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The appraisal approach to aging and emotion: An integrative theoretical framework☆

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ABSTRACT

To advance our understanding of how emotional experience changes across the adult life span, we propose an integrative theoretical framework: the appraisal approach to aging and emotion (AAAE). AAAE posits that (a) age-related cognitive, motivational, and physical changes fundamentally change the appraisal system in certain ways, and that (b) older adults often deploy appraisal processes in different ways relative to their younger counterparts. As such, we hypothesize that these age-related changes to the appraisal process underlie the finding that older and younger adults tend to experience different emotions. In this paper we integrate findings from the aging literature with appraisal theory, grounding AAAE in theoretical and empirical work relevant to the relationship between aging and appraisal processes. Using our theoretical framework, it is possible to identify critical points of investigation for aging and emotion researchers to further develop our understanding of the proximal-level determinants of age differences in emotion.

Introduction

Why might people of different ages have different emotional experiences to the same situation? In particular, what could explain decades of research documenting that older adults have different emotional responses relative to younger adults? Although decades of work have provided support for the central role of evaluative appraisals in the emotion process, appraisal theory has yet to be applied to the field of emotion and aging. Historically, it was thought that deterioration defined older adulthood and that emotional declines would follow patterns of cognitive and physical decline (for a historical review, see Charles & Hong, 2016). Relative to such presuppositions, though, robust and fascinating findings have illuminated *age-related positivity in emotional experience*, such that as individuals age, they experience greater emotional well-being (for a review, see Mikels, Reed, Hardy, & Loeckenhoff, 2014). Although great strides have been made in understanding age-related changes in emotional experience, determining the underlying mechanisms remains an actively debated area of inquiry.

Decades of research consistently have revealed age differences in positive and negative emotions. Overall, relative to their younger counterparts, older individuals report experiencing fewer negative emotions but a relatively equal – or sometimes an increased – number of positive emotions (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Carstensen et al., 2011; Charles, Reynolds, & Gatz, 2001; Mroczek & Kolarz, 1998). Regarding specific discrete emotions, findings have documented age-related reductions in anger and

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fear, but not disgust (Gross et al., 1997; Haase, Seider, Shiota, & Levenson, 2012). Interestingly, sadness appears stable or increased in later life (Haase et al., 2012; Kunzmann & Grühn, 2005; Tsai, Levenson, & Carstensen, 2000). On the positive side, contentment has been found to increase in frequency in later life (Lawton, Kleban, & Dean, 1993). In addition, older adults tend to experience greater emotional stability and co-occurrence of positive with negative emotions compared to younger adults (Carstensen et al., 2011; Charles et al., 2001; Magai, Consedine, Krivoshekova, Kudadjie-Gyamfi, & McPherson, 2006). This trend away from negative emotional experience and/or increasing positive emotional experience underscores general age-related positivity in emotional experience (Mikels et al., 2014). We see that emotional experience does not descend into despair, but in fact is relatively improved in older age. Yet, the mechanisms by which these changes in emotion occur in older adulthood are not fully understood, and they likely involve changes in emotional processes beyond simply positivity versus negativity (valence). What may be the affective mechanisms that underly the emotional improvements that older adults generally experience?

To understand developmentally how changes in emotional experience emerge, life-span theories of adult development often consider how declines in cognitive and physical abilities as well as motivational shifts impact emotional experience (Baltes & Baltes, 1990; Carstensen, 2006; Heckhausen, Wrosch, & Schulz, 2010; Labouvie-Vief, 2003; Mikels & Young, 2018). Overall, these theories focus on distal and global factors that can influence emotion, but do not necessarily focus on the proximal mechanisms in the emotion process as posited by theories of emotion. Given that contemporary emotion theories place high importance on the role of evaluative appraisal processes in the generation of emotion, it is possible that appraisal processes across the adult life span change, leading to differences in how older adults and younger adults evaluate their environments. We contend that (a) age-related cognitive and motivational changes may fundamentally impact how the appraisal system functions, and that (b) older adults often deploy appraisal processes in different ways relative to their younger counterparts. To advance the study of emotional life-span development, we propose that better integration of life-span theories with emotion theories proper is critical to propel the field toward greater insight into the mechanisms underlying age-related changes in emotion. Our theoretical approach illuminates fertile areas for future research.

An appraisal approach to aging and emotion

Here, we articulate a novel theoretical framework for adult life-span development in the emotion process: an appraisal approach to aging and emotion (AAAE). At its core, AAAE posits that appraisal processes are the proximal mechanism for age differences in emotion. This perspective considers how evaluations of various appraisal dimensions (e.g., valence, control, certainty) may differ for older versus younger adults and provides a roadmap to guide future researchers who seek to understand emotional development across adulthood. With AAAE, we propose that age-related changes in cognitive, motivational, and physical factors directly change certain appraisal processes. Additionally, our framework explicates how such distal age-related changes also influence the ways in which older individuals appraise relative to younger adults. We further postulate that these age differences in appraisal processes are the core affective mechanisms underlying age-related positivity in emotional experience as well as other changes in emotion in later life. In order to integrate findings from the aging literature with appraisal theory, we first contextualize theoretical and empirical work relevant to the relationship between aging and appraisal within appraisal theories more broadly.

Appraisal theories of emotion

What is an emotion? For decades, emotion theorists have attempted to explain what emotions are, how they are elicited, and how they are differentiated (see e.g., Gross & Barrett, 2011). Despite differences in the emphasis placed on various aspects of emotional experience and its underlying structure, most emotion theorists view emotions to be affective *processes* (Ekman & Cordaro, 2011; Gross, 2014; Levenson, 2014; Scherer, 2013). This "process model" of emotion considers emotional reactions, under normal conditions, to be adaptive responses to personally significant events (Scherer, 2009). This general model holds that typically, when an emotional experience occurs, evaluative appraisals of the relationship between the person and the environment can trigger behavioral, physiological, and motivational changes (see Ellsworth, 2013; Moors, Ellsworth, Scherer, & Frijda, 2013). As such, most theorists agree that upon *appraisal*, emotional experience unfolds via neurological changes, physiological reactivity, the subjective feeling of the affective state, a facial expression, and an action tendency, that is, an urge to act (Ekman & Cordaro, 2011; Moors et al., 2013). Some emotion theories place greater emphasis on the end result of the emotion process such as physiological reactivity and facial expressions (e.g., Levenson, 2014) or the subjective feeling (i.e., "core affect," Barrett, 2006, 2014), but one prominent perspective focuses directly on appraisal.

Appraisal theories of emotion focus on appraisal as the central mechanism that differentiates and elicits emotional experiences (see Moors et al., 2013; Scherer, 2013; Smith & Ellsworth, 1985). Although there are multiple appraisal theories with varying ideas about appraisal, they all posit that appraisal processes assess the environment on multiple dimensions for significance to the individual's motivations (Moors et al., 2013). In other words, the appraisal process assesses the environment for meaning in relation to the person's goals. As such, appraisal is considered a transactional process between what is personally relevant to the individual's goals and what is presently occurring within the environment (Moors, 2013; Scherer, 2013). Consequently, it follows that when goals differ, appraisal processes differ and different emotional experiences will occur, which is relevant considering adult age differences in motivation and emotion.

