



Culture: by the brain and in the brain?

Cultura: pelo cérebro ou no cérebro?

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Abstract

Since the 1990s, several disciplines have emerged at the interface between neuroscience and the social and human sciences. For the most part, they aim at capturing the commonalities that underlay the heterogeneity of human behaviors and experiences. Neuroanthropology and cultural neuroscience, or the “neurodisciplines of culture,” appear different, since their goal is to understand specificity rather than commonality and to address how cultural differences are inscribed in the brain. After offering an overview of these disciplines, and of their relation to endeavors such as cultural psychology and social neuroscience, this article discusses some of the most representative studies in the area in order to explore in which ways they are relevant for an understanding of culture.

Keywords: culture; cultural neuroscience; neuroanthropology; neuroimaging; neuroscience.

Resumo

Desde a década de 1990, várias disciplinas surgiram na interface entre neurociência e as ciências sociais e humanas. A maior parte delas procura capturar as semelhanças subjacentes à heterogeneidade de comportamentos e experiências humanas. Neuroantropologia e neurociência cultural, ou as “neurodisciplinas da cultura”, parecem à primeira vista diferentes, uma vez que seus objetivos são compreender as especificidades em vez das semelhanças e abordar como as diferenças culturais são inscritas no cérebro. Depois de oferecer uma visão geral dessas disciplinas e de sua relação com áreas como a psicologia cultural e a neurociência social, este artigo discute alguns dos estudos mais representativos na área, a fim de explorar de que forma são relevantes para a compreensão da cultura.

Palavras-chave: cultura; neurociência cultural; neuroantropologia; neuroimagem; neurociência.

Neurobabble, neuromythology, neurospeculation, neurotrash, neuromania, neuromadness... The use of these “neuroskeptical” terms is typically directed at claims about the relevance of neuroscientific findings to such areas of life as politics, morality, religion, economics, law, education, morals, or love. The critiques usually refer to disciplines whose names, ranging from “neuroanthropology” to “neurotheology,” combine the prefix “neuro” with the name of a human or social science, or include “neuroscience” preceded by an adjective associated with one of those sciences: social neuroscience, affective neuroscience, or cultural neuroscience. (Littlefield, Johnson, 2012; Ortega, Vidal, 2011).

Most neurodisciplines aim at capturing the commonality that underlies the heterogeneity of behaviors and experiences – in other words, universal neurobiological processes, which are to be “modulated” by contextual factors. In contrast, the neurodisciplines of culture, such as neuroanthropology and cultural neuroscience, focus less on commonality than on difference – on that which gives cultures their specificity and on how culture is “inscribed” in the brain. Like all disciplines of the “neuro,” they attempt to draw their explanations from knowledge about the brain. But they are particularly careful to emphasize their interest in the “interactions” of culture and brain, and ultimately in the brain’s “enculturation.” They thus offer an opportunity to examine how the notion of culture operates within a framework built to study transcultural neurobiological processes.

The editors of *The encultured brain*, a book that presents itself as “an introduction to neuroanthropology,” state that the discipline’s project is “to examine different neural systems empirically, understand how neural capacities develop, and document which biological and environmental factors shape their realization” (Downey, Lende, 2012, p.24). Such a project has been considered as part of an “exciting shift” toward a more “integrative” biological anthropology, insofar as it demonstrates “that anthropology can provide for neuroscience contextual examples of how enculturation can help explain differences in brain functioning, while neuroscience offers anthropology direct evidence of neuroplasticity’s role in social and cultural dynamics” (MacKinnon, 2014, p.357). *The encultured brain* claims to break with earlier notions of culture:

For a long time, anthropologists have focused on culture as a system of symbolic associations, public signs, or shared meaning. But from the perspective of the nervous system, patterns of variation among different groups also include significant unconscious, non-symbolic traits, such as patterns of behavior, automatized response, skills, and perceptual biases. This neuroanthropological framing opens more space for considering why all types of cognition may not operate in identical fashion, and how non-cognitive forms of neural enculturation may influence thought and action (Downey, Lende, 2012, p.37).

