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# HANDBOOK OF EMOTIONS

FOURTH EDITION

edited by
Lisa Feldman Barrett
Michael Lewis
Jeannette M. Haviland-Jones

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CHAPTER 18

# EMOTION AND AGING

Mara Mather and Allison Ponzio

Emotions depend on a complex circuitry of brain regions interacting with neurotransmitter systems and stress and sex hormones. They are shaped by experience and current circumstances. Feedback loops and self-directed control mechanisms regulate emotions and help curtail how long they last and how intense they get. All of these basic mechanisms and contextual factors change in normal aging and so it is not surprising that emotional experience and processes change with age as well. The changes are not what one might initially predict, however. With aging come health challenges, physical declines, and the loss of friends and family because of illness and death. Furthermore, prefrontal control processes that help regulate behavior, attention, and memory deteriorate, which should make it more difficult to regulate negative emotion. Despite these constraints and challenges, emotional well-being does not tend to decline in normal aging. Why do older adults not revert back to the emotional intelligence of teenagers, a time when their frontal lobes were not yet functioning at full capacity? The surprising lack of decline in emotional function makes aging a fascinating test case for understanding the mechanisms of emotional well-being. In this chapter, we review some key issues regarding emotion and aging: How emotional well-being is maintained across the lifespan, how aging affects specific emotions, how emotions predict longevity, the age-related positivity effect in attention and memory, which aspects of emotion regulation processes are influenced by aging, changes in arousal and stress response processes during aging, interoceptive declines in aging, changes in recognizing the emotions of others, shifts in the causes of depression and anxiety, how dementia affects emotion, and potential cultural differences in emotion and aging.

## Emotional Well-Being

As we review below, emotional functioning holds up remarkably well in normal aging. Given the limitations and biases of memory (e.g., Kennedy, Mather, & Carstensen, 2004; Levine & Safer, 2002; Redelmeier, Katz, & Kahneman, 2003), emotional well-being should ideally be assessed in the moment, with enough moments sampled over time to estimate an average. One landmark study used experience sampling methods to assess frequency and intensity of 19 emotions across a 1-week period in a representative sample of healthy adults, and repeated the assessment across three waves of data collection each 5 years apart (Carstensen et al., 2011). Emotional well-being was defined by subtracting the average frequency of negative emotions experienced from the average frequency of positive emotions experienced. At each wave, the balance of positive to negative emotional experience increased into the late 60s and then stopped increasing. The same pattern was seen within individuals who were assessed at multiple waves. In contrast, the intensity of experienced emotions did not vary based on age.

A similar age-related increase in ratios of positive to negative affect was found in a survey of over 300,000 people in the United States (Stone, Schwartz, Broderick, & Deaton, 2010). Respondents were asked, "Did you experience the following feelings during a lot of the day yesterday?" about enjoyment, happiness, stress, worry, anger, and sadness. From ages 50 to 70, positive emotions increased and negative emotions decreased with age. Before and after those ages, patterns differed across specific emotions, but the older cohorts overall had a higher positive-relative-to-negative emotional experience than the younger ones. Other studies in the United States show similar increases in emotional well-being with age (Charles, Reynolds, & Gatz, 2001; Gross et al., 1997; Mroczek & Kolarz, 1998). Such increases in emotional well-being across adulthood are intriguing. Even with aging-related hardships, older adults generally are satisfied with old age and experience relatively high levels of emotional well-being and decreases in negative affect (Grühn, Smith, & Baltes, 2005).

## Specific Emotions

In the following sections, we move from general well-being to focus on the trajectories of some specific emotions—namely, happiness, anger, sadness, and regret.

### *Happiness*

When he drafted the U.S. Declaration of Independence, Thomas Jefferson wrote that all men have the right to life, liberty, and the pursuit of happiness (Boyd, 1950). After mostly neglecting the topic, in recent years both economists and psychologists developed a stronger appreciation of the importance of happiness (e.g., Frey & Stutzer, 2010; Seligman, 2012). Happiness predicts success in many domains (Lyubomirsky, King, & Diener, 2005) and can help people develop resilience to challenging and shifting circumstances (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009).

A widespread belief is that people become less happy as they get older—but this belief conflicts with happiness self-reports. For instance, in one study, both younger and older adults estimated significant decline in happiness with age, although in fact the younger group was less happy than the older group (Figure 18.1; Lacey, Smith, & Ubel, 2006). In cross-sectional studies, happiness increases with age among cohorts in their mid-50s to mid-70s, then stabilizes or declines slightly in late life (Mroczek & Kolarz, 1998; Stone et al., 2010).

