CHAPTER 2

Culture and Neuroplasticity

SHINOBU KITAYAMA, JIYOUNG PARK, AND YAY-HYUNG CHO

Abstract

The last two decades of research have established substantial cultural variations in cognitive, emotional, and motivational processes along the axis of independent versus interdependent self-construal. It is not clear, however, whether these variations are due to controlled processes such as self-presentation and rule-based behavioral regulation or, alternatively, whether they reflect brain mechanisms that are spontaneously engaged and automatically executed. Here we draw on both behavioral and neuroscientific studies to show that many cultural variations occur through mechanisms that are engaged in early processing; thus they are spontaneous and automatic. We review six domains of psychological processes that are likely mediated by the construal of the self as independent or interdependent. We interpret this evidence within a theoretical framework of cultural task analysis, which holds that culture is composed of a variety of tasks designed to accomplish the culture's imperatives, such as independence and interdependence. Future research directions are discussed.

Keywords: cultural neuroscience, neuroplasticity, independence, interdependence, cultural tasks

I. INTRODUCTION

Cultures vary. We know this from numerous ethnographies and various travel reports. During the eighteenth century, de Tocqueville detailed how different America, the New World, was from France, his home country. He made numerous observations detailing differences in social behaviors, attitudes, social institutions, and folkways in the New World (de Tocqueville, 2004). Although these observations are fascinating in their own right, for

the most part, these and other similar observations are ignored in much of psychology today.

Typically, psychologists assume that psychological mechanisms are bounded and self-contained. This assumption is widely shared in many past analyses of information processing (Norman, 1969) and language (Chomsky & DiNozzi, 1972) and more recent analyses of social cognition (Gawronski & Bodenhausen, 2006), cognitive development (Carey & Spelke, 1994), and the neural dynamics that underlie a variety of cognitive and affective phenomena (Lieberman, 2007). These mechanisms are held to operate within an autonomous system of the mind. They are linked to the external world, receiving various inputs from it and generating outputs accordingly, so as to achieve adaptation and adjustment in the world. Yet according to this dominant perspective of the field, the mechanisms themselves are invariant and in large part fixed.

The overarching metaphor of the mind has always been that of a computer. Like a computer, the human mind is highly flexible, responding adaptively to various external demands and constraints. Within this metaphorical framework, variations are limited to inputs and outputs, or the *contents* of information processing. The *process* of information processing is considered invariant and shielded from external influences (Gawronski & Bodenhausen, 2006). Given this overarching assumption of the boundedness of the human mind, cultural variations in social behaviors and social institutions, including those observed by de Tocqueville, may be of little interest to psychologists because the mind, by definition, is independent of such variations.

Over the last two decades, however, there has emerged an alternative point of view of the human mind. This alternative view argues that psychological mechanisms might be more flexible and plastic than is allowed by the traditional information processing view. Values, norms, practices, and institutions of the external world may penetrate and cause changes in central aspects of the basic mechanisms of information processing (Markus & Kitayama, 1991b; Nisbett, Peng, Choi, & Norenzayan, 2001; Shweder & Sullivan, 1993). This point of view has been advanced by a group of cultural psychologists who discovered that certain psychological phenomena, such as dispositional bias in person perception (or the fundamental attribution error) (Nisbett & Ross, 1980) and self-serving bias or self-enhancement (Taylor & Brown, 1988) show substantial cultural differences (see Heine, 2012; Kitayama, Duffy, & Uchida, 2007, for reviews). These phenomena had been considered to be reflective of basic principles

within the information processing paradigm and thus to be universal across cultures. The cultural psychological work of the 1990s onward challenged the traditional paradigm by showing large cultural variation in a variety of mental faculties.

When the cultural perspective was first introduced (e.g., Triandis & Berry, 1980a, b), and even as recently as two decades ago, when this point of view was elaborated extensively (Markus & Kitayama, 1991b; Shweder & Sullivan, 1993), there was little more than initial cross-cultural evidence to corroborate the cultural plasticity perspective. However, over the last 10 years or so there have emerged numerous neuroscience findings that document substantial plasticity of the brain as a function of experience. Scholars have examined the use of tools, such as abacus (Hanakawa, Honda, Okada, Fukuyama, & Shibasaki, 2003), and the playing of video games (Kühn, Gleich, Lorenz, Lindenberger, & Gallinat, 2013) as well as daily practices, such as cab driving (Maguire et al., 2000) and meditation (Davidson et al., 2003). Although this work was not initially couched in terms of culture, tool use and daily practices can be seen as elements of culture that are combined in various ways to constitute daily social experience. This new evidence has thus generated a renewed interest in cultural influences on the plasticity of human psychological processes. Now there is a solid emergent literature of a neuroscience approach to the study of culture and psychology (Chiao & Ambady, 2007; Han et al., 2013; Kim & Sasaki, 2014; Kitayama & Park, 2010; Kitayama & Uskul, 2011).

The cultural neuroscience approach is important for three reasons. First, if one is to test the cultural plasticity thesis, neural evidence is indispensable. Differences in brain activation patterns or connectivities across different regions of the brain provide prima facie evidence for the penetration of culture into the brain. For example, we now have clear evidence of cultural variation in self-processing at the level of brain activity and connectivity (Ma et al., 2012; Zhu, Zhang, Fan, & Han, 2007). As shown further on, the cumulative evidence provided by cultural neuroscience makes a convincing case that culture makes sizable differences in patterns of brain activation for a variety of different tasks and domains.

Second, careful analysis of brain mechanisms underlying a given psychological phenomenon will shed new light on the nature of cultural variation. For example, there has been a debate regarding whether cognitive conflict is sufficient to produce various cognitive dissonance effects (E. Harmon-Jones, Amodio, & Harmon-Jones, 2009) or whether the self must be implicated

before these effects occur (Steele & Liu, 1983; Stone & Cooper, 2001). Careful analysis of intervening neural processes can provide important evidence in addressing this type of question (Kitayama, Chua, Tompson, & Han, 2013). In turn, this knowledge will be useful in discerning the nature of cultural variation in dissonance and other related phenomena, such as decision conflict and error processing, as well as the mechanisms underlying them (Hitokoto, Glazer, & Kitayama, 2014; Na & Kitayama, 2012; Park & Kitayama, 2014).

Third, and most important for our present purposes, neuroscience methods, particularly time-sensitive methods such as event-related brain potentials (ERPs), can show in what stages of processing cultural variation might occur. This type of evidence is crucial in elucidating the nature of cultural differences. It is possible, for example, that much of cultural variation in self-serving bias (e.g., weaker self-serving effects among Asians) (Heine, Lehman, Markus, & Kitayama, 1999) is due to explicit cultural norms enforcing modesty among Asians. If this were the case, we might expect to find evidence of self-serving bias in early, automatic stages of information processing regardless of cultures. Among Asians, this automatic reaction might be overridden by the culturally motivated modesty at later, more deliberate stages of information processing. Alternatively, cultural variation in self-serving bias might be due to culture-dependent plastic changes that influence self-relevant information processing from its very early stages. If so, we would expect variation even for neural indicators that are known to be highly spontaneous and, in large part, automatic and even unconscious.

Over the past several years, we have conducted several lines of cultural neuroscience research. The goal was to assess the extent to which neuroscience methods, particularly time-sensitive ERP methods, could inform us of plastic changes in brain processes. In the present article, we summarize this program of research and relate it to other relevant work in the field. On the basis of this review, we argue that cultural variations are deeply ingrained into processing pathways of the brain, to the point that many cultural variations can be observed in brain processes that are highly spontaneous and automatic. This evidence provides a strong case against a more traditional assumption that culture is a mere external overlay on the fundamental workings of the mind. Instead, culture is literally "embrained."

We begin with a theoretical framework designed to show how culture might influence psychological processes. We then review recent neuroscience evidence on cultural plasticity of the brain in several areas of research

including (1) object perception, (2) person perception, (3) prosodic processing, (4) emotion regulation, (5) social anxiety, and (6) self-enhancing motivation and optimism/pessimism. We conclude by suggesting future directions of research in this area.

II. CONCEPTUAL FRAMEWORK: LINKING CULTURE AND THE BRAIN

A. A Neurocultural Interaction Model

Culture is a collective-level phenomenon that is composed of socially shared norms and values (e.g., individualism versus collectivism), daily practices (e.g., discourse patterns in various social settings), and society-level social institutions (e.g., education systems). The values and norms are instrumental in shaping both practices and institutions, which in turn reflect, embody, and reinforce, the values and norms (Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997). These values, norms, practices, and institutions form a recurring pattern around larger themes, such as independence or interdependence (Adams & Markus, 2001). One major theoretical issue pertains to the question of how this collective-level phenomenon of culture could be related to individual-level psychological processes as well as the neural-level mechanisms underlying these processes. Developing a broad conceptual framework that is informed by the emerging neuroscience work would be extremely useful. Such a framework would provide a heuristic to guide further investigations. It would also shed some important light on the precise nature of cultural influences on the brain.

A conceptual framework, called the neuroculture interaction model (Kitayama & Uskul, 2011), illustrated in Figure 2-1, has been developed with these general goals in mind. The model is grounded on several theoretical and empirical pillars.

B. Cultural Tasks

Drawing on our earlier work (Kitayama, Park, Sevincer, Karasawa, & Uskul, 2009), the model assumes that culture is composed of a variety of tasks designed to achieve values held by a given group. For example, previous cultural psychological work established that cultural values vary widely on the dimension of independence versus interdependence or, equivalently, individualism versus collectivism (Markus & Kitayama, 1991b; Triandis, 1995). The central values of culture reflect various macro-level factors including

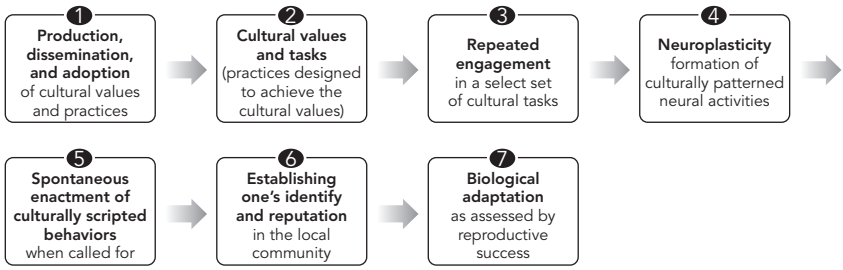


FIGURE 2-1: The neuroculture interaction model. (From Kitayama, S., & Uskul, A. K. [2011]. Culture, mind, and the brain: current evidence and future directions. *Annual Review of Psychology, 62*[1], 419–449)

ecology, subsistence, political and economic systems, pathogen prevalence, as well as physical and societal threats (Fincher, Thornhill, Murray, & Schaller, 2008; Gelfand et al., 2011; Inglehart & Baker, 2000; Talhelm, Zhang, Oishi, Shimin, Duan, Lan, & Kitayama, 2014). Over generations, each culture establishes a set of practices, conventions, and behavioral routines that are considered instrumental in achieving its central values. These activities are thought to be a means by which to achieve the culture's value (the end) and thus are called *cultural tasks*. For example, "to be unique" is a means to achieve one's independence in the comtempoary United States culture. Similarly, "to be respectful of parents" is a means to achieve interdependence in traditional Asian cultures.

Two decades of past work have suggested that in European American cultures there is a strong belief in the self as being defined by internal attributes such as attitudes, traits, and goals, which in turn are used to guide one's actions (Markus & Kitayama, 1991b). This independent construal of the self permeates daily practices, discourses, and institutions. Once engaged in a cultural world organized in terms of the independent construal of the self, individuals may be more likely to acquire certain psychological tendencies consistent with this construal. Individual members of this culture are encouraged to achieve independence by being unique, expressing their feelings and judgments, promoting their own goals, maintaining self-esteem, and so on. These cultural tasks all function to achieve the culturally valued outcome of being independent. The psychological responses fostered by these tasks would include the tendency to focus on dispositional features of another person, to assess one's well-being in reference to one's goals and desires, and to work hard on a task that one chooses.

Unlike European American cultures, Asian cultures emphasize the interdependence of the self and others. These cultures believe the self to be much more socially embedded, and significant others and key social relations are central to the definition of the self. Many daily practices, discourses, and institutions are organized in terms of this construal of the self. Asian cultures display as diverse an array of cultural tasks as do European American cultures, but the Asian cultural tasks are designed to achieve interdependence rather than independence. Typical tasks in Asia include being ordinary and compliant, not standing out, listening and absorbing what others are saying, inferring what is on others' minds, and the like. Once engaged in these cultural tasks, individuals will acquire psychological tendencies such as attending holistically to significant others, assessing one's well-being in reference to one's social self as well as others linked to it, and working hard on behalf of significant others (for reviews see Heine, 2012; Kitayama et al., 2007; Kitayama & Uskul, 2011; Markus & Kitayama, 2010).

In short, all cultural contexts offer certain tasks as a means by which to accomplish and embody pertinent values (i.e., independence for European Americans and interdependence for Asians). By performing the valued tasks well, individuals from each culture are able to establish their sense of self as, say, independent or interdependent. In this way, their self is to be culturally affirmed and vindicated.

C. Neuroplasticity

One empirical cornerstone of the neuroculture interaction model comes from recent work on neuroplasticity (Box 4 of Figure 2-1). An increasing body of neuroscientific work in the last decade has established that the neural pathways of the brain are far more plastic than previously thought. They can be formed and modified as a function of active, repetitive engagement in daily activities. The activities that have been investigated are typically behavioral, involving certain overt, concrete actions. For example, driving a cab in a complex European city (e.g., London) for an extended period of time may cause changes in the specific area of the brain implicated in spatial navigation (posterior regions of the hippocampi) (Graem et al., 1997). Because this particular region of the brain is known to shrink in size as a function of age, it would be of interest to see whether this age-related shrinkage may be negated for cabdrivers. This, in fact, appears to be the case (Maguire et al., 2000). Researchers tested London cabdrivers of varying driving experience

and observed that *anterior* regions of their hippocampi became smaller as a function of experience, which varied between 1 and 35 years. This negative association may reflect age-related shrinkage of the volume of the hippocampi. Importantly, however, the researchers observed that the *posterior* regions of the hippocampi, the regions implicated in spatial navigation, actually increased as a function of the number of years of driving experience.

Culture involves a far greater range of activities than cabdriving. Recent work has shown that many activities, including training on the abacus (Hanakawa et al., 2003), in chess (Bilalić, Kiesel, Pohl, Erb, & Grodd, 2011), juggling (Draganski et al., 2004; Scholz, Klein, Behrens, & Johansen-Berg, 2009), as well as vigorous physical exercise (Erickson et al., 2011) result in systematic changes in relevant brain regions.

Another domain of culture that also involves repetitive engagement in training-type activity is meditation. Emerging neuroscientific evidence suggests that certain meditation practices are likely to result in enhanced attentional control. That is, they may foster a mental state of expanded consciousness. For example, Tibetan monks who are highly skilled in a meditation practice involving "unconditional compassion" show a strikingly greater volume of high-frequency brain waves, called gamma waves, during meditation practice as compared with novices. The gamma waves are associated with extremely intense mental concentration on a task at hand, suggesting that mediation involves expanded forms of consciousness. Critically, the gamma waves increase as a function of the number of hours the monks have devoted to the practice (Lutz, Greischar, Rawlings, Rochard, & Davison, 2004).

More recent training studies provide converging evidence. Tang, Lu, Fan, Yang, and Posner (2012) trained novices in a meditation method called integrative body-mind training (IBMT). Originally adapted from traditional Chinese medicine, IBMT emphasizes a balance between the mind and the body and teaches the practitioner how to maintain that balance and the restful alertness that accompanies it. In the Tang et al. study, a four-week regimen of intensive training was administered to volunteers. Using diffusion tensor imaging, the researchers observed that white matter in the brain increased in volume, especially around the anterior cingulate cortex (an area involved in attention control and self-regulation), among participants in the training condition relative to both those who received relaxation training and those who did not receive any intervention because they remained on a waiting list.

D. Engagement in Cultural Tasks

If cabdriving, meditation, and the use of a variety of cultural tools systematically influence specific pathways of the brain, it is also likely that other cultural activities have similar influences (Boxes 2 and 3 of Figure 2-1). According to the neurocultural interaction model, cultural tasks serve this function. The model assumes that once born into a particular cultural context, individuals are encouraged to achieve the culture's primary values, such as independence in European American culture and interdependence in Asian culture, by engaging in some subset of available cultural tasks.

There are likely substantial individual differences in which of the available tasks people adopt as their own and around which their cultural identities are built. In some cases, certain cultural tasks might not be readily available. For example, although self-expression is a task that is recognized as a means for achieving independence in American culture at large, this recognition might be more prominent in middle-class segments of the population than in working-class segments (Stephens, Markus, & Townsend, 2007). Furthermore, even when certain tasks are equally available, some individuals may be more likely than others to actively select particular tasks as "their own." For example, Sarah may choose the task of "becoming unique" as her means to becoming independent, whereas Tom may choose a different task—say, the task of being assertive—as his means to becoming independent.

Once certain cultural tasks have been adopted as one's own means for adhering to the culture's primary values, individuals will engage in the adopted tasks actively and repeatedly. Sarah, for example, may take every opportunity to realize something unique about herself, whereas Tom may convey strong opinions whenever he is in a social setting that allows him to do so. The neuroculture interaction model hypothesizes that this active and repeated engagement with the respective cultural tasks will result in unique changes in relevant neural pathways of the brain.

E. Social Adjustment and Biological Adaptation

We have reviewed evidence that brain responses can be plastically conditioned to tasks in which individuals actively and repeatedly engage. Through this active and repeated engagement in the pertinent tasks, it will become possible for a person to carry them out in a highly spontaneous, automatic fashion (Box 5 of Figure 2-1). This point is not particularly controversial for

relatively simple practical tasks such as abacus use, video-game playing, or even driving a cab. However, similar neural consequences may be expected for cultural tasks as well. For example, the European American task of "being a unique self" (Kim & Markus, 1999) may result in a spontaneous psychological propensity to look for something unique to oneself, to attach meanings to it in a way that helps to establish one's identity as a unique individual, and then to express that unique attribute in daily life. These acts are likely performed spontaneously and are highly congruous with cultural expectations and norms in European American culture. An individual who becomes capable of perfoming these acts will be able to establish a clear identity and acquire a reputation as a respectable member of the cultural community. In this way, the cultural training of the brain is likely conducive to cultural adaptation (Box 6 of Figure 2-1).

