

# Weakened Links Between Mind and Body in Older Age: The Case for *Maturational Dualism* in the Experience of Emotion

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## Abstract

As neuroscience methods begin to dominate emotion research it is critical for researchers to remember that peripheral embodiments are critical to understanding emotional experience and emotion–behavior links. Much of modern emotion research assumes reliable mind–body connections that suggest that changes in emotional states influence bodily responses and, vice versa, that somatovisceral information shapes emotional experiences. However, there may be important qualifications to the link between the mind and the (peripheral) body. For example, the ability to sense internal and external bodily states declines in older age as does activation of physiological systems, all of which may contribute to an impairment in emotional experiences and how emotions influence behavior. I describe this phenomenon as *maturational dualism* and suggest implications of this for emotion in older adults.

## Keywords

aging, emotion experience, interoception, maturation, psychophysiology

There is little reason to be optimistic about how aging influences our brains and bodies. Cognitive declines such as deterioration in short-term memory, impaired reaction times, and loss of attention occur even in the absence of neurological diseases (e.g., Levy, 1994). In the body, loss of muscle mass, deficiencies of growth hormones, hardening of the vasculature, and blunted activation reduces the flexibility of responding to different environmental demands (e.g., Epel, Burke, & Wolkowitz, 2007; Matthews, 2005). Because bodily responses are often directly implicated in the experience of emotions, in this essay I explore some consequences of bodily changes brought on by aging in the experience of emotion. Specifically, I review evidence of declines in sensory perception of the body with age and how this decline can interrupt the mind–body connection thus influencing emotional experience. I suggest that the weakened mind–body connection in older adulthood is primarily due to a loss of peripheral perception and blunted physiological reactivity. Due to these somatovisceral changes, the ability to use internal states to guide decisions and behavior may be impaired. Thus, emotions, cognitions, and intentions may live in the mind (and brain) but not be embodied

in the same way as they are in younger adults. I then describe the idea of *maturational dualism*,<sup>1</sup> a phenomenon that suggests that blunting of bodily sensations that often co-occur with the aging process can influence the experience of emotion in specific ways. Maturational dualism challenges the idea that mind–body connections are stable across the life course and suggests that dissociations between mind and body have implications for emotions and consequent behavior and decision making, specifically, that older adults more than younger adults will rely on their external world to provide information regarding their emotional states. Some existing data are reviewed as evidence of this phenomenon and additional perspectives of this state are described.

## The Body's Role in Emotion

Though there are many disagreements in the emotion literature, a generally accepted principle is that emotions are embodied in some meaningful way. Embodiment theory suggests that a reciprocal relation exists between peripheral bodily expressions and

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central nervous system processing of information from those domains (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). To put it simple, the proverbial detached brain would be impoverished in terms of information processing without peripheral embodiments. Peripheral bodily expressions primarily take one of three forms in emotion research: (a) proprioception, the perception of the position of one's body in space, (b) interoception, the perception of internal changes in the body, and (c) intensity and specificity of physiological reactivity.

### *Proprioception*

The idea that postural changes or manipulation of facial muscles related to expressions influences emotional experience is central to several empirical approaches in emotion research. For example, the directed facial action movement task requires participants to isolate muscles in the face and contract them so that a facial expression of emotion is configured, and experiences of emotions concordant with the facial expression are then achieved (e.g., Ekman, 2007). Similarly, holding a pen with your teeth activates the zygomaticus major muscle region (i.e., muscles associated with pulling back the lips to achieve a smile), which then facilitates happier ratings due to peripheral feedback (Strack, Martin, & Stepper, 1988). Moving away from the face, posture and body positioning can also influence emotional experience in animals and humans. In fear-conditioned rats, for example, restraining the body during electric shock resulted in more threat/withdrawal physiology (i.e., moderate increases in cardiac responses and increased blood pressure) whereas unrestrained rats showed more approach physiology during shocks (i.e., increased cardiac activation and no changes in blood pressure) (Iwata & LeDoux, 1988). Even though the "emotion" was the same (fear) the body positioning influenced the physiological responses that would facilitate freezing versus escaping.