One question is how much happiness declines in very late life (after age 85). One perspective is that although things look good for the "young old" (in Western cultures, this often refers to those in their 60s and 70s), things are so bleak among the oldest old that "living longer seems to be a major

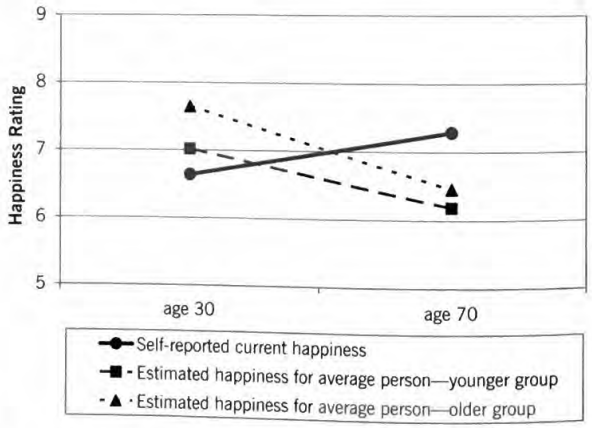


**FIGURE 18.1.** Current happiness self-reports versus happiness estimates for the average person, for ages 30 and 70. From Lacey, Smith, and Ubel (2006). Copyright 2006 by. Reprinted by permission.



risk factor for human dignity" (Baltes & Smith, 2003, p. 128). Baltes and Smith argue that aspects of emotion and well-being that show no decline in the young old show prominent decline among the oldest old. Part of their pessimism about this phase in life is that Alzheimer's disease is common among the oldest old. They state, "It may be a sad commentary, but dying before reaching the oldest ages is currently the only way to avoid succumbing to Alzheimer-type dementia!" (p. 129).

Indeed, in the face of physical dysfunction (e.g., dementia or other age-related chronic disease), it is natural to expect dramatic increases in depression. Yet, counter to this expectation, a population-based sample of German centenarians indicated as much happiness as representative middle-age and older Germans (Jopp & Rott, 2006). This counters the notion that happiness declines precipitously in the oldest old and is a striking finding given that 80% of the centenarians surveyed needed nursing care.

### *Anger*

In contrast with happiness, anger can be hazardous to one's health (Suinn, 2001; Williams, 2012). Anger is especially likely to trigger and exacerbate cardiovascular disease, the leading cause of death in the United States (Heidenreich et al., 2011). People who generally have poor anger control are more likely to develop cardiovascular disease in the next 10–15 years (Haukkala, Konttinen, Laatikainen, Kawachi, & Uutela, 2010) and outbursts of anger increase the likelihood of an acute cardiovascular event in the next 2 hours (Mostofsky, Penner, & Mittleman, 2014).

The frequency of self-reported anger increases during young adulthood but then decreases steadily until old age (Kunzmann, Richter, & Schmukle, 2013; Kunzmann & Thomas, 2014; Stone et al., 2010). When specifically asked about interpersonal tensions, older adults report experiencing less anger and using more loyalty strategies such as doing nothing and fewer anger exit strategies, such as yelling, than younger adults (Birditt & Fingerman, 2003, 2005; Birditt, Fingerman, & Almeida, 2005; Blanchard-Fields & Coats, 2008). More generally, in representative samples in both the United States and Japan, there was stability in positive interactions and decreases in negative interactions in close relationships (Akiyama, Antonucci, Takahashi, & Langfahl, 2003).

Older adults also respond to triggers with less anger than younger adults in laboratory studies. When confronted with a recorded conversation of two people ostensibly talking about them, older adults reported less anger but equal levels of sadness compared with younger adults, and their comments seemed less negative to raters (Charles & Carstensen, 2008). Compared with younger adults, older adults showed decreased visual cortex-evoked potentials in response to angry but not to sad or happy faces (Mienaltowski, Corballis, Blanchard-Fields, Parks, & Hilimire, 2011), a finding that may relate to older adults interpreting a protagonist in a videotape as less angry than younger adults do (Charles, Carstensen, & McFall, 2001). These decreases in anger as people age may be critical for survival, given that anger increases the risk of cardiovascular events and that rates of cardiovascular disease are so high among older adults (among people free of cardiovascular disease at age 50, the lifetime risk to develop it was 52% for men and 39% for women; Lloyd-Jones et al., 2010).

### *Sadness*

Losses trigger sadness (Bowlby, 1998). Losing a loved one is the most obvious example, but loss of social roles, places, or things can all lead to sadness. Older adults tend to have older peer groups and spouses, making them susceptible to loss of close loved ones. They also have a lifetime of accumulated roles, familiar places, and things that are all at risk of loss, while they suffer age-related declines in some physical and mental abilities. And they are closer to the end of their own lives. Thus, among the biggest emotional challenges older adults face is how to cope with loss, both past and future, and these challenges seem likely to lead to increases in sadness.

Although some studies show increases in older age, others show no change in sadness. Self-reported everyday sadness shows an almost flat profile across age groups, with studies showing either no age differences (Kunzmann & Thomas, 2014), a midlife small bump that decreases in later life (Stone et al., 2010), or a flat profile across most of adulthood with an increase among those in their late 70s and 80s (Kunzmann et al., 2013). When reporting on emotional reactions to interpersonal conflict, participants show no significant age differences in reported sadness (Birditt & Fingerman, 2003). In the lab, there are no age differences in sadness elicited by conversations involving disparaging comments about the participant (Charles & Carstensen, 2008), or by a film clip about a boy

mourning his father's death (Tsai, Levenson, & Carstensen, 2000), but older adults felt more sadness than younger adults after watching other film clips involving themes of death or Alzheimer's disease (Kunzmann & Gruhn, 2005; Seider, Shiota, Whalen, & Levenson, 2011).

Thus, while some (but not all) studies suggest that sadness is a more accessible emotion for older adults, there is less of an increase in sadness than might be expected given the losses associated with aging. This discrepancy between circumstances and reactions is particularly striking in a longitudinal study in which German participants ages 58–81 estimated perceived deficits in performance and losses in abilities and also rated how contented they were with themselves and their present functional state in the respective domains (Rothermund & Brandstädter, 2003). Perceived losses and deficits increased significantly with age, but contentment with performance did not decline.