Once one's reputation as a respectable member of the community is established, a variety of benefits in social relations, at work, and elsewhere will ensue. Eventually, the person will be able to find a desirable mate, which is most likely to result in reproducing of the next generation, thus enhancing biological adaptation as well (Box 7 of Figure 2-1). Thus our model hypothesizes that culture is an active factor that influences evolutionary change. More specifically, it is likely to influence the relative prevalence of genetic polymorphisms that facilitate cultural adaptation (Kim & Sasaki, 2014). Although this important topic is beyond the scope of this chapter, it is discussed briefly in the concluding section.

III. CULTURE AND PSYCHOLOGICAL PROCESSES: BEHAVIORAL AND NEURAL EVIDENCE

If different cultural worlds are organized by different ideas and practices and offer different sets of cultural tasks to choose from, we may also expect substantial behavioral and neural differences across cultures that are reflective of these divergent cultural worlds. The last 20 years of cultural psychological investigation have provided strong evidence for this general expectation (Fiske, Kitayama, Markus, & Nisbett, 1998; Kitayama et al., 2007; Markus & Kitayama, 2010). Importantly, recent cultural neuroscience studies have shown that these cultural variations are grounded in neural processes (Han et al., 2013; Kitayama & Uskul, 2011). This section summarizes the evidence for the expected psychological differences between Westerners (mostly European Americans) and Asians (mostly Asians in Asia but increasingly

Asian Americans) in each of several domains that have recently been investigated with neural methods.

For each domain, we will first briefly discuss theoretical rationales for expecting cultural differences as a function

of construals of the self as independent or interdependent. We will then summarize available behavioral evidence; then newer neural evidence is presented. We will also consider available evidence for the hypothesized mediation of the cultural difference by self-construal.

A. Object Perception

1. Will Self-Construal Influence Object Perception?

Independent versus interdependent self-construal may be expected to influence object perception. Independent self-construal may require the individual to focus attention on a small number of objects that are most relevant to his or her personal goals. Social cues in the surrounding environment are secondary and can even be distracting to the goal being pursued. In contrast, an interdependent self-construal may entail a more diffused, holistic allocation of attention for the detection of various elements in the social environment that signal social expectations and norms. We have therefore hypothesized that self-construal is likely to be a major precursor of focused versus holistic attention (Kitayama & Duffy, 2004; Varnum, Grossmann, Kitayama, & Nisbett, 2010). Object perception may be more context-dependent or context-sensitive in interdependent cultures than in independent cultures.

2. Behavioral Evidence

Numerous studies have provided support for the predicted cultural difference in holistic attention (see Miyamoto, 2013 for a review). In one study, for example, both American and Japanese participants were presented with a video vignette of an underwater scene wherein a few large fish (the focal objects) were swimming from right to left, with a variety of smaller objects depicted in the background (Masuda & Nisbett, 2001). When asked to remember what they had seen in the vignette, American participants referred to the central fish first, elaborating on their shapes and other features, before moving on to comment on contextual elements (e.g., the color of the water, small insects, rocks). In contrast, Asian participants first commented on the background, as if it set the stage to describe the main objects (the fish). In their subsequent study, the researchers examined

context-dependent memory. If Asians pay more attention to the background in which the central objects are embedded, the memory of the central objects may be closely associated with (or "binded" to) the background for Asians. For Americans, this may not be the case. Results from the study showed that this was in fact the case. Recognition memory of a central object was significantly worse for Asians when the object was paired with a novel background than it was for Americans. Subsequent studies have also shown that Asians are more likely than Americans to take note of subtle changes occurring in the background scene (Masuda & Nisbett, 2006).

Similar cultural differences can be found even when geometric figures are used as stimuli. Kitayama and colleagues show that as compared with Asians, Americans are more capable of drawing lines of the same length within square frames of different sizes (absolute task). But as compared with Americans, Asians are more capable of drawing a line that is proportional to the height of the square frames of varying sizes (relative task) (Kitayama et al., 2009; Kitayama, Duffy, Kawamura, & Larsen, 2003). Similarly, if attention is more holistic and more widely distributed to the surrounding context, individuals may be susceptible to the Ebbinghaus illusion. In this illusion, a target circle is surrounded by a set of circles that are either bigger or smaller than the target. The size of the target circle is judged to be larger when surrounded by small (versus large) circles. Doherty and colleagues found that this illusion is stronger in magnitude for Japanese than for British participants (Doherty, Tsuji, & Phillips, 2008). Similar cultural differences have been documented with young, school-age children (Duffy, Toriyama, Itakura, & Kitayama, 2009; Imada, Carlson, & Itakura, 2012).

An analogous cultural difference in context sensitivity has been shown with respect to perceptual judgment of an emotion expressed by a target person who is surrounded by other individuals with different emotional expressions. Japanese were more likely than European Americans to judge the target to be happier, for example, if the target was surrounded by other individuals who also showed happiness (versus anger) on their faces (Masuda et al., 2008). A study by Chua, Boland, and Nisbett (2005) suggests that this cultural difference is likely mediated by the greater tendency of Asians (versus European Americans) to distribute their gaze more broadly over to the surroundings of a focal object (but also see Rayner, Castelhano, & Yang, 2009).

In all of the studies reviewed here, context sensitivity is assessed with visual stimuli. Duffy and Kitayama (2010) argued that relevant context could be mnemonic. It is known that in judging the size of a stimulus (e.g., a circle),

individuals refer back to memory representations of other stimuli belonging to the same category (i.e., circle) and use this mnemonic context to inform the perception of the impinging stimulus (Huttenlocher, Hedges, & Vevea, 2000). Thus, when individuals are shown a series of circles of varying size and asked to judge the size of each circle, their judgments tend to be assimilated into the average size of the circles that have been presented in preceding trials. Consistent with the cultural differences in visual perception (e.g., Masuda et al., 2008), Duffy and Kitayama (2010) found that this mnemonic context effect is larger in magnitude for Japanese than for European Americans.

To date, only scant evidence is available outside of Asia and North America. However, one study shows that seminomadic people in Sub-Saharan Africa (the Himba) are less susceptible to the Ebbinghaus illusion relative to British subjects (de Fockert, Davidoff, Fagot, Parron, & Goldstein, 2007). A subsequent study conceptually replicated this finding with a modified version of a flanker task (de Fockert, Caparos, Linnell, & Davidoff, 2011). De Fockert and colleagues attributed the observed cultural difference to the putative tendency of the Himba to prioritize perceptual analysis of local components over global integration of the components. Exposure to modernized complex environments may be necessary to induce the global processing tendency (de Fockert et al., 2011; but also see Miyamoto, Nisbett, & Masuda, 2006). Another possibility is that the nomadic lifestyle—featuring herding and a less heavily coordinated social life—is associated with more focused (versus holistic) attention (Uskul, Kitayama, & Nisbett, 2008), which may result in a lesser context effect.

3. Neural Evidence

In one of the first functional magnetic resonance imaging (fMRI) studies examining cultural differences in perception, Gutchess and colleagues (Gutchess, Welsh, Boduroğlu, & Park, 2006) examined whether European Americans and Asian-born Asian college students in the United States would show different brain activation patterns when looking at an object (e.g., an elephant) placed against a meaningful background (e.g., savanna). Participants saw such scenes while making a judgment on the attractiveness of each scene. The researchers first identified regions of the brain that were activated more when only an object was presented (relative to when only a background was presented), called the object-processing area, as well as regions of the brain that were activated more when only a background was presented (relative to when only an object was presented), called the background-processing area.

They then examined the activity of both the object-processing and background-processing areas when a scene composed of both the object and the background (e.g., an elephant in the savanna) was presented. Supporting the notion that as compared with Asians, European Americans preferentially process a central object in lieu of its context, several regions within the object-processing area (e.g., left superior parietal cortex, left middle temporal cortex, right superior temporal gyrus) were more strongly activated for European Americans than for Asians. In contrast, very few cultural differences were observed for the background-processing area.

A recent study (Kitayama & Murata, 2013) using ERPs has conceptually replicated the findings of Gutchess et al. (2006). European Americans and Asian Americans were presented with a series of a standard stimulus (a tiger in meadow) on a computer screen. Interspersed in the series was a low-frequency target (a white coffee mug presented against the same background), which was shown in only 15% of the trials (see Figure 2-2A). Participants were asked to press a key as quickly as possible when the target appeared on the computer screen. The researchers examined three ERP components that were expected to occur when people processed the target. First, when the target was presented, individuals would take note of the difference between the target and the high-frequency standard stimulus. This recognition of difference occurs quite early in bottom-up processing and is captured by a negative spike that occurs approximately 200 ms after the presentation of the target (called N2) (Näätänen, 1992). Shortly afterward, top-down attention is applied to the target to categorize it as the target to be detected. This top-down attention is indicated by a large positive deflection that typically occurs approximately 300 ms poststimulus (called P3) (Kok, 2001). This positivity can be prolonged, especially when the target continues to be processed, with cognitive elaborations performed on the stimulus. This prolonged positivity is called slow wave (SW) (Rösler & Heil, 1991). Whereas N2 is typically observed in frontal regions, both P3 and SW are seen in parietal or occipital regions.

Figure 2-2B shows waveforms for the target (relative to those of the standard). Clear N2 is evident in anterior regions (i.e., frontal and central electrodes, Fz and Cz). Moreover, this component was significantly greater for European Americans (suggesting their enhanced early processing of the target) than for Asian Americans. Next, P3 is evident in posterior (i.e., parietal and occipital) electrodes (Pz and Oz). There was some indication that P3 was greater for European Americans than for Asian Americans at the occipital electrode (Oz), but this difference did not reach statistical significance.

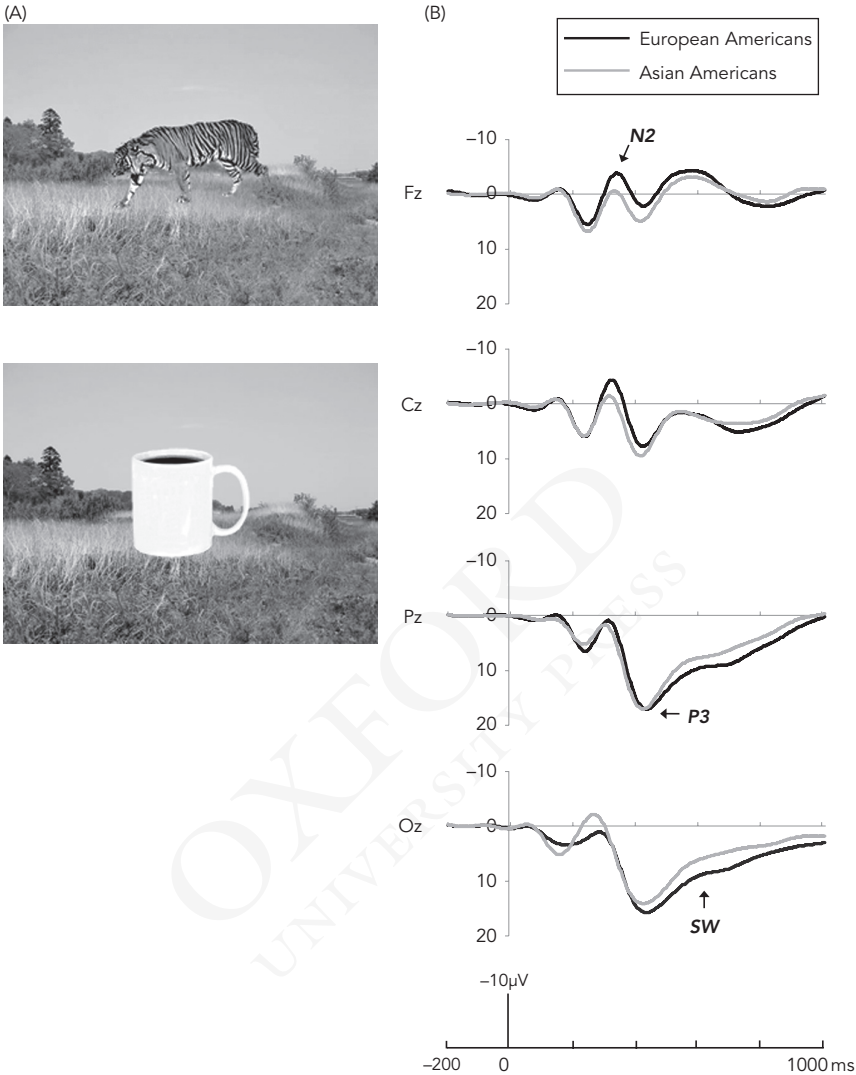


FIGURE 2-2: (A) A stand target (a tiger in a meadow) and a low-frequency target (a white mug presented against the same background) used in Kitayama and Murata (2013). (B) The different ERP waveforms obtained by subtracting ERPs elicited by the standard from those elicited by the target at the four midline electrode sites (Fz, Cz, Pz, and Oz) for European Americans and Asians. (Adapted from Kitayama, S., & Murata, A. [2013]. Culture modulates perceptual attention: an event-related potential study. *Social Cognition, 31*[6], 758–769)

Finally, there was clear SW around the same region (Oz). This component was significantly greater for European Americans, indicating their prolonged processing of the target, as compared with Asian Americans. Consistent with the Gutchess et al. (2006) study discussed above, the Kitayama and Murata findings suggest that as compared with Asians, European Americans allocated greater neural resources to the processing of a focal target stimulus. Importantly, the ERP method enabled the researchers to establish that this cultural difference appears quite early in processing, as early as 200 ms poststimulus.

Another interesting way of assessing the degree of stimulus processing is to examine how much adaptation might occur after multiple presentations of the same stimulus. For example, as previously discussed in connection with the Gutchess et al. (2006) study, when a picture of an elephant is presented for the first time, it activates regions within the object-processing area. That activation, however, will decrease when the same stimulus is repeatedly presented. This adaptation effect may be more pronounced if more processing is performed on the object initially. That idea was tested in a recent study in which both European Americans and East Asians were asked to passively view a series of four pictures (Goh et al., 2007). A pronounced cultural difference was observed when the same object (e.g., an elephant) was presented four times. The adaptation effect (i.e., reduced activation of the object-processing area) was more pronounced for European Americans than for Asians, suggesting that more processing resources were allocated to the object initially. This pattern is in line with the findings of both Gutchess et al. (2006) and Kitayama and Murata (2013). Unlike these investigators, however, Goh et al. (2007) found that the cultural difference was evident only among older (versus younger) participants. It is not clear why Goh et al. found no cultural difference among younger participants.

Interestingly, neither Goh et al. (2007) nor Gutchess et al. (2006) found any cultural difference in the background processing (Kitayama & Murata, 2013, did not address this issue). This null finding is puzzling, given behavioral evidence showing cultural difference in background processing (e.g., Kitayama et al., 2003; Masuda & Nisbett, 2001). However, another recent study provides a possible solution to this puzzle. Jenkins and colleagues (2010) scanned European Americans and Chinese participants as they passively viewed a set of pictures in which a focal object was embedded within either congruent or incongruent background scenes. Chinese participants, as compared with European Americans, showed a greater adaptation effect

(i.e., reduced activation of the object-processing area; lateral occipital complex) when incongruent (versus congruent) scenes were presented. This finding suggests that relative to European Americans, Asians are more likely to use contextual information to modulate attention to the central object. More attention is allocated to the object if it is embedded in an incongruous (versus congruous) context. This results in a greater adaptation effect in the object-processing area. It is of interest that a comparable adaptation effect for context was higher in the congruous (versus incongruous) condition regardless of culture. This means that Chinese participants did not process context any more deeply than American participants did. Chinese instead were more adept at utilizing contextual incongruity in increasing the object processing.

The possibility that Asians may be especially sensitive to semantic incongruity between an object and its context has also been demonstrated with EPRs (Goto, Ando, Huang, Yee, & Lewis, 2010). European Americans and Asian Americans were presented with a background scene (e.g., a beach) for 300 ms, followed by an either congruous (e.g., a crab) or incongruous (e.g., an automobile) object superimposed on the background for 300 ms. Participants were asked to judge whether the object was animate or inanimate. Previous work suggests that a semantic incongruity like this elicits an ERP component called N400—a prominent negative deflection that occurs approximately 400 ms poststimulus (Kutas & Hillyard, 1989). If individuals pay close attention to the background, they may respond more strongly when an incongruous object is presented. In support of the hypothesis that as compared with European Americans, Asians are more likely to use contextual information, N400 was significantly greater for Asian Americans than for European Americans. In this study, the researchers also assessed independent versus interdependent self-construal and found that the N400 incongruity effect becomes weaker as a function of independent self-construal, which suggests that individuals with independent self-construal tend to be relatively oblivious to contextextual information. This finding has been replicated with affective materials (an emotional face embedded in an affective scene) (Goto, Yee, Lowenberg, & Lewis, 2013).

As noted earlier, Masuda and Nisbett (2001) had provided initial support for the hypothesis that in encoding a target object, Asians are more likely than European Americans to bind the object to its surrounding context. In a recent study, Masuda and colleagues (2014) went a step further by examining ERPs during the recognition test. They observed that relative to European Canadians, Asians showed a stronger N400 ERP signal when the target was

presented in a new (versus the old) context during the recognition. Moreover, among Asians (but not European Canadians), the magnitude of N400 predicted poor recognition performance, suggesting that the detection of incongruous context (as indexed by the N400 ERP signal) causes confusions in the recognition judgment for Asians.

Drawing on earlier behavioral work by Kitayama and colleagues (2003), Hedden and colleagues scanned participants as they performed either a judgment of a line independent of a surrounding square frame (absolute judgment) or a judgment of the line that is proportional to the height of the square (relative judgment) (Hedden, Ketay, Aron, Markus, & Gabrieli, 2008). The tasks were either very easy (because the two squares were identical in size) or difficult (because the squares were of different sizes). The investigators found that frontal-parietal brain regions involved in attention were recruited when the judgments were difficult. But this effect was observed only when the participants performed culturally non-preferred tasks—namely, when European Americans performed the relative judgment task and when Asian Americans performed the absolute judgment task. This finding has since been replicated with a different neuroimaging method (functional Near Infrared Spectorscopy, fNIRS, Murata, Park, Kovelman, & Kitayama, 2014). Consistent with the hypothesis that independently oriented people do not require extra-attention to ignore context, Hedden et al. (2008) found that the activation of the attention network during the absolute task decreased as a function of independent self-construal among European Americans. Among Asian Americans, this activation decreased as a function of the degree of acculturation to the US culture.

