

# Cultural Neuroscience: A New Interdisciplinary Field

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**Abstract** Cultural neuroscience is a new interdisciplinary field which combines culture, mind, and the brain. This article briefly introduced the diverse ideas from 2000 to 2010 in cultural neuroscience and reviewed some typical fMRI studies in this field. It supports the idea that cultural neuroscience will bring about a new integrative theoretical framework for the study of the human mind.

**Key words** culture, neuroscience, social brain

## 1. Introduction

The term “cultural neuroscience” has not appeared in Chinese psychological journals yet, while cultural neuroscience is set to flourish in the next few years in the world of psychology and “it is just waiting to be discovered and exploited to yield a major advancement in the science of both culture and brain” (Kitayama & Tompson, 2010). The emerging research field of cultural neuroscience is an interdisciplinary field to combine culture, mind, and the brain; it may become a new theoretical framework for the study of the human mind (Kitayama & Park, 2010). Therefore, it is the time for Chinese researchers and students to know it. The purpose of this article is to briefly introduce the diverse ideas from 2000 to 2010 in cultural neuroscience and to trace some typical fMRI studies in this field.

In 2007, Chiao and Ambady (2007) firstly used the term “cultural neuroscience” which represents the emergence of a new field. However, similar ideas of cultural neuroscience appeared about 10 years ago. We guess that Globalization in economic promotes the emergence of cultural neuroscience (Choudhury & Kirmayer, 2009).

Early in 2000, Paulesu et al. (2000) have showed that cultural factors, as reflected in orthographic systems, can powerfully shape neurophysiological systems when comparing Italian

orthography with English orthography. From 2001 to 2003, based on the studies of the brain plasticity and psychological development, there was the idea of the biocultural co-constructive framework, which posited that the brain not only generates and supports cognition and sociocultural interactions, but also works in other ways around, i. e., being shaped and modified by cultures (Baltes & Singer, 2001; Li, 2003). In 2004, the term “social brain” appeared in neuroscience journals and researchers began to believe that specialized neural mechanisms had evolved to process social information because information such as gender, kin, and social status are essential for human’s reproduction and survival. Social brain, which was defined as the neural consequences of social experience (Insel & Fernald, 2004), or the complex network of areas involved in the processes of social cognition that allow humans to understand and interact with each other (Frith, 2007), or the network of brain regions involved in understanding others (Blakemore, 2008). Articles in *Science* (Miller, 2006) and *Nature* (Blakemore, 2008) also probed the social brain. Cameron Carter of UC Davis pointed out that this new area doesn’t quite have the theoretical or methodological rigor of more traditional cognitive neuroscience, such as research of memory and attention, in which scientists had probed them with fMRI or so since the early 1990s. Wexler (2006) proposed the principle of internal-external or

neuroenvironmental consonance in his book *Brain and Culture*, that is, humans are driven to match their internal neurological structures to the external environment. He argued, based on the principle, that “the brain shapes itself to the external physical, social, and cultural milieu in which it develops during the early years of life. Later in life, on the basis of this same principle, the individual seeks out an external environment that matches the already established internal structures”. Wexler (2006) gave an excellent example to show the feature of the brain by comparing the brain with stomach. The stomach can work independently of the environment, whereas the brain cannot. “The brain recreates in itself a representation of environment input which, especially in the formative years, conforms highly to the complexities of that input”.

Han & Northoff (2008) proposed a transcultural neuroimaging approach to study the human brain and mind because transcultural neuroimaging studies have demonstrated that one’s cultural background can influence one’s behavior and neural activity that underlies both high- and low-level cognitive functions. They also pointed out that “transcultural neuroimaging is based on social psychology and cognitive neuroscience and bridges the gap between the two disciplines”.