### Regret

Regret involves sadness or remorse over past acts. Having a longer life to look back on means that there are more things to regret and also potentially fewer opportunities to address the regrets via new behaviors. Surprisingly, given their longer lives and increased opportunities for regrets, older adults are less likely than younger adults to report regrets. For instance, nearly 4,000 Dutch and German adults 40–85 years old were asked to complete the sentence, "When looking back on my past life, I regret . . ." (Timmer, Westerhof, & Dittmann-Kohli, 2005); the likelihood of reporting nothing to regret increased with age. In addition, among 825 Swedish adults between 18 and 85 years old, self-reported frequency of regret decreased with age, along with the intensity and duration of everyday regrets (Västfjäll, Peters, & Bjälkebring, 2011; see also Bjälkebring, Västfjäll, & Johansson, 2013).

Even when regrets are induced in the laboratory as part of risky gamble choices and so younger and older adults have the same temporal distance from their choices, there are age differences in how much people focus on potential or past regrets. For instance, when asked why they made the choices they did in a risky gamble situation, older adults were more focused on receiving some positive reward and cared less about avoiding potential regret than younger adults (Mather, Mazar, Gorlick, Lighthall, & Ariely, 2012). In another study, feedback about missed chances on one risky-choice trial predicted risk-taking behavior on the next trial in healthy younger and depressed older adults (suggesting their choices were modulated by regret), but not in healthy older adults (Brassen, Gamer, Peters, Gluth, & Büchel, 2012). In addition, the healthy younger and depressed older adults showed decreased brain activity in reward-processing regions when shown their missed opportunities, whereas healthy older adults did not. In contrast, only the healthy older adults showed more anterior cingulate activation during presentation of missed opportunities relative to trials without a missed chance, potentially reflecting cognitive control efforts to disengage from regret.

An increased likelihood of resolving regrets among older adults was also seen in a study of 455 caregivers of terminally ill patients, when interviewed 6 months after their loved ones died (Torges, Stewart, & Nolen-Hoeksema, 2008). The likelihood the caregivers had resolved their regrets increased linearly with age, and regret resolution predicted lower depressive symptoms and higher well-being 18 months after their loved one's death.

The most effective strategies for defusing regrets may shift with age. In one study, older adults experienced less regret when they felt little control over the event, whereas younger adults felt less regret when they felt high levels of control (Wrosch & Heckhausen, 2002). The authors argued that low attributions of control could be an adaptive strategy when feeling that there is little time left for active attempts to change regrettable behavior. In another study, older adults' lower levels of regret were mediated both by postdecision reappraisal ("I try to reevaluate the decision") and by predecision avoidance ("Delay the decision"; Bjälkebring et al., 2013). Other studies also suggest older adults are more likely to avoid decisions to postpone negative affect and regret (Mather, 2006). Thus, research suggests that older adults use various strategies including decision avoidance as well as more cognitively engaging strategies to defuse regret and that, with decreasing time left in life to change regrettable things, older adults may be better off if they attribute less self-control to themselves about the things they regret.

## Emotions Predict Longevity

People who experience relatively more positive than negative emotions in their everyday lives live longer (Carstensen et al., 2011; Diener & Chan, 2011). Subjective well-being consistently predicts longevity among those who are healthy, albeit with a weaker relationship with longevity among those suffering from a disease (Diener & Chan, 2011). For instance, positive emotional content in nuns' early life autobiographies predicted longevity six decades later (Danner, Snowdon, & Friesen, 2001). Likewise, baseball players who smiled authentically (moving muscles both around the mouth and eyes) in their photos in the 1952 *Baseball Register* were half as likely to die in any subsequent year compared with nonsmilers (Figure 18.2; Abel & Kruger, 2010).

In addition to predicting mortality, negative emotions are associated with physical health in late life. For instance, among older adults, higher levels of intense life regrets are associated with more cortisol secretion and health problems (Wrosch, Bauer, Miller, & Lupien, 2007).

One question the survival effects raise is how much the decrease in negative affect among older cohorts results from the happiest people surviving the longest. So far, no studies have tackled the question of how much of the variance in cohort comparison studies is related to survival effects. Longitudinal studies, however, show emotional well-being increases within individuals across adulthood (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Carstensen et al., 2011; Charles, Reynolds, et al., 2001) indicating that it is not just a matter of all the people who are chronically unhappy dying off; instead, across the adult lifespan emotional experience tends to improve.

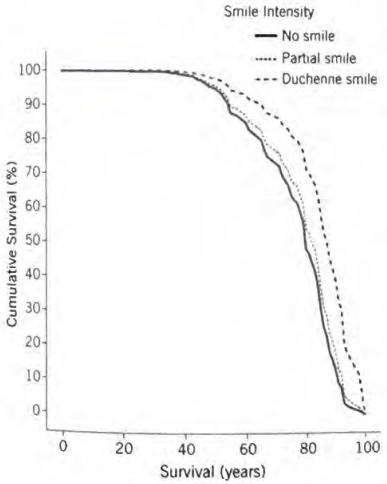


**FIGURE 18.2.** Percentage of Major League Baseball player's cumulative survival based on photographed smile intensity. The curves represent the probability of survival as predicted by a history of no smile in pictures, partial smile in pictures, or full (otherwise known as Duchenne) smile in pictures. From Abel and Kruger (2010). Copyright 2010 by. Reprinted by permission.

