CHAPTER 26

Neural Evidence for Cultural Variation in Emotion

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Most affective scientists recognize that culture plays at least some role in the experience and expression of emotion. As early as 1872, in *Expressions of Emotion in Man and Animals*, Darwin (1872) wrote about the cultural diversity of expressions reported by his friends and colleagues during their travels across the world. In the 1970s and 1980s, anthropologists described cultural differences in the experience of emotion (e.g., Briggs, 1970; Lutz, 1988), and psychologists wrote about cultural differences in elicitors, appraisals, displays, and consequences of emotion (e.g., Ekman, 1971; Scherer, Summerfield, & Wallbott, 1983). Not until 1991, however, when Hazel Markus and Shinobu Kitayama published their seminal piece, "Culture and Self: Implications for Emotion, Cognition, and Motivation," did researchers systematically begin to examine how different models of self might shape emotion (Markus & Kitayama, 1991). Findings from these studies revealed consistent differences between Western and East Asian cultures in the focus of emotion, norms regarding emotional expression, and emotions that people value and ideally want to feel (see Tsai & Clobert, 2019 for review).

In this chapter, we first define "culture" and explain why affective neuroscientists should consider cultural influences in their research. We then review emerging neural evidence for cultural differences in models of self and emotion. Our aim is to highlight consistent patterns where they exist but, as with other relatively new fields, findings from neuroscience studies of culture and emotion are sometimes mixed and more research is needed to resolve these inconsistencies. At the end of the chapter, we discuss some challenges in conducting cultural neuroscience studies and outstanding questions for future research.

What Is Culture, and Why Study It?

"Culture" refers to ideas about fundamental aspects of human experience (e.g., views of the self in relation to others) that are historically rooted and socially transmitted across generations (Kroeber & Kluckhohn, 1952; Shweder, 2003). These shared ideas are reflected in and reinforced through traditions, practices, products, and institutions (Hamedani & Markus, 2019). As members of their cultures, people are exposed to these ideas early on, begin to internalize them, and eventually recreate them – a process that Hazel Markus and her colleagues refer to as "mutual constitution" or the "culture cycle" (Markus & Conner, 2014; Markus & Hamedani, 2007; Markus & Kitayama, 2010). Although "culture" can be used to describe ideas associated with various social identities and contexts (e.g., gender, social class), we focus on national culture in this chapter.

Understanding how cultural factors shape emotion and other affective phenomena is critical for several reasons. First, given that most research in psychology has focused on Western, educated, industrialized, rich, and democratic ("WEIRD") populations, it is possible that much of what we know about emotion is specific to these populations and, therefore, may not be applicable to 80% of the world (Henrich, Heine, & Norenzayan, 2010). Second, affective processes do not exist in a vacuum; their impact and meaning depend in part on how frequent, normative, and valued they are, which are shaped by people's cultural contexts. Thus, understanding the nature of emotion depends on understanding the context in which emotion occurs. Third, because many clinical treatments and public policy interventions related to affective processes originate in the United States (US) and other Western cultures, it is likely that they must be adapted in specific ways for cultures that hold different values and ideals regarding emotion. This also applies to different ethnic groups within the US and other multicultural societies. For these reasons, we believe that identifying both cultural differences and similarities in emotion is critical to improving communication and understanding among diverse groups.

Cultural Models of Self

As previously mentioned, one fundamental aspect of human experience is how people view themselves vis-à-vis others. In their classic paper, Markus and Kitayama (1991) described different models of the self and personhood in Western and East Asian contexts. Western contexts, such as the US, promote a more *independent* model of the self, whereas East Asian contexts, like China and Japan, promote a more *interdependent* model of the self. An *independent* model of self views individuals as unique and distinct from others; defines people in terms of their personal traits; teaches people to express their preferences and emotions to set themselves apart from others; and encourages people to act on and "influence" their environments to be consistent with their internal beliefs and desires. In contrast, an *interdependent* model of self views individuals as connected to others; defines people in terms of their relationships, duties, and responsibilities to others; and encourages people to alter their internal beliefs and desires to be consistent with and "adjust" to those of the group (Markus & Kitayama, 2003; Morling, Kitayama, & Miyamoto, 2002; Tsai, Miao, Seppala, Fung, & Yeung, 2007). More recently, researchers have begun to add Latinx samples to these comparisons. Although Latinx samples have interdependent models of self that share features similar to interdependence in East Asian contexts, they are more expressive like European Americans, suggesting that multiple models of interdependence exist (Hampton, Kwon, & Varnum, 2021; Kitayama & Salvador, 2017, 2023; Salvador et al., 2024; Senft, Campos, Shiota, & Chentsova-Dutton, 2021).

Why Examine Neural Mechanisms?

Most of the findings regarding cultural differences in emotion are based on self-report and behavioral data, which are limited in several ways. First, people often cannot report on processes that they are unaware of, and people may be unaware of the specific ways in which they are influenced by their cultures. Second, even if people can report on these processes, their reports may be influenced by concerns about social desirability or self-presentation. Third, cultural influences on emotion may occur automatically at very short time intervals, which may be difficult to capture with self-report and behavior. Fourth, affective processes may involve multiple mechanisms, which are often difficult to assess with self-report and behavior *at the same time*. Fifth, although some behaviors and even self-reports may appear similar across cultures, they may actually involve different underlying mechanisms, which has implications for the development of effective interventions across cultures (e.g., Chiao et al., 2010).

Neuroscientific methods such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) can address many of these limitations. Such methods do not require participants to be aware of all the ways in which they are influenced by their cultures, and because neural activity is not typically under conscious control, it is less susceptible to social desirability and presentation concerns. Neuroimaging also allows researchers to assess affective processes that occur almost instantaneously and to examine whether similar neural mechanisms underlie ostensibly similar behaviors. Thus, these methods can help validate cultural differences and similarities in emotion self-reports and behaviors.

Although neuroscientific methods have the potential to contribute to our understanding of how culture influences emotion, these methods also have limitations, of course. First is the problem of "reverse inference," or the tendency for researchers to assume specific psychological mechanisms when they observe changes in activity in particular regions of the brain. Fortunately, tools like Neurosynth allow researchers to make these inferences based on patterns observed across a multitude of studies in the existing literature using similar and even different tasks (Yarkoni, Poldrack, Nichols, Van Essen, & Wager, 2011). Researchers can also link neural activity to relevant, observable behaviors to increase interpretability. Second is the relatively sterile and noisy environment of the scanner in the case of fMRI or wearing an electrode cap in the case of EEG, which often limits the ecological validity of the tasks researchers can use. Third is the high cost of fMRI data collection in terms of time and money, and fourth is the difficulty of comparing findings from different scanners in different settings, often limiting neuroscientists to studying samples living in the same physical location.