4. *Mediation by Self-Construal*

Two studies provide evidence for the prediction that holistic attention depends on independent versus interdependent self-construal. First, as noted above, Goto and colleagues (2010) found that the sensitivity to incongruous context assessed with N400 becomes weaker as a function of independent self-construal. Second, Hedden and colleagues (2008) found that brain activity indicative of attention used to ignore contextual information (in the absolute judgment condition) declines as a function of independent self-construal (for European Americans) and acculturation to the US culture (for Asian Americans). Independent self-construal appears to enhance the ability to filter out context that needs to be ignored.

Theoretically speaking, it would also be expected that attention paid to a focal object for European Americans, observed with both fMRI (Gutchess et al., 2006) and ERPs (Kitayama & Murata, 2013), should become more pronounced as a function of independent self-construal. At present, no evidence is available for these expectations. Nor is there any evidence connecting interdepdendence to holistic attention.

B. Person Perception

1. Will Self-Construal Influence Person Perception?

Independent versus interdependent self-construal may influence perception even when the target of perception is a person, not a physical object. Individuals with independent self-construal (e.g., European Americans) will focus on a target person and categorize the person in terms of his or her traits, attitudes, or other internal attributes or dispositions. Even when contextual factors exist, such as situational influences on the person's behavior, individuals with independent self-construal will be relatively oblivious to these contextual factors. In contrast, those with interdependent self-construal (e.g., Asians) will be more attentive to such situational factors and take them into account in perceiving the target person.

2. Behavioral Evidence

The prediction that European Americans will be more likely than Asians to make inferences about another person's dispositions has received substantial support over the last two decades. In an initial demonstration, Miller (1984) found that when asked to explain another person's behavior, European Americans are more likely than Indians in India to make dispositional inferences. Ten years later, another study demonstrated a greater tendency to form dispositional (versus situational) judgment in causal attributions among European Americans than among Chinese (Morris & Peng, 1994). Similar findings have since been reported in numerous studies (Kitayama et al., 2009).

Another paradigm widely used to investigate the dispositional bias in person perception and person inference involves attitude inference. In the typical study, participants are asked to read an essay supporting a political position. They are informed that the writer of the essay was asked to write it under certain social constraint (e.g., being asked to argue for the particular position by a professor of a course for which the essay was allegedly a

requirement). They are then asked to infer the real attitude of the essay writer. Numerous studies tested Americans and demonstrated that they inferred the attitude corresponding to the essay content. Thus it appears that they underestimated the potential role of the situational constraint (e.g., being asked by a professor of a course in the example above) (Jones, 1979). This effect, called the correspondence bias, is a variant of the dispositional bias in attribution.

At first glance, this phenomenon might seem trivial, because the social constraint noted above (i.e., a request by a professor) seems rather weak. Moreover, the constraint information is somewhat ambiguous, allowing for a variety of interpretations. The professor, for example, might have asked the essay writer to endorse a particular political position because he had known that the writer's general political attitudes were congruous with such a position. Importantly, however, subsequent studies have shown that Americans do not completely discount the content of the target person's behavior (the essay content in the above example) even when the social pressure is made blatantly obvious. For example, in one study, participants were asked to play the role of "experimenters" and to ask a target person (a stooge of the experiment) to endorse a certain attitude on a completely arbitrary basis. From the participants' point of view, it should have been obvious that the target person's behavior was strongly constrained by the participants' own requests to endorse a particular position. However, when asked to infer the real attitude of the target after observing the target's behavior, the participants still inferred the target's attitude to correspond with his or her behavior (Gilbert & Jones, 1986).

Given the propensity of Asians to attend relatively more to situational factors (vis-à-vis dispositions) in understanding another person's behavior, the correspondence bias may be weaker among them. This prediction has received support with one caveat. Recall that the type of situational constraint used in the original attitude inference paradigm (e.g., a request by a professor) was rather weak and potentially ambiguous. When this type of procedure is used, Asians do appear to infer attitudes corresponding to the behavior of a target person, just as European Americans did (Choi & Nisbett, 1998; Krull et al., 1999; Miyamoto & Kitayama, 2002). Importantly, however, once the situational constraint is made salient (either by having participants experience it at first hand or by using the perceiver-induced constraint procedure by Gilbert and Jones discussed previously), Asians show little or no correspondent inferences (Choi & Nisbett, 1998; Masuda & Kitayama, 2004).

The case for dispositional bias among European Americans is so strong and compelling that some researchers have suggested that dispositional

inferences may be drawn from a behavior *spontaneously* even when there is no need to make any such inferences (Uleman, Saribay, & Gonzalez, 2008). However, as noted previously, Asians show no evidence of dispositional inferences once situational constraints on the actor are made salient (Choi & Nisbett, 1998; Masuda & Kitayama, 2004; Miyamoto & Kitayama, 2002). Given this evidence, one may expect that in observing another person's behavior, Asians may be unlikely to spontaneously draw any dispositional inferences about the target person.

A recent study has provided evidence for this cross-cultural prediction (Na & Kitayama, 2011). Following earlier work by Uleman and colleagues (2008), the researchers used a memory procedure to assess the extent to which individuals spontaneously infer another person's disposition. European American and Asian American participants were first asked to memorize pairs of face and trait-implying behaviors (e.g., "She checks the battery of her smoke detector every night before going to bed," implying a trait of *cautiousness*). Although there is no instruction to infer the implied trait ("cautious" in this example), European Americans may be expected to draw such inferences spontaneously. For these participants, then, a trait will be attached to or incorporated into the representation of the face that was paired with the behavior. Accordingly when the face is shown again at a later point, it may automatically activate the trait concept in memory. In contrast, Asians may not infer the corresponding trait unless asked to do so. Thus when the face is shown again at a later point, it should not activate the corresponding trait concept in memory.

To test these predictions, Na and Kitayama (2011) used a lexical judgment task. Participants were shown one of the faces used in the memorization task briefly as a fixation, which was followed by either a trait word corresponding to the behavior that was paired with the face ("cautious"), a trait word unrelated to the behavior (e.g., "outgoing"), or a nonword (e.g., "strasse"). They were asked to judge whether the letter sequence signified a legitimate English word or not. As expected, there was a significant reduction of reaction time among European Americans in the lexical judgment task when the target word corresponded to the face-paired behavior (versus when it was unrelated to the behavior). This finding implies that European Americans spontaneously inferred the corresponding trait and attached it to the target during the memorization phase of the study. As also expected, there was no such priming effect among Asian Americans. For this latter group of participants, trait inference was not spontaneous.

3. Neural Evidence

Although much of the evidence for the cultural difference in causal attribution is limited to behavioral domains, a few recent studies provide initial neural evidence pointing to the same conclusion. Han and colleagues examined causal attribution of physical events between Americans and Chinese. Since prior behavioral evidence shows that contextual processing is more likely to be engaged for Asians than for European Americans, it may be anticipated that Chinese would recruit regions of the brain that are dedicated to contextual processing more than European Americans would (Han, Mao, Qin, Friederici, & Ge, 2011).

Participants were presented with movements of several balls, one of which was a target. Using fMRI, the researchers first identified regions of the brain that were activated more when a causal judgment was requested for the target ball ("Why is it moving this way?"), relative to when a movement judgment was requested for it ("In what direction is it moving?"). Several regions, including medial prefrontal cortex (mPFC) and left inferior parietal cortex (left IPC), were identified. Among these regions, left IPC showed greater activity when the remaining balls (context) showed complex movements. From these findings, the researchers hypothesized that the mPFC area is recruited in causal judgment in general, but the left IPC area is more dedicated to contextual processing, consistent with earlier findings showing greater involvement of parietal regions in spatial processing (Husain & Nachev, 2007). Next, when the researchers tested culture effects, two important findings came out. First, mPFC was recruited more in the causality judgment (relative to the direction judgment) regardless of culture, suggesting that more executive attention is required for causal (versus directional) judgment for both Americans and Chinese. Second, however, left IPC was recruited more by Chinese than by Americans during the causality judgment, suggesting that Chinese (versus Americans) spontaneously engaged a greater amount of contextual processing.[1]

1. The *greater* recruitment of the context area (parietal regions) by Asians for causality judgment in the Han et al. (2011) study might seem puzzling in view of the Hedden et al. (2008) study discussed earlier. In the latter study, as compared with European Americans, Asians recruited regions involved in attention (including the parietal areas) *less* in making a judgment of a line relative to the height of a surrounding square. However, in the Hedden et al. study, participants were required to take context into account in reaching the correct response (i.e., judging the length of the line relative to the surrounding square). Thus this study suggests that compared with European Americans, Asians

We noted previously the finding by Na and Kitayama (2011) that European Americans are more likely than Asian Americans to spontaneously infer dispositions from another person's behavior. In that study, the researchers used response time for lexical judgment as an index of spontaneous trait inference. In their follow-up study (Study 2 in Na & Kitayama, 2011), they used an ERP component as a neural indicator of spontaneous trait inference. As in their Study 1 reviewed previously, participants went through memorization of a large number of face-behavior pairs. Subsequently, they were given a lexical judgment task where they were briefly exposed to one of the faces used during the memorization task as a fixation. Shortly after the presentation of the face, a letter sequence was presented. Participants were to perform a lexical judgment on the sequence. The word sequence was either a trait word corresponding to the behavior paired with the face, its antonym, or a nonword. The expectation was that if the corresponding trait was spontaneously inferred, the face should activate the trait during the lexical judgment. Thus, when the face image was followed by an antonym of the trait word corresponding to the behavior paired with the fact, the antonym should elicit N400, an ERP signal, noted above, indexing the detection of a semantic incongruity. As shown in Figure 2-3A, this in fact was the case for European Americans. There was a significantly greater N400 in the antonym condition than in the implied trait condition for these participants. However, this evidence for spontaneous trait inference was completely absent among Asian Americans.

4. Mediation by Self-Construal

Will dispositional inferences be significantly greater as a function of one's independent self-construal or, conversely, will they be significantly weaker as a function of one's interdependent self-construal? Surprisingly, there is virtually no evidence for this anticipated relationship between independent and interdependent self-construals among numerous cross-cultural

process contextual information more effectively when this processing is required. In contrast, in the Han et al. (2011) study, participants were not required to take context into account. Thus this study suggests that compared with European Americans, Asians attend to context more when there is no need to do so. Future work should use the Han et al. procedure and make it explicitly necessary to take context into account in reaching a causality judgment (e.g., "Explain exactly how surrounding balls might have caused influences [e.g., attracted, repelled, pushed, pulled, etc.] on the target ball"). Under such conditions, compared with European Americans, Asians might be able to perform this judgment more effectively without recruiting the context-processing regions.

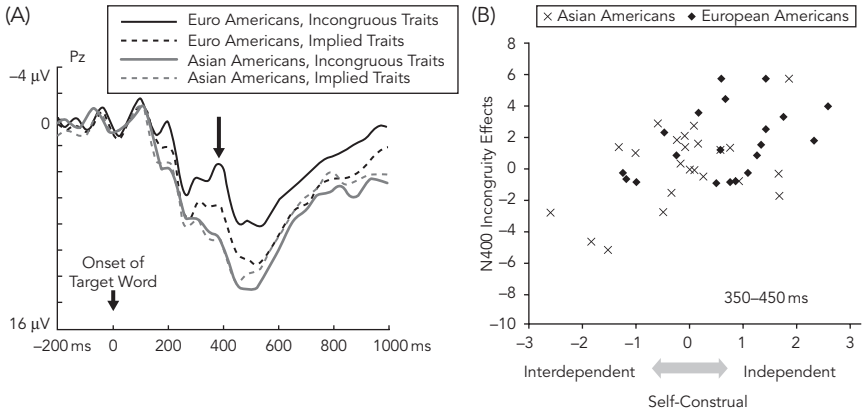


FIGURE 2-3: (A) Grand-averaged ERPs at electrode Pz for incongruous traits and implied traits for European Americans and Asian Americans. (B) The scatterplot with independent versus interdependent self-construal on the X axis and the N400 incongruity effect (N400 during the implied-trait trials minus N400 during the incongruous trait trials) during the time window of 350 to 450 ms after the onset of the target word on the Y axis. (Both figures adapted from Na, J., & Kitayama, S. [2011]. Spontaneous trait inference is culture-specific: behavioral and neural evidence. *Psychological Science*, *22*(8), 1025–1032).

behavioral studies. At least one behavioral study tested these correlations and found that there was no correlation between a tendency to draw dispositional (versus situational) attributions and independent or interdependent self-construal (Kitayama et al., 2009). Interestingly, however, the ERP study testing the expected cultural difference in spontaneous trait inference (Na & Kitayama, 2011) found a significant relationship between the ERP marker of spontaneous trait inference (a greater N400 for the antonym of a trait word corresponding to a behavior paired with a priming face, relative to the corresponding N400 elicited by the corresponding trait) and self-construal. That is, the ERP effect of spontaneous trait inference became stronger as a function of independent (versus interdependent) self-construal and, in fact, the cultural difference in this ERP effect was mediated by self-construal (see Figure 2-3B).

C. Prosody in Verbal Communication

1. Will Self-Construal Influence Prosodic Processing?

Given independent self-construal, one's own thought is considered bounded within the self. The thought will therefore have to be communicated explicitly to others. Accordingly, individuals will tend to be reliant on verbal content and

relatively less dependent on contextual paralinguistic cues. This type of communication is called "low context" (Hall, 1977). At first glance, the assumption that information is private and not shared might seem self-evident. However, this in fact is a cultural belief that is grounded in the view of the self as independent. Given interdependent self-construal, individuals in a relationship are considered related and connected; as a consequence, people may assume that information is shared among the individuals. When information is perceived as shared, there is less need to make any explicit statements in verbal communication. Instead, the listener of a communication will use contextual cues to make the best guess about what the communicator might have in mind. This type of communication is called "high context" (Hall, 1977), because of its reliance on contextual, paralinguistic cues in communication.

Among numerous contextual, paralinguistic cues, we focus on one type of cue that always exists in social communication: that is, prosody or vocal tone. We expect that depending on self-construal, individuals may vary in the extent to which they allocate attentional resources to vocal tone in the processing of verbal communication. Those with interdependent construals will be more likely than those with independent construals to attend to vocal tone and take that into account in inferering the speaker's communicative intent.

2. Behavioral Evidence

Attentional attunement to vocal tone versus verbal content has been investigated with a modified Stroop paradigm (Ishii, Reyes, & Kitayama, 2003; Kitayama & Ishii, 2002). In this paradigm, participants are exposed to a series of spoken words that vary systematically in both evaluative meaning (positive versus negative) and vocal tone (positive versus negative). In one condition, participants are asked to ignore vocal tone and judge the evaluative meaning of the word as positive or negative. Under this condition, both response accuracy and response speed may suffer if the vocal tone is incongruous (e.g., "ugly" is spoken in a positive tone or "beautiful" is spoken in a negative tone); moreover, this effect should be stronger for those who are chronically attuned to vocal tone. Consistent with this analysis, Asians show substantially greater interference effects of this sort as compared with European Americans. In another condition, participants are asked to ignore verbal meaning and judge the evaluative tone of the voice as positive or negative. Under this condition, it is now European Americans who show greater interference effects because they are much more attuned to verbal content than Asians.

The attentional attunement to verbal content appears to generalize to emotional facial expressions (which, like words, are believed to express what one has in mind) (Tanaka et al., 2010). Tanaka and colleagues presented both Japanese and Dutch participants with video clips that showed different facial expressions accompanied by a voice that varied in emotional tone. Whereas interference by the vocal tone in a judgment of facial expression was reliably larger for Japanese than for Dutch participants, interference by facial expression in a judgment of voice tone was reliably larger for Dutch than for Japanese participants.

3. Neural Evidence

When asked to judge the evaluative meaning of an emotional word spoken in an emotionally incongruous tone, individuals will have no problem carrying out this task if they are not attentive to the vocal tone. However, to the extent that their attention is automatically deployed to the vocal tone, they are likely to note the incongruence, which in turn will elicit strong N400-like negativity. We say "N400-like" because N400 is typically observed for visually presented verbal materials. Because it likely takes a longer time to process spoken words, the latency (which is typically 400 ms poststimulus on the visual mode) may be prolonged on the auditory mode.

Several studies conducted in Germany examined ERP signals to vocal incongruity and observed that the late negativity in response to vocal incongruity tends to be larger for females than for males (Schirmer & Kotz, 2003; Schirmer, Kotz, & Friederici, 2005). Because females tend to be more interdependent than males (Cross & Madson, 1997), the finding is consistent with the hypothesis that attentional attunement to vocal tone increases as a function of interdependent self-construal.[2]

Another recent study tested whether the N400-like negativity to incongruous vocal tone might be observed among Japanese (Ishii, Kobayashi, & Kitayama, 2010). Japanese participants (both males and females) were presented with a series of emotional words that were spoken

2. Interestingly, when a sad (rather than positive) voice was used, the N400-like negativity to vocal incongruity (i.e., positive words such as "love" and "beautiful" spoken in sad voice) seems to disappear, at least in one study (Schirmer et al., 2006). Instead, a comparable effect was observed in a late-positivity component that follows the N400-like negativity. At present, it is not clear why this might be the case.