Another question these findings raise is: If negative emotions are associated with shorter and less healthy lives, why do we even have them? According to functionalist theories of emotion, all emotions have some adaptive benefits (Farb, Chapman, & Anderson, 2013; Keltner & Haidt, 1999; Levenson, 1999). For instance, sadness and depression can focus and enhance analysis of social problems and signal to partners the need to help or make concessions (Watson & Andrews, 2002). Depression also facilitates disengagement from unattainable goals (Wrosch & Miller, 2009). Anger, in contrast, promotes readiness to take action and persistence (Frijda, Kuipers, & ter Schure, 1989; Lench & Levine, 2008).

The adaptations of specific emotions may change with age. For instance, goal disengagement may play a more important role for older adults as they perceive diminishing opportunities to undo the consequences of their regrets (Wrosch, Bauer, & Scheier, 2005). Consistent with the idea that certain negative emotions may promote well-being most at certain life phases, the relationship between participants' negative emotions in response to a thematically ambiguous film and their subjective well-being depended on age, with anger responses associated with higher well-being for middle age but not younger or older adults, and sadness responses associated with higher well-being for older but not the other groups (Haase, Seider, Shiota, & Levenson, 2012).

## Age-Related Positivity Effect

In the research reviewed thus far, a picture emerges of late life as a time of surprising emotional resilience, with well-maintained positive emotions and somewhat decreased negative emotions. It turns out that there is also an age-related positivity effect in attention and memory (Mather & Carstensen, 2005). For example, in one study where younger, middle-age, and older adults completed a recall test of positive negative and neutral pictures, the

ratio of positive to negative images recalled increased with the age of the participant (Figure 18.3; Charles, Mather, & Carstensen, 2003).

Similar age-by-valence interactions have emerged in other studies as well. A meta-analysis of over 100 studies using both positive and negative stimuli and testing both younger and older participants found that, compared with younger adults, older adults were significantly more likely to favor positive over negative information in attention and memory (Reed, Chan, & Mikels, 2014).

What are the mechanisms underlying this striking pattern? One obvious possibility is that it is just a side effect of older adults being in a better mood and showing mood-congruent memory and attention. Current mood and negative emotion levels fail to account for the positivity effect, however (Charles et al., 2003; Kennedy et al., 2004; Mather & Carstensen, 2003; Mather & Knight, 2005). Given everything we know about the neural, cognitive, and physical declines associated with aging, another obvious explanation is that older adults' positivity effect is a serendipitous side effect of some sort of decline. For instance, perhaps the amygdala, a brain region attuned to negative potentially threatening information, declines more than other brain regions and so leads to this pattern (Cacioppo, Berntson, Bechara, Tranel, & Hawkley, 2011).

Contrary to this aging-brain model, however, older adults show intact threat detection advantages in visual search (Leclerc & Kensinger, 2008; Mather & Knight, 2006) and less structural decline in the amygdala than in most of the rest of the brain (Mather, in press; Nashiro, Sakaki, & Mather, 2012). And although older adults show less amygdala activity in response to negative stimuli than do younger adults, this does not seem to be due to decline but instead to what they are most attuned to, as they show more amygdala response to positive than to negative stimuli (Leclerc & Kensinger, 2011; Mather et al., 2004; Waldinger, Kensinger, & Schulz, 2011). Another problem for the decline story is that the positivity effect is stronger in older adults who do well on tests of cognitive control than in those who do poorly (Mather & Knight, 2005; Petrican, Moscovitch, & Schimmack, 2008) and emerges in visual search tasks that require controlled attentional processes, but not in those that require only automatic processes (Hahn, Carlson, Singer, & Gronlund, 2006). When presented with stimuli while engaged in a task that taps cognitive control resources, older adults no longer show a positivity effect (Knight et al., 2007; Mather & Knight, 2005). Thus, cognitive control mechanisms seem to promote older adults' positivity in attention and memory. Indeed, the effect size of the positivity effect is larger when participants are free to process stimuli as they choose

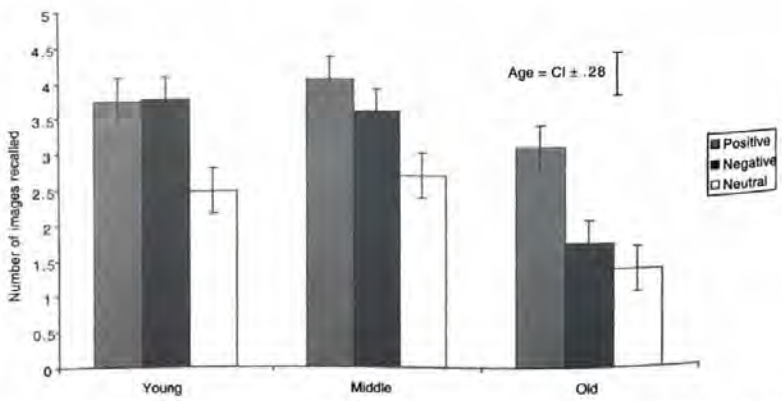


**FIGURE 18.3.** Number of positive, negative, and neutral images recalled for younger adults, middle-age adults, and older adults. From Charles, Mather, and Carstensen (2003). Copyright 2003 by. Reprinted by permission.



rather than being constrained by specific task instructions (Reed et al., 2014).