Despite these limitations, over the past few decades, neuroscientists have used fMRI methods to identify various mechanisms underlying different psychological processes. In this chapter, we focus on mechanisms related to the following: *positive affect* or *reward*, which is associated with activity in the ventral striatum, including the nucleus accumbens (Knutson & Greer, 2008; see Haber & Knutson, 2010 for review); *negative affect*, which is associated with activity in the anterior insula (Palminteri, Khamassi, Joffily, & Coricelli, 2015; Samanez-Larkin & Knutson, 2015); *social cognition*, such as reflecting about oneself or mentalizing about others' beliefs, which is associated with activity in regions such as the medial prefrontal cortex (MPFC; Denny, Kober, Wager, & Ochsner, 2012; see Lieberman, Straccia, Meyer, Du, & Tan, 2019 for a review) and right temporoparietal junction (rTPJ; Saxe & Wexler, 2005); and *visual attention*, which is associated with activity in regions of the occipital cortex or, in the case of viewing faces, with the fusiform face area (FFA; Grill-Spector, Knouf, & Kanwisher, 2004; Kanwisher, McDermott, & Chun, 1997).

Although EEG can also assess activity that occurs almost instantaneously and has excellent temporal resolution, EEG signals are less clearly tied to activity in particular areas of the brain. Despite this, researchers have used EEG methods to measure attention (e.g., P200, P300), sensitivity to errors or threats (i.e., error-related negativity [ERN]), detection of incongruence (N400), and emotional processing through the parietal late positive potential (LPP).[1]

Neural Evidence for Different Models of Self

Perhaps not surprisingly, the first cultural neuroscience studies focused on how different models of self might be reflected in brain activity in Western and East Asian samples. On the basis of social neuroscience work linking self-referential processes to activity in the MPFC, especially in ventral portions (e.g., Heatherton et al., 2006; Ochsner, Knierim et al., 2004; see Denny et al., 2012 for meta-analysis), early studies predicted that Westerners would show greater MPFC activation when making trait judgments about themselves compared with close others, whereas East Asians would show less of a difference, or perhaps no difference, when making trait judgments about themselves compared with close others.

In a classic study, Westerners from the US, Canada, England, and Australia and Chinese living in China completed a trait judgment task where they viewed different adjectives (e.g., "diligent," "wrinkled," "tenant") and indicated whether the adjectives described themselves, their mother, or a distant other. Consistent with prior work in Western samples, both Westerners and Chinese showed greater activity in the MPFC for self (vs. distant other) judgments. However, there were cultural differences when participants made trait judgments for themselves compared with their mothers. Whereas Westerners showed greater MPFC activation when judging traits for themselves compared with their mothers, Chinese showed no difference (Zhu, Zhang, Fan, & Han, 2007). Other studies have replicated the lack of differentiation in MPFC activity for self and mother judgments among Chinese (Wang et al., 2012) and have extended it to include one's spouse and children (Han, Ma, & Wang, 2016). Although the relative differences in MPFC activation for self (vs. other) judgments vary among Chinese groups as a function of acculturation or time spent in the US (see later; Chen, Wagner, Kelley, & Heatherton, 2015; Chen, Wagner, Kelley, Powers, & Heatherton, 2013), these findings suggest that, consistent with an interdependent model of self, Chinese do not process themselves as distinct from their mother and certain close others as much as Westerners do.

A similar pattern emerges when priming biculturals – individuals who are oriented to two cultural contexts – with images and icons from those two cultures. For example, after viewing Western cultural images (e.g., food and drink, celebrities) and writing about how Western culture has played a role in their lives, bicultural Hong Kong Chinese showed greater MPFC activation for self (vs. distant other) judgments, a pattern that is consistent with independent models of self. In contrast, after viewing Chinese cultural images and writing about Chinese culture, Hong Kong Chinese showed no differences in MPFC activity between the two judgments (Ng, Han, Mao, & Lai, 2010). Of course, there is also significant variability among Chinese groups. Studies of immigrant Chinese when they first arrive in the US show greater MPFC activation in self (vs. mother) conditions, perhaps because they are relatively more independent compared with Chinese who remain in China (Chen et al., 2013). Interestingly, Chinese immigrants who became *more* interdependent after 6 months -perhaps because they needed to rely more on close others in a new environment- showed lesser differentiation in the MPFC for self (vs. mother) judgments (Chen et al., 2015).

Additional work has examined cultural differences in MPFC activity when individuals process trait statements about themselves in general or in specific contexts (e.g., when with their mothers). As independence is associated with defining the self using stable, internal traits (Cousins, 1989; Rhee, Uleman, Lee, & Roman, 1995), one would predict that Westerners would show greater MPFC activation for general statements compared with contextual ones. By the same logic, because interdependence is associated with defining the self in specific relationships and situations, one would predict that East Asians would show greater MPFC activation for contextual (vs. general) statements. Consistent with these predictions, among European Americans and Japanese, the more independent participants were, the greater MPFC activation they showed in response to general (vs. contextual) statements. In contrast, the more interdependent participants were, the greater MPFC activation they showed in response to contextual (vs. general) statements (Chiao et al., 2009). Similarly, bicultural Asian Americans primed with independent values showed greater MPFC activation for general (vs. contextual) trait judgments, whereas Asian Americans primed with interdependent values showed the opposite pattern (Chiao et al., 2010).

Although much of the neuroscience research on models of self has focused on the MPFC, there is also some evidence revealing cultural differences in the temporoparietal junction (TPJ), a brain region associated with mentalizing about others (Saxe & Wexler, 2005). If individuals in interdependent cultures see themselves as more interconnected, then one would expect East Asians to show greater activity in the TPJ when thinking about themselves, which likely includes thinking about their connections with others, compared with thinking about distant others. Indeed, Koreans showed greater TPJ activation when making trait judgments about the self compared with a distant other (Sul, Choi, & Kang, 2012). In a study by Ma and colleagues, Chinese showed greater TPJ activation than Danes when making self (vs. distant other) judgments for adjectives specifically related to social roles or identities (e.g., "tenant," "professor"), and this difference was due to cultural differences in interdependence (Ma et al., 2014). Interestingly, in this study, there were no cultural differences when participants made self (vs. distant other) judgments for adjectives related to personality traits (e.g., "diligent," "talkative"). This is also consistent with more recent work revealing greater TPJ activity when Chinese made judgments about themselves in an interpersonal context (e.g., "I make friends easily") compared with an academic one (e.g., "I read very quickly") (Pfeifer et al., 2017).

