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Cultural Neuroscience: A Historical Introduction and Overview

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Cultural Neuroscience: A Historical Introduction and Overview

Abstract

The integration of cognitive neuroscience with the study of culture emerged from independent ascensions among both fields in the early 1990s. This marriage of the two previously unconnected areas of inquiry has generated a variety of empirical and theoretical works that have provided unique insights to both partners that might have otherwise gone overlooked. Here, I provide a brief historical introduction to the emergence of cultural neuroscience from its roots in cultural psychology and cognitive neuroscience to its present stature as one of the most challenging but rewarding sub-disciplines to have come from the burgeoning growth of the study of the brain and behavior. In doing so, I overview some of the more studied areas within cultural neuroscience: language, music, mathematics, visual perception, and social cognition. I conclude with a discussion of how both parent fields (cognitive neuroscience and cultural psychology) have reciprocally benefited from the involvement of the other.

Historical Background

In 1991, Hazel Markus and Shinobu Kitayama published a seminal review that brought cultural psychology to the attention of mainstream researchers in psychology. Previously an interdisciplinary subfield of social psychology, cultural differences in thought and behavior constituted a topic of interest to anthropologists, linguists, and scholars of communication as much or more than it was to psychologists. Markus and Kitayama's (1991) paper changed that by effectively integrating questions about cultural differences with questions of interest to researchers in social cognition (the dominant theoretical focus of social psychology at the time). Although scholars have not uniformly accepted some of Markus and Kitayama's arguments and questioned the magnitude of empirical support behind them (e.g., Matsumoto, 1999; Oyserman, Coon, & Kemmelmeier, 2002), their paper has garnered over 12,000 citations to date, positioning it as arguably the most influential paper in cultural psychology and one of the most cited in all of the social and behavioral sciences. Thus, the work marked a new era for cultural psychology and a historical turning point that provided momentum for rebirth of the study of culture among scholars in psychology.

At approximately the same time that Markus and Kitayama's (1991) review was reshaping the fate of cultural psychology, a separate set of exciting advances was occurring in neuroscience. Researchers at AT&T's Bell Laboratories in 1990 and at the Massachusetts General Hospital in 1991 independently developed the ability to reliably track bloodflow within the brain, setting the foundation for a revolution in cognitive neuroscience (see Kwong, 2012, for a historical review). It was not long until studies of human brain activity were being published using this technological innovation (e.g., Belliveau et al., 1991), touching off an explosion of interest in cognitive neuroscience over the next decade. The degree to which psychology departments embraced this new hybrid field was revolutionary: they invested unprecedented resources in acquiring functional Magnetic Resonance Imaging (fMRI) scanners, hired physicists and neurologists onto their faculties, and even changed their names to highlight the new "brain sciences" (Jaffe, 2011). The number of brain-imaging studies in psychology grew exponentially by the new millennium and has continued to rise in the last 25 years (e.g., Derrfuss & Mar, 2009).

It was not long after this renaissance in cognitive neuroscience that a second generation of offspring fields developed. Perhaps the most prominent of these has been social neuroscience (also called "social cognitive neuroscience" and "social cognitive affective neuroscience"; see Lieberman, 2006). Rather than applying measures of brain activity and brain-mapping to questions about basic cognition (e.g., the representation of different patterns in the visual cortex; Le Bihan et al., 1993), researchers began using these tools to ask questions about social thought and social behavior. Social neuroscience quickly splintered into a host of topic-based fields such as personality neuroscience, affective neuroscience, and neuroeconomics, each with their own flavor and inspiration from a distinct tradition that shared some interest with questions previously asked by social psychologists (i.e., personality psychologists, interdisciplinary emotion researchers, and economists, respectively). Most notable to the current work, cultural neuroscience (also referred to as “transcultural neuroscience;” Han & Northoff, 2008) was among these as well.

Cultural neuroscience may best be defined as the application of cognitive neuroscience tools to answering questions about cultural differences in thought and behavior. Similar to neuroeconomics, affective neuroscience, and personality neuroscience, cultural neuroscience shares overlap with the interests of social neuroscientists but also touches on topics of interest that are broader than those addressed in psychology. Not unlike its parent discipline of cultural psychology, the content area of cultural neuroscience is interdisciplinary: relevant to scholars in anthropology, linguistics, communication, sociology, and others within the social sciences. Cognitive neuroscience, too, is an interdisciplinary field, traditionally attracting interest from researchers in cognition, perception, vision sciences, medicine, physics, physiology, and a host of other disciplines in the natural sciences (see Gazzaniga, 1984). The product of this merging is therefore a field that is simultaneously very broad in the number of domains to which it is connected and also quite narrow in that it is limited to questions and phenomena within these fields that are only related to cultural differences.

This has resulted in a veritable cornucopia of research published in cultural neuroscience, ranging from questions about basic cognition (e.g., neural correlates of mathematical processing across cultures; Tang et al., 2006) to questions about high-level social phenomena (e.g., brain regions associated with election outcomes in different nations; Rule, Freeman, Moran, Gabrieli, & Ambady, 2010). Since its inception, cultural neuroscience has come to envelope a variety of topics and has spawned a number of edited volumes (e.g., Han & Pöppel, 2011) and special issues of journals (e.g., Chiao, 2010) devoted to cultural neuroscience exclusively. The questions investigated in these areas have continued to be wide-ranging and have even grown to include other elements of neuroscience that extend beyond the brain, such as genetic factors that differ cross-culturally and interact with the cognitive and behavioral processes more traditionally studied in cognitive neuroscience (e.g., Way & Lieberman, 2010).