Furthermore, in functional magnetic resonance imaging studies older adults show more prefrontal activity while processing emotional than neutral stimuli, compared with younger adults (Mather, 2012), suggesting they are engaging prefrontal control processes to help guide the way they process emotional information. In particular, for older adults with strong positivity biases in attention, prefrontal control processes appear to downregulate amygdala responses to negative stimuli (Sakaki, Nga, & Mather, 2013). Likewise, anterior cingulate activation is related to a positivity bias and emotional stability in successful aging (Brassen, Gamer, & Buchel, 2011).

In summary, these findings reveal a surprising answer to the question of the mechanisms leading to older adults' positivity effect. Instead of being associated with age-related decline in brain regions that detect and respond to negative information, older adults' positivity effect is associated with prefrontal control mechanisms that help people direct their own attention and memory processes. This is not yet a complete answer, however. Cognitive control processes decline more than almost all other cognitive processes in normal aging, so why would older adults use these resources more than younger adults to guide their processing of emotional stimuli?

One potential answer is offered by a lifespan theory of how time perspective can influence motivation (Carstensen, Isaacowitz, & Charles, 1999). According to socioemotional selectivity theory, time horizons shape the ways in which people prioritize and set goals. When people view their time as expansive, they spend more time investing in their future, acquiring new knowledge, looking for novelty, and expanding their time horizons. Alternatively, when people view their time as being limited, they often direct their attention to more emotionally meaningful endeavors, including the desire to have emotionally fulfilling relationships and feeling socially connected (Carstensen, 2006). This more limited time perspective among older adults may account for their greater focus on regulating emotions, a better emotional well-being profile, and their positivity effect (Barber, Opitz, Martins, Sakaki, & Mather, in press; Carstensen, Mikels, & Mather, 2006; Reed & Carstensen, 2012). In addition, in terms of the question about how older adults could rely more than younger adults on cognitive control resources to direct attention and memory when processing emotional stimuli, insofar as older adults chronically focus more on emotion regulation goals than younger adults do, older adults should also recruit cognitive control processes more in the service of emotional goals than do younger adults, even if they have diminished cognitive control resources overall (Kryla-Lighthall & Mather, 2009).

## Emotion Regulation

Given the findings covered so far about how the balance of positive to negative affect improves with age, an obvious assumption is that older adults get better at regulating their emotions. Consistent with this possibility, older adults give themselves higher ratings than younger adults in response to the question, "Overall, how much control would you say you have over your emotions?" (Gross et al., 1997). In addition, older adults are less likely to ruminate on negative emotions (McConatha & Huba, 1999). Life experience might also help people become expert emotion regulators (e.g., Blanchard-Fields, 2007), just as it seems to increase their social expertise (Hess & Kotter-Grühn, 2011). Yet laboratory studies that compare younger and older adults' performance when they are instructed to regulate in response to emotional stimuli reveal no consistent age advantages for either younger or older adults (see Mather, 2012, for a review). Instead, where age differences are more likely to emerge is in which regulation strategies people tend to use. Older people are more likely to report using suppression and less likely to report using reappraisal, rumination, and active coping than younger adults (Nolen-Hoeksema & Aldao, 2011; Marquez-Gonzalez, de Troconiz, Cerrato, & Baltar, 2008; but see John & Gross, 2004). Older adults also report prioritizing avoiding emotional situations more than do younger adults (Lawton, Kleban, Rajagopal, & Dean, 1992). This pattern of age differences is more challenging to investigate using laboratory methods, as what needs to be measured are people's habitual modes of processing rather than their skill at any one type of processing.

A recent framework explains why younger and older adults spontaneously select different strategies to regulate their emotions. The framework—selection, optimization, and compensation with emotion regulation (Urry & Gross, 2010)—follows previous theoretical thinking (Baltes & Baltes, 1990) that by sticking to three core tenets (selection, optimization, and compensation), suc-

cessful living can be achieved at any stage of life. Selection requires an individual to assess his or her own realistic capabilities and make realistic goals. Optimization requires time, practice, and effort to achieve the set goals. And finally, compensation involves increasing effort or acquiring help to overcome losses. Applying these principles to emotion regulation strategies (Opitz, Gross, & Urry, 2012), available cognitive resources may influence strategy selection. Younger people may be more likely to use regulation strategies that require heavy cognitive control involvement, such as reappraisal. In contrast, older adults may rely more heavily on social support and situation selection (Sims & Carstensen, 2014).

## Emotion and Physiology

### *Arousal*

Common aging ailments like peripheral neuropathy and cataracts can impact arousal responses, including skin conductance and pupil dilation. As people age, their arteries become less plastic and cardiac muscles become weaker, resulting in greater peripheral resistance and poorer blood circulation efficiency (Lakatta, 1990). These changes in the cardiovascular system influence some psychophysiological measures of arousal, like blood pressure and heartbeat. Aging also causes changes in the electrodermal system, resulting in a decrease in the quantity of sweat glands, the amount of sweat produced (Porges & Fox, 1986), and the accuracy with which we may be able to measure skin conductance. Thus, not surprisingly, age-related decreases on measures such as heartbeat interval, skin conductance, respiration period, ear pulse transmission, and systolic blood pressure have been found in people's responses to emotional cues (Kunzmann, Kupperbusch, & Levenson, 2005; Levenson, Friesen, Ekman, & Carstensen, 1991; Tsai et al., 2000; but see Denburg, Buchanan, Tranel, & Adolphs, 2003; Neiss, Leigland, Carlson, & Janowsky, 2009, for studies finding no significant age differences for skin conductance).

