whereas it had no effect on the positivity of younger adults' memories. In fact, distracting older adults during encoding not only eliminated but reversed their positivity effect, such that they showed a negativity effect, with most of their recall consisting of negative pictures. These findings indicate that older adults automatically detect negative information in the environment (see also Mather & Knight, 2003), even when they are distracted. In fact, when older adults' attention is divided, they seem to be even more susceptible to the influence of negative and highly arousing stimuli (Mather & Knight, 2005; Wurm et al., 2004).

However, when they have the available cognitive resources, they act quickly to diminish their response to the negative information. This goal-directed stage of the process is more likely to be engaged in by older adults than by younger adults because emotion regulation becomes a more salient goal as people approach the end of life (Carstensen & Charles, 1998; Carstensen et al., 1999).

Supporting the role of time perspective in older adults' positivity effects, controlling for the amount of time participants felt they had left in life can eliminate age differences in the positivity effect (Löckenhoff & Carstensen, 2005).

IX. Future Directions

Until recently, the ways that motivation and cognition might interact were rarely considered by researchers, investigating the effects of aging. However, increasing research suggests that neither age-related cognitive nor emotional processes can be understood fully in isolation. An age-related stereotype threat, for example, worsens performance (Hess et al., 1999), whereas emotional content that appeals strongly to the emotion regulatory goals of older individuals appears to improve performance (Carstensen et al., 2003).

We have interpreted the changes in emotion regulation with age in motivational terms and argue that experimental evidence for flexibility in performance based on instructional conditions that direct motivation is compelling (Hess, Waters, & Bolstad, 2000; Kennedy et al., 2004; Rahhal et al., 2002). Still other factors may contribute to the pattern of age differences emerging in the literature. Differential changes in the neural substrates underlying cognitive and emotional processes could explain some of the behavioral patterns reviewed previously. From functional neuroimaging we now know that on tasks that place a large demand on controlled and deliberative processes, such as working memory, older adults evidence bilateral prefrontal activation. Importantly, this bilateral prefrontal activation has been observed in the dorsolateral prefrontal cortex, the area critical to the executive and deliberative processes involved in working memory tasks

(Smith & Jonides, 1999). This overactivation has been interpreted as compensation for the neural degradation present with increasing age (Park et al., 2001; Reuter-Lorenz, 2002). As such, it reflects previously unsuspected neural plasticity across the life span even into old age. This compensatory model has been driven by the assumption that degeneration of the adult brain is responsible for losses in domains such as working memory and executive function (Park et al., 2001; Reuter-Lorenz, 2002).

Consistent with this degenerative process explanation, the documented improvements in emotion regulation and experience with age may merely be the result of neural change associated with aging. For instance, the finding of disproportionately greater atrophy of the dorsolateral prefrontal cortex relative to the orbital frontal cortex (Duara et al., 1983; Haug et al., 1983; Salat, Kaye, & Janowsky, 2001; however, see Raz et al., 1997) may help support preserved emotion regulation in the face of declines in cognitive deliberative processes and executive processing of nonemotional information. Teasing apart these alternative explanations and scenarios represents an exciting frontier in explorations of the aging mind and brain.

With socioemotional selectivity theory, we interpret the findings reviewed earlier in motivational terms. There are, however, other developmental models within which to consider emotion-cognition interactions. As noted previously, for example, Labouvie-Vief (2003) distinguished between affective experience and cognitive-affect complexity, the former referring to emotions experienced in everyday life and the latter referring to a conceptual understanding of emotional experience. Labouvie-Vief (2003) argued that these two aspects of emotional aging are separable and further that they show different aging trajectories with experience

improving but emotional understanding declining as people move from middle to old age. Her group maintains that less sophisticated understanding may actually contribute to a more positive experience because of its relatively simple structure and that older adults are increasingly likely to use emotion regulation strategies that are automated and do not rely on cognitive resources. Thus, she suggested that “negative affect—but not positive affect—is related to cognitive functioning, perhaps because processing negative experience is more cognitively demanding” (Labouvie-Vief, 2003, p. 202). Labouvie-Vief argued that in contrast to the cognitive demands of integrating negative affect into one’s experience, “optimization is automatic and relatively effortless” (Labouvie-Vief, 2003, p. 202). Mather and Knight’s (2005) provide a counterexample to this idea, as older people who reported the most positive memories scored highest on cognitive tests and reducing cognitive resources eliminated older adults’ positivity effects. Thus, Labouvie-Vief’s theory also predicts that emotional and cognitive trajectories are interrelated but in a quite different form. Future research is needed to better understand the relationship between cognitive functioning and affect among older adults.