In sum, neural findings suggest that culture shapes the degree to which individuals identify with and see themselves as distinct from close and distant others, as well as the degree to which individuals think about others' beliefs and the social context when thinking about themselves. Together, these studies provide neural support for cultural differences in models of self among members of Western and East Asian contexts.

Three Empirical Patterns Regarding Culture, Self, and Emotion

Markus and Kitayama (1991) proposed that these cultural differences in models of self had implications for emotion (as well as cognitive and motivation), and three decades of research have supported this view. Specifically, three consistent patterns have emerged demonstrating differences between Western and East Asian cultural contexts in the focus of emotion (e.g., whether emotions are more self-focused vs. other-focused), norms regarding emotional expression (e.g., whether people are encouraged to express their emotions or to moderate and control them), and ideals regarding affective experience (e.g., whether people want to feel high arousal vs. low arousal positive or negative states) (Tsai & Clobert, 2019). In the next section, we describe each pattern and review relevant neuroscience studies. Most of the research on cultural differences in emotion has focused on Western–East Asian comparisons, but we also discuss more recent work on Latinx contexts, which suggests both similar and different associations between these patterns of emotion and interdependence (Acevedo, Herrera, Shenhav, Yim, & Campos, 2020; Kitayama & Salvador, 2023; Senft et al., 2021), as shown in Figure 26.1.

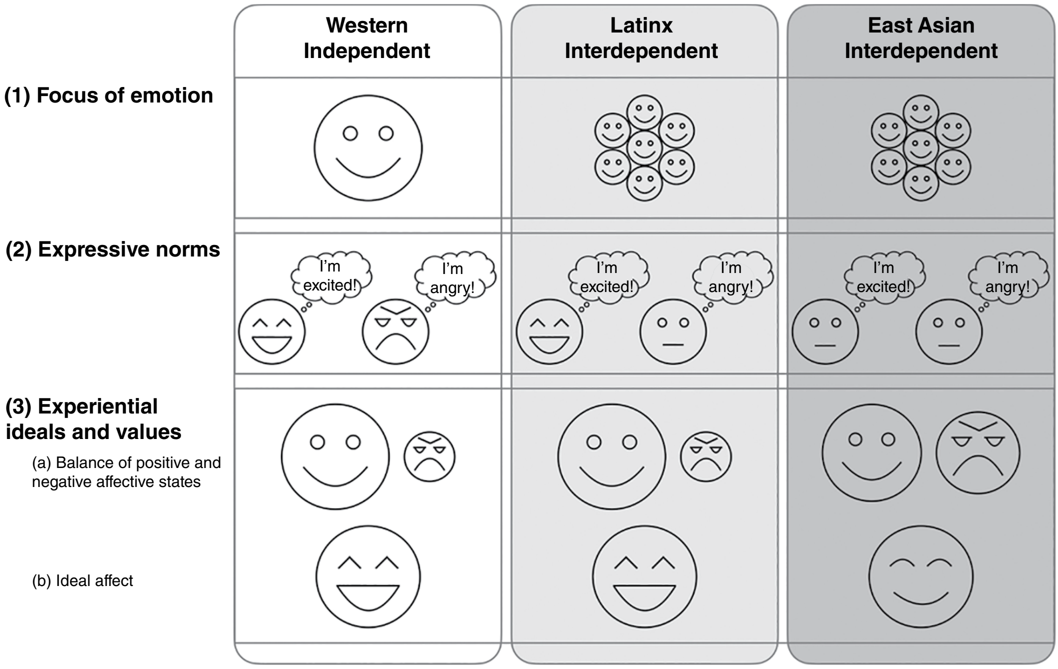

Figure 26.1 Cultural variation in emotion. Cultural variation in the (1) focus of emotion, (2) expressive norms, and (3) experiential ideals and values based on empirical studies comparing Western, Latinx, and East Asian cultural contexts. Adapted from Tsai and Clobert (2019).

Focus of Emotion

Cultural differences in models of self predict that emotions will be more self-focused in independent cultures and more other-focused in interdependent cultures. This difference manifests itself in various ways. For instance, European Americans tend to experience more intense emotions when focusing on themselves compared with their family members, whereas East Asian Americans experience more intense emotions when focusing on their family members than themselves (Chentsova-Dutton & Tsai, 2010). These findings suggest that people with more interdependent selves might experience emotional tasks that involve close others like family members to be at least as rewarding, or even more rewarding, than emotional tasks that involve only themselves.

To test this prediction, Telzer, Masten, Berkman, Lieberman, and Fuligni (2010) presented White and Latinx adolescents with decisions to earn money for themselves or their families inside the fMRI scanner. Whereas both groups chose to earn more money for themselves than for their families, White adolescents showed greater brain activity in reward-related regions, including the ventral striatum, when earning money for themselves (vs. their families). In contrast, Latinx adolescents showed either similar or greater activity when earning money for their families (vs. themselves) (Telzer et al., 2010). Additional supporting evidence comes from priming studies. Chinese primed with independent cultural values showed greater ventral striatal activity when earning money for themselves than for their friends, whereas Chinese primed with interdependent cultural values showed similar levels of ventral striatal activation when earning money for themselves and for their friends (Varnum, Shi, Chen, Qiu, & Han, 2014).

Cultural differences in the motivation to earn more for close others, even at the expense of earning for oneself, have also been examined using EEG. In particular, researchers have examined ERN, a signal that is sensitive to incorrect responses in tasks requiring fast reaction times, and therefore, is considered an index of error monitoring, threat, and motivational relevance. Indeed, greater ERN signals have been observed when individuals have the opportunity to earn high (vs. low) amounts of money for their task performance (Hajcak, Moser, Yeung, & Simons, 2005; Holroyd & Coles, 2002). On the basis of cultural differences in models of self, one would expect European Americans to show a greater ERN signal when earning money for themselves compared with for close others, whereas East Asians would show a similar or greater ERN signal when earning money for close others compared with for themselves.

Kitayama and Park (2014) had European Americans and Asians studying in the US (including East Asians and Asian Americans) complete a flanker task in which they could earn points for themselves or for their close friend. There were no group differences in performance on the flanker task or in self-reports of engagement or task difficulty when playing for oneself or for a friend. However, European Americans showed a larger difference between the ERN signal compared to the correct-response negativity (CRN) signal when earning points for themselves than for their close friends. In contrast, Asians showed no ERN difference between the two conditions. Furthermore, levels of interdependence accounted for this group difference: Asians valued interdependence more than European Americans, which was associated with less of a difference in ERN when earning points for themselves compared with earning points for their friends.