In other words, culture is not only about shared representations, but also about “shared conditionings of the nervous system.” This may seem self-evident, since there can be no shared patterns of behavior, symbolic or automatic, in the absence of some shared brain processes. Yet for the neuroanthropologists who wrote the quoted passage, it is the “implications” of that principle that appear “obvious.” As they write,

forms of enculturation, social norms, training regimens, ritual, language and patterns of experience shape how our brains work and are structured. But the predominant reasons

that culture becomes embodied ... is that neuroanatomy inherently makes experience material. Without material change in the brain, learning, memory, maturation, and even trauma could not happen. ... Through systematic change in the nervous system, the human body learns to orchestrate itself. Cultural concepts and meanings become neurological anatomy (Downey, Lende, 2012, p.37).

All of this, as the authors say, is obvious. The questions are whether, or in what sense, examining changes in the brain significantly adds to an understanding of culture beyond reiterating that those changes happen and may be necessary; and how the notion of “culture” operates within a conceptual and methodological framework built to study transcultural neurobiological processes across cultures.

These issues can be explored in at least two ways. On the one hand, with respect to research itself, we may ask: How do the neurodisciplines of culture’s stress on brain-culture “bidirectionality” translate into concrete investigative strategies? And what are its empirical results? On the other hand, these disciplines can be examined in regard to their implicit values and epistemic hierarchy. In spite of their emphasis on the two-way processes that embody the brain in culture and culture in the brain, they frequently convey the belief in the ontological primacy of the brain, and see the human groups that constitute cultures as a “community of brains” (Domínguez Duque, 2015, p.292). Such ontological primacy turns culture, however defined, into an external factor that “shapes,” “influences” and “impacts on” neural activity, function and processes: the spontaneous use of such action verbs is emblematic of how the neurodisciplines of culture approach their object (Gutchess, Goh, 2013; other examples are given throughout this article). What is the consequence of that for both the neurodisciplines of culture and the very concept of culture? This is the main question this article proposes to explore.

Neurologizing culture

Like some of the other neurodisciplines, those that concern culture passed in a few years from being an informal group of scholars with common interests to having their own name and Wikipedia article, professionals, institutions, journals, societies, colloquia, educational events, blogs and websites, programs, and graduate students. Special issues of journals not specifically devoted to them highlight their interactions with more established fields. For example, cultural neuroscience has been the subject of special issues of *Psychological Inquiry* (2013), *Social Cognitive and Affective Neuroscience* (2010), the *Asian Journal of Social Psychology* (2010) and *Progress in Brain Research* (2009). The *Handbook of social neuroscience* offers an overview (Chiao, 2011), and the collective volume *Cultural and neural frames of cognition and communication* (Han, Pöppel, 2011) includes several contributions from the discipline. As for neuroanthropology, calls for such an endeavor first emerged in the late 1970s, and the word was in use by the early 1990s (see the overview in Downey, 2012a); by the mid-1990s, the term could already be found in reference works of anthropology (e.g. Marcus, 1997), where it is likely to stay (e.g. Downey, 2012a). In 2012, the same year *The encultured brain* appeared, two journals, *Anthropological Theory* and *Annals of Anthropological Practice*, devoted special issues to neuroanthropology.

In turn, the term “cultural neuroscience” seems to have first appeared in print in 2007, in a chapter for the *Handbook of cultural psychology*. It was then defined as “an area of research that investigates cultural variation in psychological, neural, and genomic processes as a means of articulating the interrelationship of these processes and their emergent properties” (Chiao, Ambady, 2007, p.238). Cultural neuroscientists acknowledge that it is misguided to imagine that social factors have “minimal interest” for understanding brain and behavioral processes (Zhou, Cacioppo, 2010). At the same time, considering that the sociocultural level of analysis is by itself insufficient, they emphasize the “interdisciplinarity” of their endeavor and the “bidirectionality” of the processes they investigate, and speak of “biocultural co-constructivism” and “multiple” or “reciprocal determinism” (Zhou, Cacioppo, 2010). Cultural neuroscientists hold that values, practices and beliefs both “shape and are shaped by the mind, brain and genes,” and that the study of “cultural variation in mental, neural and genomic processes” therefore constitutes a means of “articulating the bidirectional relationship of these processes and their emergent properties” (Chiao, Cheon, 2012, p.288; Chiao et al., 2013; Kim, Sasaki, 2014).