Empirical work in cognitive neuroscience can be logistically challenging and many of these challenges are only compounded by those inherent to conducting cross-cultural work. A common assumption (and, thus, criticism—see Poldrack, 2010) of cognitive neuroscience is that the brain’s structure and function are equivocally linked. Harkening back to phrenological claims about the areas of the brain that are responsible for particular thoughts (such as described by Browne, 1869, for example), there is a temptation in brain-mapping to isolate “the part of the brain that does X.” Perhaps unsurprisingly, the operations of the brain are not so simple. Although there may be correlations between measures of metabolism, bloodflow, or electroconductivity in the brain with specific or general classes of thought and behavior, these data are only suggestive (e.g., Horwitz, 2003). An important distinction is therefore that cognitive neuroscience may provide instruments to test hypotheses about brain function and behavior, rather than objective measurements of cognitive processes or their sequelae. Much of cognitive neuroscience has been, and presently remains, exploratory and this may be particularly true of its offspring fields like cultural neuroscience that are working at the frontiers of what is known.

In terms of theory, measurement, and analysis (for which there are many variables requiring consideration; see Poldrack et al., 2008), cognitive neuroscience is still an emerging field. Hence, its offspring, such as cultural neuroscience, depend critically upon the resolution of a great many issues within the parent.

Exacerbating this, cultural neuroscience invites unique complications of its own. For instance, if one wishes to truly compare the brain response of individuals from two cultures, it is best if data are collected using the same fMRI scanner, or at least using the same model of fMRI scanner. The calibrations and parameters that must be programmed into a scanning protocol are also highly multivariate even within the same machine. Thus, great care must be taken to assure that a long list of variables is kept constant in addition to all of the usual challenges and preconditions of cross-cultural work, such as the possible overreliance upon dichotomies (interdependent versus independent; East versus West) that may not capture the breadth of cultural differences (e.g., Sperber, Devellis, & Boehlecke, 1994; van de Vijver & Leung, 1997; Weeks, Swerissen, & Belfrage, 2007). Indeed, a key limitation of cultural psychology that is magnified in cultural neuroscience is the solicitation of participants from wealthy nations that possess the resources needed to carry out such studies (see Henrich, Heine, & Norenzayan, 2010, and Chiao & Cheon, 2010, for related discussion). This, in combination with the relatively small sample sizes inherent to many studies in neuroscience (e.g., Button et al., 2013), can exacerbate a researcher's ability to generalizing to entire cultures or nations. The practical limitations relevant to cultural neuroscience have hindered its progression relative to the rapid expansion of its peer fields (e.g., neuroeconomics). Yet, despite these staggering challenges, there have been impressive advances in understanding the interface between culture and the brain across a number of different research areas.

Below, I provide a brief review of the variety of research in cultural neuroscience to date. This is principally organized into sections based on contributing subfields, all of which are bound by their shared interest in the role that cultural variation might contribute to differences in cognitive and perceptual processing: language, music, mathematics, visual perception, and social cognition. As the overview of each of these topics represents merely a taste of each, readers are encouraged to consult the Further Reading section below to gain satiety with any particular area of specific interest.

Language

Arguably the most obvious cultural difference comes from differences in language. Although there are different cultures that may speak what is considered the same language (e.g., English spoken by Britons, Americans, Canadians, and Australians) and cases in which people who speak different languages may comprise what some might consider the same culture (e.g., Scandinavians may speak Norwegian, Swedish, or Danish; see Romaine, 1994), variation in language may be the strongest correlate of variation in culture overall.

Language and culture tend to be reciprocally constructive. Culture influences language; for example, by introducing new turns of phrase and trends in speech (Romaine, 1994). Yet language may also influence culture (see Sapir, 1929/1958; Whorf, 1940). Given the variability across languages, it is perhaps unsurprising that the brain may organize different types of languages differently. For example, Chinese is a highly visual language in the way that it is written. Each Chinese character is the descendant of what originated as a drawn picture of the thing or idea that it represents; hence, the characters are referred to as "ideographs" (e.g., Norman, 1988). In contrast, most Western languages are written with phonographs—symbols that represent sounds that combine to form representations of ideas. Unsurprisingly, the part of the brain known to respond to the visual perception of words (the so-called "visual word-form area" located in the fusiform gyrus; see Figure 1) tends to be more active among Chinese readers than among Western readers (see Bolger, Perfetti, & Schneider, 2005, for details).