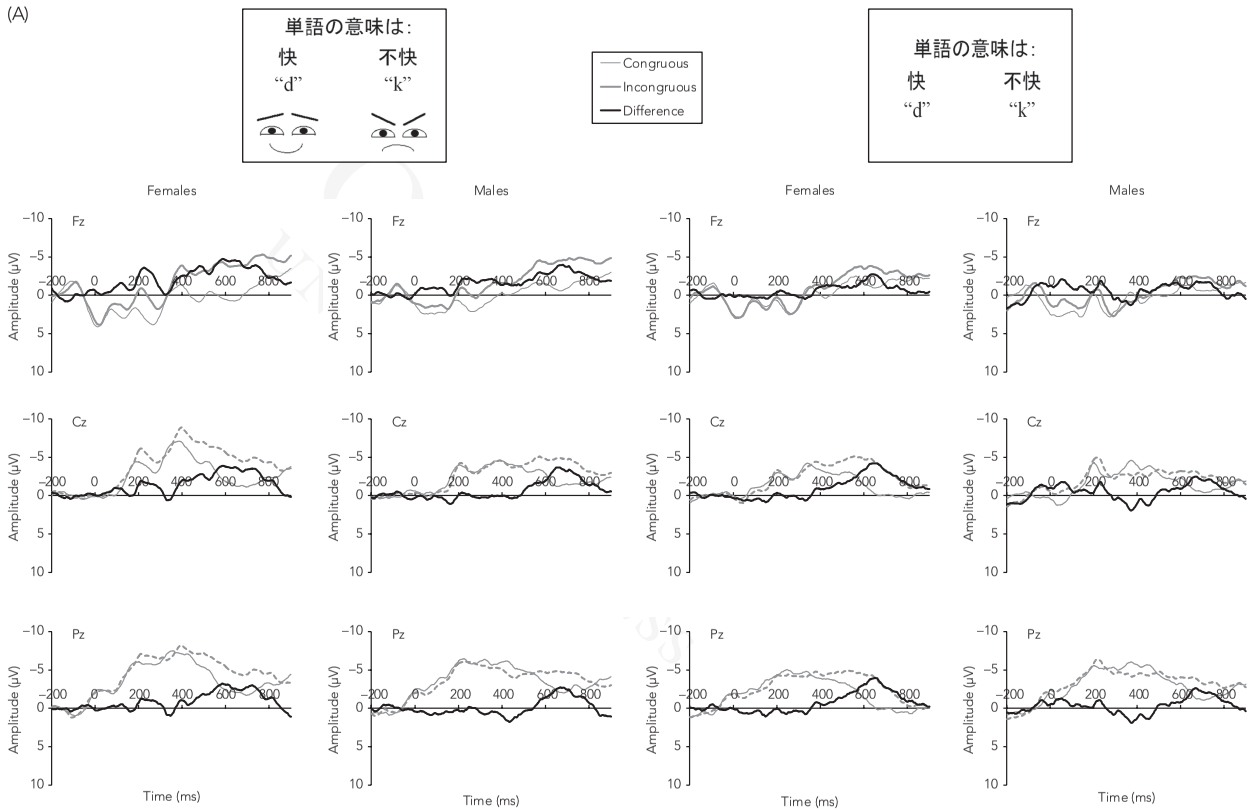
in either emotionally congruous or incongruous tones. Furthermore, while listening to the words, half of the participants were exposed to two schematic faces that were presented inconspicuously as part of the response scale while the remaining half were not (see Figure 2-4A). The researchers expected that vocal sensitivity would increase in social situations cued by the "watching faces."

Figure 2-4A shows waveforms in the face versus nonface conditions separately for males and females. Most relevant are the waveforms (designated in black) that signify the relative magnitude of negativity for the incongruous (versus congruous) stimuli. First, there is a gender effect around 450 to 600 ms at central and posterior electrodes (Cz and Pz). As summarized in Figure 2-4B, incongruity was associated with greater N400-like negativity; but this effect was more pronounced for females than for males, consistent with the study of Schirmer et al. (2006) noted earlier. Furthermore, as evident from Figure 2-4B, the magnitude of the incongruity effect for females was approximately equal regardless of the two valence combinations. Ishii et al. (2010) also found a reliable effect of incidental exposure to schematic faces. As predicted by the hypothesis that vocal sensitivity is enhanced in social (versus nonsocial) situations, the 400-like negativity to vocal incongruity was significantly stronger in the face condition than in the nonface condition, which was most evident in the frontal electrode (Fz; Figure 2-4C). Again, as shown in Figure 2-4C, the magnitude of the incongruity effect in the face condition was no different for the two valence combinations.

4. Mediation by Self-Construal

Only the Ishii et al. (2010) study examined this issue, with evidence suggesting that interdependent self-construal is likely to increase attention to vocal tone. Interestingly, interdependent self-construal predicted the 400-like negativity in the face condition but not in the nonface condition. Furthermore, the effect of interdependence on the N400-like negativity was evident for females but not for males. The authors interpreted this pattern to suggest that the effect of interdependent self-construal might be stronger when the situation is construed as social. Incidental exposure to face stimuli might make such a construal more likely. Moreover, females might entertain that construal more than males. Further research is required to address these interpretations.

(A)


単語の意味は:
快
不快
“d”
“k”
Congruous
Incongruous
Difference
単語の意味は:
快
不快
“d”
“k”
Females
Males
Females
Males
Fz
Cz
Pz
Amplitude (μV)
Time (ms)

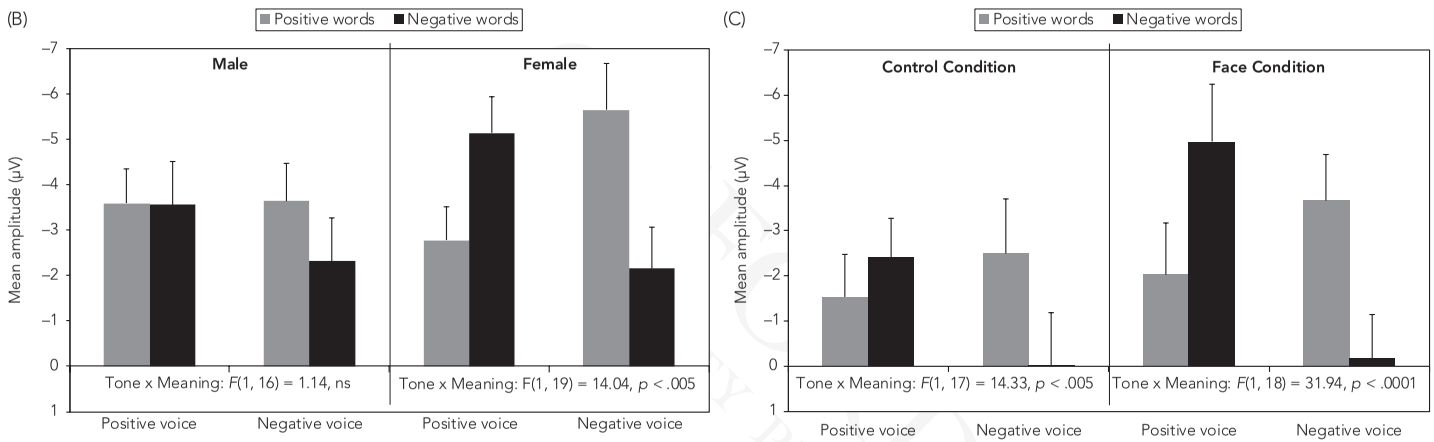


FIGURE 2-4: (A) ERP waveforms in the face condition (left) and the control condition (right) by male and female participants in Ishii et al. (2010). (B) The greater incongruity effect (the relative magnitude of N400-like negativity for the incongruent versus congruent stimuli) at electrode Cz in the 450- to 600-ms time window among females (right) versus males (left). (C) The greater incongruity effect at electrode Fz in the 600- to 750-ms time window in the face (right) versus the control condition (left) in Ishii et al. (2010). The vertical bars are the standard errors of means. (All figures adapted from Ishii, K., Kobayashi, Y., & Kitayama, S. [2010]. Interdependence modulates the brain response to word-voice incongruity. *Social Cognitive and Affective Neuroscience, 5*[2–3], 307–317.)

D. Regulation of Emotion

1. Will Self-Construal Influence the Regulation of Emotion?

Emotions are often spontaneous, involving automatic appraisals of the surrounding situation and physiological and motor preparedness for adaptive actions (Frijda, 1986). One burgeoning area of research concerns regulation of spontaneously generated emotions (Gross & John, 2003). This work has mostly tested European American populations and compared two contrasting strategies for regulating emotions. One strategy is *cognitive reappraisal*, which involves changing meanings attached to an otherwise strongly emotional event. Once these meanings have been changed, the initial emotion may be attenuated. Another strategy is *expressive suppression*, which involves hiding the external expression of the emotion that is being experienced. A growing body of evidence suggests that European Americans perform cognitive reappraisal more effectively than expressive suppression (Goldin, McRae, Ramel, & Gross, 2008); moreover, chronic use of cognitive reappraisal is associated with positive health while chronic use of expressive suppression is associated with negative health (Gross & John, 2003; John & Gross, 2004). In short, expressive suppression appears to be not only ineffective but also maladaptive among European Americans.

Expressive suppression may be ineffective in part because it goes against a pervasive western cultural norm of self-expression (Kim & Markus, 1999). This norm is grounded in a construal of the self as independent. With the independent construal of the self, emotions—especially emotions that are intense and high in arousal (Tsai, 2007)—may be recognized as defining one's inner self. Since these emotions are likely highly valued by those with independent self-construal, suppressing these emotions may be experienced as denial of the self.

The cultural incongruity of expressive suppression may be relatively unique to cultures that value independent construal of the self. Intense emotions such as pride and anger are sometimes socially disruptive (Lutz & White, 1986) especially in Asian interdependent societies (Adam & Shirako, 2013). Accordingly those with interdependent self-construal may value these emotions much less. Instead, they may value emotions that are contrastingly low in intensity. Consistent with these suppositions, Tsai and colleagues have shown that high-arousal positive emotions (e.g., excitement) are valued more by European Americans than by Asians, but low-arousal positive emotions (e.g., calm feelings) are valued more by Asians than by European Americans (Tsai, 2007). Suppression of intense emotions such as anger and frustration

may then be relatively effective. Furthermore, insofar as suppression is culturally sanctioned and positively valued, it may prove to be more adaptive.

2. Behavioral Evidence

When the extent of expressive suppression is measured with reliable questionnaires, it has consistently been observed that Asians report higher levels of expressive suppression as compared with European Americans (Gross & John, 2003; Matsumoto, Yoo, & Nakagawa, 2007; Soto, Perez, Kim, Lee, & Minnick, 2011). Moreover, within a multicultural American university community, individuals who were high in traditional Asian values reportedly engaged in more suppression of emotion (Butler, Lee, & Gross, 2007). Likewise, when value placed on emotional control was measured (e.g., "People in general should control their emotions more"), it was linked strongly to expressive suppression; moreover, those high in this value (i.e., Asian Americans) reportedly experienced less anger when provoked (Mauss, Butler, Roberts, & Chu, 2010). Thus evidence converges to suggest that emotional control in general, and expressive suppression in particular, is more positively sanctioned in Asian culture than in European American culture.

If the suppression of emotion is culturally sanctioned in Asian cultures, it may not entail negative psychological consequences. In the aforementioned study by Butler and colleagues (2007), among holders of European American values, the reported level of expressive suppression is associated with negative emotions and self-defense, consistent with previous findings suggesting maladaptive effects of expressive suppression among European Americans (Gross & John, 2003; John & Gross, 2004). However, among those who hold traditional Asian values, expressive suppression was not associated with either negative emotion or self-defense (Butler et al., 2007). Similarly, Soto and colleagues (2011) have observed significant cultural moderation of the link between expressive suppression and negative emotion. Their study found a negative association between expressive suppression and psychological adjustment (indexed by both low depression and life satisfaction) among European Americans. However, there was no such association among Hong Kong Chinese.

It is of note that in interdependent cultural contexts, anger is particularly undesirable because of its relationship-disrupting effects (Lutz & White, 1986). For the most part, then, anger may be suppressed in these cultures. However, there may be one important exception to this. Individuals who have power and status may be exempt from this cultural norm against anger

expression (Park et al., 2013). In interdependent cultures, then, higher-status individuals may express more anger. In contrast, in independent cultures, there may be little prohibition against anger expression. Instead, in these cultures, anger may primarily signify one's frustration, insofar as anger arises when one's own goals and desires are blocked. Accordingly, it may be typically those with little power or status who express more anger because they are likely to experience more frustration. Park and colleagues (2013) tested these predictions by examining a large number of adult Japanese in a wide age range who participated in the Midlife in Japan (MIDJA) survey project; these investigators found, as expected, that reported levels of anger expression increased as a function of social status. In contrast, when Park and colleagues examined data from a companion survey from the United States (Midlife in the United States, or MIDUS), they found that Americans with lower social status reportedly expressed more anger.

There was one important caveat to the contrastingly opposite relationships between social status and anger expression in Japan and the United States. Consistent with cross-cultural work suggesting the significance of socially shared appraisals in self-definition for Asians (Cohen, Hoshino-Browne, & Leung, 2007), it was an objectively defined index of social status (educational attainment and occupational prestige) that was responsible for the Japanese effect. This is in contrast to American self-definitions, which are grounded primarily in one's own appraisals of the self or direct appraisals (Cohen et al., 2007). Thus, among Americans, it was a subjective index of social status (self-report of where one is placed in a status hierarchy in his or her own community) that mattered. The resulting patterns are illustrated in Figures 2-5A and B. When anger expression was plotted as a function of objective social status (Figure 2-5A), it increased as a function of status for Japanese, but there was no such association for Americans. However, when anger expression was plotted as a function of subjective social status (Figure 2-5B), it decreased as a function of status for Americans, but there was no such association for Japanese.

3. Neural Evidence

If the task of emotional control is positively sanctioned in Asian culture, individuals may be positively challenged to perform this task when required to do so. In contrast, the same task is likely to be negatively sanctioned in European American cultures. If so, under the same circumstances, those engaging in

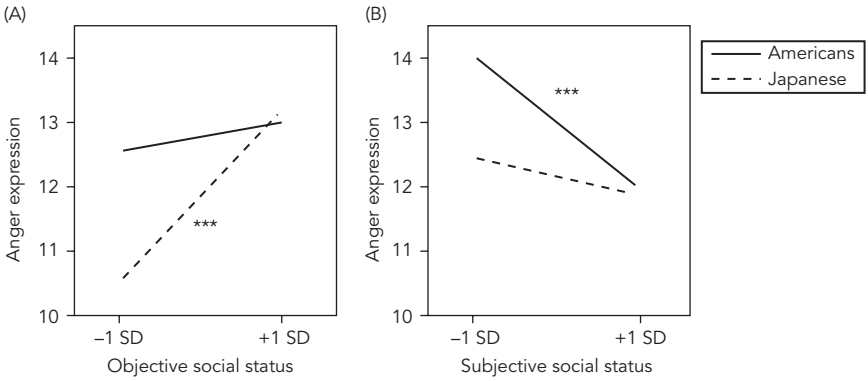


FIGURE 2-5: The relationships between anger expression and social status (A: objective, B: subjective) for Americans and Japanese. Statistical significance indicated by asterisks (*** $P < .001$).
(From Park, J., Kitayama, S., Markus, H. R., Coe, C. L., Miyamoto, Y., Karasawa, M., . . . & Ryff, C. D [2013]. Social status and anger expression: the cultural moderation hypothesis. *Emotion, 13*[6], 1122–1131)

European American cultures may be rather threatened. In a recent study, participants' autonomic nervous system (ANS) responses were monitored as they were exposed to either a neutral film clip or a provocation to experience anger (Mauss & Butler, 2010). Previous work shows that different patterns of ANS responses are associated with challenge versus threat responses (Mendes, Blascovich, Major, & Seery, 2001; Mendes, Reis, Seery, & Blascovich, 2003). For example, when individuals perceive situations as challenging, they show a particular pattern of cardiovascular reaction linked to increased cardiac performance (increases in cardiac output [CO] and decreases in total peripheral resistance [TPR]). In contrast, they show a contrasting pattern of cardiovascular reaction (no increase in CO and increases in TPR) when they are threatened rather than challenged.

Mauss and Butler (2010) found that for Asians, cardiac performance during emotion provocation increased as a function of their emotional control value, suggesting that those who valued emotional control and thus tried to control their emotions were psychologically challenged. In contrast, among European Americans, cardiac performance during emotion provocation decreased as a function of their emotional control value, suggesting that those who valued emotional control and thus tried to control their emotions were psychologically threatened.

If emotional control by suppression is positively sanctioned and perceived as a challenge (rather than a threat) in Asian cultures, it may result in the downregulation of emotional responses, including neural activity linked

to the emotion among Asians. In contrast, if emotional control by suppression is negatively sanctioned and perceived as a threat (rather than as a challenge) in European American cultures, it may not lead to the downregulation of emotional responses among European Americans, even though the overt emotional expression may be tightly regulated with effort. Furthermore, the resulting conflict—involved in the effort to do what is perceived as a threatening, norm-incongruous act—may produce a strong negative emotion (Goldin et al., 2008).

These possibilities were addressed in a recent study that tested ERPs to aversive emotional pictures (Murata, Moser, & Kitayama, 2013). When individuals are exposed to a highly aversive emotional picture, a strong positivity is typically observed around parietal electrodes 350 to 400 ms poststimulus, which persists for the period of stimulus presentation. This long-lasting positivity is referred to as a late positive potential (LPP) and is considered to reflect emotional processing. The magnitude of the LPP is closely associated with perceived arousal of stimuli (Cuthbert, Schupp, & Bradley, 2000). Moreover, evidence indicates that LPP is localized in visual cortices that receive signals from subcortical emotion areas, including the amygdala (Sabatinelli, Bradley, Fitzsimmons, & Lang, 2005). Murata and colleagues (2013) therefore observed the magnitude of the LPP when participants were exposed to emotional or neutral pictures while instructed to merely attend to the pictures or to suppress all emotional responses.

The waveforms from the parietal center electrode (Pz) for both European Americans and Asians are shown in Figure 2-6. As can be seen,

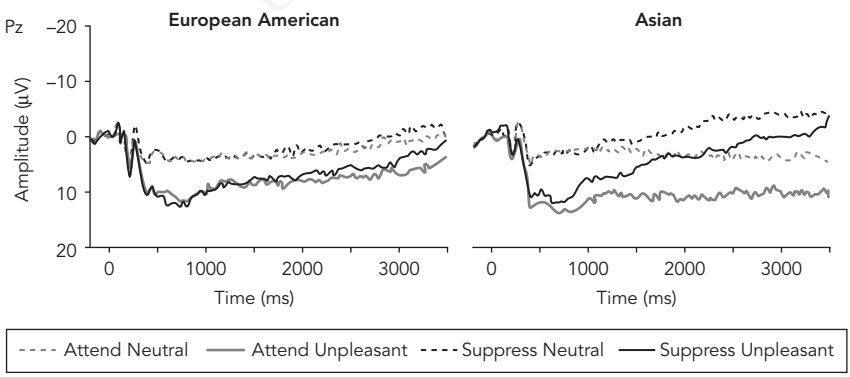


FIGURE 2-6: Grand averaged ERP waveforms at electrode Pz for neutral and unpleasant pictures for European Americans and Asians. (From Murata, A., Moser, J. S., & Kitayama, S. [2013]. Culture shapes electrocortical responses during emotion suppression. *Social Cognitive and Affective Neuroscience, 8*[5], 595–601)

in all conditions a marked late positivity is observed for emotional pictures approximately 400 ms poststimulus. Thus participants clearly engaged in emotional processing regardless of conditions. However, there was an equally marked cultural difference in the suppression condition. Whereas European Americans showed no sign of downregulation of the LPP in the suppression condition, Asians downregulated the LPP quite rapidly, so that by 2,000 ms poststimulus, the LPP for emotional pictures essentially disappeared relative to the neutral picture control. Interestingly, Asians showed similar downregulation of late positivity even when pictures were apparently neutral. Supposedly even seemingly neutral pictures have certain (mild) emotional cues, leading Asians to downregulate their emotional responses to these cues.