One theoretical appraisal perspective that comprehensively outlines how appraisal fits into the emotion process is the component process model (CPM; Scherer, 2009, 2013; Scherer & Moors, 2019). According to CPM, emotional experience is a continuous and recursive process (Moors et al., 2013; Scherer, 2009). Consistent with this view, Ellsworth (2013) explains that under many circumstances, certain appraisals may initiate an emotional response, but after the initial response, subsequent appraisals change

Table 1
An Integrative Taxonomy of AAAE Predictions within the Context of Appraisal Theory.

Component Process Model (Scherer, 2013)			AAAE Age-related Testable Predictions	
Appraisal Category	Appraisal Dimension	Appraisal Description	Theoretically and Empirically Derived Appraisal Predictions	Emotion Predictions
Relevance	Novelty/ Expectedness	How sudden, unfamiliar, unexpected is the event?	Older adults appraise less novelty relative to younger adults	Decreases in negative emotion and high arousal positive emotion and increases in low arousal positive emotion
	Valence/ Pleasantness	How pleasant or unpleasant is the event?	Older adults appraise less negativity/more positivity relative to younger adults	Decreases in negative emotion and increases in positive emotion
	Goal Relevance	Is the event relevant to my goals?	Older adults' goals are present-oriented and focused on social and emotional well-being. Younger adults' goals focus on knowledge and resource acquisition in the service of preparing for an uncertain future	Older and younger adults' emotions will diverge when their goals differ in relation to a situation
Implication	Causal Attribution	Did I/someone else/ circumstance intentionally cause this event?	Older adults appraise less blame to relationship partners relative to younger adults	Relationship-related decreases in stress and anger and increases in interpersonal positive affect
	Certainty	Am I certain about what is/ will be happening?	Older adults appraise more certainty relative to younger adults	Increases in positive emotions and a decrease in anxiety, fear, and other negative emotions
	Discrepancy	Does this event align with my understanding/what I expected?	Older adults appraise new information as less discrepant to their prior beliefs than younger adults	Older adults' emotions are more likely to be stable in response to new information
	Goal Conduciveness	Does this event help/hinder my goals?	Given that older and younger adults' goals are fundamentally different (see goal relevance above) they will appraise different things as conducive to their goals	Older and younger adults' emotions will diverge when their goals differ in relation to a situation
	Urgency	Do I need to respond to the event immediately or not?	Older adults appraise less urgency than younger adults	The evaluation of urgency may be less impactful on the emotions of older adults
Coping Potential	Control	Can I/someone else/no one control the outcomes of the event?	Older adults perceive that they have a greater ability to influence situational control relative to younger adults	Older adults' greater appraisal of self-control may relate to higher levels of positive affect
	Power	If in control, how much ability do I have to control?	When older adults perceive themselves to be in control, they appraise greater ability to control outcomes	Older adults who have greater power over a situation tend to have more positive emotions and less anger
	Adjustment	If not in control, can I cope with the consequences?	When older adults perceive that they are not in control, they appraise greater ability to adapt to negative situations	Older adults who believe they can control their emotions are more likely to experience lower levels of distress and greater well-being
Norm Compatibility	Personal Standards	Is the event congruent with my values, morals, and beliefs?	Motivational relevance is important for the flexibility of older adults' moral judgments	Older adults rigidly appraise violation of standards and respond negatively to violations. However, motivationally relevant situations lead to greater flexibility in older adults' appraisal of standards leading to greater possibilities of less negative/more positive emotions.
	Societal Standards	Does the event violate societal norms, morals, and laws?	Older adults show higher levels of judgment of a perpetrator's poor moral character when they intended to cause harm relative to when a consequence occurred accidentally	Older adults should report less anger and increased levels of positive emotions insofar as they benignly appraise fault in a situation caused by accident. However, when harm is appraised as intentional, older adults experience greater disgust and anger.

emotional experience as the emotional components fluctuate. Importantly, the appraisal process can occur via an associative route and a rule-based route (Clore & Ortony, 2000; Kappas, 2006; Moors, 2010; Moors et al., 2013). The associative route of appraisal consists of learned associations between stimuli in the environment and appraisals (Moors, 2010). The rule-based appraisal route consists of appraisals that use conceptual knowledge in step-by-step online evaluations (Clore & Ortony, 2000; Moors et al., 2013). In most cases, though, the appraisal process is thought to occur automatically in a fast and efficient manner (Clore & Ortony, 2000; Kappas, 2006; Moors, 2010; Moors et al., 2013; Scherer, 2009, 2013). Dovetailing with the CPM, Smith and Lane (2015) propose an appraisal hierarchy from a neuroscience perspective. Smith and Lane (2015) suggest that there are faster (beginning around 100 ms) and slower (occurring closer to 1 s) appraisals. Evidence indicates that faster appraisal mechanisms include appraisals such as novelty (100 ms; Blackford, Buckholtz, Avery, & Zald, 2010; Brown & Bashir, 2002; Schwartz et al., 2003) and goal relevance (140 ms; Brosch, Coppin, Scherer, Schwartz, & Sander, 2011; LaBar et al., 2001; Sander, Grafman, & Zalla, 2003). Slower mechanisms include appraisals such as goal congruence (340–380 ms; Van Veen & Carter, 2002) and causal attribution (450 ms; McCleery, Surtees, Graham, Richards, & Apperly, 2011). Future research will need to continue to explore the time course by which appraisal dimensions can be processed, which is especially important considering age-related cognitive declines and improvements as well as motivational shifts.

Although the appraisal process is thought to occur quickly, in some cases certain appraisals may require greater cognitive resources. According to CPM, the different evaluations of information that evoke an emotional experience – *appraisal dimensions* – are organized into four distinct appraisal categories (*Relevance*, *Implication*¸ *Coping potential*, and *Normative significance*, see Table 1; Scherer, 2009, 2013). The organization of these appraisal categories is based upon: (1) the information that is necessary and sufficient to inform subsequent appraisals, and (2) the complexity of the evaluations which may require additional processing and time (Scherer, 2013). As such, the CPM posits that the appraisal dimensions included in the relevance category are quickly processed (due to less complexity) and are the most fundamental in facilitating the processing of subsequent appraisal categories (due to these appraisals informing the other three categories). In contrast, the normative significance appraisal category is the most complex and relatedly the last set of appraisals to occur, if at all. This organization of appraisal dimensions is one of several appraisal theory models that could be used to conceptualize the appraisal process. Here, the appraisal categories are organized as to when in the appraisal process each appraisal occurs. The categories presented here could be reconceptualized, but the dimensions are in order from the earliest to the latest appraisal dimension according to the CPM and empirical evidence (see the above paragraph). Using this model of the appraisal process, it is possible to identify critical points of investigation for aging and emotion research to further develop our understanding of the proximal level determinants of age differences in emotion. Table 1 provides a summary of the appraisals included in the CPM and our age-related testable predictions. The table begins with the initial and least complex appraisals in the emotion process (Relevance) and ends with the most complex appraisals (Personal and Societal Standards).