In a recent paper, Harmon-Jones and Peterson (2009) highlighted the importance of body positioning in the experience of anger. To illustrate, imagine you are lying in bed next to your spouse and you start to argue. You may have the impulse to sit upright when you are arguing. Sitting upright would facilitate action and is thus more concordant with the motivational orientation of anger (Carver & Harmon-Jones, 2009). If the postural position was inconsistent with anger (e.g., lying down) this might dampen the emotional response. To test the importance of congruent postural positioning for the experience of anger, Harmon-Jones and Peterson asked participants to either sit upright or recline while they received an insult (or neutral feedback) from another "student" while electroencephalogram (EEG) activity was recorded. Consistent with embodiment theory, and specifically proprioceptive influences, when participants were upright and "angry" they showed greater left frontal cortical activation compared to the upright-neutral condition. Importantly, the comparison of recline-insult to upright-insult was also significantly different. When participants were reclined and insulted they did not show shifts in left frontal cortical activation. Thus, postural changes blunted the experience of anger as indicated by neural activation. Similar to other sensory

modalities such as taste, hearing and vision, proprioception appears to decline with age. In a recent review article, Goble, Coxon, Wenderoth, van Impe, and Swinnen (2009) provide evidence of proprioceptive impairments with age along varied dimensions of static and dynamic body positions. If aging impairs proprioception, how might this loss of detecting one's external body in space influence emotion? Let's imagine the Harmon-Jones study just described with supine body position dampening left frontal EEG activation. If proprioceptive influences are weakened with age then it would be more difficult to sense one's body in space and the supine versus upright position manipulations might have less of an impact on anger in older adults.

### *Interoception*

The ability to sense visceral organ activity, interoception, is implicated in the experience of emotion as well. For example, Hantas, Katkin, and Blascovich (1982) found that more accurate heart beat detectors self-reported greater emotional reactions to emotionally evocative photographs than inaccurate ones. More recently, Barrett, Quigley, Bliss-Moreau and Aronson (2004) proposed that visceral interoceptive ability was positively related to the intensity of emotional experience as delineated in Barrett's core affect model (Barrett & Bliss-Moreau, 2009). They observed that participants with weaker interoception were less likely to make distinctions between emotions of different arousal intensity. Like proprioception, interoception also declines with age. In a recent paper, Khalsa, Rudrauf, and Tranel (2009) used a heart-beat detection paradigm with participants ranging in age from 22 to 63. Older subjects, on average, showed poorer detection of their heart beats than younger and middle aged adults, and the overall bivariate correlation between age and accurate heart beat detection was  $r = -.49$  and  $r = -.45$  at two time points. These effects persisted after controlling for body mass index (BMI), sex, and the ability to detect one's own pulse directly from the wrist.

### *Physiological Reactivity*

Lay theories and observations abound regarding how our bodies respond to emotional states—hearts pound with fear; skin burns with anger; palms sweat from anxiety; cheeks turn red from embarrassment. Indeed, the relation between bodily changes and emotional responses seems so inextricably linked that emotion researchers often invoke the William James quote "the only emotions I propose expressly to consider here are those that have a distinct bodily expression" (James, 1884, p. 189). In more modern times, Ekman et al. and Levenson et al. (Ekman, Levenson, & Friesen, 1983; Levenson, Ekman, Heider, & Friesen, 1992) argued that specific autonomic nervous system (ANS) changes would result from the experience of discrete (i.e., basic) emotions. Empirically, these researchers attempted to manipulate specific emotions and then examine an array of peripheral physiological responses. Results showed some support for ANS differences between discrete emotions. Specifically, emotional manipulations of happiness, disgust, and surprise