Recently, these findings have been extended to a sample of Latinx, East Asian, and non-Latinx White adolescents who completed a go/no-go task to earn points as part of a team or as individuals. As Latinx and East Asian adolescents tend to be more interdependent than non-Latinx White adolescents, their ERN signals should show similar or greater differentiation in ERN signals between the team and individual conditions. As predicted, among Latinx and East Asian adolescents, the more individuals valued interdependence and collectivism, the greater the differentiation in their ERN (vs. CRN) signals when completing the task as part of a team than by themselves (Rapp et al., 2021). Together, these studies provide neural evidence suggesting that interdependent cultures perceive earning prizes for close others or working together with peers as more motivationally relevant than earning for oneself or working alone.

Cultural differences in models of self also shape how individuals judge others' emotional expressions. When determining the emotions of a central target who is presented with other people, European Americans rely on the central target's expression more and the expressions of the other people less compared with Japanese (Masuda et al., 2008). To probe this at the neural level, researchers have used EEG to measure the N400, which is sensitive to detecting an incongruence between a central target and a background scene. For instance, Goto, Ando, Huang, Yee, and Lewis (2010) found that Asian Americans showed a greater magnitude N400 to semantic incongruence between targets and their background scenes than did European Americans. Similarly, when viewing emotional faces that were superimposed on a congruent or incongruent emotional scene, Asian Americans showed a greater N400 in response to incongruent images (e.g., happy face superimposed on a sad scene) than congruent images (e.g., happy face superimposed on a happy scene) relative to European Americans (Figure 26.2). Furthermore, greater N400 responses to incongruent (vs. congruent) images were associated with greater self-reported interdependence (Goto, Yee, Lowenberg, & Lewis, 2013).

The same pattern emerges when viewing a lineup of faces in which the central target's emotional expression either matches or differs from those of others in the group. Russell, Masuda, Hioki, and Singhal (2015) presented European Canadians and Japanese with congruent lineups of faces, in which the central target's emotional expression matched those of the four others in the group (e.g., happy central face presented with

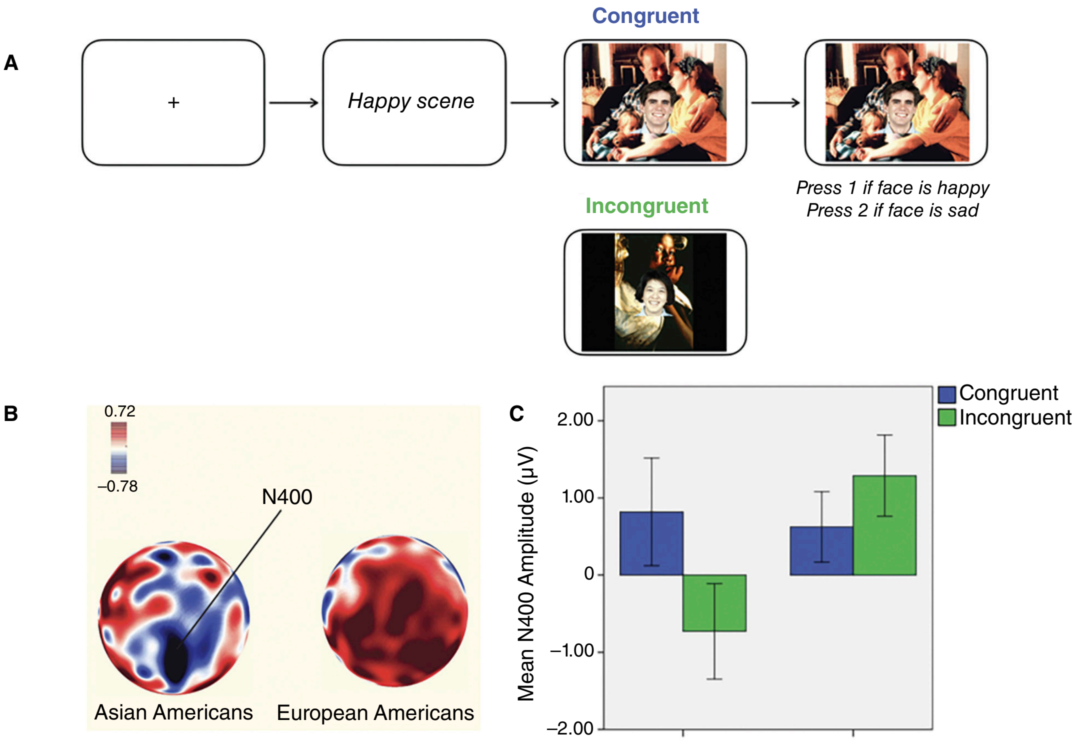

Figure 26.2 Cultural differences in neural responses to emotional scenes. (A) Overview of one trial in EEG task. (B) N400 for incongruent vs. congruent trials for Asian Americans and European Americans. Greater negativity in voltage differences for incongruent vs. congruent trials is reflected by cooler colors. (C) Cultural differences in mean N400 amplitude on congruent (blue) and incongruent (green) trials. Asian Americans showed greater negativity on incongruent than congruent trials. Adapted from Goto et al. (2013).

four other happy faces), as well as incongruent lineups, in which the central target's emotional expression differed from those of the four others (e.g., happy central face presented with four sad faces). As predicted and in line with findings from Goto et al. (2013), Japanese showed a greater N400 response for incongruent lineups compared with European Canadians. The researchers also examined cultural differences in the late positive complex (LPC), which is also sensitive to incongruence but begins after the N400. Interestingly, Japanese showed a greater LPC for incongruent (vs. congruent) lineups relative to European Canadians, suggesting that Japanese were not only more sensitive to the emotional expressions of the group when they differed from that of the central target but also continued to pay attention to and process them.

Accumulating neural evidence is consistent with research suggesting that emotions are more self-focused in independent contexts and more other-focused in interdependent contexts. Compared with members of Western contexts, members of East Asian and Latinx contexts find events more emotionally rewarding and motivating when they involve close others, and they pay greater attention to the larger context when judging how a central target feels.

Expressive Values and Norms

Cultural differences in models of self have important implications for the norms and values regarding emotional expression. Whereas independent Western cultures encourage people to express their emotions so they can stand out and be unique, interdependent East Asian cultures encourage people to moderate and control their emotions to maintain interpersonal harmony and fit in with the group (Matsumoto, Yoo, & Fontaine, 2008). Recent work suggests that Latinx groups fall between these two ends of the continuum encouraging both the expression of positive emotion to connect with others and the moderation and control of negative emotions (Acevedo et al., 2020; Kitayama & Salvador, 2023; Salvador et al., 2024; Senft et al., 2021). Supporting these differences, researchers have observed that emotional suppression is more harmful in independent than interdependent contexts (Butler, Lee, & Gross, 2007; Soto, Perez, Kim, Lee, & Minnick, 2011; Wei, Su, Carrera, Lin, & Yi, 2013; Zhu, Martin Kane & Park, 2023).