## 2. Theoretical discussion of cultural neuroscience and some typical fMRI studies

From 2008, more and more articles aimed to discuss the cultural neuroscience theories and methods (Ambady & Bharucha, 2009; Ames & Fiske, 2010; Chiao, Li, & Harada 2008; Chiao et al., 2010; Choudhury & Kirmayer, 2009; Dominguez, Turner, Lewis, & Egan, 2010; Kitayama & Park, 2010; Kitayama & Tompson, 2010; Losin, Dapretto, & Iacoboni, 2010).

Ambady & Bharucha (2009) suggested that there were two objectives in cultural neuroscience. One is to map the cultural architecture of the brain (culture mapping) and the other is to tease apart the sources of cultural mappings. As a good example, Chinese psychologist Tang and his colleagues (2006)

found that relative to native English speakers, native Chinese speakers use a different region of the brain to conduct a simple arithmetic (e. g.  $3 + 4$ ) or decide which number is larger, even though same Arabic numbers are used in the both cultural groups. Native English speakers show more activation in Wernicke’s and Broca’s areas, which are associated with language processing, whereas native Chinese speakers show more activation in a visual-premotor association region associated with visual-spatial processing. These results may be due to the differences in languages between two cultural groups: English is phonological language and Chinese has its visuospatial natures. Ambady & Bharucha (2009) expected that “Historically, psychology has swung between a focus on learning and a focus on innateness. An examination of the neuroscience of culture provides the exciting opportunity to examine the mutual interplay of culture and biology across multiple levels of analysis, from genes and brain to mind and behavior, across the life span”. Thus, this is an echo of the biocultural co-constructive framework mentioned above (Baltes & Singer, 2001; Li, 2003).

Ames and Fiske (2010) considered cultural neuroscience as a combination between neuroscience and cultural psychology. After summing up the studies of cultural neuroscience including perception, attention, thinking (e. g. number counting), language, inferring others’ emotions, attribution and belief inference, self, social interaction, and genes, they made a conclusion that “Culture is, after all, stored in people’s brains. Moreover, human brain is biologically prepared to acquire culture: the ability to coordinate thoughts and behaviors within social groups has aided primate and hominid survival”. One of good examples of empirical study of cultural neuroscience is about different “perceptual and thinking styles” between Westerners and East Asian. It is well known that “East Asians and Westerners perceive the world and think about it in very different ways. Westerners are inclined to attend to some focal object whereas East Asians are more likely to attend to a broad perceptual and conceptual field” (Nisbett & Masuda,

2003). Gutchess, Welsh, Boduroglu and Park. (2006) conducted an fMRI study to examine the neural basis for this difference: Chinese and American participants judged various pictures of objects, backgrounds, and object-background combinations. The results showed that American participants, relative to Chinese participants, demonstrated stronger and more distributed neural activations including the middle temporal gyrus, right superior temporal/supramarginal gyrus, and superior parietal lobule during object processing. Another good example in cultural neuroscience is the cultural variation in neural basis for Western independent self and East Asian interdependent self. Self studies of neuroscience have begun for about 10 years since Craik et al.'s initial work (1999). Now, it is clear that both Western (Kelley et al., 2002) and Eastern or Chinese (Zhang et al., 2006) participants showed activity of an area of the ventral MPFC/anterior cingulate cortex (ACC) more for thinking about the self compared with thinking about other people. However, people in different cultures have strikingly different construals of the self. People with Western cultural background hold independent self-construal which emphasize separateness between the self and others, whereas people with Eastern cultural background hold interdependent self-construal which emphasize connectedness between the self and others (Markus & Kitayama, 1991). This hypothesis was recently tested in an fMRI study, in which Western and Chinese participants were asked to think about both the self and a close other (one's mother) during fMRI scanning. The results showed that both Western and Chinese participants activated the ventral MPFC (and perigenual ACC) when thinking about the self, which is consistent with prior work. However, thinking about one's mother yielded preferential activation in the ventral MPFC only for Chinese participants (Zhu, Zhang, Fan, & Han, 2007). "This finding first provides the neural evidence for self-construal theoretical assertions (Markus & Kitayama, 1991) that Easterners view close others (and their relationships to those close others) as the part of the self, whereas Westerners