resulted in lower heart rate; fear and sadness were associated with higher heart rate and lower skin temperature; and anger was associated with higher heart rate and higher skin temperature (cf. Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000). For the past two decades, Levenson, Carstensen, Friesen, and Ekman have examined physiological reactivity during emotional experiences among older adults relative to younger adults (e.g., Levenson, Carstensen, Friesen, & Ekman, 1991). Across a number of studies they report a blunting of sympathetic nervous system responses in older adults. For example, they find lower heart rate responses for anger, fear, and sadness in older adults compared to younger adults during a directed facial action task. In some cases younger adults had twice as large sympathetic nervous system (SNS) increases as older adults (a finding that mirrors physical exercise). Indeed, this observed blunting of SNS activity led Levenson et al. (1991) to suggest that “emotional experience may become more cognitive over time.” In one study, older adults did not show increases in peripheral (finger) skin temperature during anger evocations (Levenson et al., 1991). Changes in the flexibility of the vasculature especially in the peripheral regions—arms and hands; legs and feet—can be affected by neuropathy (i.e., nerve damage) that can co-occur with age, and the extremities are typically affected first. The lack of skin temperature increases during anger is especially interesting given that anger is typically characterized as having an approach orientation (Carver & Harmon-Jones, 2009) and has been associated with greater dilation of the arterioles allowing more blood to get to the effector muscles and periphery, which is one of the likely physiological changes that increases skin temperature during anger (Mendes, Major, McCoy, & Blascovich, 2008). However, it is important to note that the flexibility of the vasculature is compromised in an asymmetrical form with age—vessels can still constrict easily but dilation is more difficult. Therefore, emotions that are more approach-oriented, like anger, may be compromised before emotions that are more threat/withdrawal related, like fear. In sum, changes in the body that are impaired with age include loss of interoception, proprioception, and blunted sympathetic nervous system, all of which are implicated in emotion embodiment.

## Maturation Dualism

Maturation dualism is the idea that the weakening of mind–body connections with age can influence emotional experiences. The aging process reduces interoceptive sensitivity primarily through increased neuropathy, which influences sensitivity and blunts perception of activation of physiological changes during emotional experiences. Without perception of arousal as a component of the emotional experience, valence might be all that is left to detect (see Barrett et al., 2004). If interoception declines with age then the ability to experience emotions—especially distinctions in emotions that are arousal based—might be impaired resulting in fewer distinctions of emotions like fear and sadness, for example. There are intriguing clues in the literature regarding how the mind–body disconnection in older age

may affect emotional experience and emotion–behavior links. For example, one study examined the somatic-marker hypothesis in older adults (Denburg, Tranel, & Bechara, 2005). In previous papers, Damasio and his colleagues (e.g., Bechara, Damasio, Tranel, & Damasio, 1997) described the somatic-marker hypothesis, which suggested that bodily states outside of conscious awareness could influence behavior. To support this hypothesis, participants (brain damaged and control) were presented with four decks of cards with various gains and losses associated with the cards. Two of the decks resulted in overall losses—large gains, but large losses as well, whereas the other two decks resulted in smaller gains, but smaller losses. They found that as participants turned over cards from the various decks, changes in skin conductance (activity in the eccrine gland indicating sympathetic activation innervated by acetylcholine) co-occurred with choices from the riskier decks. Importantly, these bodily changes preceded conscious reporting of which decks were risky by approximately 40 trials (cf. Maia & McClelland, 2005). Thus, the somatic-marker hypothesis claims that bodily changes can indicate psychological or mental states prior to conscious reporting. In the original article, healthy participants were compared to patients with ventromedial prefrontal cortex lesions. While healthy participants consciously reported which decks were risky by about the 40th trial, lesion patients were not able to learn the gain–loss pattern. In an extension of this earlier study, older adults (defined as 56 to 85 years old), compared to younger adults, did not show preferences for the advantageous decks across five trials (or 100 cards) (Denburg et al., 2005). When examining individual responses, the authors reported that among the younger group, 37 out of 40 participants eventually picked from the advantaged deck, while among the older group only 15 out of 40 showed this same “unimpaired” pattern. The remaining older participants either showed greater preference for the disadvantaged deck or no preference. There are at least two possible interpretations of these data in light of the ideas presented here: (a) similar to Levenson’s data, older participants had blunted physiological responses during the task, which limited the ability to sense internal states vis-à-vis the somatic-marker hypothesis, or (b) the sympathetic response was intact and as strong as that experienced by younger participants, but the ability to sense the bodily changes—interoceptive awareness—was diminished (Khalsa et al., 2009). Of course, another possibility is that the lack of choice of the advantageous decks was due to a combination of blunted reactivity and loss of interoception. It might be intuitive to assume that these deficits in older age are due to changes in brain structure, but a recent article cautions against a purely localized brain-based explanation of interoceptive awareness (Khalsa, Rudrauf, Feinstein, & Tranel, 2009). These authors suggest that interoception may not be tied exclusively to the insula and anterior cingulate cortex (ACC) as suggested by others (e.g., Craig, 2009). In this study, a single patient with bilateral insula and ACC damage was given dosage level increases of isoproterenol—a sympathetic agonist similar to epinephrine—and was asked to self-report on his heart rate changes. Similar to control participants, the patient both showed dosage level increases in heart rate and reported