The influence of age on the appraisal process

Building from the primary tenets of AAAE, we contend that age-related changes in cognition, motivation, and physical ability lead to developmental changes in appraisal processes as one grows older, as depicted in the top of Fig. 1. Regarding cognitive change, we posit that cognitive declines can lead to a number of changes in the appraisal system such as reduced sensitivity to appraisal-related information, a slower appraisal process, and greater reliance on prior knowledge and less deliberative processing during appraisal of

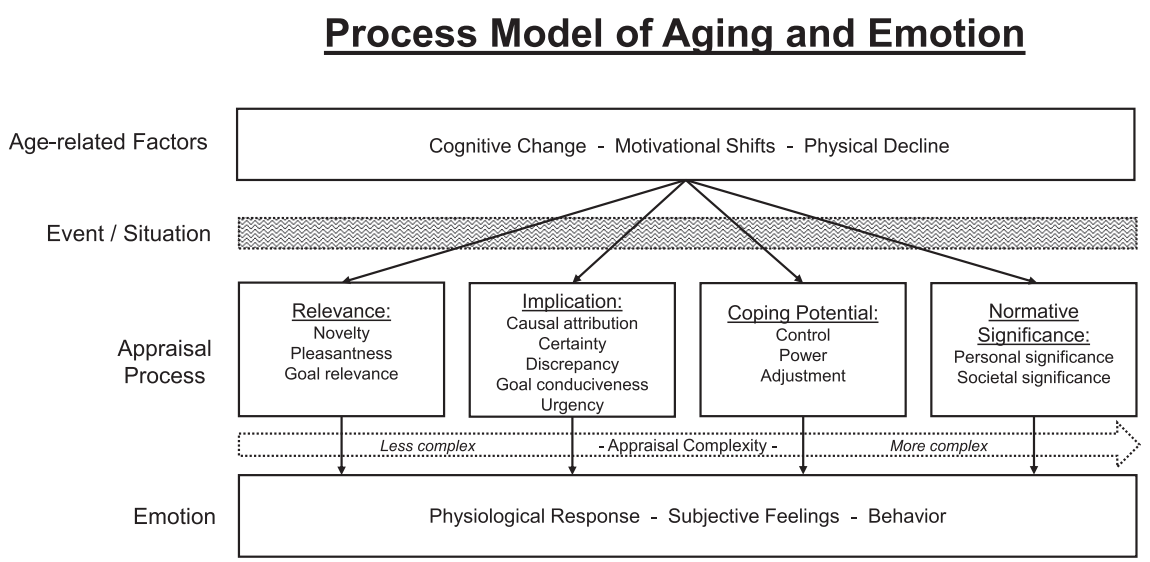

Fig. 1. The appraisal approach to aging and emotion's process model that integrates aging, appraisal, and emotion. Age-related changes in cognition and physical ability and shifts in motivation lead to fundamental changes in the appraisal process for older versus younger adults. Subsequently, age differences in appraisal emerge, and in the end, younger and older adults tend to have different emotional experiences.

events. Though some age-related cognitive changes have a negative impact on older adults, it is important to note that aging also leads to improvements such as better competence in domains such as decisions involving sunk costs (Bruine de Bruin, Strough, & Parker, 2014). In terms of motivation, the aging literature emphasizes that older and younger adults' motivations differ for a number of different reasons (reviewed below). As such, we contend that the appraisal processes of older and younger adults fundamentally change in terms of what is emotionally relevant across the adult life span. Additionally, physical declines in old age lead to age differences in the capacity to interact with the environment. Thus, we hypothesize that these physical changes alter the way in which older and younger adults evaluate the environment in relation to its implications and their ability to control events. Acknowledging that all of these influences impact the appraisal process, we contend generally that age-related changes in cognition, motivation, and physical ability lead to age differences in the appraisal system, which subsequently leads to different emotions. In the following sections, we outline how aging impacts the processing of the appraisal dimensions proposed by the CPM and how those changes may impact younger versus older adults' emotional experience.

Relevance. According to appraisal theories broadly, the relevance of a new situation to an individual is a central criterion to the generation of emotion (Moors et al., 2013; Scherer, 2013). In the context of the CPM, the relevance category of appraisal includes evaluations that determine if an event's immediate characteristics indicate that the individual should devote additional attentional resources and processing due to its potential impact on the individual (Scherer, 2013). The appraisal dimensions that are generally considered to determine relevance are *novelty*, *valence*, and *goal relevance*. Upon a potentially significant encounter, evaluations of these dimensions provide the initial information that leads to further emotional elaboration via the subsequent appraisal categories (Scherer, 2009, 2013). Importantly, these appraisal dimensions are integral to attentional processes that orient the individual. Evidence indicates that *novel* events are more likely to garner sustained attention than familiar or expected events (Daffner et al., 2006), *negative* stimuli capture attention to a greater extent than positive stimuli (Vaish, Grossman, & Woodward, 2008), and stimuli with *greater relevance* to an individual's goals receive greater attention than irrelevant stimuli (Bayer, Ruthmann, & Schacht, 2017). Taken together, events with greater novelty, negativity, and personal relevance tend to lead to greater sustained processing. However, as people age, cognitive and motivational changes occur leading to shifts in the way novelty, valence, and personal relevance are evaluated. Extensive theoretical and empirical work in the psychology of aging strongly suggests that each of these appraisal dimensions change substantially with advancing age.

Novelty. Regarding the appraisal dimension of novelty, research indicates that older adults become less sensitive and are slower to respond to novel stimuli, reflecting slower stimulus evaluation (Fabiani & Friedman, 1995; Friedman, Kazmerski, & Cycowicz, 1998; Polich, 1996; Walhovd & Fjell, 2001). Relatedly, mild cognitive impairment is associated with reductions in sensitivity to novelty (Daffner et al., 2001). As such, due to cognitive decline, older adults may appraise less novelty and/or be slower to determine the appraisal of novelty relative to younger adults. Age-related declines in cognitive ability such as processing speed and working memory (Craik & Salthouse, 2011) may underlie shifts in the appraisal of novelty. According to dynamic integration theory, declines in cognitive ability result in a decreased ability to process emotional complexity and subsequently increased positivity in later life (Labouvie-Vief, 2003; Labouvie-Vief, Grühn, & Studer, 2010). As such, reduced novelty processing in older adulthood may underlie age-related decreases in negative emotion and increases in positive emotion. In other words, insofar as older adults are slower at detecting novelty, they may appraise less novelty, ultimately leading to less negative and more positive emotion. However, it is possible that reductions in the appraisal of novelty may also lead to reductions in specific high arousal positive affective states normally associated with novelty such as excitement, curiosity, and exhilaration. Insofar as older adults appraise less novelty, research indicates that older adults tend to experience lower arousal positive emotions than higher arousal emotions (Scheibe, English, Tsai, & Carstensen, 2013). In addition, it is possible that age differences in novelty are due to older adults' wealth of life experience, relative to younger adults, and that increases in life experience reduce what is novel to older individuals. As such, increases in crystallized intelligence (e.g., world knowledge, vocabulary, etc.; Craik & Salthouse, 2011) may also explain reductions in the processing and impact of novelty in later life. Thoroughly documenting these linkages represents one rich area for future research.