Do these cultural differences in values and norms alter people's abilities to regulate their emotions? Because East Asians and other members of interdependent cultures value emotional moderation and control more, one might predict that they regulate their emotions more often, require less effort to do so, and may even be more effective in controlling their emotions than Westerners. Previous research suggests that emotion regulation strategies, such as reappraisal, recruit increased activation in regions associated with control, including the ventrolateral prefrontal cortex (VLPFC) (Ochsner, Silvers, & Buhle, 2012; see Cohen & Lieberman, 2010 for review). Furthermore, studies have found that decreasing negative emotion is associated with lesser amygdala activation, whereas increasing negative emotion is associated with greater amygdala activation (Ochsner, Ray et al., 2004).

In a comparison among emotion regulation strategies, Goldin, McRae, Ramel, and Gross (2008) had Americans view negative film clips inside the scanner, and reappraise their emotional response, suppress their emotional response, or respond naturally, which was included as a control. Compared with the control condition, reappraisal was associated with early (0–4.5 s) increases in VLPFC activity and later (10.5–15 s) *decreases* in amygdala and insula activity. Suppression was associated with later increases in VLPFC activity, but also with *increases* in amygdala and insula activity, suggesting that suppression was less effective at downregulating neural responses in emotion-related regions in this US sample (Goldin et al., 2008). Interestingly, in a Japanese sample, suppression was also associated with increases in prefrontal cortex activity but with *decreases* in amygdala activity (Ohira et al., 2006). This may have been because Japanese were instructed to "try to remain calm and to diminish any response of subjective feelings" (p. 723), rather than to focus on suppressing the external expression of emotion, as in Goldin et al. (2008). However, it is also possible that Japanese were better able to suppress their emotions because they value emotional control more and engage in it more than Americans do.[2]

More recently, Qu and Telzer (2017) compared neural activity in a sample of Americans and Chinese as they decreased or increased their emotional responses to negative images using reappraisal. Despite similarities in self-reports of subjective experience after regulation, there were cultural differences in VLPFC activity. Americans again showed greater activity in the VLPFC, which the authors associated with effort, than Chinese when both decreasing and increasing their emotional responses (Figure 26.3). These findings suggest that Westerners may require greater effort when regulating their emotions than East Asians do, perhaps because they value and engage in emotional control less. Indeed, Americans reported using reappraisal emotion regulation strategies less than did Chinese in this study.

Studies using EEG methods provide converging evidence that emotional suppression may be less effective for European Americans than for East Asians. To examine the effects of emotional regulation, researchers have measured the magnitude of the parietal LPP, an index of emotional processing (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000) that decreases during emotion regulation (Hajcak & Nieuwenhuis, 2006; Moser, Krompinger,

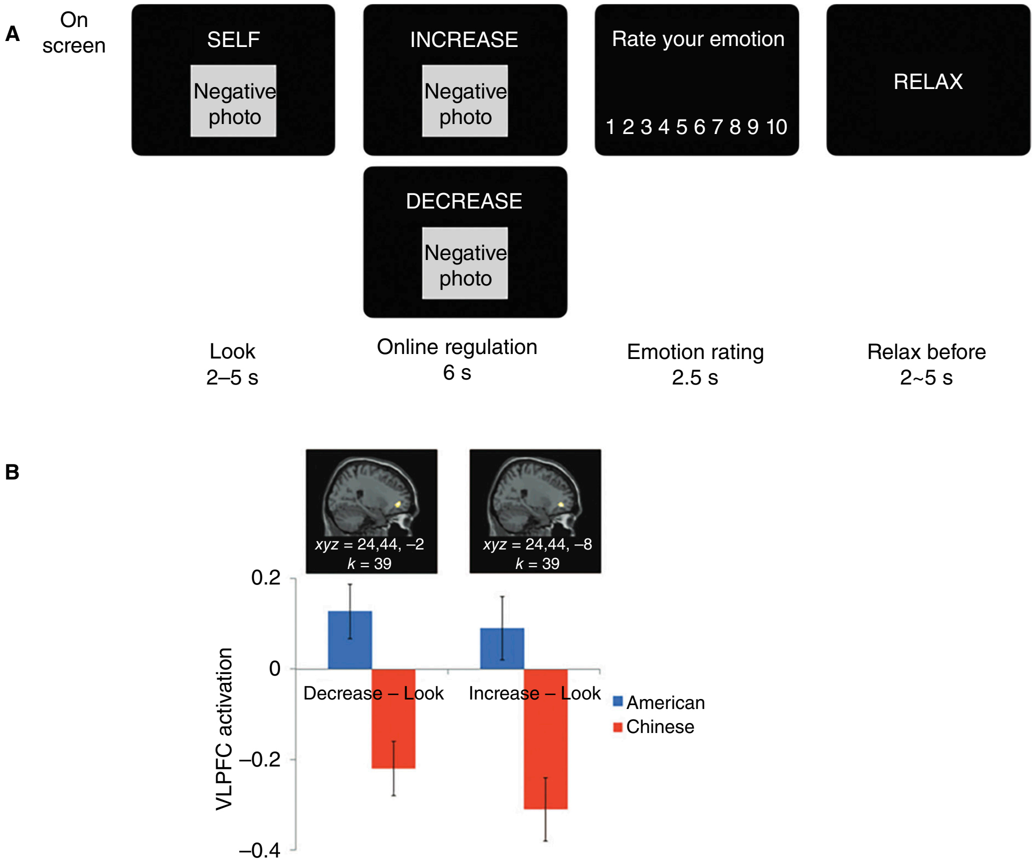

Figure 26.3 Cultural differences in neural responses during emotion regulation. (A) Overview of one trial from an emotion regulation task. (B) Cultural differences in ventrolateral prefrontal cortex (VLPFC) activation when decreasing and increasing negative emotions vs. control. Americans (blue) showed greater VLPFC activation when decreasing and increasing negative emotions compared with Chinese (red). Adapted from Qu and Telzer (2017).