While the notion that complex behavior “results from the dynamic interaction of genes and cultural environment” is not new, cultural neuroscience is supposed to represent “a novel empirical approach to demonstrating bidirectional interactions between culture and biology by integrating theory and methods from cultural psychology, neuroscience and neurogenetics” (Chiao, Cheon, 2012, p.289). It claims to have “potential implications” – not only for psychiatry, business, and technology, but also for global public policy issues in health, globalization, immigration, and interethnic ideology (Chiao, 2009; Denkhaus, Bös, 2012). At the research level, cultural neuroscientists are motivated by two “still unanswered” questions: How do cultural traits “shape” neurobiology and behavior, and how do neurobiological mechanisms “facilitate” the emergence and transmission of cultural traits? (Chiao et al., 2010, p.356).

Neither neuroanthropology nor cultural neuroscience are the first attempts at approaching culture with neuroscientific tools. Since the early 1990s, cognitive neuroscience has incorporated the study of interpersonal and social behavior, and “social neuroscience” emerged towards the end of the decade (see Cacioppo, Berntson, 1992, for an early use of the term). The field derives from findings in cross-cultural psychology that show how social cognition and behavior depend on sociocultural context, and combines neuroimaging, cognitive science, and social psychology to investigate the neural “representation” of social interaction and the neural “substrates” of social processes (Han, Northoff, 2008; Zhou, Cacioppo, 2010). The journals *Social Neuroscience* and *Social Cognitive and Affective Neuroscience* were launched in 2006. A Social and Affective Neuroscience Society “committed to research investigating the neural basis of social and affective processes” was established in 2008, and it was followed in 2010 by a Society for Social Neuroscience (<https://s4sn.org/drupal/>). The journal *Culture and Brain* was founded in 2013, with a focus on “cultural differences in neural activity” and “the mutual constitution of culture and the brain” (Han, 2013).

The social, affective, and cultural neurosciences largely overlap with each other as well as with neuroanthropology (Domínguez Duque et al., 2009, 2010; Lende, Downey, 2012a); labels such as “sociocultural neuroscience” are forged to underline interconnection (Wajman

et al., 2015). At the same time, these emerging disciplines are engaged in differentiation dynamics. In particular neuroanthropologists have emphasized the differences between their approach and that of cultural neuroscience (Domínguez Duque, 2012; Lende, Downey, 2012a). While, in their view, cultural neuroscience wishes to provide brain-level explanations, neuroanthropology tries to combine such explanations with an ethnographic perspective, thus placing itself “in a better position to move back and forth between the neural, the phenomenal, and the cultural domains” (Domínguez Duque, 2012, p.22) and to test neuroscientific hypotheses “against the reality of what people actually do, say, and experience” (Downey, Lende, 2012, p.42). Field ethnography should provide “empirical access” to the ways social and cultural processes shape brain function, meaning, and behavior (Downey, Lende, 2012). Some neuroanthropologists have expressed concern about cultural biases in research, and called for an increased awareness of the historical, social and political circumstances under which experiments are conducted (Domínguez Duque et al., 2010), while others see the interface between anthropology and the neurosciences as a way of doing anthropology experimentally (Roepstorff, Frith, 2012).

In short, there is a cluster of neurodisciplines aimed at understanding how the brain “mediates” social interactions and culture, and produces emotion and cognition. The question is how – and whether – these questions and programmatic statements translate into research results capable of going beyond statements such as “Cultural practices adapt to neural constraints, and the brain adapts to cultural practice” (Ambady, Bharucha, 2009, p.342), which simply reiterate the field’s premise.