4. Mediation by Self-Construal

Butler and colleagues (2007) tested a multicultural US university student population and assessed the degree to which the participants endorsed both European American cultural values and traditional Asian values. As noted earlier, endorsement of the traditional Asian values was associated with self-reported levels of expressive suppression. Other studies did not test effects of similar cultural variables including self-construal. At this point, then, it is not possible to draw any conclusions regarding the hypothesized mediating role of self-construal on emotional control or expressive suppression.

E. Social Anxiety

1. Will Self-Construal Influence Social Anxiety?

It is fair to assume that people in all cultures seek social acceptance and avoid social rejection (Baumeister & Leary, 1995). However, individuals may vary widely in their sensitivity to social rejection cues, depending on their social orientation. In interdependent cultures, the self is conceptualized as connected with others and defined primarily by social relations. These individuals are thus more likely to rely on social evaluations in judging their own self-worth. They are attuned to social expectations so as to prevent deviations from them. This prevention orientation comes with worry, anxiety, apprehension, and pessimism (Higgins, 1987). Moreover, these negative emotions or feelings are likely to be adaptive because they signal the need to improve and adjust better to the social expectations (Heine et al., 2001).

Conversely, in independent cultures, a strong emphasis is placed on personal attributes. One's own appraisal of the self may be more important than evaluations by others in judging self-worth (Cohen et al., 2007), and people tend to pursue personal goals and be optimistic (Higgins, 1987; Taylor & Brown, 1988). Accordingly, individuals with interdependent self-construal may experience greater social anxiety, especially when others' appraisals and evaluations are at issue.

2. Behavioral Evidence

Evidence for the cross-cultural prediction on social anxiety is somewhat mixed because of possible cross-cultural variations in the form of social anxiety. Numerous clinical observations suggest that Social Anxiety Disorder (SAD) involves a fear of social interaction accompanied by a strong fear of being evaluated by others. Attention tends to be fixated on the self (Schlenker & Leary, 1982). In contrast, social anxiety appears to take different forms in Japan, Korea, and some other Asian societies. Asians suffering from social anxiety seem very concerned with the trouble they cause on others, resulting in attention dispersed to many individuals in a given context. This form of social anxiety is called *Taijin-kyofu-sho* (TKS) (Norasakkunkit, Kitayama, & Uchida, 2012).

In a recent study, Norasakkunkit and colleagues suggest that among European Americans, SAD is associated with focused attention because socially anxious European Americans are likely to be fixated on drawbacks of themselves in the eyes of the public. Support was obtained for this prediction with a behavioral measure involving the ability to draw lines of either absolute or relative length (Kitayama et al., 2003). But among Japanese, social anxiety (TKS) may be associated with holistic attention because socially anxious Japanese are likely to be vigilant of troubles they might be causing on potentially numerous others.

When TKS is assessed in self-report, Asians are clearly more anxieous than European Americans (Norasakkunkit et al., 2012). When SAD is assessed in self-report, Asians and Asian Americans are also generally more socially anxious and fearful of negative social evaluations as compared with European Americans (Hashimoto & Yamagishi, 2013; Kim & Markman, 2006; Norasakkunkit & Kalick, 2002; Okazaki, 2000; Okazaki, Liu, Longworth, & Minn, 2002), but some exceptions occur (Dinnel, Kleinknecht, & Tanaka-Matsumi, 2002; Norasakkunkit et al., 2012). Overall, then, it is

fair to conclude that Asians tend to be higher in social anxiety than European Americans although exceptions can arise.

This overall cultural difference in social anxiety may be mediated both by interdependent self-construal (Norasakkunkit & Kalick, 2002) and independent self-construal (Hong & Woody, 2007): Asians are higher than European Americans in interdependent self-construal and lower in independent self-construal, both of which may increase evaluation apprehension, worry, and social anxiety (Park & Kitayama, 2014). Importantly, when independence is primed, social anxiety decreases for both European Americans and Asians (Norasakkunkit & Kalick, 2007).

Consistent with the high level of social anxiety for Asians, Asians appear particularly vigilant for cues signaling potential social rejection. In a recent study, American and Japanese participants were presented with a morphed movie of a target person whose facial expression gradually changed from either happiness or sadness to no emotion (Ishii, Miyamoto, Mayama, & Niedenthal, 2011). Participants were asked to stop the movie when the target person was no longer displaying the initial emotion (happiness or sadness). Japanese and European Americans were no different in detecting the disappearance of sadness. However, Japanese were faster than European Americans in detecting the disappearance of happiness, indicating that Japanese are particularly sensitive to another person's smile fading away. This cultural difference was mediated by a fear of social rejection or rejection sensitivity. That is, relative to European Americans, Japanese were particularly high in rejection sensitivity, which in turn was associated with the increased sensitivity to the disappearance of positive affect from another person's face.

3. Neural Evidence

If Asians are prone to social anxiety, they may eventually associate this anxiety to representations of the generalized other. They may come to feel anxieous when exposed to these representations. That is, they may feel threatened by a face and, moreover, this may be true even when the face is emotionally neural because the ambiguity of the face is probably sufficient to provoke anxiety in general and evaluation apprehension in particular. When anxiety is provoked, it is likely to sensitize brain mechanisms involved in error monitoring. Accordingly, when exposed to a face cue, Asians (but not European Americans) would be more responsive to error signals – signals indicating that they are committing a mistake.

To investigate whether mere exposure to a neutral face would be sufficient to enhance error processing, Park and Kitayama (2014) used an ERP error-processing paradigm. Participants performed a flanker task. On each trial they were presented with a sequence of five arrows and asked to identify the direction of the central arrow while ignoring the remaining four. When the flanker arrows were pointing to the direction opposite to the central arrow (> > < > > or < < > < <), participants tended to make errors. When an error is made, the error is detected within a fraction of a second and leads to a conspicuous negative deflection of brain wave called error-related negativity (ERN). The ERN is an ERP component involved in error processing, which occurs 0 to 100 ms after an erroneous response is made in choice response-time tasks (Falkenstein, Hohnsbein, Hoormann, & Blanke, 1991; Gehring, Goss, Coles, Meyer, & Donchin, 1993). Emerging evidence suggests that the ERN reflects motivational states because exposure to threat cues increases error processing (Hajcak, 2012; Foti & Hajcak, 2008; Weinberg, Riesel, & Hajcak, 2013).

Park and Kitayama (2014) hypothesized that a neutral face would serve as a threat cue and, as a consequence, it would engage error processing more and thus lead to increased ERN for Asians. In order to test this analysis, on each trial participants were briefly exposed to an image of a face or one of two control images (a scrambled face or a house) right before the presentation of the arrows. If people are threatened by the exposure to a watching face and thus become more vigilant of their errors, they should show increased ERN amplitudes. Confirming this prediction, Park and Kitayama found that Asians, who are high in interdependent social orientation, showed larger ERN on the face-priming trials than on the control-priming trials (see Figure 2-7A). In contrast, there was no such effect of face priming among European Americans. If anything, they showed a marginal tendency to decrease their ERN on the face (versus control) priming trials (see Figure 2-7B). This basic pattern has since been replicated with another ERP signal that is analogous to ERN, called feedback related negativity or FRN (Hitokoto et al., 2014).

4. Mediation by Self-Construal

The cultural differences in social evaluative threat previously discussed may be due to a corresponding difference in self-construal. Park and Kitayama (2014) tested this prediction by examining a relationship between the construal of the self as independent or interdependent and the face-priming effect. The face-priming effect was computed by subtracting the ERN on the

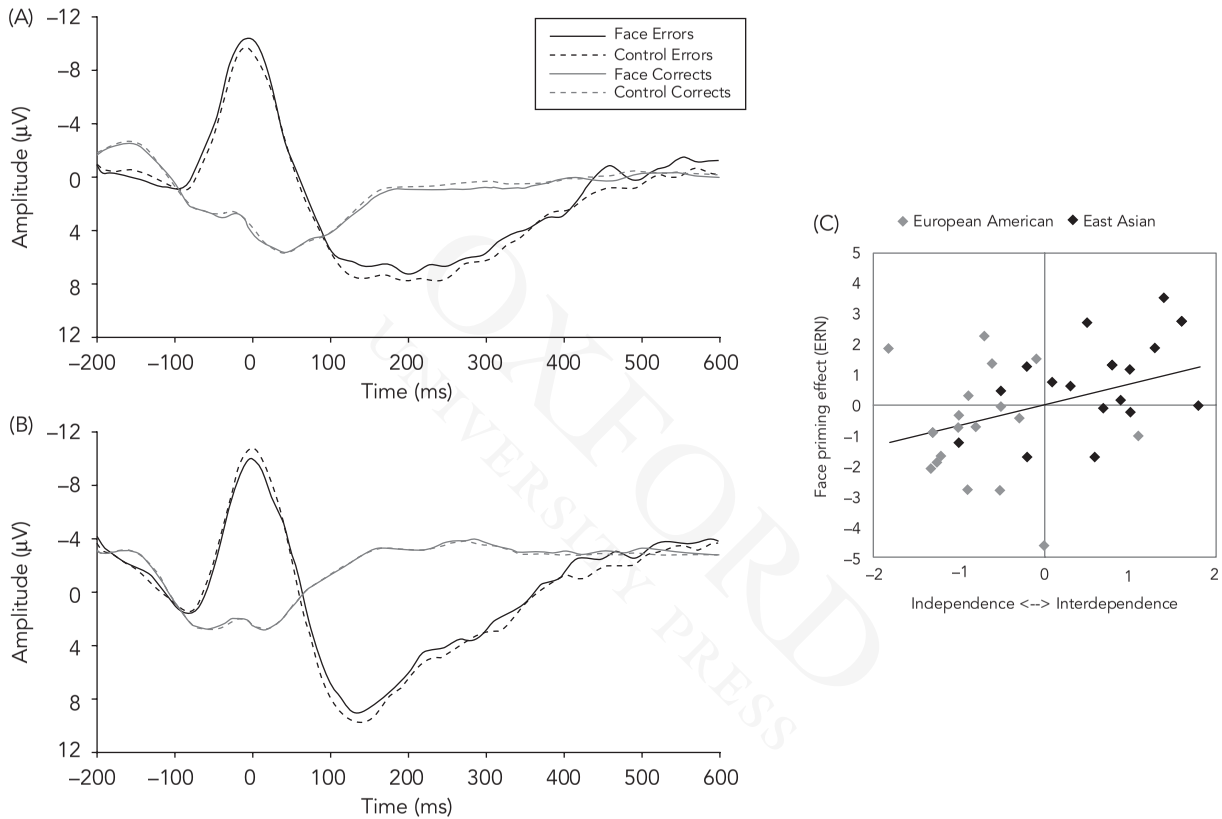


FIGURE 2-7: ERN (error-related negativity) and CRN (correct-response negativity) waveforms at electrode FCz for the face-priming trials (solid lines) and the control-priming trials (dotted lines) for Asians (A) and European Americans (B) and the scatterplot with interdependent versus independent self-construal on the X axis and the face-priming effect (ERN in the control-priming trials minus ERN in the face-priming trials) on the Y axis. (From Park, J., & Kitayama, S. [2014]. Interdependent selves show face-induced facilitation of error processing: cultural neuroscience of self-threat. *Social Cognitive and Affective Neuroscience, 9*[2], 201–208).

face-priming trials from the ERN on the control-priming trials such that greater values on this index indicate greater sensitivity to social evaluative threat. As expected, this index was significantly predicted by interdependent (versus independent) self-construal assessed with a self-construal scale (see Figure 2-7C). Moreover, this relationship remained significant when relevant personality variables—such as trait social anxiety, neuroticism, and public and private self-consciousness—were controlled.

F. Self-Enhancing Motivation and Optimism/Pessimism

1. Will Self-Construal Influence Self-Enhancing Motivation?

Individuals with independent construal of the self may value their own internal attributes highly and, as a consequence, may be motivated to enhance the positivity of these attributes. In contrast, those with interdependent construal of the self may value their relationships much more and, as a consequence, the self-enhancing motivation may be attenuated or even vanish (Heine et al., 1999). Moreover, as noted previously, a contrastingly opposite tendency of self-criticism may sometimes be instrumental in Asian cultures in performing a much more important task, such as fitting in and adjusting to social expectations in a given relationship. Under such circumstances, the psychological bias in self-evaluation may operate not in self-enhancing directions but rather in self-critical or self-effacing directions for Asians.

2. Behavioral Evidence

One form of self-enhancing bias occurs in explaining one's own success and failure. Social psychologists have long observed that people take credit for their own successes while blaming others for their failures (Miller & Ross, 1975). Kitayama, Takagi, and Matsumoto (1995) found little evidence for this pattern in 23 studies conducted in Japan. It is also common for a majority of people in any given group to estimate their abilities to be "better than average" (Taylor & Brown, 1988). As it turns out, when individuals are asked to indicate whether they would be literally "better than average," they tend to endorse this statement regardless of culture, presumably because of negative connotations associated with the term "average." This semantic confound may be avoided, however, by asking individuals to estimate the proportion of others in a given group who are better than themselves. In the absence of any systematic psychological bias, the overall mean should converge to 50%.

However, self-enhancing motivations would produce a systematic bias for lowered percentage estimates of people who are better than oneself. This was exactly what was found among European Americans (Markus & Kitayama, 1991a). However, the average Japanese means in this study converged to 50. Thus, the better-than-average effect is robust for European Americans, but negligible for Japanese.

Another form of self-inflation effect can be found in an investigation of the size of symbolic self. In one study, American, British, German, and Japanese participants were asked to draw their own social network, with circles to designate both the self and others in the network and lines to indicate social connections among them (Kitayama et al., 2009). The key variable of interest was the size of the circles used to designate the self versus others. Regardless of culture, there was no difference in the size of the circles for others. However, the size of the self-circle varied systematically, with American selves much larger than Japanese selves and with the two western European groups (British and German) falling in between.

One phenomenon that is closely related to self-enhancement is illusory optimism (Taylor & Brown, 1988). It has been suggested that individuals overestimate the likelihood that positive events will happen for themselves (relative to the likelihood of such events happening to others) while underestimating the likelihood that negative events will happen to themselves. Although this effect is quite robust among European Americans, it is much less stable among Japanese (Heine & Lehman, 1995). In fact, when the self is compared with specific others in a relationship, a bias occurs in the opposite, more pessimistic direction (Chang & Asakawa, 2003). Thus, pessimistic, self-critical, and self-effacing biases appear just as pronounced among Japanese as optimistic, self-enhancing, and self-serving biases are among European Americans.

The cultural difference in self-enhancement versus self-criticism has also been observed when individuals are asked to estimate how they would feel in different social situations involving either success or failure. Kitayama et al. (1997) presented both American and Japanese participants with a number of situations that tend to increase self-esteem (e.g., "Getting an A+ in an important exam") or those that tend to decrease one's self-esteem (e.g., "When I expressed my opinion, others around me just ignored what I said"). All European American participants were students at the University of Oregon in Eugene. Approximately half of the Japanese were college students at Kyoto University (in Japan), whereas the

remaining half were Japanese-born Japanese sojourners at the University of Oregon. It is also worthy of note that in this study, the researchers tested cultural differences in how social situations are defined in both the United States and Japan. Separate groups of Americans and Japanese had provided situations in which their self-esteem went up (success) or went down (failure). From a large pool of situations generated this way, 400 situations were randomly sampled so that half were American-made whereas the remaining half were Japanese-made.

The participants were asked to imagine that they were in each situation and to estimate how much their own self-esteem would go up or go down in the situation. The key dependent variable was the relative magnitude of the extent to which one's self-esteem was judged to increase in success situations versus the extent to which one's self-esteem was judged to decrease in failure situations. These two estimates were subtracted to yield a measure of self-judgment bias. Positive values indicate self-enhancement (greater perceived increase of self-esteem in the success situations relative to perceived decrease of self-esteem in the failure situations), whereas negative values indicate self-criticism (greater perceived decrease of self-esteem in the failure situations relative to perceived increase of self-esteem in the success situations). As shown in Figure 2-8, European Americans showed a strong self-enhancement effect. Importantly, however, this effect was more pronounced when Americans were responding to American-made situations. Indeed, in the American-made situations, nearly 90% of Americans showed self-enhancing patterns. In contrast, the Japanese showed an equally strong bias in the opposite direction (self-criticism). Again this bias was more pronounced when the Japanese were responding to Japanese-made situations, with nearly 90% of Japanese showing self-criticizing patterns. Finally, Japanese sojourners in the United States showed a pattern that fell in between. The fact that culture-typical bias is most pronounced in culturally matched situations suggests that psychological biases are not purely psychological, but are likely to be situated and afforded by ways in which social situations are collectively constructed and made meaningful.