Valence. In addition to novelty, there are established age differences in the processing of valence (positive vs. negative). For instance, the highly established and documented preference for negative information in youth shifts toward a preference for positive information in older adulthood. Specifically, the greater impact of negativity on attention and memory (i.e., *the negativity bias*; see e.g., Baumeister, Bratslaavsky, Finkenauer, & Vohs, 2001; Vaish et al., 2008) shifts in later life, and positive information becomes more preferred, better captures attention, and is remembered better (i.e., *the positivity effect*; Carstensen & Mikels, 2005; Reed, Chan, & Mikels, 2014). Although the positivity effect is sometimes thought to reflect the regulation of negative emotion resulting in greater positivity in emotional experience (Isaacowitz & Blanchard-Fields, 2012), the positivity effect also has been conceptualized as the product of automatic goal-directed cognitive processing rather than a deliberative strategy (Mather & Carstensen, 2005). According to this perspective derived from socioemotional selectivity theory (Carstensen, 2006), due to inherent age differences in the perception of future time horizon, older adults are motivated to cultivate and maintain well-being in the present moment to a greater extent than younger adults. Extensive research findings strongly support this motivational explanation for the positivity effect (see e.g., Reed et al., 2014). Given that motivational factors influence the attention of older adults to positive elements of a situation, it follows that the ways in which older adults appraise relative to younger adults also shift toward the positive. Indeed, research has shown that older adults interpret ambiguous situations and emotional expressions with less negativity and greater positivity than do younger adults (Mikels & Shuster, 2016; Shuster, Mikels, & Camras, 2017). As such, age differences in emotion, such as fewer negative emotional experiences

and/or more frequent positive emotional experiences, are potentially due to motivated shifts in cognition that affect the appraisal process in its early stages. Additional research directly examining age differences in valence appraisals and their relationship to emotion regulation and motivation would provide a deeper understanding of adult life-span differences for this appraisal dimension.

Goal Appraisals. Goal relevance and goal conduciveness[1] change across adulthood; as mentioned above, the goals of younger and older adults differ (Carstensen, 2006) and therefore according to AAAE, what is relevant and conducive to those goals will also differ. According to socioemotional selectivity theory, goals shift from knowledge and resource acquisition in the service of preparing for an uncertain future in younger adulthood to maintaining and maximizing present-oriented social and emotional well-being in older adulthood (Carstensen, 1992; Fung, Carstensen, & Lang, 2001; Yeung, Fung, & Lang, 2008). Theories in the psychology of aging account for these motivational shifts by positing that changes in goals from younger to older adulthood are the result of: (1) regulation, such that older adults adapt to losses in physical and cognitive domains (Baltes & Baltes, 1990; Heckhausen et al., 2010), and (2) goal prioritization, such that socioemotional goals take precedence in later life (Carstensen, 2006). Given that the goals of younger and older adults differ for multiple reasons, it follows that older and younger adults will appraise goal relevance and conduciveness differently due to fundamental differences in their goals. In other words, if goals are different, what is relevant and conducive to those goals will be different. Research directly examining age differences in goal-related appraisal dimensions and their relationship to emotional experiences is warranted.

Implication. The CPM posits that the implications and consequences of an event for an individual can be determined once the relevance of an event is appraised (Scherer, 2009, 2013). The appraisal dimensions of *causal attribution*, *certainty*, *discrepancy*, *goal conduciveness* (discussed above), and *urgency* are included in the implication category. These appraisal dimensions determine what has happened and what may happen as a result of a relevant event. As such, these appraisals are more complex and increasingly lead to divergences in emotional experience. For example, an internal causal attribution (i.e., self-blame) can lead to shame, guilt, or pride (Tracy & Robins, 2006, 2007), whereas an external causal attribution (i.e., other-blame) leads to anger and contempt as well as gratitude (Ellsworth & Smith, 1988a). In addition, low certainty is related to fear and hope, whereas high certainty is related to anger (Ellsworth & Smith, 1988b; Smith & Ellsworth, 1985). Age-related changes in cognition and motivation likely play a role in differentiating younger and older adults' appraisals of implication and subsequently lead to divergent emotional experiences. For the category of implication appraisals, extensive theoretical and empirical work in the psychology of aging here too indicates that each of these appraisal dimensions change significantly in later life.

Causal Attribution. Regarding age-related changes in causal attribution, older individuals differentially attribute valenced and situational antecedents to outcomes relative to their younger counterparts. For example, when older adults perceive a person to have negative personal characteristics, they are more likely to blame that person for negative situations compared to younger adults (Blanchard-Fields, 1994). To explain such findings, a social-cognitive perspective suggests that declines in cognitive ability in turn lead older adults to use heuristics that rely on readily available information to base their judgments (Blanchard-Fields, 1999; Jacoby, 1999). However, this explanation does not account for situations that may be more *motivationally relevant* for older adults. Specifically, when in a relationship with another person, older adults are more likely to blame situational factors for a negative situation with that person rather than personal characteristics relative to younger adults (Blanchard-Fields, 1994). In addition, when negative interpersonal situations are perceived to be possibly resolved amicably, older relative to younger adults are more likely to attempt to salvage the relationship than focus on personal concerns (Blanchard-Fields & Beatty, 2005). Thus, these findings indicate that older adults are generally more likely to assign blame to others due to perceived negative personal characteristics. However, they are less likely to blame social partners with whom they have a relationship.

This pattern in causal attribution is consistent with theories of emotion and aging that suggest older adults prioritize socioemotional well-being (see Carstensen, 2006). Consistent with the above findings, evidence indicates that older adults have better relationships than younger adults (Birditt & Fingerman, 2003; Birditt, Fingerman, & Almeida, 2005; Charles & Carstensen, 2008; Fingerman, Hay, & Birditt, 2004; Luong & Charles, 2014). According to AAAE, older adults' decreased appraisals of blame to relationship partners underlies older adults' disproportionate avoidance of conflict with others and their expression of greater positivity when there is conflict relative to younger adults (Charles, Piazza, Luong, & Almeida, 2009; Folkman, Lazarus, Pimley, & Novacek, 1987; Levenson, Carstensen, & Gottman, 1994). These age-related social and emotional improvements in social situations may be related to age-related changes in the assignment of blame. Specifically, older adults' reduced appraisal of blame to others may account for relationship-related decreases in stress and anger and increases in positive interpersonal affect. Research directly linking age differences in causal attributions to improved interpersonal well-being represents a broadly integrative and rich area for future research.

Certainty. Certainty is another appraisal dimension in the implication category that likely changes across adulthood. Extant relevant research is mostly in the context of risky decision making, such that older adults are more likely to avoid uncertain risks when an alternate sure gain is available (Mikels & Reed, 2009; Weller, Levin, & Denburg, 2011; *cf.*, O'Brien & Hess, 2020). Relatedly, Mather et al. (2012) found that when presented with a certain choice and an uncertain gamble choice, older adults were more influenced by choices with higher certainty than were younger adults. Specifically, older, compared to younger, adults were more likely to choose sure gains and were more likely to avoid sure losses relative to risky gambles. Taken together, these findings suggest that older adults' preferences are more sensitive to certain choices than are younger adults' preferences. These findings could be explained by fuzzy-trace theory and/or construal level theory, which posit that gist mental representations better cue people's core values (see Fujita

[1] Although goal conduciveness is from the implication appraisal category, we discuss it here due to its intrinsic relatedness to goal relevance and the same hypothesized motivational changes that influence both.

& Han, 2009; Reyna, 2020). Older adults' mental representations may connect better to their values in decisions involving certainty relative to younger adults. In other words, when older adults use gist representations to make choices involving certainty, they may more greatly value positive gains and devalue negative losses compared to younger adults. In addition, research indicates that an increased influence of certainty in older adulthood is related to greater positive emotions compared to younger adults (Mather et al., 2012). Moreover, some research indicates that younger adults' emotions are more sensitive to uncertainty compared to older adults. Specifically, evidence indicates that younger adults report an uncertain future as more negative relative to older adults (Steinman, Smyth, Bucks, MacLeod, & Teachman, 2013). Given that uncertainty about a potential future negative event is a defining element of anxiety (see Grupe & Nitschke, 2013), these findings may at least partially explain why younger adults experience greater levels of anxiety compared to older adults (Kessler et al., 2005; Piazza & Charles, 2006). Taken together, it follows then that age-related divergence in the appraisal of situational certainty/uncertainty may underlie increases in positive and negative emotional experiences for older relative to younger adults, respectively, though future research is needed to establish these connections.