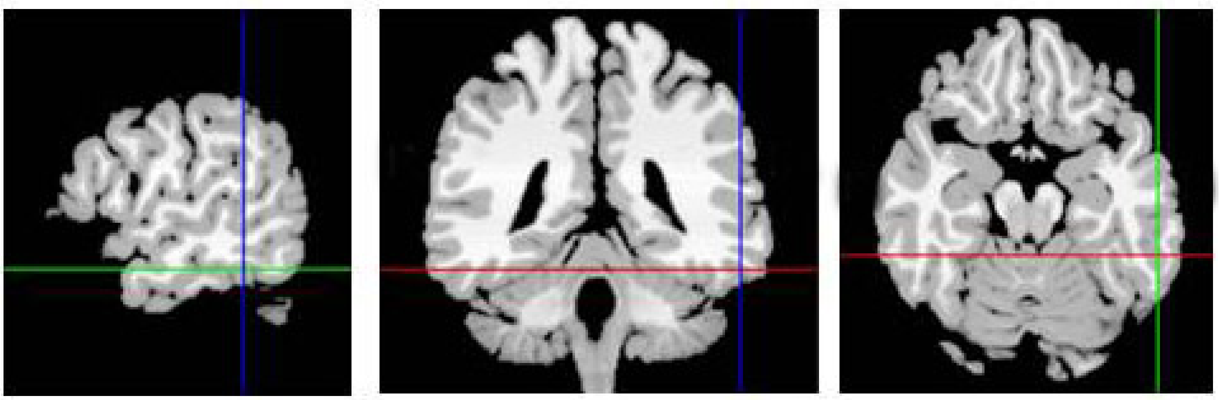

Figure 1. Sagittal (side to side), coronal (front to back), and axial (top to bottom) views of the approximate mean point (located at crosshairs) of the visual word form area (VWFA) found by Bolger et al. (2005) to be more active among Chinese versus Western readers.

Reading is a specific sub-form of language, however, and cultures need not be literate to have language. Yet there is also evidence that culture may influence the neural processing of speech. Perani and Abutalebi (2005), for instance, found that language-processing areas of the brain were influenced by the age of language acquisition, degree of mastery, and the amount of language exposure in bilingual speakers. Notably, Pallier et al. (2003) reported that the brains of French speakers responded similarly whether they heard phrases spoken in their native French or in unfamiliar languages, suggesting some degree of universality in how the brain processes spoken language.

Music

In a number of ways, music and language have a great deal in common. Physically, they both rely on sound waves to be communicated and perceived. Behaviorally, both music and language can be written and "spoken." Structurally, the two are often integrated (e.g., songs typically consist of words). And, neurally, they tend to elicit responses in similar brain regions (e.g., Janata et al., 2002).

Music varies across culture in myriad ways. Cultural groups differ with regard to the music they produce and consume, leading to the use of different instruments, beats, and patterns between cultures. Relatedly, musical styles vary across culture and time, as most immigrants (or even parents of teenagers) may attest. This variability notwithstanding, there are also cultural universals in music and in many of its properties (e.g., loudness, tempo, and timbre). Moreover, these have been found to evoke similar emotions cross-culturally (Balkwill, Thompson, & Matsunaga, 2004)—for example, music perceived as "sad" by members of one culture tends to be perceived as "sad" by members of another culture (see also Gendron, Roberson, van der Vyver, & Barrett, 2014, for related findings with *vocal* expressions of emotion as well as Curtis & Bharucha, 2010).

Yet, also like language, there are cultural differences in the brain's response to music that suggest that early exposure to particular types of music can create the acquisition of culture-specific musical knowledge, similar to the way that early language exposure can shape an individual's perception of specific sounds in language (e.g., Trainor, 2005). For example, Neuhaus (2003) reported that German, Turkish, and Indian musicians showed different electrical patterns in the brain's cortex (measured using electroencephalography, or EEG) when listening to culturally-unfamiliar musical tones. Nan, Knosche, and Friederici (2006) found similar effects for perceptions of larger musical phrases among trained musicians—an effect that they later replicated among non-musicians as well (Nan, Knosche, & Friederici, 2009).

Using fMRI, Morrison, Demorest, Aylward, Cramer, and Maravilla (2003) compared responses to culturally-native versus culturally-unfamiliar music and found no such differences in neural activation (see also Demorest, Morrison, Beken, & Jungbuth, 2008; Morrison, Demorest, & Stambaugh, 2008). Extending this work, however, they later found significant differences in areas of the superior temporal gyrus (the raised sausage-appearing ridge indicated by the yellow arrow in Figure 2) bilaterally (that is, in both brain hemispheres) when Western and Turkish participants listened to music from their own culture versus the other's culture, or from a third culture unfamiliar to both (i.e., Chinese music; Demorest et al., 2010). Morrison, Demorest, and colleagues reconciled the differences between the two studies' conflicting findings by highlighting limitations to the experimental design in their earlier study (i.e., Morrison et al., 2003) such as the noisy environment of the fMRI scanner interfering with aural perception—yet another challenge of fMRI research entirely independent of those introduced by culture or differences in scanning equipment (see https://www.youtube.com/watch?v=9GZvd_4ot04 for a demonstration of the fMRI's noisy environment).

Figure 2. The superior temporal gyrus (indicated by the yellow arrow) and superior temporal sulcus (traced in red) as viewed from the right side of the head.

Mathematics

Language, music, and mathematics all share a common foundation through their reliance on logical processing. Yet, although the neural response to language and music is somewhat debated in terms of whether it is culturally-specific or universal (as reviewed above), there is less ambiguity when it comes to mathematical processing.

Behaviorally, East-Asians greatly outperform Westerners in math (Stevenson & Stigler, 1992). Expounding upon the neural basis for this, Tang et al. (2006) examined the brain activity of native English and Chinese speakers while they performed numerical tasks. Native English speakers showed more activation in areas of the left perisylvian cortices that are associated with language processing (such as Wernicke's and Broca's areas), whereas native Chinese speakers showed more activation in a visual-premotor area associated with visuospatial processing. The authors of that work suggested that greater premotor activity for native Chinese speakers may be due to the visuospatial nature of the Chinese language (i.e., its emphasis on symbols and writing), similar to the findings reviewed for language processing above. For English speakers, however, retrieval of mathematical facts may be mediated by phonological processing (e.g., the verbalization of numbers during calculations; see also Holloway, Battista, Vogel, & Ansari, 2013).