tend to conceive of the self as an independent entity" (Ames & Fiske, 2010). Another example is a cultural priming study which appeared to show that a few minutes of cultural priming can modulate neural substrates of self-awareness (Sui & Han, 2007). In their study Chinese participants identified the orientation of their own face and close friends after self-construal priming. Neural activity in the right middle frontal cortex was greater when participants viewed their own than familiar faces. The time courses of the blood-oxygenation-level-dependent (BOLD) signals in the right middle frontal cortex after independent and interdependent self-construal priming were analyzed. The results showed that the signal changes associated with self faces were larger than those linked to familiar faces only in the independent self-construal priming condition.

In the article "Theory and methods in cultural neuroscience", Chiao et al. (2010) defined cultural neuroscience as "an emerging research discipline that investigates cultural variation in psychological, neural and genomic processes as a means of articulating the bidirectional relationship of these processes and their emergent properties". Similar to other interdisciplinary fields such as social neuroscience or social cognitive neuroscience, affective neuroscience and neuroeconomics, cultural neuroscience "aims to explain a given mental phenomenon in terms of a synergistic product of mental, neural and genetic variables of interest." ... "However, cultural neuroscience is also unique from related disciplines in that it focuses explicitly on way that mental and neural events vary as a function of cultural traits (e.g. values, practices and beliefs) in some meaningful way". After discussing some challenges in conducting cultural neuroscience research, they summed up that "similar to research biases in the behavioral sciences, within the field of human neuroimaging, over 90% of peer-reviewed neuroimaging studies come from Western, industrialized nations and most do not consider the impact of environmental factors, such as cultural values, practices and beliefs, on the relation between human brain function and behavior". As to the goal, they concluded that cultural neuroscience

will “enhance our understanding how sociocultural and biological forces interact and shape each other across multiple time points”.

Kitayama & Tompson (2010) listed three reasons why we need cultural neuroscience.

(a) The empirical reason: Neuroscience measures provide unique and indispensable information for theory building. For example, the theory of cognitive dissonance may be the most important theory in social psychology in the last century. However, it is well acknowledged that it is too difficult to verify the theory with behavioural measures alone. We now know that certain brain areas that are linked to conflict monitoring (ACC) and negative somatic arousal (anterior insula) are strongly activated when people behave in an attitude-incongruous fashion and, moreover, these activations do predict subsequent attitude change.

(b) The theoretical reason: Culture and the brain make each other up. Human brain is fundamentally social, thus it needs a massive amount of external input for it to be fully functional. This idea is similar to “social brain” mentioned above. Conversely, the brain is an indispensable element for culture to work because brain generate and support cognition and sociocultural interactions. Here we hear the echo of the idea of the biocultural co-constructive framework (Baltes & Singer, 2001; Li, 2003) and the idea of Wexler (2006) again.

(c) The meta-theoretical reason: Integrating nature and nurture. “Historically, psychology has swung between a focus on learning and a focus on innateness” (Ambady & Bharucha, 2009). Now we can expect that learning and innateness can be understood as just two sides of one thing. “Because culture can provide a dynamic context for genetic selection, while, at the same time, genes have the potential to be an extremely powerful force that motivates certain forms of culture in lieu of others” (Kitayama & Tompson, 2010). For example, “gene expressions are contingent on daily experiences throughout the life span ... external environmental inputs (e.g. trauma early in life) can change the expression of certain genes, resulting in considerable

behavioral differences (e.g. depression, aggressiveness, or violence) later in life” (Kitayama & Tompson, 2010). This idea is similar to Chiao et al.’s idea (2010) that cultural neuroscience investigates cultural variation in psychological, neural and genomic processes.