The increased weight toward certainty in older adulthood may be due to age-related declines in cognition as well as shifts in motivation. For instance, research indicates that age differences in risk preferences for sure gains and risk avoidance of sure losses are the result of age-related declines in cognitive ability such as a decreased ability to compute and understand probability (Chen, Wang, Kirk, Pethtel, & Kiefner, 2014). In addition, O'Brien and Hess (2020) found that controlling for cognitive ability reduced age differences in risk preferences for gain domains, but not loss domains. As such, age-related cognitive decline may change the appraisal of certainty in positive, but not negative, contexts (in appraisal terms, an interaction of certainty with valence). Another possibility is that age-related shifts in motivation alter the perceptions of older adults such that they are more motivated by situations with certain outcomes. For example, socioemotional selectivity theory posits that the goals of younger adults focus on the future – to deal with *uncertain* future challenges. In contrast, the goals of older adults focus on the present moment – to maintain *certain* socially and emotionally meaningful relationships. As such, older adults prioritize goals in domains that are more certain relative to younger adults. Consequently, a postulate of AAAE is that older adults appraise certainty to a greater extent than younger adults. Overall, age-related changes in cognition and motivation may influence age-related shifts in the weight of certainty and subsequently may lead to age differences in emotion such as an increase in positive emotions and a decrease in anxiety, fear, and other negative emotions. Although some research suggests that older adults are motivated to avoid losses in general (Depping & Freund, 2011), older adults may instead be motivated to avoid certain losses for socioemotional reasons. Future research is needed to examine how age-related motivational changes may relate to the appraisal of certainty, as well as how appraisals of certainty may underlie age differences in decision making.

Discrepancy. Age differences exist in the influence of discrepant information on a person's knowledge of a situation. For example, research indicates that compared to younger adults, older adults are less likely to recall situational information that is discrepant from their existing knowledge (Hess & Tate, 1991). Such findings suggest that younger adults process discrepant information to a greater extent than do older adults. One possible explanation is that older adults do not have the cognitive processing resources to fully evaluate discrepant information and instead rely on their prior knowledge. As such, it follows that older adults increasingly rely on previously acquired knowledge (i.e., crystallized intelligence), which shows maintained or increased levels relative to younger adults (Craik & Salthouse, 2011). Another possibility is that motivational shifts lead to differential goal-directed processing for older versus younger adults, subsequently altering how discrepant information is processed. Supporting this hypothesis, evidence indicates that when older adults have a positive impression of another person (compared to a negative impression), they have a more difficult time integrating new inconsistent negative (compared to positive) information relative to younger adults (Ybarra & Park, 2002). In other words, relative to younger adults, older adults have a more difficult time updating positive impressions with inconsistent negative information. This finding indicates that new inconsistent negative information is particularly difficult for older adults to integrate into existing knowledge representations, but inconsistent positive information is not. In other words, older adults' preference for positive information, relative to younger adults, also manifests itself when information is discrepant from their prior knowledge.

Although there appears to be age differences in response to discrepant information, there is little work investigating how this relates to the emotional experiences of younger and older adults. Future work needs to examine if older adults' deficits in processing inconsistent negative information relates to age differences in negative emotional reactions. It is possible that when an older adult has a positive impression of another person, new negative information will be less likely to cause a negative emotional reaction partly because older adults do not process new negative discrepant information to the same extent as younger adults. This hypothesis implies that age-related improvements in socioemotional well-being may in part be due to older adults' lesser appraisal of discrepancy compared to their younger counterparts.

Urgency. The appraised need to respond to an event quickly (or not) – urgency – is another appraisal that helps determine a situation's implications. From our view, there is little work that directly suggests there are documented age differences in this type of evaluation. However, related research implies that older adults decide and behave less impulsively than younger adults. Specifically, when deciding between smaller-sooner rewards and later-larger rewards, older adults choose later-larger rewards more than younger adults (i.e., less delay discounting; Bixter & Rogers, 2019; Löckenhoff, O'Donoghue, & Dunning, 2011). This suggests that older adults are less impulsive and behave with less urgency than younger adults. As such, it follows that older adults may tend to appraise less urgency than younger adults.

Research attempting to explain these findings suggests that cognitive decline in old age predicts increases in delay discounting, but these studies did not include younger adults (James, Boyle, Yu, Han, & Bennett, 2015; Thoma, Maercker, & Forstmeier, 2016). In contrast, Löckenhoff et al. (2011) found that affective reactions mediated age differences in delay discounting, but cognitive factors did not. This study found that increases in the delay of rewards do not impact older adults' emotions or their delay of future rewards, but it did for younger adults. As such, younger adults' delay discounting and emotions reflected greater urgency such that they felt more positively about sooner rewards and more negatively about later rewards. In other words, how urgently rewards were received

mattered for younger but not older adults. Thus, the appraisal of urgency may be less important for older adults' emotions compared to younger adults. Another alternative explanation for increased delay of rewards in older adulthood is an increase in crystallized intelligence relative to younger adulthood. Yi, Baldassi, Johnson, & Weber (2013) found that increases in older adults' crystallized intelligence offset the impact of cognitive decline (e.g., declines in speed of processing and working memory) and led to greater patience when choosing delayed rewards compared to younger adults. In sum, it appears that dynamic cognitive changes impact the evaluation of urgency, and the evaluation of urgency may be less impactful on the emotions of older adults. However, future work will need to be conducted to more closely tie how appraisals of urgency relate to the emotions of younger and older adults.

Coping Potential. After the implications of an event are determined, sometimes one appraises their ability to control and cope with the consequences of the event (Scherer, 2009, 2013). The appraisal dimensions of *control*, *power*, and *adjustment* are included in the coping potential category. These appraisal dimensions determine if the individual can influence the outcome of an event. The appraisal of control determines the extent to which the individual, someone else, or something else can influence the event and/or its consequences. If the individual can control the event, the appraisal of power determines how much the event is able to be influenced by the individual's potential efforts. If the individual cannot sufficiently control the event, the appraisal of adjustment determines if the individual can regulate their behavior, emotions, or motives to adapt to the event if there are negative implications for the individual. Evidence indicates that these appraisals relate to and further differentiate emotional experience (Smith & Ellsworth, 1985). Regarding *control*, appraising a loss of control relates to lower positive affect and increases in depressive affect, whereas higher control beliefs relate to greater emotional well-being (Kaufmann, Goetz, Lipnevich, & Pekrun, 2019; Kunzmann, Little, & Smith, 2000, Price, Choi, & Vinokur, 2002; Rodin, 2014). Relatedly, individuals who have greater *power* over a situation tend to have more positive emotions, less anger, and are more likely to express their opinions relative to individuals with lower power (Berdahl & Martorana, 2006). In terms of *adjustment*, evidence indicates that when people believe they can control their emotions, they are more likely to experience lower levels of distress and greater well-being (De Castella et al., 2013; Ford & Gross, 2019; Ford, Lwi, Gentzler, Hankin, & Mauss, 2018). Overall, these findings suggest that these appraisals greatly contribute to emotional experience. Importantly, though, age-related changes in cognitive and physical ability differentiate these appraisals for older and younger adults. There is less extant theoretical and empirical work that directly links these appraisal dimensions to emotional experience across the adult life span, thus representing a bountiful area for future research.