Thus, the neural processes involved in mathematical calculation may be influenced by culture as a consequence of the language in which mathematical concepts and operations are learned (see also Cao, Li, & Li, 2010, and Lin, Imada, & Kuhl, 2012). This may help to explain the observation of such profound differences in math performance across cultures.

Visual Perception

As just mentioned, studies of behavior have reliably shown that Westerners focus on the central object within a scene or background whereas Easterners attend to the background or situational context in which the object appears (Kitayama, Duffy, Kawamura, & Larsen, 2003). Easterners therefore tend to perceive people and scenes holistically whereas Westerners more easily separate the object from its context, even to the point of what would seem to be relative contextual blindness in assessing and evaluating objects (including people).

This difference is evident in neural activity as well as behavior. One study compared East Asians' and Americans' brain responses during the line judgment task (an adaptation of the classic rod-and-frame task measuring field dependence; Witkin & Goodenough, 1977) to assess the extent to which object-context perception related to brain responses across cultures (Hedden, Ketay, Aron, Markus, & Gabrieli, 2008). In doing so, they found that East Asian study participants were characterized by a stronger response in the dorsolateral prefrontal cortex (an area that has been implicated in tasks requiring greater cognitive control—shown in red from three different views in Figure 3) when making judgments of absolute line length, which are advantaged by processing independent visual features, as opposed to judgments of relative line length, which are more closely aligned with interdependent and holistic processing of visual stimuli (see also Gutchess, Welsh, Boduroglu, & Park, 2006, for similar cultural differences in brain areas associated with visual processing). Notably, this difference diminished as a function of how acculturated the East Asian participants were to the U.S., suggesting that cultural exposure and values might mitigate cultural differences in perception at both cognitive and behavioral levels.