In a longitudinal clinical–pathological cohort study, researchers found that a higher density of noradrenergic neurons in the locus coeruleus, a structure in the pons important for physiological responses to arousal, was predictive of a slower rate of cognitive decline (Wilson et al., 2013). This suggests that there is a relationship between the integrity of emotional arousal processes and cognitive performance during late life (Watson et al., 2006). One intriguing possibility is that, via noradrenaline's neuroprotective effects, experiencing novel, arousing events throughout life by having an engaging career and social life maintains brain function (and builds "cognitive reserve") even as neuropathology increases (Robertson, 2013).

### *Stress*

Cortisol, a hormone responsible for stress regulation, on average shows a different diurnal rhythm in younger and older people. Although both younger and older people experience a peak (and subsequent slow decline) in the hormone after waking, older adults never reach the same lowest level as younger adults (Van Cauter, Leproult, & Kupfer, 1996). Since older adults never reach the same low cortisol levels achieved by younger adults, mean daily cortisol levels increase 20–50% from age 20 to 80 (Van Cauter et al., 1996; see also Nicolson, Storms, Ponds, & Sulon, 1997). In another study that examined subgroups, 50% of older adults in the sample maintained typical cycles, while most of the rest of the sample had daily cycles that varied substantially from day to day (Ice, Katz-Stein, Himes, & Kane, 2004). This indicates that, while day-to-day variation may increase, normal diurnal rhythms of cortisol can be maintained in late life.

Younger and older adults show similar cortisol responses to acute physical stressors such as holding a hand in ice water (Mather, Gorlick, & Lighthall, 2009; Lighthall, Gorlick, Schoeke, Frank, & Mather, 2013) and to the Trier Social Stress Test, an acute social stressors test (Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004; Rohleder, Kudielka, Hellhammer, Wolf, & Kirschbaum, 2002). One study, looking at adrenaline and noradrenaline (hormones responsible for the fight-or-flight response) effects on psychophysiological responses in older men, found that, after experiencing a psychosocial stressor, blood pressure and adrenaline levels increased steadily in both middle-age and older men, but were slower to return to normal levels in the older men (Faucheux, Bourliere, Baulon, & Dupuis, 1981). A meta-analysis that included studies using pharmacological challenges found that, on average, older adults (and especially women) showed greater cortisol responses to challenge (Otte et al., 2005). So, in general, older adults' cortisol response to acute stress is as strong or stronger than that of younger adults.

According to strength and vulnerability integration (SAVI) theory, in order to understand how age, stress, and affective experience interact, the context of daily life needs to be understood (Charles & Piazza, 2009; Charles, 2010). When older adults avoid or reduce exposure to emotional distress, they often respond better than younger adults. But when older adults experience high levels of sustained emotional arousal, age-related advantages in emotional well-being are diminished, and older adults have greater difficulties returning to homeostasis (see Charles & Luong, 2013, for a review). The theory claims that there are three instances that make people unable to avoid stressors or reduce exposure to caustic events: social isolation (see Ong, Rothstein, & Uchino, 2012), neurological dysregulation (see Kryla-Lighthall & Mather, 2009, for review), and exposure to chronic and unpredictable stressors and inevitable stressor overload (see Piazza, Charles, Stawski, & Almeida, 2013).



### *Interoception*

Since the work of William James and Carl Lange (Lange & James, 1922), research in the field of emotion has recognized the key role of body sensations in emotion. Signals from brain regions that track body sensations such as heartbeats, breath, digestion processes, and skin flushing help shape our emotional experience (Barrett, Quigley, Bliss-Moreau, & Aronson, 2004; Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004; Damasio, 1999). With age, people are less able to detect visceral sensations such as gastric distension, rectal distension, esophageal pain, and their own heartbeat (Khalsa, Rudrauf, & Tranel, 2009; Lagier et al., 1999; Lasch, Castell, & Castell, 1997; Rayner, MacIntosh, Chapman, & Horowitz, 2000). The as-yet-unanswered question in the field is how these changes influence emotional experience and general well-being. Even just the simple question of whether these interoceptive sensation declines correlate with emotional experience has not been addressed and is an important question for future research.

## Recognizing Others' Emotional Facial Expressions

Other people are the most likely trigger as well as object of emotions for almost all humans (Oatley, 2004). What would life be like if we could not detect the emotions of others? Without this skill, it would be much more challenging to fulfill social goals such as cooperating, forming a new relationship, showing affection, seeking help, deferring to others, and fighting. Emotions are conveyed in many ways, but faces are often the most specific and clear signal of emotions.