Control, power, and adjustment are a highly interdependent group of appraisals that we posit change in dynamic and consistent ways across the life span. On the one hand, older adults' actual ability to physically control their environment decreases relative to younger and middle adulthood (i.e., *power*; *primary control*), but on the other hand, older adults become more adept at controlling their response to an environment that they may be unable to directly influence (i.e., *adjustment*; *secondary control*; see Heckhausen et al., 2010). What is less known is how these two facets of control manifest in the appraisal of personal control of the environment and how this relates to the emotional experiences of older and younger adults. Due to cognitive and physical declines that lead to a reduced ability to exert direct control over situations for older versus younger adults, do older adults appraise less personal control? Or due to a greater ability to adjust to situational demands, do older adults appraise greater personal control than their younger counterparts?

Research investigating perceptions of control across the life span indicates that perceived control increases until age 40, then

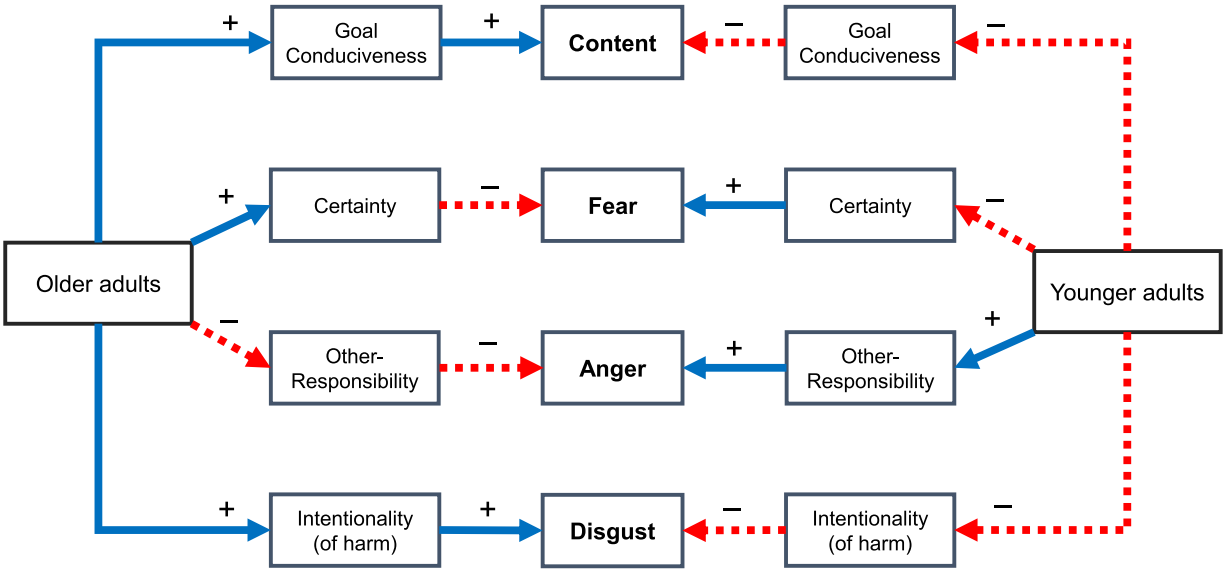

Fig. 2. An illustration of age differences in appraisal variables and the associated emotional implications. Dashed arrows with a minus sign indicate a decreased level relative to the other age group (e.g., we hypothesize that older adults generally appraise less other-responsibility relative to younger adults, with subsequent reductions in anger). Solid arrows with a plus sign indicate an increased level relative to the other age group (e.g., we hypothesize that older adults generally appraise more goal conduciveness relative to younger adults, with subsequent increases in contentment).

declines to age 60, then increases again in older adults age 65+ (Specht, Egloff, & Schukle, 2013). This suggests that appraised control does not decline in older adults, and in fact, it increases into older old age. Importantly, nascent work directly exploring AAAE in the context of control appraisals has shed light on this appraisal dimension. When appraising control of ambiguous situations, compared to younger adults, older adults appraise more self-control (Young & Mikels, 2019). In other words, older adults perceive that they have a greater ability to influence a situation than younger adults. Moreover, older adults' greater appraisal of self-control was related to higher levels of positive emotional reactivity to the ambiguous situations relative to younger adults. Overall, these findings suggest that older adults' appraisals of control are greater than those of younger adults in at least some situations and relate to more positive emotional reactivity in old age. Although some work has considered how the balance of a person's actual power over the environment and adjustment to it change into older adulthood (see Heckhausen et al., 2010), future research is needed to examine how situational appraisals of control, power, and adjustment each dynamically contribute to changes in appraisal and emotion across the adult life span.

Norm compatibility. According the CPM, the final and most complex appraisals are those that evaluate an event in relation to how compatible it is with a person's self-concept and values, as well as societal norms and moral standards, which has been termed – *norm compatibility* (Scherer, 2013). These appraisals determine the extent to which the consequences of an event, given the individual's control and power in situation, violate *personal standards* (an individual's values, morals, and beliefs) and/or *societal standards* (the society's held values, morals, and beliefs). Research indicates that expressions of virtuous character (or lack thereof) can lead to a variety of emotions (for review see Hutcherson & Gross, 2011; Tangney, Stuewig, & Mashek, 2007). For instance, greater appraised moral violation has been linked to increases in emotions such as anger and guilt (Tong et al., 2007), and knowledge that a perpetrator has the desire to cause harm to another person has been linked to greater experiences of disgust (Giner-Sorolla & Chapman, 2017). Yet, how aging impacts values and morals, and subsequently appraisals and emotional experience, remains an understudied area of emotion and aging.

In terms of appraisals of *personal* and *societal standards*, extant evidence indicates that compared to younger adults, older adults' moral judgments are more deontological (i.e., the view that an action itself can be right or wrong, while its consequences and outcomes do not matter; McNair, Okan, Hadjichristidis, & Bruine de Bruin, 2018). One possible explanation for this finding is that age-related declines in cognitive ability lead to a greater rigidity and/or less elaborative processing in moral judgment. However, other research indicates that older adults more flexibly apply their moral standards across situations (Ramsey, Marshall, Johnston, & Deeter-Schmelz, 2007). As such, rather than rigidly applying the same standards, flexibility in the application of values and moral principles opens the possibility for motivational influences. Specifically, age-related shifts in goals toward maintaining socioemotional harmony in older adulthood may explain age differences in these appraisals. For instance, recent work indicates that when *accidental* harm occurs to an innocent person, older adults judge the perpetrator's accident as reflecting less poor moral character than younger adults (Minton, Snyder, Young, Graupmann, & Mikels, 2021). On one hand, this indicates that, compared to younger adults, older adults are less likely to appraise accidental harms as a violation of personal values and societal standards. On the other hand, when a perpetrator *intends* to cause harm to a person, older adults show higher levels of judgement of the perpetrator's poor moral character than do younger adults (Minton, Snyder, Young, Graupmann, & Mikels, 2021). Taken together, these findings suggest that although accidental harm is judged more benignly in older adulthood, an intention to cause harm is judged more harshly in older adulthood.