Causes, correlations, plasticity

Neuroimaging is supposed to show “how ‘deep’ culture can go into the human brain” (Kitayama, Park, 2010, p.124) and is, therefore, the method of choice for directly studying the “encultured” brain. However, insofar as neuroanthropology draws its main concepts and questions from cultural anthropology, it emphasizes fieldwork as its empirical basis, and as a consequence is less inclined to use neuroimaging, which requires an experimental setting. That is why most neuroanthropological studies limit themselves to citing brain research and juxtaposing it to other kinds of materials, drawn directly from the study of cultural settings and situations, which seem to demonstrate the impact of those situations on the brain or the “interplay” of culture, brains and experience (see for example *The encultured brain* [Lende, Downey, 2012a] or the special issue “Neuroanthropology and its applications” of the *Annals of Anthropological Practice* [2012]). “Neuroanthropology” has so far been merely the name of a potential framework, with seemingly little impact on concrete anthropological work. Typical of this is a recent article on the anthropology of opioid maintenance treatments for addiction: although it describes its point of view as “neuroanthropology” and its topic as “the neuroeconomics and neuroracial politics of opioid pharmaceuticals,” it demonstrates no empirical, descriptive or analytical gains from applying the prefix “neuro” to “anthropology,” and its application to “economics” and “racial” remain unclear (Hansen, Skinner, 2012). Similarly, it is simply by attaching the label “neurocognitive” to the skills involved that an

ethnography of rugby or capoeira practices is turned into “neuroanthropology” (Downey, 2012b, 2012c).

In contrast to neuroanthropology, cultural neuroscience uses neuroimaging so systematically that it is often described as “cultural neuroimaging.” This is not to say that neuroanthropology should turn to neuroimaging to realize its program, but that, until now, imaging methods have been the chief way of empirically going beyond merely juxtaposing the neurobiological and the cultural. But do those methods work when the stated purpose of using them is to study culture?

The difference between neuroanthropology and cultural neuroscience with regard to neuroimaging is consistent with their conceptual and disciplinary roots, in cultural anthropology and cultural psychology respectively. Cultural psychology is indeed cultural neuroscience’s “parent discipline” (Denkhaus, Bös, 2012) – but in a manner that involves little more than replacing the “mind” of the “psy” by the “brain” of the “neuro.” Indeed, University of Chicago anthropologist Richard Shweder (1991, p.72) defined cultural psychology as the study of “the way cultural traditions and social practices regulate, express, and transform the human psyche, resulting less in psychic unity for humankind than in ethnic divergences in mind, self, and emotion.” Substitute “human brain” for “human psyche,” then “neural unity” for “psychic unity,” add “neurobiological” to the varieties of ethnic divergence – and you have an accurate depiction of cultural neuroscience.

Cultural neuroscience assumes that “understanding cultural and genetic ‘influences’ on brain function likely holds the key to articulating better psychological theory” (Chiao, 2009, p.290; emphasis in the original). The quest for “influences” is reinforced by the premise that “human behavior ‘results’ from neural activity,” and by the further inference that behavioral variation among cultures “likely ‘emerges’ from cultural variation in neural mechanisms underlying these behaviors” (Chiao, 2009, p.290; our emphasis; see also Chiao, Cheon, 2012, p.289). Though here left vague through the use of “likely,” the reasoning presupposes a direction and hierarchy of causes, from genetics and the brain towards mind and culture. Neuroimaging and genomic methods for “mapping” neural processes and genes “to” neural, mental and cultural processes produce correlations, but these are presented in a causal perspective reinforced by the belief that cultural traits constitute evolutionary adaptations (Chiao, Blizinsky, 2010).

The tension between correlational results and causal claims, as well as the existence of an implicit epistemic hierarchy, undermine cultural neuroscience’s calls for synergy and bidirectionality. We later examine the relevant research, but now let us take as an example the assertion that cultural values, practices and beliefs “impact human behavior,” or that the “cultural dimension” of “individualism-collectivism” (a favorite of cultural psychology) “affect[s] a wide variety of human mental processes at a behavioral level” and “modulate[s] neural and electrophysiological responses” (Chiao, 2009, p.291, 295). Such statements embody a circular reasoning. On the one hand, a cultural “dimension” includes by definition mental and behavioral processes, and these necessarily correlate with some feature of brain functioning. On the other hand, the cultural dimension is itself defined, at least in part, on the basis of the mental and behavioral processes it is supposed to “affect.”