3. Neural Evidence

Although a body of evidence showed the presence of cultural variation on pursuing self-interest (self-enhancing motivation), it fell short of identifying the nature of this motivation. This was mostly because available evidence on

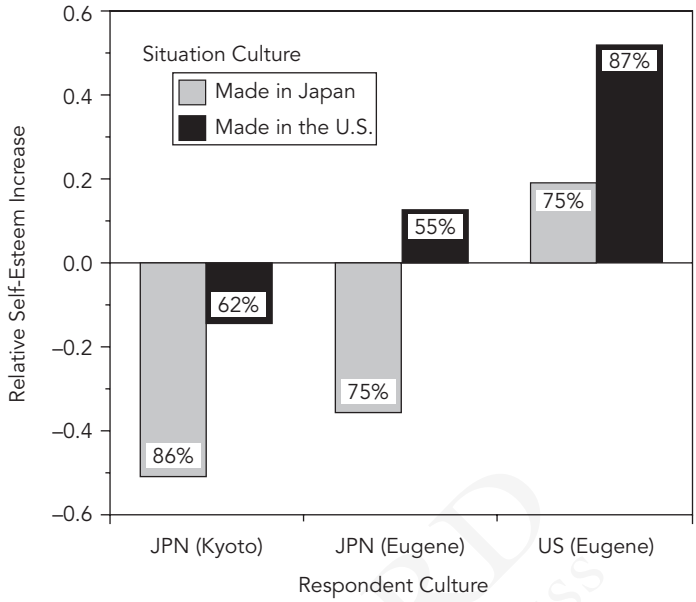


FIGURE 2-8: Relative perceived self-esteem change as a function of the cultural origin of both respondents (respondent culture) and situations (situation culture). JPN, Japan; US, United States. The percentage in each bar signifies the proportion of respondents who show either one of the two biases typical in each condition. (From Kitayama, S., Markus, H. R., Matsumoto, H., & Norasakkunkit, V. [1997]. Individual and collective processes in the construction of the self: self-enhancement in the United States and self-criticism in Japan. *Journal of Personality and Social Psychology, 72*[6], 1245–1267)

cultural difference in self-enhancing and self-criticizing motivation is based exclusively on self-reports. It could be argued that these psychological biases are no more than a deliberate self-presentation in normatively expected directions of either showing the self in a more positive, optimistic fashion (self-enhancement) or showing the self in a more cautious, pessimistic fashion (self-criticism). However, self-enhancing motivation might have a deeper neurophysiological root. One way to address this issue is to use automatic neural measures that are unlikely to be affected by self-presentational concerns. If European Americans show self-enhancing motivation and if Asians show attenuated self-enhancing effect even in spontaneous neural activity, this cultural variation would be hard to interpret with self-presentation strategy alone.

In an initial effort in this direction, Kitayama and Park (2014) had European American and Asian participants perform a simple cognitive task and measured error-related negativity (ERN). The goal was to see if the

magnitude of ERN would be greater if individuals performed the task for the self or for a friend. As noted earlier, ERN (a negative deflection of brain waves that occurs contingently on commission of an error in a speeded cognitive task) is known to increase in magnitude when more is at stake on performance of the task. Thus, if individuals automatically or unconsciously care more when they make mistakes for the self-related task, this motivational difference should be reflected in the magnitude of ERN. The participants were told that by performing the cognitive task both accurately and quickly, they would be able to earn points. The points earned during some blocks of the experiments would be exchanged for a gift for themselves. Those earned during the remaining blocks would be exchanged for a gift that would be sent to a close friend.

After the experiment, participants reported that they had worked just as hard for their friends as they did for themselves. However, the pattern observed in ERN showed a very different story for European Americans. For these individuals, ERN was significantly greater when they tried to earn points for themselves than when they did so for a friend (Figure 2-9A). Thus, European Americans show a robust self-enhancing pattern. Conceptually replicating earlier behavioral cross-cultural findings, there was no such self-enhancing pattern for Asians (Figure 2-9B). The finding that the self-centric effect was absent among Asian samples shows that the absence of self-serving bias among Asians is not due to the self-presentation strategy alone.

Another recent study provides neural evidence for both strong optimism among European Americans and equally strong pessimism among Asians (Hitokoto et al., 2014). Participants played a series of gambles. In each gamble, they chose between two options, one of which would offer a gain of certain amount of points and the other of which would entail a loss of the same amount of points. The outcome was determined randomly so that the odds of gain (or loss) were 50%. One second after the choice, feedback was provided on the outcome of the gamble. In a gamble task like this, it is common to observe a negative deflection of ERPs, approximately 270 msec post-feedback, around the froto-central electrode upon loss feedback (called feedback-related negativity or FRN) (Gehring, 2002). This is especially the case when the likelihood of gain is set high so that the loss is unexpected. Thus, FRN indicates a detection of negative reward prediction errors. Recent research indicates, however, that a positive deflection of ERPs is observed around the same region upon feedback of win especially when the likelihood of win is set to be low so that the win is unexpected (Walsh & Anderson, 2012). This ERP signal

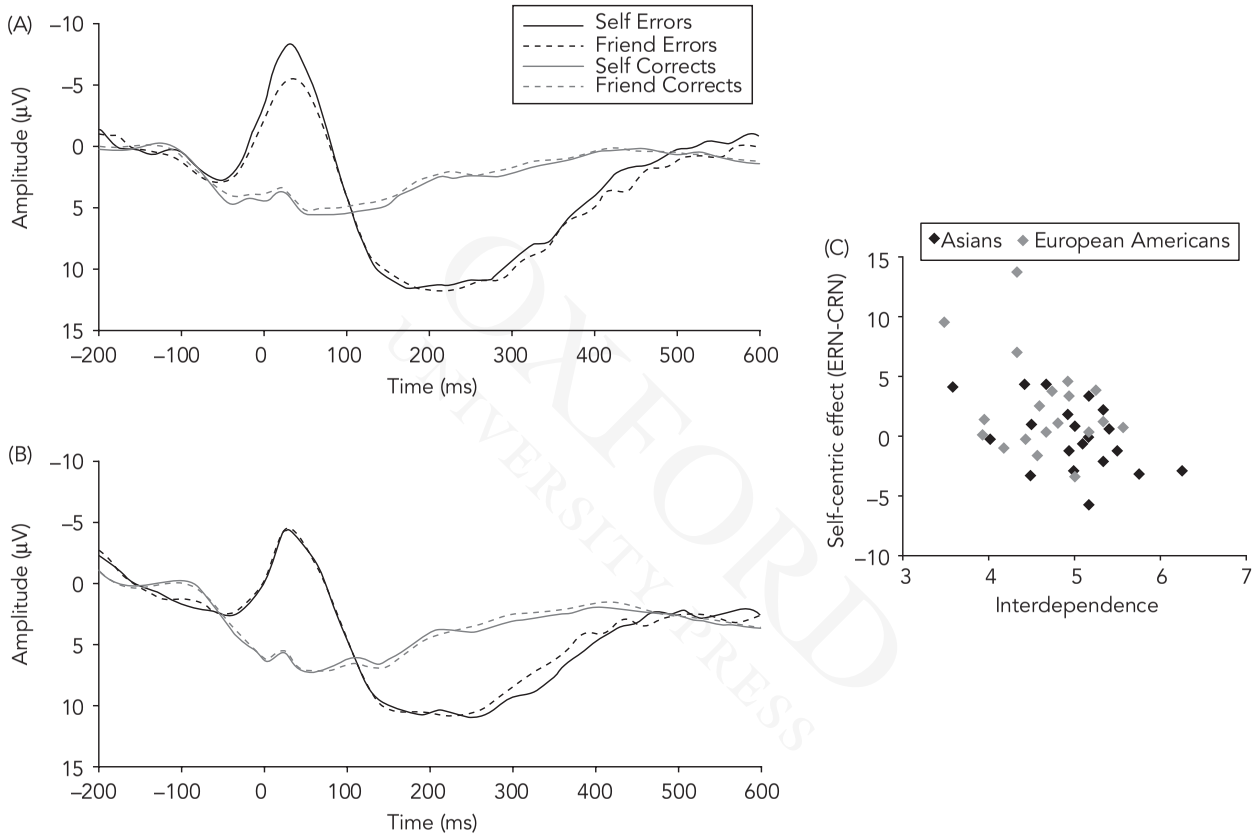


FIGURE 2-9: ERN (error-related negativity) and CRN (correct-response negativity) waveforms at electrode FCz in the self condition (sold lines) and the friend condition (dotted lines) for European Americans (A) and Asians (B) and the scatterplot with independent self-construal on the X axis and the self-centric effect (ERN-CRN in the friend condition minus ERN-CRN in the self condition) on the Y-axis. (From Kitayama, S., & Park, J. (2014). Error-related brain activity reveals self-centric motivation: Culture matters. Journal of Experimental Psychology: General, 143[1], 62–70

is called feedback-related positivity (FRP). FRP indicates a detection of positive reward prediction errors.

In the Hitokoto et al. study, the objective likelihood of gain/loss was set at 50%. Thus, with no psychological bias to either optimism or pessimism, both FRN (the response to loss) and FRP (the response to gain) may be expected to be equal. If, however, people are generally optimistic so that they anticipate gain more than loss, then FRN should be greater than FRP. Conversely, if people are generally pessimistic so that they anticipate loss more than gain, then FRP should be greater than FRN. The cross-cultural behavioral evidence discussed previously (Kitayama et al., 1997) suggests that there should be a systematic cultural difference. The Hitokoto et al. study confirmed this prediction. For European Americans, FRN was quite strong, but FRP was barely observed. Thus, they appear to have an optimism that clearly was illustory (because the objective odds for gain were 50%) (Taylor & Brown, 1988). In contrast, for Asians, FRP was reliable, but FRN was not. Thus, they clearly had a pessimism that was equally illusory.

4. Mediation by Self-Construal

Could self-enhancing effects be predicted by independent (versus interdependent) self-construal? In the aforementioned ERN experiment, Kitayama and Park (2014) tested this possibility and found that the increased ERN in the self (versus friend) condition was negatively associated with interdependent self-construal as assessed by the Singelis (1994) self-construal scale (Figure 2-9C). The neural marker of egocentric motivation was computed by subtracting the ERN in the self blocks from the ERN in the friend blocks. A mediation analysis confirmed that the cultural difference in the ERN self-enhancing effect was mediated by interdependent self-construal. The FRN/FRP indicator of optimism/pessimism in the Hitokoto et al. study did not correlate with either independence or interdependence.

IV. CONCLUSIONS AND FUTURE DIRECTIONS

A. Accomplishment So Far

Several years ago, when Chiao and Ambady (2007) published an article on cultural neuroscience in the *Handbook of Cultural Psychology*, the field hardly existed. Since then, many scholars joined forces and have added meat to the bones of the field. The accomplishment so far is substantial. Today cultural neuroscience is a young, active field of research informed by various

neighboring disciplines of cognitive, social, and affective neuroscience; cultural, social, and developmental psychology; genetics; and evolutionary biology. This emerging field is well described in a recent series of review articles by Ambady (2012), Chiao and colleagues (2014), Kitayama & Uskul (2011), Han and colleagues (2013), and Kim and Sasaki (2014). In this chapter, we have added to these existing reviews by providing an overview of recent evidence for cultural variations in neural mechanisms within several domains of psychological function. We have emphasized the lines of work we have conducted over the last several years, relating them to other relevant work that has emerged over the same period of time.

From the current review, it is clear that many of the cultural differences that have been documented with behavioral measures can be found just as clearly with neural indicators. Overall, evidence is consistent with the hypothesis that whereas normative tasks available in Asian cultures emphasize interdependent self-construal and the holistic cognition that accompanies this construal, normative tasks available in European American cultures emphasize independent self-construal and the more analytic cognition that accompanies independent self-construal.

More specifically, in object perception, as compared to European Americans, Asians are more holistic in attention. This basic pattern has been shown with both fMRI (e.g., Guttchess et al., 2006) and ERPs (Kitayama & Murata, 2013). Attention is more focused on a target for European Americans than for Asians. Further, Asians attend more holistically to context, especially when the context does not fit well to the target. The same conclusion extends to social domains, with initial neuroscience evidence pertaining to both causal inference (Han et al., 2011a; Na & Kitayama, 2011) and the processing of verbal content versus vocal tone (Ishii et al., 2010).

Another area of burgeoning research concerns emotion regulation. One important recent insight is cultural dependency on the effectiveness and adaptiveness of expressive suppression as strategy for the regulation of emotion. As compared with European Americans, Asians are less threatened and more challenged in trying to suppress their anger (Mauss & Butler, 2010); moreover, they are more effective in downregulating their emotions (Murata et al., 2013). Another important area of emotion research concerns social anxiety. Behavioral work suggests that the vulnerability to social anxiety might be greater for Asians than for European Americans (Okazaki et al., 2002). This cultural difference has been extended with a neural indicator of a threat posted by face cues (Hitokoto et al., 2014; Park & Kitayama, 2014).

Finally, self-serving tendencies widely observed among European Americans are often absent among Asians. Moreover, this cultural difference reflects spontaneous and potentially automatic components of processing self- versus other-relevant information (Kitayama & Park, 2014).

In many of these cases, the tested neural responses are hardly controllable. Hence it is likely that the observed cultural differences reflect well-automatized neural or psychological processing bias or structure. These cultural differences therefore can be observed in very early stages of information processing, as shown by studies using time-sensitive ERP measures. This emerging evidence is consistent with the hypothesis that cultural differences result from plastic changes in the brain caused by active repeated engagement in cultural tasks (see Figure 2-1).

B. Future Directions

1. Broadening the Scope of the Field

Future work should extend the scope of this field and cover other population-based variations in ecology, socioeconomic status, and additional variables so as to achieve a better understanding of how sociocultural contexts might influence neural mechanisms.

First, socioeconomic status or social class will be one major focus in the future (Hackman, Farah, & Meaney, 2010; Kraus, Piff, Mendoza-Denton, Rheinschmidt, & Keltner, 2012; Stephens & Markus, 2014). The availability of tangible economic and symbolic resources or the relative shortage thereof determines high versus low social class. Defined this way, social class is a universal phenomenon. Because one significant contributor to individualism is wealth (Inglehart & Baker, 2000), high social class may be associated with greater individualism (Kraus et al., 2010). Indeed, neural evidence to that effect already exists (Varnum, Na, Murata, & Kitayama, 2012). However, as noted earlier in the discussion of emotion regulation (see Figure 2-5), social class is multifaceted; as a consequence, it can have more nuanced interfacing with traditional culture. For example, the cultural meaning of having a high or low social class might prove to be different depending on overarching values of culture favoring equality or hierarchy.

Second, the focus of the current literature on European Americans and East Asians or Asian Americans in some of the top universities in both Asia and the United States is one significant shortcoming of psychological work. It may well be the case that the dimension of independence and interdependence as

formulated in the current literature is most readily applicable to comparisons between European Americans and Asians. Additional research is required to explore, say, Latinos or Middle Easterners. The African continent has continued to be outside of the current map in psychology, including cultural neuroscience. This must be corrected.

Third, the same plea for expansion of the scope of the field can be made domestically for North Americans as well. Virtually all work in mainstream psychology, including cognitive or affective neuroscience, has focused almost exclusively on White Americans. What about African Americans, Native Americans, or Hispanics? These minority groups are oppressed and subordinated for a variety of unique, historically contingent reasons. It is important to address the neural consequences of this oppression and possible historical contingencies in understanding the effects of historical oppression. Most likely, the construal of the self as independent or interdependent will continue to be relevant in the analysis of this issue but will surely be not sufficient to cover the range of issues inherent in historically unique forms of oppression.

2. Mechanisms of Cultural Acquisition

Simultaneously with the effort to broaden the scope of the field on the three fronts discussed previously, it will be increasingly important to sharpen our understanding of cultural acquisition. So far, in both cultural psychology and cultural neuroscience, it is assumed that culture is acquired through some mechanisms of learning. In line with this general assumption of the field, our model (see Figure 2-1) also hypothesizes that culture is acquired through active, repeated engagement in cultural tasks. One promising direction of future work would be to address specific mechanisms involved in cultural acquisition. There are many aspects in culture and, depending on which aspects of culture are under discussion, different mechanisms might be involved in the acquisition of culture. For example, cultural norms may be acquired through incentive learning (Kitayama et al., 2014). That is, behaviors that conform to certain cultural rules may be reinforced and thus more likely to be acquired, whereas those that go against such rules may be punished and thus may be dropped out. It is also possible that certain simple behavioral patterns are acquired through imitation (Losin, Iacoboni, Martin, Cross, & Dapretto, 2012). Still other aspects of culture may be acquired through motivated learning. For example, people may be motivated to endorse certain ideological views

of culture so as to reduce ontological anxiety (Greenberg, Solomon, & Pyszczynski, 1997).

One promising avenue of research is to use genetic information to test specific hypotheses on the mechanisms of cultural acquisition. We may theorize that depending on the specific mechanisms involved in cultural acquisition, different neurotransmitter systems are involved; thus certain relevant genetic polymorphisms are likely to influence the degree to which culture is acquired. To begin, as suggested by Kitayama and colleagues (2014), cultural norms and beliefs may be acquired through incentive learning. It may then be expected that genes of the dopaminergic system will be involved in cultural acquisition. Genetic polymorphisms that foster greater dopamine signaling capacity and thus enhanced reward processing and executive function (certain allelic variants of the dopamine receptor gene, *DRD4*) may facilitate cultural acquisition. If so, cultural difference in self-construal may be more pronounced for carriers of *DRD4* variants that are linked to high (versus low) dopamine signaling. In a recent study, Kitayama et al. (2014) administered scales measuring independent versus interdependent self-construals and found that European Americans are in fact more independent and less interdependent as compared with Asians. Importantly, this cultural difference was evident only for European Americans and Asians who carried variants of *DRD4* linked to increased dopamine signaling.

There are other types of genes that may also facilitate cultural acquisition. For example, to the extent that certain oxytocin genes increase sensitivity to interpersonal cues, carriers of those genes may be more likely to act in accordance with relational expectations of the culture (Kim et al., 2010). Moreover, certain polymorphisms of the serotonin transporter gene (5HTTLPR) are involved in negative emotional reactivity (Canli & Lesch, 2007; Hariri, 2009; Carver, Johnson, & Joormann, 2008), and these genes may motivate the endorsement of cultural values by way of managing negative emotional arousal (e.g., anxiety). These possibilities must be further addressed in future work (Kim & Sasaki, 2014).

3. Concluding Thought

In conclusion, the research summarized here illustrates the promise of cultural neuroscience. Engagement in the cultural world leads to changes in the functional connectivity and structure of the brain. Culture therefore is embrained. It is also clear, however, that the brain is a preeminently biological organ that has evolved and continues to evolve through genetic and

epigenetic selection mechanisms. Indeed, recent evidence based on sequencing of the entire human genomes suggests that the pace of this genetic and epigenetic selection process has accelerated over the last 10,000 years, ever since major, large-scale cultures emerged and took hold (Hawks et al., 2007), thus strongly implying an abundance of gene-by-culture coevolutionary processes.

The neural evidence discussed in this chapter must be understood and appreciated within this broad theoretical context. The same applies to the gene-by-culture interaction findings discussed above (e.g., Kitayama et al., 2014). Although genes never determine behavior or cultural forms, they may still loosely constrain such behaviors and cultural forms, making some easier to emerge and be maintained while making others more difficult to sustain. The resulting cultural forms, in turn, constantly influence the selection of various gene variants. Much has yet to be learned on this topic. Nevertheless, the very fact that the brain (a preeminently biological organ) is the key site in which culture is stored makes it clear that it will be impossible to carry out the study of culture without reference to genetic and epigenetic selection mechanisms. In our assessment, the field of cultural neuroscience offers the potential of advancing a broad intellectual agenda that integrates information about sociocultural conditions and factors and information about evolutionary and biological mechanisms, with the brain as the key interface between them. We hope that by realizing this potential, we can achieve a novel, comprehensive, enhanced level of theoretical understanding of what it means to be human.