Given that older adults prioritize socioemotional harmony to a greater extent than younger adults according to socioemotional selectivity theory (Carstensen, 2006), such prioritized social values may result in older adults being more forgiving of accidents but also more punishing of those that violate sociomoral standards. As derived from AAAE, older adults' norm compatibility appraisals may lead them toward better relationships but also a greater desire to remove possibly harmful others from their social circles. Moreover, although some work suggests that outcomes do not matter for older adults' moral judgments (e.g., McNair et al., 2018), it is possible that motivational relevance is important for the observed flexibility older adults' moral judgments. When a situation is relevant to an older adult's socioemotional goals, flexibility may be observed, but when a situation is not relevant, older adults may show a deontological pattern of judgment. Future research will have to investigate how changes in cognition and motivation across the life span contribute to age differences in these appraisals, and how they relate to the emotions of older and younger adults. Insofar as older adults more benignly appraise fault in situations caused by an accident, older adults should report less anger and increased levels of positive emotions compared to younger adults. However, under conditions in which older adults appraise situations caused by intentional harm more harshly, older adults should report more anger and disgust toward the perpetrator.

The importance of an appraisal approach to aging and emotion

Most of the literature to date has examined how age-related factors (e.g., motivational shifts) influence the emotions of older relative to younger adults – or has examined how appraisal processes relate to emotion universally. However, rarely have these two research enterprises met, but both sets of literature can inform the other. As the above integrative review of hypothesized age differences in numerous appraisal dimensions illuminates, age-related *cognitive and physical decline* may fundamentally change the appraisal system of older adults. In addition, age-related *motivational shifts* may lead to changes in how younger and older adults appraise the same situation. Ultimately, these age differences in appraisal processes then may be what underlies age differences in emotion. This is the appraisal approach to aging and emotion: AAAE integrates insights from aging and emotion with appraisal theories of emotion to propose a process model of aging and emotion that can lead to new insights and developments for emotion theory broadly. This approach builds upon appraisal theories by suggesting that age-related changes (i.e., declines in deliberative cognitive processes and physical ability, improvements in crystallized intelligence, shifts in motivation) lead to changes in older adults' appraisal system and the way older adults appraise relative to younger adults. As reviewed above, related evidence suggests that older adults

may be less sensitive to and slower to respond to information central to some appraisals proposed by the CPM (e.g., novelty, valence, discrepancy), which are generally less complex appraisals. In other words, the lens that older adults use to interpret the world around them is fundamentally different from younger adults. As such, certain aspects of the appraisal system are different for older relative to younger adults. Other evidence indicates that older adults deploy appraisals differently than younger adults due in large part to motivational differences (e.g., coping potential, norm compatibility), which in turn suggests that *how* older adults regularly appraise a situation is different from younger adults. In addition, there are other directions for future work on aging, appraisal, and emotion such as mental representation and life experience. These insights build upon and extend appraisal theory in suggesting that the *process* of emotion changes across the life span.

Implications of Age-Related appraisal differences for discrete emotions

Although AAAE focuses on the appraisal process in a direct and specific way, our theoretical framework has broad applicability to other theoretical approaches to the emotion process, such as a discrete emotion approach. Many discrete emotions have been examined in association with specific patterns of appraisal (Ellsworth & Smith, 1988b; Smith & Ellsworth, 1985; Smith, Tong, & Ellsworth, 2014). Given age-related divergence in various appraisal dimensions, there should be an age-related association between appraisal patterns and the experience of specific discrete emotions. As described above, goals and relatedly the management of social partners change with age (for review see Baltes & Baltes, 1990; Carstensen, 2006; Charles, 2010). These changes may manifest themselves in the underlying appraisals that are associated with specific emotions. For example, age differences in the appraisals of goal conduciveness, certainty, and causal attribution (assignment of blame: "who is at fault?"; determination of intentionality: "did the perpetrator intend to cause harm?") can all lead to a greater or lesser frequency of certain emotions for older versus younger adults. To illustrate future directions in a discrete emotion approach, we provide a brief overview of how age differences in goal conduciveness, certainty, and causal attribution can lead to age differences in the specific emotions of contentment, fear, and anger, and disgust (see Fig. 2).

Contentment. Compared to younger adulthood, older adulthood is associated with increased experience of low arousal positive emotional states such as contentment (Scheibe et al., 2013). Contentment involves the perception that the present situation is aligned with and meeting the goals of the individual (Smith et al., 2014). One reason why older adults may experience contentment to a greater degree is due to their appraisal of goal conduciveness. As socioemotional selectivity theory posits, younger adults' goals focus on acquiring new resources to meet future demands, whereas older adults focus on meeting their present focused socioemotional goals (Carstensen, 2006). This shift in goals may lead to an increase in the experience of contentment for older adults via the appraisal of goal conduciveness. Thus, it would be a reasonable hypothesis that older adults tend to experience more contentment in daily life than do younger adults because they perceive situations as more goal conducive than younger adults in general, though future research is needed to bear that out.

Fear. Research suggests that younger adults tend to be more anxious than older adults (Kessler et al., 2005; Piazza & Charles, 2006). Fear is elicited by uncertainty toward future events (Lerner, Li, Valdesolo, & Kassam, 2015). Given that younger adults' goals tend to be focused on acquiring resources to combat an uncertain future, and that older adults tend to focus on their relatively more certain present state and goals, this difference in certainty may manifest in the experience of fear via the appraisal of certain/uncertain information. Some evidence supports this difference in certainty versus uncertainty in older and younger adults. As discussed above, older adults tend to weigh certainty in decision contexts over uncertain information relative to younger adults (Mather et al., 2012). Alternatively, older adults' mental representations may be more related to their values relative to younger adults. These potential age differences in how certainty is processed and/or represented may underlie age differences in the experience of fear. As such, it is hypothesized according to AAAE that relative to younger adults, older adults should experience relatively less fear, and this age difference in fear should be able to be at least partially explained by age differences in the evaluation of certainty/uncertainty of situations that may induce fear, though support for this prediction requires future research.

Anger & Disgust. Research has demonstrated that age differences exist in the emotional experience of anger, but not for disgust. Specifically, older adults tend to experience less anger than younger adults (Kunzmann, Rohr, Wieck, Kappes, & Wrosch, 2017). Anger is elicited by the perception of goals being obstructed by other people (Kunzman et al., 2017; Lerner et al., 2015). In other words, anger is partially a function of assigning blame to others and determining their intentions for their actions. Given that older adults tend to prioritize socioemotional harmony, appraisals of responsibility and intentionality may underlie older adults' emotions and behaviors in relation to social conflicts. This may be the reason that older adults avoid social conflict, and when they do engage in a conflict, they express more positivity toward their social partners compared to younger adults (Charles et al., 2009; Folkman et al., 1987; Levenson et al., 1994; Luong & Charles, 2014). For example, in situations in which another person caused harm and obstructed goals, younger adults' appraisal of responsibility of others could be greater than older adults. However, older adults' appraisal of intentionality of harm may be greater than younger adults, leading to an alternative pattern of emotional experience. Thus, responsibility and intentionality could interact to determine exactly what emotion is experienced. Evidence suggests that when there is no intentionality for harm, but a harmful consequence occurred, younger adults report more anger compared to disgust. Alternatively, when there is intentionality for harm, but no harmful consequence occurred, younger adults report more disgust compared to anger (Giner-Sorolla & Chapman, 2017).

In the context of aging, younger adults may focus more on who is responsible, allowing them to identify problems and take direct action against the problem whereas older adults may focus more on the intentions of others because they prioritize harmony between people. This appraisal difference would allow older adults to prune their social network of people with bad moral character based on appraisals of intentionality. As such, it is hypothesized that compared to older adults, younger adults may appraise an offending person as warranting more blame, even if there was no desire to cause harm, ultimately leading to a greater anger experience. Moreover,

because older adults are more concerned about socially and emotionally meaningful others, they may experience more moral disgust than younger adults. Future research should explore how these appraisals lead to differences in anger and disgust in older adults, as limited research has considered elicitors of moral emotions and their underlying appraisals in older adulthood.