Culture “influences” brain functioning, “modulates” neural mechanisms, “shapes” neural systems (Chiao, 2009, p.291). Thus, people living in culture X may develop “distinct neural mechanisms.” Yet these mechanisms may “underlie” behaviors identical to those observable in culture Y, where they correlate with other neural processes (p.290). Cultural neuroscience has explored these effects in connection with emotion (providing “evidence that culture influences how people infer emotional states;” [p.296]), interpersonal perception (showing that individuals from egalitarian vs. hierarchical cultures display greater mesolimbic activity to dominant vs. facial cues), and social cognition (demonstrating that cultural values rather than ethnic affiliation “modulate neural response during self-evaluation;” [p.297]). The discipline studies a wide range of psychological process, from visual and semantic processing (Goh et al., 2010; Gutchess et al., 2010) to fear (Chiao et al., 2008), empathy (Cheon et al., 2011), and self-representation (Kitayama, Park, 2010; Mrazek, Harada, Chiao, 2014).

Cultural neuroscientists consider their findings (basically, “modulated” neural activity) supported by the existence of neuroplasticity – the brain’s ability to change as a result of experience – and its main theoretical consequence: to challenge the notion that brain functions have fixed localizations, and that the brain is malleable only within strictly limited critical periods. Celebrated as a revolutionary finding, and immediately taken up by a large spectrum of interested individuals from brain fitness dealers to philosophers and psychiatrists, political scientists, and rehabilitation specialists (Malabou, 2008; Ortega, 2011; Pitts-Taylor, 2010; Rees, 2010), neuroplasticity also seems to confirm that cultural differences at the neural level reside in patterns of connectivity. Sustained engagement in cultural tasks, understood as repeated participation in routinized behaviors, results in different patterns of brain activation and functional and structural modifications (see Hanawaka et al., 2003 for Japanese abacus experts, or Maguire et al., 2000, for London taxi drivers). Brain plasticity, therefore, is depicted as the feature that enables the interaction of brain and culture at the three interrelated levels of explicit values, conventions, and routines; socially shared scripts for action; and individual idiosyncrasy. In other words, it explains intercultural neural differences as a consequence of practice and experience.

Investigative practices

Cultural neuroscience has followed two strategies. One, “culture mapping,” involves “determining which cognitive or neural processes vary across cultures without determining whether the differences are learned or innate” (Ambady, Bharucha, 2009, p.342). The term “culture” or “cultural mapping,” endorsed by UNESCO and many official institutions, designates the identification and documentation of tangible and intangible cultural resources at a local level (see Duxbury, Garrett-Petts, MacLennan, 2015, for the most recent discussion and examples). While performing numerical tasks, for example, native English speakers showed more activation in brain areas “associated” with language processing, while native Chinese speakers showed more activation in an area “associated” with visual-spatial processing (Tang et al., 2006). The finding is hypothetically attributed to exposure to different visual patterns. Greater premotor activity in the Chinese “could be due” to the visuospatial

nature of their language, whereas activation of language areas in English speakers suggests “the retrieval of mathematical facts may be mediated by phonological processing” (Ambady, Bharucha, 2009, p.342-343). The second strategy, “source analysis,” attempts to determine “the source or causes” of cultural mappings, including genetic commonality or difference, cultural learning “mediated by brain plasticity,” and the degree of similarity between cultural environments. This strategy has been less pursued than mapping, “but new technologies promise to advance” it “quickly” (Ambady, Bharucha, 2009, p.343, 344). At the time we write these lines, it seems to have remained programmatic (Chiao et al., 2013).

In turn, neuroanthropologists see themselves as uniquely situated to explore brain culture-bidirectionality, and (as we mentioned) they take a critical stance *vis-à-vis* cultural neuroscience. Yet they too focus on how culture “influences” or “changes” brain function and structure, and how brain areas “respond to regularities in the cultural stream of experience” (Domínguez Duque et al., 2009, p.43). They too hail as “extraordinary” the fact that culture “affects” not only brain function, but also brain structure (Domínguez Duque et al., 2009, p.60; see also Domínguez Duque, 2012, p.22). Indeed, as neuroanthropologists explain, the prefrontal cortex “stands first to be modified or constituted by cultural experience as it is the structure that ‘lays’ culture’s foundations” (Domínguez Duque et al., 2009, p.60-61; our emphasis). The notion that the prefrontal cortex is “constituted by” culture while also being that which ultimately “generates” it goes beyond describing the reciprocal interaction of body and world at all levels. It highlights the foundational asymmetry of the neurodisciplines of culture. The assertion that culture, as a complex of activities including forms of learning, “modifies” the brain is certainly substantiated by empirical observation. In contrast, except in its most diluted interpretation, the claim that the prefrontal cortex “lays” the foundations of culture formulates an ontological assumption. And this assumption translates into the way research is performed.