Recognition of some emotions is more impaired by aging than others (see Isaacowitz & Stanley, 2011; Ruffman, Henry, Livingstone, & Phillips, 2008, for reviews). Older adults are typically worse than younger adults at recognizing fear and sadness. They also sometimes are worse at recognizing angry expressions. They typically are as good as or better than younger adults, however, at recognizing disgusted expressions. Older adults also show age equivalence, smaller deficits, or even advantages in recognizing happy and surprised facial expressions.

Older adults' maintained ability to identify facial expressions of disgust is particularly striking because disgust is one of the emotions younger adults find most difficult to identify (Ruffman et al., 2008). Disgust recognition seems to depend in particular on the insula (Adolphs, Tranel, & Damasio, 2003; Calder, Keane, Manes, Antoun, & Young, 2000). Thus, one possibility is that the insula maintains its influence over face-processing networks more effectively with age than other brain regions that are more important for other types of facial emotions, such as the ventral striatum or amygdala (Adolphs et al., 2005; Calder, Keane, Lawrence, & Manes, 2004). For instance, while encoding fearful faces, younger adults showed more amygdala and hippocampal activation than older adults, while older adults showed more insular cortex and right superior frontal gyrus activity (Fischer, Nyberg, & Backman, 2010). Neither age difference was apparent during encoding of neutral faces. Likewise, another study found that older adults showed greater insula activity than younger adults during rating emotional expressions (Keightley, Chiew, Winocur, & Grady, 2007). Thus, shifts in the brain regions most likely to contribute to face processing may contribute to which types of facial expressions are most likely to be recognized.

Another possibility is that age-related shifts in which emotions are easiest to identify result from changes in which facial features are noticed most. When viewing faces, older adults fixate less on the eyes than younger adults do, and more on the mouth and nose (Firestone, Turk-Browne, & Ryan, 2007; Murphy & Isaacowitz, 2010; Sullivan, Ruffman, & Hutton, 2007; Wong, Cronin-Golomb, & Neargarder, 2005), especially when the faces have

already been seen recently (Heisz & Ryan, 2011). In addition, older adults are less likely than younger adults to follow the eye gaze cues of younger adults (Slessor, Phillips, & Bull, 2008).

## Clinical Issues

### Depression

Contrary to common perception, rates of depression in older adults are lower than in younger adults (Blazer, 2003; Hasin, Goodwin, Stinson, & Grant, 2005). But older adults' symptoms of depression may be more harmful than younger adults' symptoms (Fiske, Wetherell, & Gatz, 2009). Depression at older ages is associated with decreased cognitive, physical, and social functioning; increased risk of morbidity; increased risk of suicide; increased self-neglect; and increased mortality (Blazer, 2003). Clinical presentation at old age is the sum of a lifetime of social, environmental, and physiological risk and protective factors (Fiske et al., 2009). Depression is also associated with increased frailty (Mezuk, Edwards, Lohman, Choi, & Lapane, 2012). Stressful life events have been associated with an increased risk of depression at all ages (Nolen-Hoeksema & Ahrens, 2002), though the types of events would likely differ for younger and older people. Precipitating events in later life include financial difficulties, a new illness or disability, a family member with a new illness or disability, retirement, or change in living situation (Fiske et al., 2009). Older adults who experience socioeconomic disadvantage are more likely to have higher rates of depression (Mojtabai & Olfson, 2004). Several age-related diseases lead to an increased risk for depression, including cardiovascular disease (Carney & Freedland, 2003) and diabetes (Li, Ford, Strine, & Mokdad, 2008). Depression in older people can present as either a lifetime illness with repeated depressive symptoms across the lifespan, or solely as a late-life condition. Differences in depression in late life as compared with early in life exist in etiology, prognosis, and lived experiences (Fiske et al., 2009). There are some important differences between early and late onset. Those with early onset of depression are more likely to have a family history of depression, suggesting a possible genetic influence (Heun, Papassotiropoulos, Jessen, Maier, & Breitner, 2001). Older adults with late-onset depression are more likely to have vascular risk factors, experience disruption in cognitive functioning, and are more likely to develop dementia (Hickie et al., 2005; Schweitzer, Tuckwell, O'Brien, & Ames, 2002).

Depressed older adults often present with more physical than emotional symptoms (Büchtemann, Luppa, Bramesfeld, & Riedel-Heller, 2012). Older adults with depression are less likely to endorse dysphoria (a state of unease or general dissatisfaction with life) and feelings of worthlessness or guilt. Older adults with late-onset depression display sleep disturbances, fatigue, psychomotor retardation, loss of interest in living, and hopelessness about the future, more so than younger adults or older adults who had early-onset depression (Fiske et al., 2009). Depressed older adults are also more likely to complain about poor memory and concentration (Christensen, Jorm, MacKinnon, Korten, Jacomb, et al., 1999).