awareness of this change. Following this, the experimenters then applied a topical anesthetic on the chest skin covering the heart rate sensation region. With the skin area anesthetized, the patient could no longer report increases in heart rate, whereas control subjects could still report dosage level increases. This finding underscores the importance of considering multiple pathways to interoception. Maturational dualism suggests that older participants would be more susceptible to suggestions of an emotional state since they might have to rely more on their external world to provide information about their emotional state. Although recent theory and evidence suggest that environmental cues can strongly influence emotional states and meaning even among young adults (Barrett and Bliss-Moreau, 2009; Jamieson, Mendes, Blackstock, & Schmader, 2009), the loss of the ability to detect internal states should make older participants more susceptible to environmental cues. This is generally consistent with Carstensen's socioemotional selectivity theory (Carstensen, 2006), which describes a positivity effect in older adults who direct attention away from negative stimuli toward more positive stimuli. This motivated attention might be partly inspired by an inability to access internal information to determine how one feels.

## Future of Emotion Research

This essay focused on drawing from existing data and theory to examine how mind-body relations may differ across the life span and how those relations might influence the experience, perception, and consequences of emotions. Although one can imagine that there might be some advantage to becoming less sensitive to internal states as we age, possibly to protect us from debilitating pain, there are obviously some serious downsides of not having strong mind-body connections, especially when considering how this connection benefits emotional experience. Most critically, to the extent that the bodily responses that co-occur with emotions tend to provide signals on how to best to behave (e.g., approach, avoid, or freeze) the lack of association between the mind and body might impair the ability to make good decisions. In this essay I focused on how age reduces sensitivity of bodily sensations which could influence emotional experience, but similar effects would be hypothesized for any bodily changes that reduced interoception, proprioception, and blunted physiological responding. For example, Type I diabetes is often associated with peripheral neuropathy, which can blunt sensations and this may influence emotional experience and emotion-behavior links in similar ways as aging does. Studying individuals with specific peripheral neuropathy would provide a window into the importance of bodily sensations in emotion, and may shed light on the processes described here. In the 1999 movie *The Matrix* people lived in fluid-filled chambers while their minds inhabited virtual avatar bodies where perceptions of fear, anger, and compassion were altered and risky actions were often inconsequential. In our enthusiasm to embrace purely brain-based explanations for emotional experiences we cannot treat individuals as disembodied brains that exist without

peripheral embodiments. To do so would ignore the importance of how the body provides both critical inputs that can shape emotion, as well as critical end-points that relate to emotion-behavior links.

## Notes

- 1 The term *dualism* is used here loosely to represent dissociations between the mind (conscious thoughts) and the peripheral body. Readers should not infer the stricter definition of Cartesian dualism referring to mental states as nonphysical phenomena.

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