### 3. Cultural neuroscience as new integrative theoretical framework

Now we turn to the question about cultural neuroscience as new integrative theoretical framework for the study of the human mind proposed by Kitayama & Park (2010). They go back to the computer metaphor which is a view of the human mind as an autonomous computational machine. The computer metaphor is a methodological basis of cognitive psychology which played a key role in the psychological kingdom from 1960 to 1985. It led us to distinguish between control processes (software) and structural features (hardware). Thus, cognitive psychologists can only study the processes of information processing without involving its natural structure—the human brain. However, the basis of the computer metaphor is information theory that holds that information transmission should be the only thing to focus on, and the device that transmit information can be ignored. This idea is limiting in our understanding of the mind, because mental processing is the function of the brain and it is impossible to understand the mind without considering the human brain (Chen, Zhu, & Chen, 1996; Smith, 1999). So a new metaphor, the brain metaphor, has emerged since about 1990 to replace the computer metaphor in psychology; and it has gradually become a methodological basis of cognitive neuroscience, which is widely considered as a new stage of psychology instead of cognitive psychology (Gazzaniga, 1995).

Moreover, Kitayama & Park (2010) argued that “computer metaphor is limiting in some important ways... in particular, the computer metaphor would portray the mind as fixed, bounded and housed neatly in the head, and but for sensory receptors nearly completely insulated from the external environment.

However, recent demonstration of neural plasticity and epigenesis emphasize the significance of experience in brain development by suggesting that non-genetic, environmental factors can lead to dramatic changes in gene expression. Given this emerging evidence, it has become increasingly clear that ‘the mind itself’ is significantly influenced by soci-cultural contexts insofar as experience is powerfully organized by culture”. A new theoretical framework of cultural neuroscience is an alternative view of the human mind as biologically prepared and, yet, supplemented, transformed and fully completed through active participation and engagement in the eco-symbolic environment called culture. In our view, cultural neuroscience is an interdisciplinary field of research that investigates interrelations among culture, mind and brain, which is different from any traditional areas of psychology. It can bring the interdisciplinary perspectives and methodologies together to form a novel theoretical framework of understanding the human mind.

#### 4. Conclusion

Cultural neuroscience as new interdisciplinary field combining culture, mind, and brain has developed rapidly. It represents a new way of thinking today that emphasizes synthesizing methods and perspectives, not reductionism, in scientific research. In the case of cultural neuroscience, it is to synthesize abstract idea such as culture and the concrete neural activity and genetic processes.

Recently researchers such as Henrich, Heine and Norenzayan (2010) argued “to understand human psychology, behavioral scientists must stop doing most of their experiments on Westerners” and Chiao et al. (2010) also argued that “similar to research biases in the behavioral sciences, within the field of human neuroimaging, over 90% of peer-reviewed neuroimaging studies come from Western, industrialized nations and most do not consider the impact of environmental factors, such as cultural values, practices and beliefs, on the relation between human brain function and behavior”. Thus, Chinese psychologists need to grasp this opportunity of

cultural neuroscience to catch up their Western partner since we have duty to do better research on cultural neuroscience by Chinese subjects. For example, Chinese psychologists have done good jobs on neural basis of Chinese self (Zhang et al., 2006; Zhu et al., 2007; Sui et al., 2007; Han et al., 2008; Chen et al., 2008; Han et al., 2009; Wu et al., 2010; Ng et al., 2010).

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## 文化神经科学：一个新兴的跨学科领域

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**摘要** 文化神经科学是一个将文化、心理与大脑整合起来的新兴的跨学科领域。本文简要地介绍了从2000年到2010年在文化神经科学领域内的各种观点,同时回顾了该领域里一些典型的功能性磁共振(fMRI)的研究成果。文章认为,文化神经科学可为人类心理的研究提供一个全新的,整合性的理论框架,而且,它还为中国心理家提供了机遇:使用中国被试开展文化神经科学研究去取得世界一流的成果。

**关键词** 文化 神经科学 社会脑