Let us take a frequently quoted article in the field, Chiao and her colleagues’s “Neural basis of individualistic and collectivistic views of the self,” published in 2009 in *Human Brain Mapping*. Their goal was to understand how individualism and collectivism “modulate neural representations underlying social cognition” (Chiao et al., 2009, p.2813). According to earlier studies, people who support individualistic values think of themselves and others as independent and as having stable personal traits, whereas those who endorse collectivistic ideals see people as interconnected and describe themselves as immersed in a social context. The authors drew on the notion of self-construal style (SCS), which has been used to differentiate Western and East Asian views of the self, without reference to research questioning that self-construal reflects individual-level cultural orientation or mediates and explains cross-cultural differences (Levine et al., 2003).

Based on previous work suggesting that activity in the medial prefrontal cortex (MPFC) “reflect[s] the neural basis of self-knowledge” (Chiao et al., 2009, p.2814; Kelley et al., 2002), the authors hypothesized that individualists would show greater response for general self-descriptions, and collectivists, for contextual self-descriptions in the anterior rostral portion of the MPFC. Twenty-four right-handed university students were recruited for the study, half native Japanese from Nagoya, and half “Caucasian-Americans” from Chicago. They were shown 72 stimuli (in Japanese or English respectively): 24 general self-descriptions, 24 contextual self-descriptions, and 24 self-descriptions in italicized or non-italicized font.

The results seemed to demonstrate that “self-relevant processing within MPFC varies as a function of SCS.” People who endorse individualistic values show greater MPFC activation during general self-descriptions, while those who endorse collectivist values display greater MPFC activation during contextual self-descriptions. In both cases, increased MPFC activity “reflects the role SCS plays in how knowledge about the self is formed, and possibly also stored and retrieved.” The researchers concluded that “knowledge self-representations of one’s self ... are culturally specific at the neural level.” They also speculated that greater activity within the right superior frontal gyrus may “reflect evidence of enhanced self-relevant processing in individualists relative to collectivists,” and called for more research to elucidate how cultural values “affect” neural processing (Chiao et al., 2009, p.2819). A meta-analysis of research in the area published between 2003 and 2014 confirmed that result: “East Asian cultures are associated with increased neural activity in the brain regions related to inference of others’ mind and emotion regulation, whereas Western cultures are associated with enhanced neural activity in the brain areas related to self-relevance encoding and emotional responses during social cognitive/affective processes” (Han, Ma, 2014, p.293).

In at least two ways, such a study of the neural “bases” of individualism and collectivism is characteristic of the “neuro” disciplines. First, it illustrates the slippage typical of this kind of research (Schleim, Rosier, 2009), between establishing statistical correlations (here, with culture as predictor) and inferring anatomo-functional “bases” or “underpinnings.” Second, the outcomes are predictable without neuroscience or neuroimaging. The authors point to “an intriguing aspect” of their findings, namely that participants’ cultural values (individualism or collectivism), rather than cultural affiliation (being white American or native Japanese), “modulated” neural response during self-judgments (Chiao et al., 2009, p.2819). In the Western and East Asian contexts from which the study drew its subjects, people adjust to various environmental demands, so that culture, as defined by ethnic or national affiliation, does not always match individual behavior. Its findings are therefore far from “intriguing.” The main thing a study such as the one we just summarized does is to convey the assumptions that culture is based on the brain, and that a phenomenon becomes more real or objective by virtue of having a neural correlate. Unless these assumptions are made, there is no need of neuroscience to apprehend the “dynamic nature of cultural values across individuals and cultural groups” (Chiao et al., 2009, p.2819).