### Anxiety

Anxiety symptoms are likely twice as prevalent as depression symptoms in older people (Singleton, Bumpstead, O'Brien, Lee, & Meltzer, 2003) and a mix of anxiety and depression is common (Wetherell, Maser, & Balkom, 2005). Depression and anxiety often present together and have similar risk profiles (Vink, Aartsen, & Schoevers, 2008). Though anxiety is a common psychological symptom at any age, it has several older-age specific facets (Wolitzky-Taylor, Castriotta, Lenze, Stanley, & Craske, 2010). Anxiety related to fear of falling and anxiety comorbid to other illnesses are most common in older ages. Fear of falling has a strong relationship with limiting physical and social activity, and therefore has an impact on independence and mobility. Anxiety also predicts limited activity independent of depression (Norton et al., 2012). Poor balance and reduced activity levels make individuals fear falling and its serious health outcomes, such as hip fractures (Cumming, Salkeld, Thomas, & Szonyi, 2000). Sometimes referred to as "postfall syndrome," this disorder has been cited as the most common anxiety reported in older people (Howland et al., 1993). Anxiety can often be comorbid to other diseases. In a community dwelling group of older adults with cardiovascular diseases, subthreshold anxiety was found to be highly prevalent, suggesting that anxiety could be comorbid with high blood pressure and depression (Grenier et al., 2012). A review indicated that there was a relationship between anxiety and menopause. Specifically, menopause was linked to both vasomotor symptoms and panic disorder (Bryant, Judd, & Hickey, 2012).



### Dementia and Alzheimer's Disease

Alzheimer's disease and other dementias impair thinking and reasoning and increase in prevalence with age (Corrada, Brookmeyer, Paganini-Hill, Berlau, & Kawas, 2010). Population-based studies that surveyed centenarians estimated 51% in Denmark had dementia (Andersen-Ranberg, Vasegaard, & Jeune, 2001) and 70% in Japan (Asada et al., 1996). While normal aging has the biggest impact on fronto-striatal brain systems, Alzheimer's disease targets medial temporal lobes and cortical networks involving the posterior cingulate and retrosplenial cortex (Buckner, 2004). These different trajectories are also apparent for emotions, which fare worse in Alzheimer's disease than in normal aging. A community-based sample study of dementia found that apathy was the most common emotional symptom, followed by depression and agitation or aggression (Lyketsos et al., 2000). Both depression and Alzheimer's disease involve chronic inflammation and hyperactivation of the hypothalamic–pituitary–adrenal axis (Caraci, Copani, Nicoletti, & Drago, 2010). The aggression and other psychiatric symptoms sometimes seen with Alzheimer's disease have been linked to damage to the serotonergic and dopaminergic systems in the brain (Katz et al., 1999; Assal & Cummings, 2002).

## Cultural Caveats in How Age Relates to Emotion

One limitation of this review is that the majority of age-related comparisons in emotion and associated processes have been conducted in English-speaking countries. It is unclear if there are similar age associations elsewhere or if there are cultural differences. One study suggests that culture can have a significant impact on how emotional well-being differs across age cohorts (Steptoe, Deaton, & Stone, 2015). While English-speaking wealthy countries showed the general pattern of increasing emotional well-being with age, regions such as the former Soviet Union and Eastern European satellites showed a decreasing ratio of positive-to-negative emotional ratings, and other regions such as Africa and Latin American regions showed few age differences or mixed patterns. Differences in these cross-sectional trends across countries may be the result of societal upheavals in some regions of the world that deprive older adults of security and economic resources. Further research is needed to better understand cultural factors influencing well-being, ideally, longitudinal studies that involve experience sampling.

Only a few studies examining how valence influences emotional attention or memory have been run in non-Western samples (Reed et al., 2014), however, among those there were significant positive effect age × valence interactions among Koreans (Ko, Lee, Yoon, Kwon, & Mather, 2011; Kwon, Scheibe, Samanez-Larkin, & Tsai, 2009) and Hong Kong Chinese (Fung, Isaacowitz, Lu, & Li, 2010; but see Fung et al., 2008), suggesting that the shift toward remembering positive relatively better than negative information occurs in Asian as well as Western cultures.

Do individuals within a culture take on more of their culture's values over time? If so, this would predict that cultural differences would be most pronounced among older cohorts. Indeed, there are some initial findings suggesting that social values and personality traits such as optimism differ most across cultures among older cohorts (Fung, 2013). But cultural differences are sometimes most pronounced among the younger cohorts (Fung & You, 2011; Ko et al., 2011). Whereas younger Koreans versus Americans show the expected cultural difference in which Asians integrate the emotional context more when rating the emotion of a foreground face, older Koreans versus Americans do not show any differences in context integration (Ko et al., 2011). Thus, emotional differences across cultures are likely influenced by factors other than a deepening identification with one's culture over time.

## Conclusion

Whether addressing the topics of discrete emotions, psychophysiological arousal, or emotion regulation, it is clear that in terms of aging, the results are not always what people initially assume. Even though people believe that they will get less happy with age, older adults tend to self-report being more happy and less angry then their younger adult counterparts. As they age, people are more likely to lose those they care about, yet they do not necessarily become sadder with time. After a lifetime of learning from emotion regulation successes and failures, older adults report feeling more in control of their own emotions. Older adults may experience declines in systems important for *feeling* emotion (i.e., electrodermal and cardiovascular systems) but some measures of psychophysiological

arousal show similar results between younger and older people. Depression is less frequent in later than earlier adulthood and depression that starts at older ages is associated with a lifetime of stressful experiences, a decrease in social networks, and an increase in comorbidities, and differs from depression at younger ages. Older people are often anxious about falling and comorbidities—things younger people worry little about. In general, emotion is a domain in which older adults fare surprisingly well especially considering declines in cognitive and physical domains. Current theoretical models have helped explain some of the age differences in emotional processes, but more research is needed to see which (if any) of the theoretical frameworks outlined above can be ruled out or further supported.

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