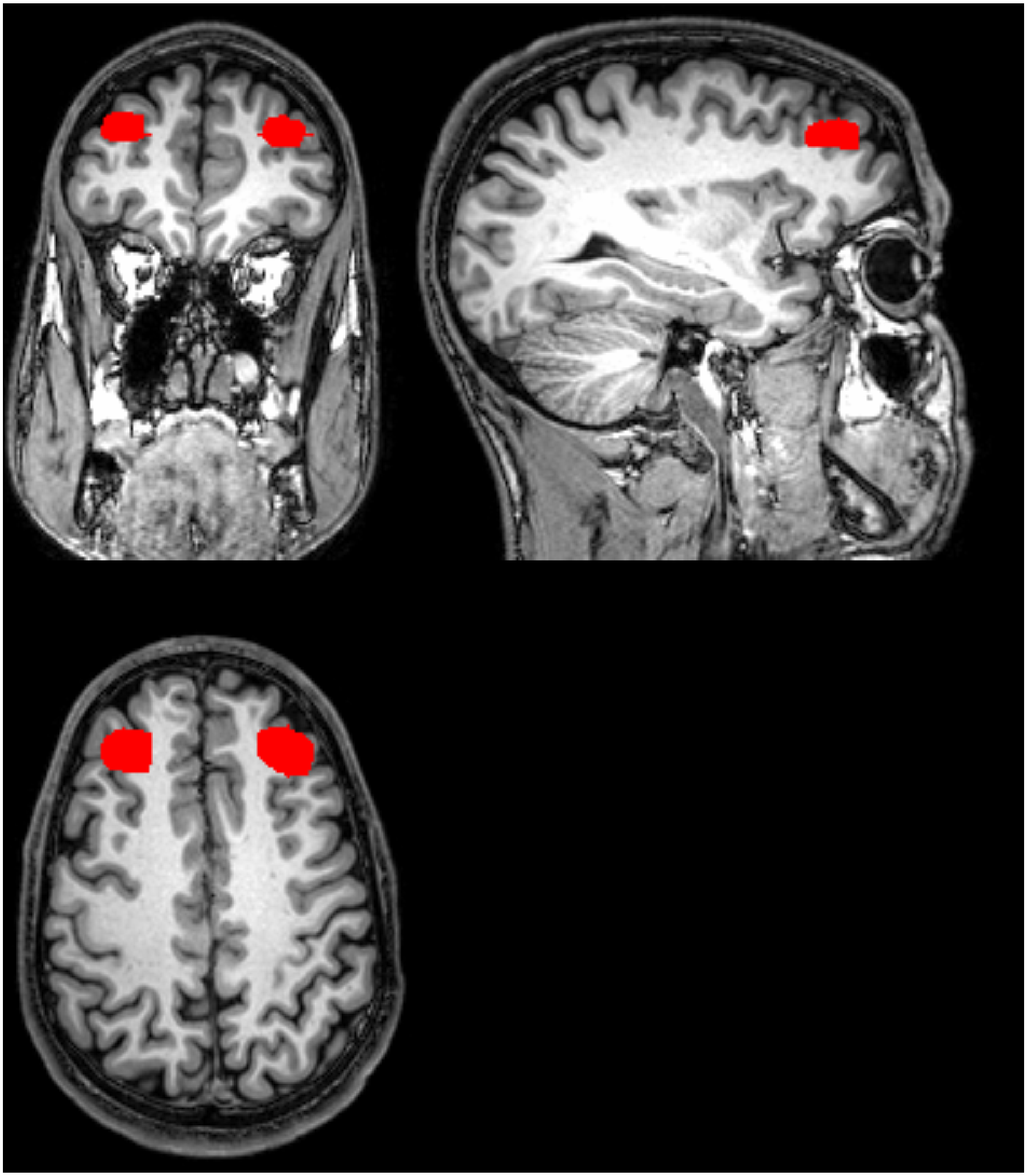

Figure 3. Approximate location corresponding to the dorsolateral prefrontal cortex presented bilaterally (in both brain hemispheres) in axial (top to bottom), coronal (front to back), and sagittal (side to side) views (clockwise from bottom).

Social Cognition

Thus, people differ across cultures in the way that they view and think about objects in context, and this difference is reflected in neural activity. Perhaps the most salient visual targets that individuals perceive are other people. Although there tends to be high agreement in the way that people from different cultures perceive each other (e.g., Albright et al., 1997), agreement in what is seen does not equate with agreement in what is *interpreted* from what is seen (e.g., Peng, Zebrowitz, & Lee, 1993). For example, Rule, Ambady, et al. (2010) found that American and Japanese perceivers exhibited high levels of agreement about how powerful and warm different political candidates looked in photos of their faces. The perceivers used this information differently, however, according to distinctions in cultural values associated with leadership. Specifically, the Japanese perceivers indicated that they would be more likely to vote for the candidates that were consensually perceived as warm (who actually did win the elections in Japan) but American perceivers indicated that they would be more likely to vote for the candidates perceived as powerful (who did, indeed, win the real elections in the U.S.).

Similar discrepancies between perception and cognition are evident in neuroimaging data comparing these two cultural groups. Freeman, Rule, Adams, and Ambady (2009), for instance, asked Americans and Japanese exchange students visiting the U.S. to view photos of people posing in ways that very obviously reflected dominance and submissiveness. Although the participants from both groups agreed about which stimuli were dominant and which were submissive, they varied with regard to what this meant to them. Japanese participants showed greater activation in regions of the brain that process rewards (the very same that respond to treats like sugar, money, and cocaine; see Berridge & Kringelbach, 2008, for review) when viewing submissively-posed targets. Americans, on the other hand, showed greater activation in these regions when viewing dominantly-posed targets. This difference in brain response was consistent with differences in cultural values regarding behavior: collectivists (here, the Japanese) typically value deference and submission to authority, whereas individualists (here, the Americans) tend to prize dominance and individual assertion.

Effects such as these occur for more complex social tasks as well. Mental “mind reading” need not refer to a parapsychological phenomenon but is often used to describe an activity that people engage in consistently: inferring others’ states of mind (Mitchell, 2006). Understanding others’ intentions is an important antecedent to successful social functioning, which requires a theory of mind—that is, the understanding that others have a mind and perspective different from one’s own (e.g., Premack & Woodruff, 1978). A handful of tasks have been developed to test theory of mind processing. One of the most popular is known as the Reading the Mind in the Eyes Test (Baron-Cohen, Wheelright, Hill, Raste, & Plumb, 2001). This task presents study participants with pairs of eyes surrounded by adjectives that may describe the target’s mental state (see Figure 4 for an example stimulus developed for the cross-cultural version of the task described below). Adams, Rule, et al. (2010) adapted the original test, which used only Caucasian targets, to