Dietz, & Simons, 2009). In an early demonstration, European Americans and East Asians viewed negative and neutral images and were instructed to either suppress their emotional responses or attend to them and respond naturally (Murata, Moser, & Kitayama, 2013). Both European Americans and East Asians showed an enhanced LPP from 400 to 700 ms after the onset of negative images. However, beginning 800 ms after the onset, East Asians showed a decreased LPP when asked to suppress their responses, which disappeared by 2000 ms, suggesting that they successfully dampened emotional processing during suppression. European Americans, in contrast, showed no such decrease in LPP in the suppression condition, perhaps suggesting that suppressing emotions had less of an impact on their emotional processing.

Within cultures, emotional suppression (using similar instructions as Goldin et al., 2008; Ochsner, Ray et al., 2004) has been shown to decrease LPP amplitudes as well as self-reported negative mood among Chinese men living in China, and to be more effective in reducing negative emotion than reappraisal for this sample (Yuan et al., 2015). Kraus and Kitayama (2019) also found that suppression led to decreased LPP amplitudes for Asian Americans, but only among those who scored high in interdependence. These findings suggest that suppression may be overall more effective in East Asian than in European American contexts.

Whereas the above studies focused on cultural differences in downregulating emotional responses, especially negative ones, other research has examined the ability to upregulate emotional responses. Perhaps in independent Western cultural contexts, which endorse emotional expression, individuals might be better able to enhance their emotional responses compared with individuals from interdependent contexts. Indeed, when instructed to enhance their emotional responses (vs. to attend and respond naturally), European Americans showed an increased LPP amplitude for both positive and negative images. In contrast, for East Asians, there were no significant differences in LPP amplitude between the enhance and attend conditions for either positive or negative images (Varnum & Hampton, 2017).

More recent work has included Latinx samples, who tend to be more interdependent than European Americans but at the same time value emotional expression more than East Asians. For example, in one study, European Americans as well as international and first-generation Mexicans and Chinese completed an emotion regulation task similar to that used in prior work (Hampton et al., 2021). Participants viewed positive, negative, and neutral images and were asked to attend to them, suppress their emotional responses, or enhance their emotional responses. Compared with Chinese, both European Americans and Mexicans were able to enhance their physiological emotional response – as reflected by increased LPP amplitude – for positive and negative images compared with attending to the images naturally. Interestingly, Mexicans were also able to downregulate their emotional responses to positive images, as indexed by a decreased LPP amplitude. Surprisingly, Chinese did not show a significant difference for upregulating or downregulating emotional responses compared with attending to the images, which runs contrary to Murata et al. (2013) but is consistent with Varnum and Hampton (2017).

Considerable work using both fMRI and EEG suggests that emotional moderation and control may be more effortful for European Americans compared with East Asians. The findings are more mixed about whether there are cultural differences in effectiveness: Early studies suggested that East Asians were more effective at suppressing their emotions, but more recent work suggests no differences. In addition, European Americans and Latinx appear better able to upregulate or amplify their emotions than East Asians, perhaps because they value expressing emotions more than do East Asian cultural groups.

Experiential Ideals and Values

Since the early 2000s, we have examined the affective states that people value and ideally want to feel, or people's "ideal affect." Our work has been guided by Affect Valuation Theory, which argues that (1) how people actually feel (their "actual affect") is different from how people ideally want to feel (their "ideal affect"); (2) culture has a stronger influence on ideal affect than on actual affect, whereas temperament has a stronger influence on actual affect than on ideal affect; and (3) people act to achieve their ideal affect (Tsai, Knutson, & Fung, 2006; Tsai, 2007, 2017, 2024).

Our studies have revealed that although most people want to feel positive, there is variation both within and across cultures in the particular positive states people value and ideally want to feel. European Americans – who were born in the US, whose parents were born in the US or Canada, and whose grandparents were born in the US, Canada, or Western Europe – reported valuing high arousal positive states (HAP) like excitement and enthusiasm more than Hong Kong Chinese. In contrast, Hong Kong Chinese who were born and raised in Hong Kong – and whose parents and grandparents were born in Hong Kong, Taiwan, or mainland China – reported valuing low arousal positive states (LAP) like calm and peacefulness more than European Americans (Tsai et al., 2006; Tsai et al., 2007).[3] We have also shown that these cultural differences in ideal affect are related to differences in influence and adjustment goals, which stem from independent and interdependent models of self (Tsai et al., 2007).

Importantly, these differences in wanting to feel HAP and LAP have consequences for behavior. For example, they influence what consumer products people purchase (Tsai, Chim, & Sims, 2015), how much people enjoy different activities (Chim, Hogan, Fung, & Tsai, 2018), which physicians people choose (Sims & Tsai, 2015; Sims, Tsai, Koopmann-Holm, Thomas, & Goldstein et al., 2014), whom people hire (Bencharit et al., 2019), and with whom people are willing to share monetary resources (Cachia et al., 2024; Park, Blevins, Knutson, & Tsai, 2017; Park, Genevsky, Knutson, & Tsai, 2020).

We have also begun to examine how ideal affect influences how people judge others. When rating static or dynamic faces, both European Americans and Hong Kong Chinese judged faces with open, toothy "excited" smiles as more affiliative (e.g., extraverted, friendly) than faces with closed "calm" smiles. European Americans, however, rated excited smiling faces as even more affiliative than Hong Kong Chinese did, and this cultural difference was explained by valuing HAP (Tsai et al., 2019). We did not find consistent differences in ratings of competence or dominance, suggesting that cultural differences in ideal affect might be particularly relevant for judgments of affiliation.

What specific neural mechanisms underlie cultural differences in these trait judgments? Specifically, we probed mechanisms related to reward, negative affect, self-relevance, and visual attention as described earlier in the chapter. Perhaps people find smiling expressions that are congruent with their own ideal affect to be more rewarding, which would be reflected in greater activity in the ventral striatum. People might also experience less negative affect when viewing smiling expressions that match their ideal affect, which would be related to lesser activity in regions like the amygdala or anterior insula. Alternatively, people might find smiling expressions that are congruent with their own ideal affect to be more self-relevant, which would be reflected in greater activity in the MPFC. Another possibility is that people might pay more attention to these congruent smiling expressions, which would be related to greater activity in the FFA.

To test these mechanisms, we scanned European American and Chinese international students (i.e., Chinese nationals studying in the US) while they viewed excited and calm smiling faces. Afterward, once they were outside of the scanner, European Americans and Chinese made a series of trait judgments about each face they had seen. A subset of participants also completed a preference task months later, which measured how much they wanted to see excited or calm smiling faces again. We found the strongest evidence for a reward mechanism: European Americans showed greater ventral striatal activity when viewing excited (vs. calm) smiling faces compared with Chinese (Park, Tsai, Chim, Blevins, & Knutson, 2016). This cultural difference, however, was driven by the Chinese. Whereas European Americans did not distinguish between excited and calm smiling faces, Chinese showed lesser ventral striatal activity for excited (vs. calm) smiling faces.