Cultural neuroscientists may retort that they have not simply corroborated results from the social sciences, but added something essential by showing “how such dynamic cultural values shape neural representations” (Chiao et al., 2009, p.2819). However, in the same way that they cannot demonstrate the neural “bases” of culturally contingent values or attitudes, they cannot show how “particular” values or attitudes shape the brain. For sure, “cultural values, beliefs, and practices must be important for social brain functioning” (p.2819). This, however, is so by definition. First, because anything brained organisms do is related to brain function. Second, because given that the “social brain” refers to the brain regions involved in understanding others (Blakemore, 2008) and that social cognition is, in humans at least, inseparable from culturally determined ways of interacting with others, culture is necessarily “important” for the social brain. The contrary would in both cases constitute a sensational finding, if not a *contradictio in adjecto*.

Cultural diversity as “neurodiversity”

On the one hand, with respect to their significance for understanding culture, imaging experiments recover at the end what they put in at the beginning, namely the notion that culture has “neural bases.” On the other hand, the rhetoric of wonder – findings are always “intriguing” or “extraordinary” – betrays the persistence of a dualistic attitude. Celebrating the discovery that “culture” somehow “modifies” brain function implies imagining at least two dualities: brain and person, culture and individual. Yet, as has been pointed out from inside the discipline, “it should not be surprising per se that there exists a neural difference underlying a psychological difference” – in fact, the existence of such a difference is “an axiomatic assumption” of cultural neuroscience, not an “empirical question” (Freeman, 2013, p.26).

The cultural neuroscientists whose study we just sketched reported on the “influence of cultural values on neural responses within MPFC during self judgments, despite the absence of differences at the behavioral level,” and concluded that their “results reveal an advantage of examining cultural values such as SCS at the neural level” (Chiao et al., 2009, p.2819). The “advantage” seems to consist in the capacity of discovering cultural affiliation in the absence of overt behavior. Now, such inscription of cultural values “at the neural level” could mean two things. One is that culture, including beliefs, norms and meanings, is somehow embodied in individuals, and specifically in their brains, pre-reflexively shaping their actions (Choudhury, Slaby, 2012a; Gallagher, Zahavi, 2008; Noë, 2009). Another is that the neural level displays a truth about humans as cultural beings that is not knowable by examining social and cultural practices. Although the programmatic statements of cultural neuroscience seem to favor the former interpretation, cultural neuroscientific practice rather tends to embody the latter.

A frequently cited study on the “neural basis of cultural influence on self representation” provides another illustration of such a perspective (Zhu et al., 2007; see also the replications: Ng et al., 2010; Ray et al., 2010). The authors used fMRI to analyze brain activity of Western and Chinese subjects as they judged personal trait adjectives regarding self, the mother, or a public person. Like others in the field, they started with the observation that North Americans and Europeans tend to view the self as independent, autonomous and separate from others, while East Asians emphasize interdependence and interconnectedness. The experimental design was standard: 13 Chinese and 13 Western college students were scanned while asked to judge if an adjective was adequate to describe the self, the mother and other, and to judge the font of the words.

The findings were said to provide evidence of a neural distinction between self and intimate persons for Westerners but not for Chinese. Thus,

in Chinese individuals, mother-judgments generated enhanced MPFC activity compared with other-judgments and the null condition. Consequently, the representation of Chinese mother cannot be distinguished from the representation of their selves, in terms of the MPFC activity, indicating that Chinese individuals use MPFC to represent both mother and the self. In contrast, MPFC activity corresponds to a representation of only the individual self in Western subjects (Zhu et al., 2007, p.1314)

These results seemed to the authors significant for both anthropology and neuroscience insofar as they suggested “that culture influences the functional neuroanatomy of self-representation,” and were said to provide evidence of an “interplay of biology and culture in shaping the mind and the brain” (Zhu et al., 2007, p.1315).

The study apparently stood between two extremes: a social constructivism that downplays the role of biology in cultural and social processes and practices, and a materialist reductionism according to which interpersonal and cultural relations arise in the brain. However, unless one holds one of the two positions, it is hard to justify costly experiments to arrive at statements such as “culture influences the functional neuroanatomy of self-representation” or “habitual cognitive processes are accompanied by detectible [sic] parallel neural processes” (Zhu et al., 2007, p.1315, 1314). The paradox is that a significant “Cartesian” bias persists behind the explicit emphasis on brain-culture reciprocal interactions.