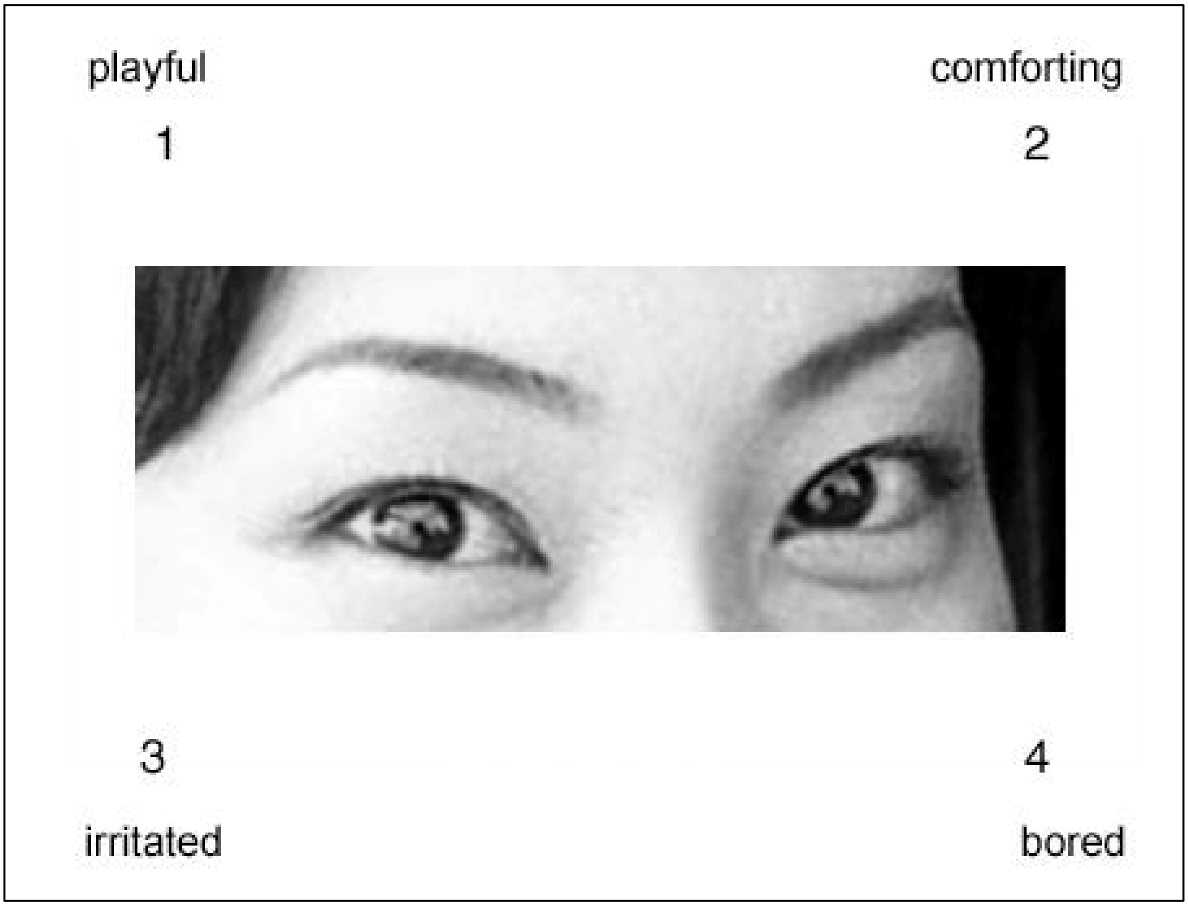

Figure 4. Example of a stimulus from the Asian version of the Reading the Mind in the Eyes Test developed by Adams, Rule, et al. (2010)

construct one with Asian faces. They then used this to measure the extent to which American and Japanese perceivers would be able to infer the mental states of people from the opposite cultural group and examined their brain responses when doing so. Behaviorally, the Americans were better with the Caucasian (versus Asian) targets and the Japanese were better with the Asian (versus Caucasian) targets. This advantage for inferring the mental states of ingroup members was reflected in brain activity as well. Neurally, the Americans showed a stronger response in the superior temporal sulcus (STS; a key brain region for inferring the intentions of others that is indicated by the red line drawn within the furrow underneath the superior temporal gyrus in Figure 2) when judging the Caucasian stimuli and the Japanese showed a stronger response in the STS was judging the Asian stimuli.

These effects for mental state inference might suggest a neural and behavioral basis for cross-cultural understanding. Note that the task was minimally language-based and that all of the stimuli and instructions were presented in the participant's native language, following careful vetting and back-translation of the stimuli prior to conducting the research. Visual perception of an ingroup versus outgroup member therefore guides the level at which a perceiver's brain responds to thinking about the mindset of another person. More important, reduced activation to outgroup members produces a cost in performance for understanding the thoughts and intentions of people who are different from one's self.

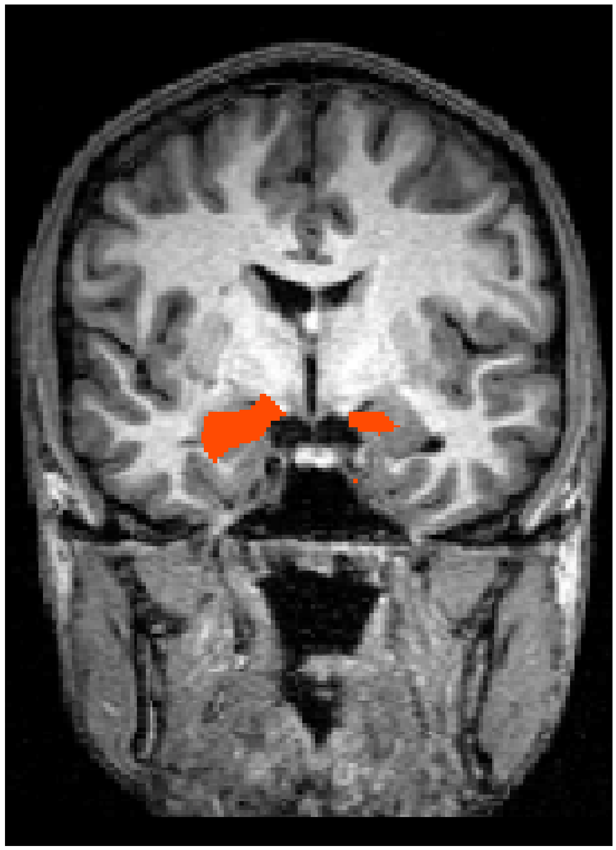

Figure 5. Bilateral amygdala response in coronal (front to back) view from the brain of a participant in the study conducted by Rule, Freeman, et al. (2010).