Most life span theories view selection as a key component of development. As Hess et al. (2001) observed, most view selection as motivated by age-related loss and the subsequent need to husband resources toward increasingly circumscribed domains of life (Baltes & Baltes, 1990; Brandtstädter & Greve, 1994; Heckhausen & Schulz, 1995). Socioemotional selectivity theory asserts a different type of selection, not motivated by individualized goals and strivings but by broadly generalizable shifts in motivation that result from changes in temporal horizons. Such motivational shifts result in a favoring of positive

over negative information in the processing of information.

There is, of course, much to learn. One important line of inquiry concerns the ways in which emotional material draws attention away from material highly relevant to the task. Consedine, Magai, and King (2004) pointed out that we are only beginning to understand the role of discrete emotions and their interactions with cognition. Although well-being may benefit from changes described earlier, there may be problems in other areas. In keeping with life span theory, development entails gains and losses. Research attention to such issues is likely to be fruitful in the future.

X. Summary

This chapter sought to integrate the disparate domains of cognitive aging and socioemotional aging from the perspective of a motivational theory of life span development. In order to accomplish this endeavor, we reviewed the dominant findings in cognitive and socioemotional aging, introduced socioemotional selectivity theory as one potential integrative perspective, and then demonstrated how changes in emotion–cognition interactions serve the emotion regulatory goals of older adults. The research presented in this final section suggests that a thorough understanding of how the human mind adapts ontogenetically requires an integrative perspective of cognition, emotion, and motivation.

The aging mind is generally characterized by divergent trajectories. Research in cognitive aging indicates that old age is marked by deterioration; most mental processes, especially those that are effortful and deliberative, decline ubiquitously while a few automatic processes and well-learned expertise-related functions remain unscathed. Importantly, evidence also indicates that even in old age there

is remarkable plasticity of function. Not only can practice improve the performance of older adults, but instructional frames that portray a positive account of aging and memory can also improve performance. Such malleability suggests that motivation and emotion may play critical roles in the cognitive lives of older individuals. Thus, the nature of changes in the emotional lives of older adults should figure prominently in accounts of cognitive aging. In stark contrast to cognitive deterioration, emotional experience and emotion regulation emerge enhanced across the life span. Most emotional processes remain intact, and any changes, such as decreases in negative affect or increases in emotional control, indicate enhancements in the emotional lives of older adults. Understanding the intersection of cognitive decline and emotional enhancement appears to be critical to understanding the aging mind.

Socioemotional selectivity theory offers a motivational explanation for these changes in suggesting that due to an expanded time perspective, younger adults seek information, whereas due to a limited time perspective, older adults seek emotional satisfaction. The theory also generates hypotheses about emotion-cognition interactions in that the postulated emotion focus of older adults could direct attention and memory in line with emotional goals. The research reviewed in this chapter supports this postulate. Not only do older adults prefer, attend to, and show superior memory for emotional relative to nonemotional stimuli, but this emotion effect is disproportionate for positively relative to negatively valenced stimuli. This positivity effect associated with age appears to rely on resource-intensive processing, further suggesting that information processing changes in older adults are goal directed.

It appears that the long-standing independence of socioemotional and cognitive research arenas may have led to the inadvertent exclusion of important aspects of the psychology of aging. Whereas motivation has been a central focus in the area of *social* cognition, it has received relatively little attention in studies of basic mechanisms involved in information processing. This likely reflects a tacit assumption that social motives and social context affect social processes but not the basic elements of attention, memory, and other aspects of information processing. Research reviewed herein suggests that a more complete understanding demands consideration of the interplay of emotion, motivation, and cognition.

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