Ventral striatal activity was also associated with trait judgments and later preferences. European Americans showed a greater ventral striatal response to excited (vs. calm) smiling faces than the Chinese did, which in turn, was associated with European Americans rating excited (vs. calm) smiling faces as more affiliative relative to Chinese (Park et al., 2018). Furthermore, across cultures, the greater ventral striatal activity European Americans and Chinese showed in response to excited (vs. calm) smiling faces, the more they preferred seeing excited (vs. calm) smiling faces months later. These findings revealed that cultural differences in ideal affect shaped reward-related neural responses to smiling faces, which had implications for how people judged those faces. We also found *no* evidence that these cultural differences were supported by mechanisms related to negative affect, self-relevance, or visual attention.

Building on this line of work, we explored whether these cultural differences in reward-related neural activity generalize to other incentives and whether they are related to meaningful social behaviors outside of the lab. We adapted a Social Incentive Delay task that distinguished the anticipation of viewing excited and calm smiling faces from the outcome of actually viewing them to address some of the limitations of previous tasks (Rademacher et al., 2010; Spreckelmeyer et al., 2009). We also administered the Monetary Incentive Delay task (Knutson, Adams, Fong, & Hommer, 2001), which distinguished between the anticipation and outcome of earning high and low monetary incentives and was the basis of our Social Incentive Delay task. After European Americans and Chinese completed these two tasks inside the scanner, we asked participants to provide information about their friends' emotional expressions on their social media profiles to see if participants' neural responses were related to their real-world relationships.

Although European Americans showed greater ventral striatal activity than Chinese when anticipating excited smiling (vs. neutral) faces, the largest cultural difference was when participants viewed excited smiling faces during the outcome phase (Figure 26.4; Blevins et al., 2023). Importantly, European Americans

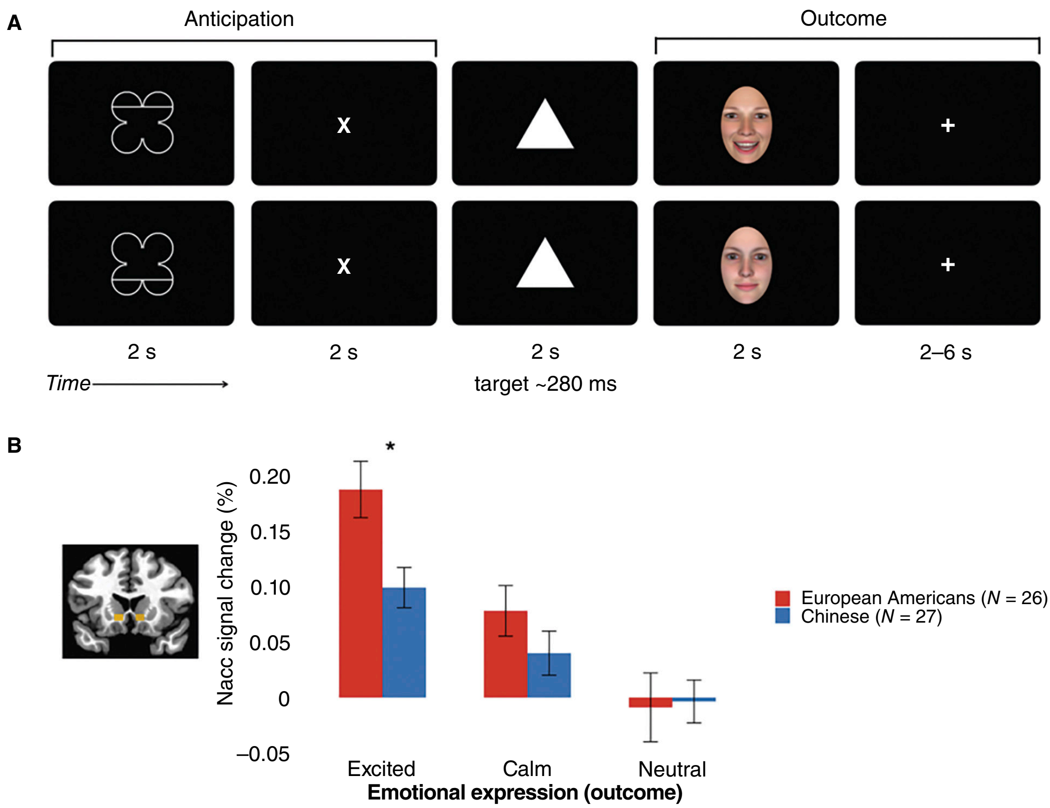

Figure 26.4 Cultural differences in neural responses to social reward outcomes. (A) Overview of trials with excited (top) and calm (bottom) smiling faces in the Social Incentive Delay task. (B) Cultural differences in nucleus accumbens (NAcc) activation during outcome. European Americans showed greater NAcc activation to excited smiling faces than did Chinese. Adapted from Blevins et al. (2023).

and Chinese did not differ in their neural responses to high intensity angry faces in the social task or to earning money in the monetary task, suggesting that the observed cultural differences in ventral striatal activity were indeed specific to excited smiles. Moreover, across cultures, participants' ventral striatal responses to excited smiling faces were associated with the number of excited friends that participants had on social media – those who showed big, toothy smiles in their profile photos – suggesting that participants' neural responses in the scanner were related to their social relationships outside of the lab.

In other work, we have examined the links between ideal affect and charitable giving to excited and calm recipients. Whereas increased ventral striatal activity predicted greater giving to recipients, decreased activity in the rTPJ predicted giving more to recipients who matched participants' ideal affect (Park et al., 2017). Because the rTPJ has been associated with detecting different beliefs and values, decreases in rTPJ activity may reflect detecting similarities. Indeed, in our sample, decreased rTPJ activity was associated with self-reports of targets' trustworthiness. This suggests that when people view others who match their ideal affect, they judge them as more trustworthy and share greater resources in part because they seem more similar in their thoughts and values.

Together, our findings suggest that culture shapes the emotions people value and ideally want to feel. These cultural differences in ideal affect influence activity in reward regions and social cognitive regions, which has implications for people's own social relationships as well as prosocial behavior. In ongoing work, we are examining whether similar neural mechanisms are involved when people have access to other information in addition to ideal affect when deciding with whom to share resources (Cachia et al., 2024; Wang, Uricher, Huang, Knutson, & Tsai, 2024). We also hope to extend this work to include Latinx and other cultural groups (Ruby, Falk, Heine, & Villa, 2012).