Future directions for investigating aging, appraisal, and emotion

In addition to the open research areas directly related to AAAE as described above, there are several other broad future directions for research investigating age differences in appraisal processes. In light of AAAE, we see at least two broad directions to further our understanding of the role of appraisals in age differences in emotion: (1) determine which appraisal dimensions (and interactions between appraisal dimensions) are most important to accounting for age differences in emotional experience; (2) investigate age differences in appraisal and emotion by examining these questions from a neuroscientific approach to determine how age differences in the brain can account for age differences in appraisal dimensions.

To investigate if appraisal dimensions and the interactions between dimensions can account for age differences in emotional experience, future research could take two approaches. The first approach involves observing the natural appraisal patterns of younger and older adults within a given situation and determining whether patterns of appraisal can account for typical age-related patterns of emotion. Researchers taking the first approach could ask participants to appraise one or more situations via self-reported appraisal dimensions and then ask how the participants felt during each situation. The advantage of the first approach is that it allows for the researcher to investigate if relatively natural patterns of individual differences in appraisals between younger and older adults can account for the emotions experienced during the given situation. For example, a recent investigation into the relationship between patterns of appraisal and emotion found that four distinct appraisal patterns emerged in response to the coronavirus pandemic that started in 2020 (Young et al., 2021). Each of these appraisal patterns was related to a unique emotional reaction and differences in coping in response to the stress of the pandemic. Overall, this study indicated that accounting for patterns of appraisal is important to understand how people of various ages emotionally respond to and cope with a novel stressor.

The second approach involves exposing younger and older adults to situations that have been manipulated based upon one or more appraisal dimensions. Researchers taking this second approach could ideally identify appraisal dimensions that would be most different between younger and older adults based upon typical age-related characteristics to investigate if they can create situations that lead to age-related patterns of emotion. For example, theories of emotion and aging suggest that goals (Carstensen, 2006) and control (Heckhausen et al., 2010) tend to be different across the life span. Researchers could design situations that contrast goal relevance (irrelevant, relevant) and control (low, high). In this case, goal relevance could be manipulated by aligning the situation to age-related goals as described by theoretical postulates. Based upon socioemotional selectivity theory, for example, older adults may appraise high goal relevance toward situations that focus on maximizing social and emotional meaning, whereas younger adults may appraise high goal relevance in situations that maximize their ability to acquire resources and knowledge. To manipulate control, one could alter the extent to which older and younger adults are allowed to influence the situation they are experiencing. This type of study could determine the extent to which goal relevance, control, and their interaction lead to different emotional experiences of the situation for younger and older adults.

Adopting a neuroimaging approach to explore age differences in appraisals and brain activation is also an important future direction (e.g., see Brosch & Sander, 2013; Smith & Lane, 2015). Not only is it important for understanding more deeply the relation between appraisal and emotion in adult emotional development, but it also can help to refine appraisal theory by helping appraisal theorists define the neural structure underlying the appraisal process. Although appraisal theories of emotion assume that appraisals are mediated by patterns of brain activation, they do not explicitly describe the neural mechanisms that underlie appraisal processes. However, Smith and Lane (2015) have developed a model showing how appraisal dimensions have underlying patterns of brain activation.

Smith and Lane (2015) have identified research that supports the idea that the appraisals of novelty, goal relevance, goal congruence, agency and norm compatibility all have associated neural circuits. For example, research indicates that the amygdala is sensitive to novelty and goal relevance (Brosch et al., 2011; LaBar et al., 2001). Interestingly, older adults tend have decreased amygdala responses toward negative stimuli, but relatively equal or greater responses toward positive stimuli compared to younger adults (Mather et al., 2004). One possible explanation for this age difference in amygdala activation is that older adults regulate their response toward negative stimuli better than do younger adults. However, another possibility is that positive stimuli are goal relevant for both older adults and younger adults, whereas negative stimuli are not. Future work examining age differences in the amygdala will need to determine if sensitivities to the goal relevance of stimuli or emotion regulation can explain these patterns of results.

In addition, research indicates that certainty may be processed by underlying neural circuits that involve the dorsal striatum, prefrontal cortex, insula, and anterior cingulate cortex (Fox & Poldrack, 2009; Paulus & Frank, 2006). However, the brain regions that process the evaluation of certain versus uncertain information when making a decision have not been determined due to a lack of consistency between studies (Fox & Poldrack, 2009). Research examining age differences in the processing of certain and uncertain events may provide some insight into this appraisal dimension. As predicted from AAAE, older adults should be less sensitive to uncertain future events compared to younger adults, and brain activity that is associated with this reduced sensitivity should show an age difference as well.

Currently, neuroscientific evidence suggests that the appraisal of agency is processed by brain circuits involved in self-other referential processing and the comparison of sensory-motor information and perceptual feedback (Seidel et al., 2010; Smith & Lane, 2015; Sperduti, Delaveau, Fossati, & Nadel, 2011; Wolpert, Doya, & Kawato, 2003). The appraisal of self-causation occurs when the prediction of motor commands and perceptual feedback are congruent (Smith & Lane, 2015). When the appraisal of cause is

attributed to others, a network consisting of the temporoparietal junction (TPJ), dorsomedial prefrontal cortex (DMPFC), and the precuneus is activated to process the cause and intentions of the person who caused the event (Van Overwalle, 2009). Future work exploring age differences in the appraisal and attribution of agency could focus on these brain regions. Potentially, brain regions associated with others being at fault will be less activated for older adults than for younger adults. Moreover, when older adults are in a situation with a person that is emotionally meaningful, they may show greater activation than younger adults. Crucially, it will be important to determine if this proposed pattern of appraisals and brain activation underlie age differences in interpersonal emotional experiences and interpersonal conflict.

Conclusions

The appraisal approach to aging and emotion underscores highly promising yet widely understudied areas of research in adult emotional development. Here, we propose that new directions in aging and emotion research could incorporate an appraisal approach to aging and emotion to build on the current state of the literature, thereby bringing additional insight to the field. AAAE proposes advancing age leads to fundamental differences in the appraisal process, which can account for age differences in emotion. Specifically, we hypothesize that age-related changes in cognition, motivation, and physical ability not only alter the appraisals made by older adults but also changes the appraisal systems of older adults, which in turn lead to significantly different emotional experience in older adulthood. Given that this consideration is new in the context of appraisal theories of emotion, we believe it would also benefit emotion theory broadly to consider how the appraisal system develops across the adult life span. We reviewed evidence from multiple disparate areas of aging research that supports the tenets of AAAE positing changes in several appraisal dimensions from younger to older adulthood. However, there is still much work to be done to directly examine age differences in appraisal processes and their utility in accounting for age-related changes in emotion. Moreover, there are many more appraisal dimensions (e.g., anticipated effort, fairness, legitimacy; see Smith & Ellsworth, 1985) not considered here that also could be relevant in accounting for age differences in other emotional states such as shame, guilt, pride, and gratitude among others. Ultimately, the study of appraisal processes and their fundamental role in the relationship between aging and emotion holds great promise to make insightful and integrative contributions to our understanding of how growing older changes how we feel.

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