Indeed, similar ingroup effects are found for cross-cultural tasks investigating the recognition of emotional expressions. Although emotions are largely accurately perceived across cultures, there is variability in the extent of this accuracy (Elfenbein & Ambady, 2002; Jack, Garrod, Yu, Caldara, & Schyns, 2012). One study investigating the neural correlates of emotion recognition across cultural groups found that Japanese participants in Japan and Caucasian participants in the U.S. each produced stronger responses in the amygdala (a subcortical structure implicated in the early stages of emotion recognition, highlighted in orange in Figure 5) to expressions of fear in the faces of Japanese and Caucasian faces, respectively (Chiao et al., 2008). Adams, Franklin, et al. (2010) reported similar results, finding that the direction of targets' eye gaze moderated these effects.

Specifically, faces expressing fear with their eyes averted to the side (a feature highly relevant to the expression of fear; see Adams, Gordon, Baird, Ambady, & Kleck, 2003) elicited a greater amygdala response when the face belonged to someone of the same culture as the perceiver. When the eyes were looking directly at the perceiver, however, the amygdala response was greater when the face was from a culture different from the perceiver's own (Adams, Franklin, et al., 2010).

Finally, in light of the historical importance of Markus and Kityama's (1991) summary of cultural differences in self-referential processing, it is not surprising that one of the most-studied research areas in social neuroscience, let alone cultural neuroscience, has been the neural basis of thoughts about the self. Consistent with Markus and Kitayama's (1991) description of the self as an independent construct in individualistic cultures and the self as an interdependent construct in collectivistic cultures (i.e., intertwined with conceptions of close others), several studies have shown that participants from collectivist cultures respond differently to thoughts about family members than do participants from individualist cultures.

Not considering cultural differences, Kelley et al. (2002) found that the ventral-medial prefrontal cortex (VMPFC; displayed in the artist's illustration presented in Figure 6) showed stronger activation among Americans when they were thinking about themselves versus other people. Five years later, a study in China found different effects. Because of the importance of interdependent relationships between an individual and his or her mother, Zhu, Zhang, Fan, and Han (2007) found that the same area active in Kelley et al.'s (2002) study responded not just to thoughts about the self but also to thoughts about one's mother among a sample of Chinese participants (but substantially less so for one's father or best friend; Wang et al., 2011).

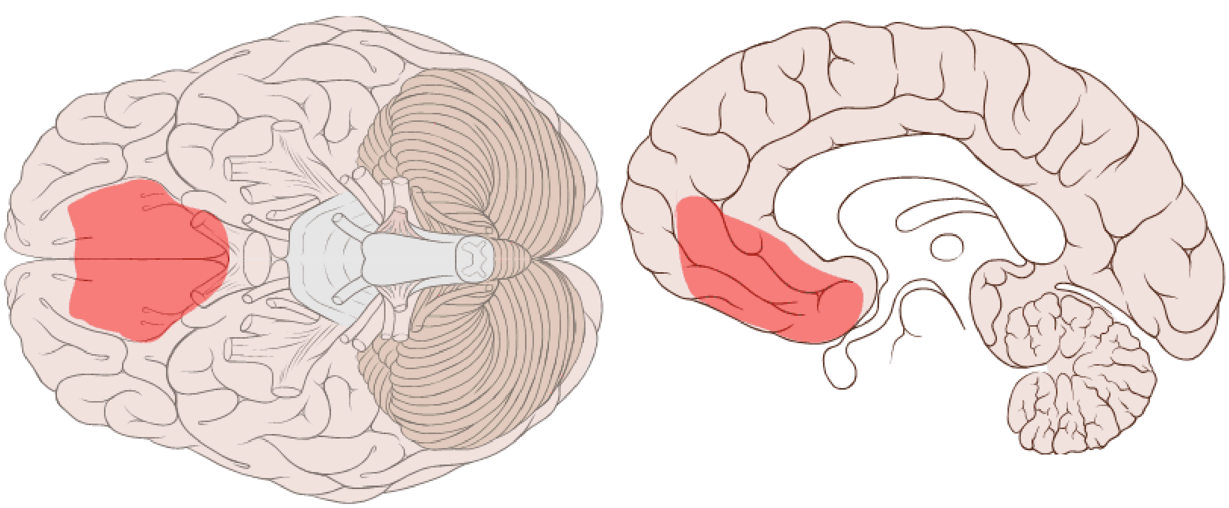

Figure 6. Illustration of the ventral medial prefrontal cortex viewed from the bottom and left side of the brain; views adapted from an image available courtesy of the Wikimedia Commons
(http://upload.wikimedia.org/wikipedia/commons/c/c8/Ventromedial_prefrontal_cortex.png)

A follow-up study reported similar effects among bicultural Chinese participants depending on whether they were primed with a Western or Chinese stimulus (Ng, Han, Mao, & Lai, 2010). When in a Chinese mindset, the self and mother produced overlapping activations in the VMPFC. When primed to be in a Western mindset, however, the activations were not overlapping (see also Chiao et al., 2010, and Ray et al., 2010).

Conclusion

Some scholars have argued that cognitive neuroscience comprises little more than a modern-day phrenology: a mapping of "who does what" in the brain that may contribute little to understanding how people actually think or behave (see Poldrack, 2010, for discussion). This is a criticism that may equally befall cultural neuroscience, the ultimate question being what have we learned about *culture* from studying the brain? Reciprocally, researchers in cognitive neuroscience might ask what they have learned about the brain from considering culture. Here, I hope to have illuminated some of these contributions while also providing an introduction and overview of the history and current state of cultural neuroscience as a discipline.