REFERENCES

Adam, H., & Shirako, A. (2013). Not all anger is created equal: the impact of the expresser's culture on the social effects of anger in negotiations. *Journal of Applied Psychology*, *98*(5), 785–798. doi:10.1037/a0032387

Adams, G., & Markus, H. R. (2001). Culture as patterns: An alternative approach to the problem of reification. *Culture & Psychology*, 7(3), 283–296. doi:10.1177/1354067X0173002

Ambady, N. (2012). Culture, brain, and behavior. In M. J. Gelfand, C.Y. Chui, & Y.Y. Hong (Eds.), *Advances in culture and psychology* (Vol. 4, pp. 53–90). New York: Oxford University Press.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497. doi:10.1037/0033-2909.117.3.497

Bilalić, M., Kiesel, A., Pohl, C., Erb, M., & Grodd, W. (2011). It takes two–skilled recognition of objects engages lateral areas in both hemispheres. *PLOS ONE*, *6*(1), e16202. doi:10.1371/journal.pone.0016202

Butler, E. A., Lee, T. L., & Gross, J. J. (2007). Emotion regulation and culture: Are the social consequences of emotion suppression culture-specific? *Emotion*, *7*(1), 30–48. doi:10.1037/1528-3542.7.1.30

Canli, T., & Lesch, K.-P. (2007). Long story short: The serotonin transporter in emotion regulation and social cognition. *Nature Neuroscience*, *10*(9), 1103–1109. doi:10.1038/nn1964

Carey, S., & Spelke, E. (1994). Domain-specific knowledge and conceptual change. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture*, 169–200). Cambridge, UK: Cambridge University Press.

Carver, C. S., Johnson, S. L., & Joormann, J. (2008). Serotonergic function, two-mode models of self-regulation, and vulnerarlity to depression: What depression has in common with impulsive aggression. *Psychological Bulletin*, *134*, 912–943.

Chang, E. C., & Asakawa, K. (2003). Cultural variations on optimistic and pessimistic bias for self versus a sibling: Is there evidence for self-enhancement in the West and for self-criticism in the East when the referent group is specified? *Journal of Personality and Social Psychology*, *84*(3), 569–581. doi:10.1037/0022-3514.84.3.569

Chiao, J. Y., & Ambady, N. (2007). Cultural neuroscience: Parsing universality and diversity across levels of analysis. In S. Kitayama & D. Cohen (Eds.), *Handbook of cultural psychology*. New York, NY, Guilford Press.

Chiao, J. Y. Cheon, B. K., Pornpattananangkul, N., Mrazek, A. J., & Blizinsky, K. D. (2014). Cultural neuroscience: Understanding human diversity. In M. J. Gelfand, C.Y. Chui, & Y. Y. Hong (Eds.), *Advances in culture and psychology* (Vol. 4, pp. 1–77). New York: Oxford University Press.

Chida, Y., & Steptoe, A. (2009). The Association of Anger and Hostility With Future Coronary Heart Disease: A Meta-Analytic Review of Prospective Evidence. *Journal of the American College of Cardiology*, *53*(11), 936–946.

Choi, I., & Nisbett, R. E. (1998). Situational salience and cultural differences in the correspondence bias and actor-observer bias. *Personality and Social Psychology Bulletin*, *24*(9), 949–960. doi:10.1177/0146167298249003

Chomsky, N., & DiNozzi, R. (1972). *Language and mind*. New York: Harcourt Brace Jovanovich.

Chua, H. F., Boland, J. E., & Nisbett, R. E. (2005). Cultural variation in eye movements during scene perception. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(35), 12629–12633.

Cohen, D., Hoshino-Browne, E., & Leung, A. K. (2007). Culture and the structure of personal experience: Insider and outsider phenomenologies of the self and social world. *Advances in Experimental Social Psychology*, *39*, 1–67.

Cross, S. E., & Madson, L. (1997). Models of the self: Self-construals and gender. *Psychological Bulletin*, *122*(1), 5–37. doi:10.1037/0033-2909.122.1.5

Cuthbert, B. N., Schupp, H. T., & Bradley, M. M. (2000). Brain potentials in affective picture processing: Covariation with autonomic arousal and affective report. *Biological Psychology*, *52*(2), 95–111.

Davidson, R. J., Kabat-Zinn, J., Schumacher, J., Rosenkranz, M., Muller, D., Santorelli, S. F., . . . & Sheridan, J. F. (2003). Alterations in brain and immune function produced by mindfulness meditation. *Psychosomatic medicine*, *65*(4), 564–570.

de Fockert, J. W., Caparos, S., Linnell, K. J., & Davidoff, J. (2011). Reduced distractibility in a remote culture. *PLOS ONE*, *6*(10), e26337. doi:10.1371/journal.pone.0026337

de Fockert, J., Davidoff, J., Fagot, J., Parron, C., & Goldstein, J. (2007). More accurate size contrast judgments in the Ebbinghaus illusion by a remote culture. *Journal of Experimental Psychology: Human Perception and Performance*, *33*(3), 738–742. doi:10.1037/0096-1523.33.3.738

de Tocqueville, A. (2004). *Democracy in America*. Philadelphia: Pennsylvania State University Press.

Dinnel, D. L., Kleinknecht, R. A., & Tanaka-Matsumi, J. (2002). A cross-cultural comparison of social phobia symptoms. *Journal of Psychopathology and Behavioral Assessment*, *24*(2), 75–84. doi:10.1023/A:1015316223631

Doherty, M., Tsuji, H., & Phillips, W. A. (2008). The context sensitivity of visual size perception varies across cultures. *Perception*, *37*(9), 1426–1433. doi:10.1068/p5946

Draganski, B., Gaser, C., Busch, V., Schuierer, G., Bogdahn, U., & May, A. (2004). Neuroplasticity: Changes in grey matter induced by training. *Nature*, *427*(6972), 311–312. doi:10.1038/427311a

Duffy, S., & Kitayama, S. (2010). Mnemonic context effect in two cultures: Attention to memory representations? *Cognitive Science*, *31*(6), 1009–1020. doi:10.1080/03640210701703808

Duffy, S., Toriyama, R., Itakura, S., & Kitayama, S. (2009). Development of cultural strategies of attention in North American and Japanese children. *Journal of Experimental Child Psychology*, *102*, 351–359.

Erickson, K. I., Voss, M. W., Prakash, R. S., Basak, C., Szabo, A., Chaddock, L., . . . & Kramer, A. F. (2011). Exercise training increases size of hippocampus and improves memory. *Proceedings of the National Academy of Sciences*, *108*(7), 3017–3022.

Falkenstein, M., Hohnsbein, J., Hoormann, J., & Blanke, L. (1991). Effects of crossmodal divided attention on late ERP components. II. Error processing in choice reaction tasks. *Electroencephalography and Clinical Neurophysiology*, *78*(6), 447–455.

Fincher, C. L., Thornhill, R., Murray, D. R., & Schaller, M. (2008). Pathogen prevalence predicts human cross-cultural variability in individualism/

collectivism. *Proceedings of the Royal Society B: Biological Sciences*, *275*(1640), 1279–1285.

Fiske, A. P., Kitayama, S., Markus, H. R., & Nisbett, R. E. (1998). The cultural matrix of social psychology. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology*. New York: McGraw-Hill. Retrieved from http://psycnet.apa.org/psycinfo/1998-07091-036

Foti, D., & Hajcak, G. (2008). Deconstructing reappraisal: Descriptions preceding arousing pictures modulate the subsequent neural response. *Journal of Cognitive Neuroscience*, *20*(6), 977–988.

Frijda, N. H. (1986). *The emotions*. Cambridge, UK: Cambridge University Press.

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*(5), 692–731. doi:10. 1037/0033-2909.132.5.692

Gehring, W. J. (2002). The Medial Frontal Cortex and the Rapid Processing of Monetary Gains and Losses. *Science*, *295*(5563), 2279–2282.

Gehring, W. J., Goss, B., Coles, M. G., Meyer, D. E., & Donchin, E. (1993). A neural system for error detection and compensation. *Psychological science*, *4*(6), 385–390.

Gelfand, M. J., Raver, J. L., Nishii, L., Leslie, L. M., Lun, J., Lim, B. C., . . . & Yamaguchi, S. (2011). Differences between tight and loose cultures: A 33-nation study. *science*, *332*(6033), 1100–1104.

Gilbert, D. T., & Jones, E. E. (1986). Perceiver-induced constraint: Interpretations of self-generated reality. *Journal of Personality and Social Psychology*, *50*(2), 269–280. doi:10.1037/0022-3514.50.2.269

Goh, J. O., Chee, M. W., Tan, J. C., Venkatraman, V., Hebrank, A., Leshikar, E. D., . . . & Park, D. C. (2007). Age and culture modulate object processing and object—scene binding in the ventral visual area. *Cognitive, Affective, & Behavioral Neuroscience*, *7*(1), 44–52.

Goldin, P. R., McRae, K., Ramel, W., & Gross, J. J. (2008). The neural bases of emotion regulation: Reappraisal and suppression of negative emotion. *Biological Psychiatry*, *63*(6), 577–586. doi:10.1016/j.biopsych.2007.05.031

Goto, S. G., Ando, Y., Huang, C., Yee, A., & Lewis, R. S. (2010). Cultural differences in the visual processing of meaning: Detecting incongruities between background and foreground objects using the N400. *Social Cognitive and Affective Neuroscience*, *5*, 242–253.

Goto, S. G., Yee, A., Lowenberg, K., & Lewis, R. S. (2013). Cultural differences in sensitivity to social context: Detecting affective incongruity using the N400. *Social Neuroscience*, *8*(1), 63–74. doi:10.1080/17470919.2012.739202

Graem, O., Mellet, E., Crivello, F., Tzourio, N., Mazoyer, B., Berthoz, A., & Denis, M. (1997). Mental navigation along memorized routes activates the hippocampus, precuneus, and insula. *NeuroReport*, *8*, 739–744.

Greenberg, J., Solomon, S., & Pyszczynski, T. (1997). Terror management theory of self-esteem and cultural worldviews: Empirical assessments and

conceptual refinements. *Advances in Experimental Social Psychology*, *29*, 61–139. Retrieved from http://www.sciencedirect.com/science/article/pii/S0065260108600167

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, *85*(2), 348–362.

Gutchess, A. H., Welsh, R. C., Boduroğlu, A., & Park, D. C. (2006). Cultural differences in neural function associated with object processing. *Cognitive, Affective, & Behavioral Neuroscience*, *6*(2), 102–109. doi:10.3758/CABN.6.2.102

Hackman, D. A., Farah, M. J., & Meaney, M. J. (2010). Socioeconomic status and the brain: mechanistic insights from human and animal research. *Nature Reviews Neuroscience*, *11*(9), 651–659.

Hajcak, G. (2012). What We've Learned From Mistakes Insights From Error-Related Brain Activity. *Current Directions in Psychological Science*, *21*(2), 101–106.

Hall, E. T. (1977). *Beyond culture*. New York: Random House.

Han, S., Mao, L., Qin, J., Friederici, A. D., & Ge, J. (2011). Functional roles and cultural modulations of the medial prefrontal and parietal activity associated with causal attribution. *Neuropsychologia*, *49*(1), 83–91.

Han, S., Northoff, G., Vogeley, K., Wexler, B. E., Kitayama, S., & Varnum, M. E. W. (2013). A cultural neuroscience approach to the biosocial nature of the human brain. *Annual Review of Psychology*, *64*(1), 120920151208003. doi:10.1146/annurev-psych-071112-054629

Hanakawa, T., Honda, M., Okada, T., Fukuyama, H., & Shibasaki, H. (2003). Neural correlates underlying mental calculation in abacus experts: A functional magnetic resonance imaging study. *NeuroImage*, *19*(2), 296–307. doi:10.1016/S1053-8119(03)00050-8

Hariri, A. R. (2009). The neurobiology of individual differences in complex behavioral traits. *Annual Review of Neuroscience*, *32*, 225–247.

Harmon-Jones, E., Amodio, D. M., & Harmon-Jones, C. (2009). Action-based model of dissonance: A review, integration, and expansion of conceptions of cognitive conflict. *Advances in Experimental Social Psychology*, *41*, 119–166. doi:10.1016/S0065-2601(08)00403-6

Hashimoto, H., & Yamagishi, T. (2013). Two faces of interdependence: Harmony seeking and rejection avoidance. *Asian Journal of Social Psychology*, *16*(2), 142–151. doi:10.1111/ajsp.12022

Hawks, J., Wang, E. T., Cochran, G. M., Harpending, H. C., & Moyzis, R. K. (2007). Recent acceleration of human adaptive evolution. *Proceedings of the National Academy of Sciences*, *104*(52), 20753–20758.

Hedden, T., Ketay, S., Aron, A., Markus, H. R., & Gabrieli, J.D.E. (2008). Cultural influences on neural substrates of attentional control. *Psychological Science*, 12–17.

Heine, S. J. (2012). *Cultural psychology* (2nd ed.). New York: W. W. Norton& Company.

Heine, S. J., & Lehman, D. R. (1995). Cultural variation in unrealistic optimism: Does the West feel more vulnerable than the East?. *Journal of personality and social psychology*, *68*(4), 595.

Heine, S. J., Lehman, D. R., Markus, H. R., & Kitayama, S. (1999). Is there a universal need for positive self-regard? *Psychological Review*, *106*(4), 766. doi:10.1037/0033-295X.106.4.766

Higgins, E. T. (1987). Self-discrepancy: A theory relating self and affect. *Psychological Review*, *94*(3), 319–340. doi:10.1037/0033-295X.94.3.319

Hitokoto, H., Glazer, J., & Kitayama, S. (2014). *Are you more motivated when watched? Feedback-related potentials vary with culture and face priming.* Unpublished manuscript, University of Michigan.

Hong, J. J., & Woody, S. R. (2007). Cultural mediators of self-reported social anxiety. *Behaviour Research and Therapy*, *45*(8), 1779–1789.

Husain, M., & Nachev, P. (2007). Space and the parietal cortex. *Trends in Cognitive Sciences*, *11*(1), 30–36. doi:10.1016/j.tics.2006.10.011

Huttenlocher, J., Hedges, L. V., & Vevea, J. L. (2000). Why do categories affect stimulus judgment? *Journal of Experimental Psychology: General*, *129*(2), 220–241. doi:10.1037/0096-3445.129.2.220

Imada, T., Carlson, S. M., & Itakura, S. (2012). East-West cultural differences in context-sensitivity are evident in early childhood. *Developmental Science*, *16*(2), 198–208. doi:10.1111/desc.12016

Inglehart, R., & Baker, W. E. (2000). Modernization, cultural change, and the persistence of traditional values. *American Sociological Review*, 19–51.

Ishii, K., Kobayashi, Y., & Kitayama, S. (2010). Interdependence modulates the brain response to word-voice incongruity. *Social Cognitive and Affective Neuroscience*, *5*(2–3), 307–317. doi:10.1093/scan/nsp044

Ishii, K., Miyamoto, Y., Mayama, K., & Niedenthal, P. M. (2011). When your smile fades away: Cultural differences in sensitivity to the disappearance of smiles. *Social Psychological and Personality Science*, *2*(5), 516–522. doi:10.1177/1948550611399153

Ishii, K., Reyes, J. A., & Kitayama, S. (2003). Spontaneous attention to word content versus emotional tone: Differences among three cultures. *Psychological Science*, *14*(1), 39–46.

Jenkins, L. J., Yang, Y.-J., Goh, J., Hong, Y.-Y., & Park, D. C. (2010). Cultural differences in the lateral occipital complex while viewing incongruent scenes. *Social Cognitive and Affective Neuroscience*, *5*(2-3), 236–241. doi:10.1093/scan/nsp056

John, O. P., & Gross, J. J. (2004). Healthy and unhealthy emotion regulation: Personality processes, individual differences, and life span development. *Journal of Personality*, *72*(6), 1301–1334.

Jones, E. E. (1979). The rocky road from acts to dispositions. *American Psychologist*, *34*(2), 107–117. doi:10.1037/0003-066X.34.2.107

Kim, H. S., & Sasaki, J. Y. (2014). Cultural neuroscience: biology of the mind in cultural contexts. *Annual Review of Psychology*, *65*, 487–514. doi:10.1146/annurev-psych-010213-115040

Kim, H. S., Sherman, D. K., Sasaki, J. Y., Xu, J., Chu, T. Q., Ryu, C., . . . & Taylor, S. E. (2010). Culture, distress, and oxytocin receptor polymorphism (OXTR) interact to influence emotional support seeking. *Proceedings of the National Academy of Sciences*, *107*(36), 15717–15721.

Kim, H., & Markus, H. R. (1999). Deviance or uniqueness, harmony or conformity? A cultural analysis. *Journal of Personality and Social Psychology*, *77*(4), 785–800.

Kim, K., & Markman, A. B. (2006). Differences in fear of isolation as an explanation of cultural differences: Evidence from memory and reasoning. *Journal of Experimental Social Psychology*, *42*(3), 350–364. doi:10.1016/j.jesp.2005.06.005

Kitayama, S., Chua, H. F., Tompson, S., & Han, S. (2013). Neural mechanisms of dissonance: An fMRI investigation of choice justification. *NeuroImage*, *69*, 206–212. doi:10.1016/j.neuroimage.2012.11.034

Kitayama, S., & Duffy, S. (2004). Cultural competence—tacit, yet fundamental: Self, social relations, and cognition in the United States and Japan. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Culture and competence*. Washington, D.C. Retrieved from http://www.crab.rutgers.edu/~seduffy/KD_chapter.pdf

Kitayama, S., Duffy, S., & Uchida, Y. (2007). Self as cultural mode of being. In S. Kitayama & D. Cohen (Eds.), *Handbook of cultural psychology* (pp. 136–174). New York, NY, Guilford Press.

Kitayama, S., Duffy, S., Kawamura, T., & Larsen, J. T. (2003). Perceiving an object and its context in different cultures: A cultural look at new look. *Psychological Science*, *14*(3), 201–206.