Current Challenges

Although research on the cultural neuroscience of emotion is continually growing, there are several challenges that researchers face (Tsai & Qu, 2018). These challenges include: (1) measurement of culture, (2) sample selection and recruitment, and (3) ecological validity of emotional tasks.

Measurement of culture

The first challenge has to do with the measurement of cultural variables, which are often dynamic and heterogeneous. For instance, the influence of specific cultural ideas on behavior may vary by situation, and therefore, differences in emotion related to those ideas may emerge in one situation but not in another. Whereas some cultural ideas and values persist over time, others may change temporarily or even permanently in response to different sociocultural events (e.g., pandemic, war), and therefore, cultural differences may be stronger in some cohorts and time periods than others. Finally, individuals' experiences of their cultures might vary as a function of other factors, such as their place of residence, socioeconomic status, or gender, and therefore, the expression of a particular cultural idea may differ along these lines. For these reasons, researchers should assess the cultural orientation of their samples, provide as much description of their samples in their studies as possible, and contextualize their findings to allow examination of variability within cultures and changes in culture over time.

Sample selection and recruitment

Given the enormous variation within cultural groups, it is critical that researchers recruit participants who are oriented to the cultures of interest. But this may be particularly difficult for studies that use neuroscientific methods. For instance, in order to use the same scanner, we recruited European American and Chinese international students who had just arrived in the US. In some of our early studies, after data collection, we realized that many of the Chinese students valued HAP as much as the European American students. We learned after speaking with participants that the Chinese who were willing to participate in fMRI studies were less afraid of scanning and valued HAP the most. Therefore, in subsequent studies, we provided additional information about scanner safety, and we translated all recruitment and screening materials into participants' native language. However, we always have to consider the possibility that people who are living abroad and those who are willing to participate in fMRI studies are different from the average members of their culture. Researchers should consider what role these factors may play in their findings.

In addition to recruiting participants from the cultures of interest, it is equally important to recruit the requisite number of participants needed to detect significant effects. It is not always clear how many participants to recruit. As we are often interested in examining differences between two cultures, a gut feeling might be to recruit twice as many participants. But what is the "right" sample size? Some of the earliest cultural neuroscience studies had samples with as few as 10 participants, but sample sizes have increased over time. It is important for researchers to consider the size of their effect and even measure it behaviorally first to better understand how many participants to recruit for resource-intensive fMRI studies.

Ecological validity of emotional tasks

A perpetual challenge is creating tasks that capture the relevant social and psychological processes within the confines of the scanning or lab environment. An added complication for cultural neuroscientists is ensuring that the tasks are meaningful and equivalent in the different cultures of interest. This is particularly concerning when examining the link between cultural models of self and emotion because the situations in which interdependence may matter may – by definition – require the presence of close others, and this is often difficult to do in the laboratory, especially in a scanning environment. One way of addressing this is to demonstrate links between neural responses during the task with behavior outside the lab, as in Blevins et al. (2023), to ensure that what researchers observe in the lab is relevant to people's daily lives.

Outstanding Scientific Questions

In addition to current challenges, there are still many unanswered scientific questions. Indeed, for each empirical pattern described earlier, there are self-report and behavioral findings whose neural correlates remain unexplored. For instance, one body of work supporting cultural differences in the focus of emotion finds that in particular situations, Westerners experience "socially disengaged" emotions such as pride and anger more than East Asians, whereas East Asians experience more "socially engaged" emotions such as respect and sympathy more than European Americans (Kitayama, Mesquita, & Karasawa, 2006; Kitayama, Park, Sevincer, Karasawa, & Uskul, 2009). Is this indeed because East Asians are thinking about others more in these situations than European Americans are? If so, one might predict that East Asians would show greater rTPJ activity in these situations than European Americans would.

Another example is related to cultural differences in experiential ideals and norms (Figure 26.1). There are cultural differences in the degree to which people value maximizing positive and minimizing negative emotions or achieving more of a balance between the two, which has consequences for people's experiences of mixed emotions (Sims et al., 2015). Recent neuroimaging research suggests that in a US sample, participants engaged more complex processing when watching mixed emotional film clips compared with positive or negative emotional clips (Murray et al., 2023). Are these findings specific to the US, where mixed emotional states are experienced less frequently and valued less? Perhaps in East Asian cultural contexts, where people experience and value more mixed emotions, viewing these mixed film clips might not require as much complex processing.

The existing research findings raise more general questions as well. Although some cultural differences in neural responses seem overall consistent across studies, others are less so. What is the source of this variability across studies? How do we make sense of findings in which there are no cultural differences in behavior, but there are cultural differences in underlying neural activity? Can we assume that those different neural responses will generalize to cases when there are behavioral differences? Conversely, what does it mean when there are differences in self-report and behavior but not in neural response? Does this diminish the significance of the cultural differences? Is it accurate to assume that they are "just" due to social desirability or self-presentation? More research will help us answer these questions.

Conclusion

Over the last decade, significant advances have been made in our understanding of cultural influences on emotion. Neuroscience methods have contributed to these advances by validating cultural differences in self-report and behavior as well as by revealing supporting neural mechanisms. But this is just the beginning, and much more work is needed to further illuminate cultural differences in emotion and their consequences for daily life, including research that samples other understudied cultures. Although there are significant challenges to doing this research, we believe we must (and will) overcome them if we want the field of affective neuroscience to be applicable across the globe.

Acknowledgments

Preparation of this chapter was supported by National Science Foundation (NSF) grant BCS 2214203 awarded to J. T. We thank Angela Yang for her help with the literature review, as well as Julie Cachia, Huan Wang, Verity Lua, Raphael Uricher, Christy Wang, Brian Knutson, and members of the Stanford Culture and Emotion Lab for their feedback on earlier drafts of this manuscript. We are grateful to the Social Psychology Program at NSF, which funded our research described in this chapter (NSF grants BCS 1324461 and 1732963).

Notes

1. Although the field of cultural neuroscience also includes research on interactions between cultural and genetic factors, due to space constraints, we do not discuss this research here. See Kitayama, Varnum, and Salvador (2019) for a review of this literature.
2. This work used positron emission tomography (PET), which is another neuroimaging method that was used early on to study emotion but has largely been replaced by fMRI because of its better spatial and temporal resolution. See Chapter 6 for the current use of PET in affective neuroscience.
3. In a recent meta-analysis of 124 datasets, cultural differences between European Americans and East Asians in self-reported ideal HAP persisted, whereas cultural differences in ideal LAP no longer emerged because European Americans have increased their valuation of LAP over time (Tsai et al., 2025).

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