Few within cultural neuroscience would dispute that studying the brain has shed new light on processes underlying cultural differences in thought and behavior. One example comes from a cultural neuroscience study of memory in which researchers found that, although the surface observation of behavior was the same (participants from both Eastern and Western cultures remember objects just as well as the other), different neural regions supported the processes leading to these similar outcomes (Gutchess et al., 2006). Specifically, Easterners may see objects and their contexts as one percept whereas Westerners may separate objects from their context, suggesting that the two groups actually see and think about objects in different ways. Parallel findings are sewn throughout the studies described here: from the way that Chinese process language more visually than Americans (Bolger et al., 2005), to the apparent consideration of one's mother as a different person versus part of one's self (Zhu et al., 2007).

Similar value may be offered to cognitive neuroscientists. The studies reviewed here suggest that culture may be an important moderating variable of some of the most basic effects in cognitive neuroscience. For example, although the STS responds regardless of the apparent culture of the target for whom a mental state inference is made, its magnitude varies depending on the match between the target's and perceiver's cultural affiliation (Adams, Rule, et al., 2010). Perhaps more striking, even basic responses to visual stimuli in the occipital cortex—one of the best mapped regions in cognitive neuroscience—may vary in terms of which areas are active according to one's culture for simple object perception (e.g., Gutchess et al., 2006).

Cultural neuroscience may therefore be a derivative field, a grandchild of the merging of cognitive psychology and neuroscience. However, like its progenitor of cultural psychology, it is not easily reduced to an extension of social psychology or social neuroscience. Rather, by combining questions, methods, and theories from a multitude of disciplines, cultural psychology and cultural neuroscience are able to contribute unique perspectives towards better understanding human thought and behavior that would otherwise not be captured without such integration.

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Discussion Questions

1. How has the history of cultural neuroscience paralleled the history of cultural psychology? How is it different?

2. The author argues that cultural neuroscience provides unique contributions to both cultural psychology and cognitive neuroscience. Is a separate field of cultural neuroscience necessary to achieve this? What are the negative effects of dividing academic disciplines into narrower fields of inquiry, given the amount of overlap and the interdisciplinary approach now found in many of the mainstream, parent disciplines?

3. The author notes the critique that cognitive neuroscience is sometimes considered a modern-day variant of phrenology. However, might there be value in mapping the brain for its own sake? How do recent brain-mapping initiatives compare to the Human Genome Project of the 1990's and what lessons might be learned from genetics to help advance brain-mapping today?

Further Readings

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A brief review of cultural neuroscience that is slightly more technical than that offered in the present article.

Boroditsky, L. (2001). Does language shape thought? Mandarin and English speakers' conceptions of time. *Cognitive Psychology, 43*, 1-22. http://dx.doi.org/10.1006/cogp.2001.0748

Empirical article on the relationship between language and culture that provides much of the conceptual foundation for the effects in cultural neuroscience regarding language that are described here.

Derrfuss, J., & Mar, R. A. (2009). Lost in localization: The need for a universal coordinate database. *NeuroImage, 48, 1-7.* http://dx.doi.org/10.1016/j.neuroimage.2009.01.053
A recent discussion of advances in brainmapping, including past successes and limitations to be addressed by the field in the future.

Gazzaniga, M. S. (1984). *Handbook of Cognitive Neuroscience*. New York: Plenum Press.
The original edition of perhaps the most comprehensive resource for understanding cognitive neuroscience; later editions are updated to reflect advances in the field of cognitive neuroscience over time.

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An important empirical article on the influence of culture on visual processing for readers interested in learning more about this particular content area.

Han, S., & Northoff, G. (2008). Culture-sensitive neural sub-strates of human cognition: A transcultural neuroimaging approach. *Nature Reviews Neuroscience, 9*, 646–654. http://dx.doi.org/10.1038/nrn2456
Another brief review of cultural neuroscience that is slightly more technical in nature.

Holloway, I. D., Battista, C. Vogel, S. E., & Ansari, D. (2013). Semantic and perceptual processing of number symbols: Evidence from a cross-linguistic fMRI adaptation study. *Journal of Cognitive Neuroscience, 25, 388-400.* http://dx.doi.org/10.1162/jocn_a_00323
A recent empirical article on the role of culture in mathematical processing.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98,* 224-253. http://dx.doi.org/10.1037/0033-295X.98.2.224
Seminal article in cultural psychology reviewing conceptions of the self across cultures; a classic paper in cultural psychology that is one of the most cited in the behavioral sciences.

Rule, N. O., Freeman, J. B., & Ambady, N. (2013). Culture in social neuroscience: A review. *Social Neuroscience, 8,* 3-10. http://dx.doi.org/10.1080/17470919.2012.695293

A lengthier and more technical review of cultural neuroscience that is more specific to social psychology and social neuroscience.

About the Author

Nicholas O. Rule is assistant professor of psychology and Canada Research Chair in Social Perception and Cognition at the University of Toronto. His research principally focuses on processes related to person perception, particularly as they relate to the accurate inference of social information from minimal nonverbal cues. He employs a diverse array of methodological tools to investigate these questions, ranging from the observation of micro-level contributions at the level of specific neural structures to macro-level comparisons across nations and cultures touching on a variety of methods and approaches in between. He has published numerous papers in the domains of cultural psychology, cognitive neuroscience, and the merging of the two (i.e., cultural neuroscience). More information can be found on his website: http://psych.utoronto.ca/users/rule.