Kitayama, S., & Ishii, K. (2002). Word and voice: Spontaneous attention to emotional utterances in two languages. *Cognition & Emotion*, *16*(1), 29–59.

Kitayama, S., King, A., Tompson, S., Huff, S., Yoon, C., & Liberzon, I. (2014). The dopamine receptor gene (DRD4) moderates cultural difference in independent versus interdependent social orientation. *Psychological Science*, *25*(6), 1169–1177.

Kitayama, S., Markus, H. R., Matsumoto, H., & Norasakkunkit, V. (1997). Individual and collective processes in the construction of the self: Self-enhancement in the United States and self-criticism in Japan. *Journal of Personality and Social Psychology*, *72*(6), 1245–1267. doi:10.1037/0022-3514.72.6.1245

Kitayama, S., & Murata, A. (2013). Culture modulates perceptual attention: An event-related potential study. *Social Cognition*, *31*(6), 758–769.

Kitayama, S., & Park, J. (2010). Cultural neuroscience of the self: Understanding the social grounding of the brain. *Social Cognitive and Affective Neuroscience*, *5*, 111–129.

Kitayama, S., & Park, J. (2014). Error-related brain activity reveals self-centric motivation: Culture matters. *Journal of Experimental Psychology: General*, *143*(1), 62–70. doi:10.1037/a0031696

Kitayama, S., Park, J., Boylan, J. M., Miyamoto, Y., Levine, Markus, H. R., . . . & Ryff, R. D. (in press). Anger expression and ill-health in two cultures: An examination of inflammation and cardiovascular risk. *Psychological Science*.

Kitayama, S., Park, H., Sevincer, A. T., Karasawa, M., & Uskul, A. K. (2009). A cultural task analysis of implicit independence: Comparing North America, Western Europe, and East Asia. *Journal of Personality and Social Psychology*, *97*(2), 236–255. doi:10.1037/a0015999

Kitayama, S., Takagi, H., & Matsumoto, H. (1995). Causal attribution of success and failure: Cultural psychology of the Japanese self. *Japanese Psychological Review*, *38*(2), 247–280.

Kitayama, S., & Uskul, A. K. (2011). Culture, mind, and the brain: Current evidence and future directions. *Annual Review of Psychology*, *62*(1), 419–449. doi:10.1146/annurev-psych-120709-145357

Kok, A. (2001). On the utility of P3 amplitude as a measure of processing capacity. *Psychophysiology*, *38*(3), 557–577. doi:10.1017/S0048577201990559

Kraus, M. W., Piff, P. K., Mendoza-Denton, R., Rheinschmidt, M. L., & Keltner, D. (2012). Social class, solipsism, and contextualism: How the rich are different from the poor. *Psychological Review*, *119*(3), 546–572. doi:10.1037/a0028756

Krull, D. S., Loy, M. H.-M., Lin, J., Wang, C.-F., Chen, S., & Zhao, X. (1999). The fundamental fundamental attribution error: Correspondence bias in individualist and collectivist cultures. *Personality and Social Psychology Bulletin*, *25*(10), 1208–1219.

Kutas, M., & Hillyard, S. A. (1989). An electrophysiological probe of incidental semantic association. *Journal of Cognitive Neuroscience*, *1*(1), 38–49. doi:10.1162/jocn.1989.1.1.38

Kühn, S., Gleich, T., Lorenz, R. C., Lindenberger, U., & Gallinat, J. (2013). Playing Super Mario induces structural brain plasticity: Gray matter changes resulting from training with a commercial video game. *Molecular Psychiatry*. *9*(2), 265–271.

Lieberman, M. D. (2007). Social cognitive neuroscience: A review of core processes. *Annual Review of Psychology*, *58*, 259–289.

Losin, E.A.R., Iacoboni, M., Martin, A., Cross, K. A., & Dapretto, M. (2012). Race modulates neural activity during imitation. *NeuroImage*, *59*(4), 3594–3603. doi:10.1016/j.neuroimage.2011.10.074

Lutz, A., Greischar, L. L., Rawlings, N. B., Rochard, M., & Davison, R. J. (2004). Long-term meditators self-induce high-amplitude gamma synchrony during mental practice. *Proceedings of the National Academy of Sciences*, *101*(46), 16369–16373. doi:10.1073/pnas.0407401101

Lutz, C., & White, G. M. (1986). The anthroplogy of emotions. *Annual Review of Anthropology*, *15*, 405–436.

Ma, Y., Bang, D., Wang, C., Allen, M., Frith, C., Roepstorff, A., & Han, S. (2012). Sociocultural patterning of neural activity during self-reflection. *Social Cognitive and Affective Neuroscience*, *9*(1), 73–80.

Maguire, E. A., Gadian, D. G., Johnsrude, I. S., Good, C. D., Ashburner, J., Frackowiak, R.S.J., & Frith, C. D. (2000). Navigation-related structural change in the hippocampi of taxi drivers. *Proceedings of the National Academy of Sciences*, *97*, 4398–4403.

Markus, H. R., & Kitayama, S. (1991a). Cultural variation in the self-concept. In J. Strauss & G. R. Goethals (Eds.), *The self: Interdisciplinary approaches* (pp. 18–48). New York: Springer. doi:10.1007/978-1-4684-8264-5_2

Markus, H. R., & Kitayama, S. (1991b). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, *98*(2), 224–253. doi:10.1037/0033-295X.98.2.224

Markus, H. R., & Kitayama, S. (2010). Cultures and selves: A cycle of mutual constitution. *Perspectives on Psychological Science*, *5*(4), 420–430.

Masuda, T., & Kitayama, S. (2004). Perceiver-induced constraint and attitude attribution in Japan and the US: A case for the cultural dependence of the correspondence bias. *Journal of Experimental Social Psychology*, *40*(3), 409–416.

Masuda, T., & Nisbett, R. E. (2001). Attending holistically versus analytically: Comparing the context sensitivity of Japanese and Americans. *Journal of Personality and Social Psychology*, *81*(5), 922–934. doi:10. 1037/0022-3514.81.5.922

Masuda, T., & Nisbett, R. E. (2006). Culture and change blindness. *Cognitive Science*, *30*(2), 381–399. doi:10.1207/s15516709cog0000_63

Masuda, T., Ellsworth, P. C., Mesquita, B., Leu, J., Tanida, S., & Van de Veerdonk, E. (2008). Placing the face in context: Cultural differences in the perception of facial emotion. *Journal of Personality and Social Psychology*, *94*(3), 365–381. doi:10.1037/0022-3514.94.3.365

Masuda, T., Russell, M. J., Chen, Y. Y., Hioki, K., & Caplan, J. B. (2014). N400 incongruity effect in an episodic memory task reveals different strategies for handling irrelevant contextual information for Japanese than European Canadians. *Cognitive Neuroscience*, *5*, 17–25.

Matsumoto, D., Yoo, S. H., & Nakagawa, S. (2007). Culture, emotion regulation, and adjustment. *Journal of Personality and Social Psychology*, *94*(6), 925–937.

Mauss, I. B., & Butler, E. A. (2010). Cultural context moderates the relationship between emotion control values and cardiovascular challenge versus threat responses. *Biological Psychology*, *84*(3), 521–530.

Mauss, I. B., Butler, E. A., Roberts, N. A., & Chu, A. (2010). Emotion control values and responding to an anger provocation in Asian-American and European-American individuals. *Cognition & Emotion*, *24*(6), 1026–1043. doi:10.1080/02699930903122273

Mendes, W. B., Blascovich, J., Major, B., & Seery, M. (2001). Challenge and threat responses during downward and upward social comparisons. *European Journal of Social Psychology*, *31*(5), 477–497. doi:10.1002/ejsp.80

Mendes, W. B., Reis, H. T., Seery, M. D., & Blascovich, J. (2003). Cardiovascular correlates of emotional expression and suppression: Do content and gender context matter? *Journal of Personality and Social Psychology*, *84*(4), 771–792. doi:10.1037/0022-3514.84.4.771

Miller, D. T., & Ross, M. (1975). Self-serving biases in the attribution of causality: Fact or fiction? *Psychological Bulletin*, *82*(2), 213–225. doi:10.1037/h0076486

Miller, J. G. (1984). Culture and the development of everyday social explanation. *Journal of Personality and Social Psychology*, *46*(5), 961–978. doi:10.1037/0022-3514.46.5.961

Miyamoto, Y. (2013). Culture and analytic versus holistic cognition: Toward multilevel analyses of cultural influences. *Advances in Experimental Social Psychology*, *47*, 131–188.

Miyamoto, Y., & Kitayama, S. (2002). Cultural variation in correspondence bias: The critical role of attitude diagnosticity of socially constrained behavior. *Journal of Personality and Social Psychology*, *83*(5), 1239.

Miyamoto, Y., Nisbett, R. E., & Masuda, T. (2006). Culture and the physical environment holistic versus analytic perceptual affordances. *Psychological Science*, *17*(2), 113–119.

Morris, M. W., & Peng, K. (1994). Culture and cause: American and Chinese attributions for social and physical events. *Journal of Personality and Social Psychology*, *67*(6), 949–971. doi:10.1037/0022-3514.67.6.949

Murata, A., Park, J., Kovelman, L., & Kitayama, S. (2014). *Culturally non-preferred cognitive tasks require compensatory attention: A functional Near Infrared Spectroscopy (fNIRS) investigation*. Unpublished manuscript, University of Michigan.

Murata, A., Moser, J. S., & Kitayama, S. (2013). Culture shapes electrocortical responses during emotion suppression. *Social Cognitive and Affective Neuroscience*, *8*(5), 595–601. Retrieved from http://scan.oxfordjournals.org/content/8/5/595.short

Na, J., & Kitayama, S. (2011). Spontaneous trait inference is culture-specific: behavioral and neural evidence. *Psychological Science*, *22*(8), 1025–1032. doi:10.1177/0956797611414727

Na, J., & Kitayama, S. (2012). Will people work hard on a task they choose? Social-eyes priming in different cultural contexts. *Journal of Experimental Social Psychology*, *48*(1), 284–290. doi:10.1016/j.jesp.2011.09.003

Näätänen, R. (1992). *Attention and brain function*. Mahwah, NJ: Lawrence Erlbaum Associates.

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review*, *108*(2), 291–310. doi:10.1037/0033-295X.108.2.291

Nisbett, R. E., & Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment*. Englewood Cliffs, NJ: Prentice Hall. Retrieved from http://www.getcited.org/pub/101972193

Norasakkunkit, V., & Kalick, S. M. (2002). Culture, ethnicity, and emotional distress measures the role of self-construal and self-enhancement. *Journal of Cross-Cultural Psychology*, *33*(1), 56–70.

Norasakkunkit, V., & Kalick, S. M. (2007). Experimentally detecting how cultural differences on social anxiety measures misrepresent cultural differences

in emotional well-being. *Journal of Happiness Studies*, *10*(3), 313–327. doi:10.1007/s10902-007-9082-1

Norasakkunkit, V., Kitayama, S., & Uchida, Y. (2012). Social anxiety and holistic cognition. *Journal of Cross-Cultural Psychology*, *43*(5), 742–757. Retrieved from http://jcc.sagepub.com/content/43/5/742.short

Norman, D. A. (1969). Memory and attention: An introduction to human information processing. New York: Wiley, 1969.

Okazaki, S. (2000). Asian American and White American differences on affective distress symptoms: Do symptom reports differ across reporting methods? *Journal of Cross-Cultural Psychology*, *31*(5), 603–625. doi:10.1177/0022022100031005004

Okazaki, S., Liu, J. F., Longworth, S. L., & Minn, J. Y. (2002). Asian American–White American differences in expressions of social anxiety: A replication and extension. *Cultural Diversity & Ethnic Minority Psychology*, *8*(3), 234–247. doi:10.1037/1099-9809.8.3.234

Park, J., & Kitayama, S. (2014). Interdependent selves show face-induced facilitation of error processing: Cultural neuroscience of self-threat. *Social Cognitive and Affective Neuroscience*, *9*(2), 201–208.

Park, J., Kitayama, S., Markus, H. R., Coe, C. L., Miyamoto, Y., Karasawa, M., . . . & Ryff, C. D. (2013). Social status and anger expression: The cultural moderation hypothesis. *Emotion*, *13*(6), 1122.

Rayner, K., Castelhano, M. S., & Yang, J. (2009). Eye movements when looking at unusual/weird scenes: Are there cultural differences? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *35*(1), 254–259. doi:10.1037/a0013508

Rösler, F., & Heil, M. (1991). Toward a functional categorization of slow waves: Taking into account past and future events. *Psychophysiology*, *28*(3), 344–358. doi:10.1111/j.1469-8986.1991.tb02205.x

Sabatinelli, D., Bradley, M. M., Fitzsimmons, J. R., & Lang, P. J. (2005). Parallel amygdala and inferotemporal activation reflect emotional intensity and fear relevance. *NeuroImage*, *24*(4), 1265–1270. doi:10.1016/j.neuroimage.2004.12.015

Schirmer, A., & Kotz, S. A. (2003). ERP evidence for a sex-specific Stroop effect in emotional speech. *Journal of Cognitive Neuroscience*, *15*(8), 1135–1148. doi:10.1080/14640747708400601

Schirmer, A., Kotz, S. A., & Friederici, A. D. (2005). On the role of attention for the processing of emotions in speech: Sex differences revisited. *Cognitive Brain Research*, *24*(3), 442–452.

Schirmer, A., Lui, M., Maess, B., Escoffier, N., Chan, M., & Penney, T. B. (2006). Task and sex modulate the brain response to emotional incongruity in Asian listeners. *Emotion*, *6*(3), 406–417. doi:10.1037/1528-3542.6.3.406

Schlenker, B. R., & Leary, M. R. (1982). Social anxiety and self-presentation: A conceptualization model. *Psychological Bulletin*, *92*(3), 641–669. doi:10.1037/0033-2909.92.3.641

Scholz, J., Klein, M. C., Behrens, T.E.J., & Johansen-Berg, H. (2009). Training induces changes in white-matter architecture. *Nature Neuroscience*, *12*(11), 1370–1371. doi:10.1038/nn.2412

Shweder, R. A., & Sullivan, M. A. (1993). Cultural psychology: Who needs it? *Annual Review of Psychology*, *44*, 497–527.

Singelis, T. M. (1994). The measurement of independent and interdependent self-construals. *Personality and Social Psychology Bulletin*, *20*(5), 580–591.

Soto, J. A., Perez, C. R., Kim, Y.-H., Lee, E. A., & Minnick, M. R. (2011). Is expressive suppression always associated with poorer psychological functioning? A cross-cultural comparison between European Americans and Hong Kong Chinese. *Emotion*, *11*(6), 1450–1455. doi:10.1037/a0023340

Steele, C. M., & Liu, T. J. (1983). Dissonance processes as self-affirmation. *Journal of Personality and Social Psychology*, *45*(1), 5–19. doi:10.1037/0022-3514.45.1.5

Stephens, N. M., & Markus, H. R. (2014). Social class culture cycles: How three gateway contexts shape selves and fuel inequality. *Annual Review of Psychology*, *65*, 611–634.

Stephens, N. M., Markus, H. R., & Townsend, S.S.M. (2007). Choice as an act of meaning: The case of social class. *Journal of Personality and Social Psychology*, *93*(5), 814–830. doi:10.1037/0022-3514.93.5.814

Stone, J., & Cooper, J. (2001). A self-standards model of cognitive dissonance. *Journal of Experimental Social Psychology*, *37*(3), 228–243.

Talhelm, T., Zhang, X., Oishi, S., Shimin, C., Duan, D., Lan, X., & Kitayama, S. (2014). Large-Scale Psychological Differences Within China Explained by Rice Versus Wheat Agriculture. *Science*, *344*, 603–608.

Tanaka, A., Koizumi, A., Imai, H., Hiramatsu, S., Hiramoto, E., & de Gelder, B. (2010). I feel your voice: Cultural differences in the multisensory perception of emotion. *Psychological Science*, *21*(9), 1259–1262. doi:10.1177/0956797610380698

Tang, Y. Y., Lu, Q., Fan, M., Yang, Y., & Posner, M. I. (2012). Mechanisms of white matter changes induced by meditation. *Proceedings of the National Academy of Sciences*, *109*(26), 10570–10574. doi:10.1073/pnas.1207817109

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin*, *103*(2), 193–210. doi:10.1037/0033-2909.103.2.193

Triandis, H. C. (1995). *Individualism & collectivism*. Boulder, CO, Westview Press.

Traindis, H. C., & Berry, J. M. (1980a). *Handbook of cross-cultural psychology: Methodology* (Vol. 2). Boston: Allyn and Bacon.

Traindis, H. C., & Berry, J. M. (1980b). *Handbook of cross-cultural psychology: Social psychology* (Vol. 5). Boston: Allyn and Bacon.

Tsai, J. L. (2007). Ideal affect: Cultural causes and behavioral consequences. *Perspectives on Psychological Science*, *2*(3), 242–259.

Uleman, J. S., Saribay, S. A., & Gonzalez, C. M. (2008). Spontaneous inferences, implicit impressions, and implicit theories. *Annual Review of Psychology*, *59*, 329–360.

Uskul, A. K., Kitayama, S., & Nisbett, R. E. (2008). Ecocultural basis of cognition: Farmers and fishermen are more holistic than herders. *Proceedings of the National Academy of Sciences*, *105*(25), 8552–8556. doi:10.1073/pnas.0803874105

Varnum, M.E.W., Grossmann, I., Kitayama, S., & Nisbett, R. E. (2010). The origin of cultural differences in cognition the social orientation hypothesis. *Current Directions in Psychological Science*, *19*(1), 9–13.

Varnum, M.E.W., Na, J., Murata, A., & Kitayama, S. (2012). Social class differences in N400 indicate differences in spontaneous trait inference. *Journal of Experimental Psychology: General*, *141*(3), 518–526.

Walsh, M. M., & Anderson, J. R. (2012). Learning from experience: Event-related potential correlates of reward processing, neural adaptation, and behavioral choice. *Neuroscience & Biobehavioral Reviews*, *36*(8), 1870–1884. doi:10.1016/j.neubiorev.2012.05.008

Weinberg, A., Riesel, A., & Hajcak, G. (2012). Integrating multiple perspectives on error-related brain activity: the ERN as a neural indicator of trait defensive reactivity. *Motivation and Emotion*, *36*(1), 84–100.

Zhu, Y., Zhang, L., Fan, J., & Han, S. (2007). Neural basis of cultural influence on self-representation. *NeuroImage*, *34*, 1310–1316.