As the authors explain, culture both “affects the psychological structure of self” and “shapes the functional anatomy of self-representation” (Zhu et al., 2007, p.1310). The problem with such claims is twofold. On the one hand, correlations do not reveal connections that can be captured by verbs such as “affect” and “shape.” On the other hand, the use of those verbs manifests a peculiarly abstract and mechanical view of culture. Contrary to the way they are here conceptualized, notions, attitudes and practices connected to the self are integral parts of culture; they are among the key features that contribute to enact it, not something that a mysterious agent called “culture” shapes from the outside.

Insofar as cultural diversity is conceptualized essentially as a form of “neurodiversity” (Ortega, 2009), the experimental setups and results of cultural neuroscience may become part of identity politics (Roepstorff, 2011, p.40). At the same time, by positing the existence of differences between selves “at a neural level,” cultural neuroscience contributes to downplaying diversity within the group. In both scenarios – interethnic difference and intra-group identity – the brain is endowed with ontological primacy: the mind is what the brain does, and culture is included in the process. One of the main problems here is not that cultural neuroscience seems to suggest that universal values do not exist (Begley, 17 Feb. 2010), but that it naturalizes cultural stereotypes in the laboratory (Choudhury, 2010; Choudhury, Kirmayer, 2009). There have been calls for a more nuanced consideration of socioecological factors (Cheon et al., 2013), but so far they have not been systematically translated into experimental work, and cultural neuroscience still has to draw conclusions from the complex intellectual and political histories of sampling categories such as the usual “Caucasian-American” (see Painter, 2010, for an overview). Indeed, as critics have pointed out, in practice cultural neuroscience tends to classify subjects on the basis of outer appearance at the expense of behavior or sociological or cultural dimensions, and has “an understanding of ‘culture’ and ‘race’ which still appeals to biology, blood and ancestry” (Martinez Mateo et al., 2012, p.160; emphasis in the original). Whether or not cultural neuroscience indeed reinforces “Western dominance in a postcolonial situation” (Martinez Mateo et al., 2013, p.3), it cannot be doubted that, under its neutral appearance, the notion of “culture,” as used in the neurodisciplines that deal with it, functions as a proxy of “race” (Heinz et al. 2014).

From culture to brain

One could object that individualism/collectivism and self-representation are particularly problematic topics, or that we confined ourselves to investigations that explicitly claim to be about a “neural basis” (for a synthesis, see Zhu, Han, 2008). Research has been carried out on topics such as perceptual processing (Kitayama et al., 2003), attentional modulation (Hedden et al., 2008), language (Tan et al., 2005), music (Nan et al., 2008), number representation and mental calculation (Tang et al., 2006), emotional processes (Chiao et al., 2008), mental attribution (Tang et al., 2006), and self-representation and self-awareness (Han, Northoff, 2008). Other topics, such as default network, regulation and inhibition of feelings, thoughts and actions, prejudice and dehumanization, and fundamental warmth and competence judgments (Ames, Fiske, 2010), have been identified as promising future research areas, and important integrative efforts have been made concerning the neuroscience of intergroup and intercultural relations (Cikara, Van Bavel, 2014; Warnick, Landis, 2015).

We have already noted that some contributors to the neurodisciplines of culture think of their object in a more nuanced way. Anthropologists have suggested an experimental approach that would take into account both the anthropology of experimentation and research subjects’ lived experiences (Roepstorff, Frith, 2012; Roepstorff, Vogeley, 2009). Domínguez Duque has criticized cultural neuroscience’s “primarily psychological” concept of culture, understood as a set of variables affecting the brain, but not taken as an object of study in itself. Such an approach ends up setting aside “the actual social processes by which cultural knowledge is constituted” (Domínguez Duque et al., 2010, p.143, 144).

For example, Domínguez Duque and his colleagues would like to reduce the projection of the investigator’s cultural values and beliefs onto the groups analyzed, and to situate the circumstances under which experiments takes place. For them, neuroanthropology is a sort of self-reflexive radicalization of cultural neuroscience, one in which “research and analysis techniques from cultural (and more broadly, social) neuroscience are integrated into and embedded in ethnographic research” (Domínguez Duque, 2012, p.25). In a similar vein, Suparna Choudhury (2010) proposes to approach cultural neuroscience from the angle of “critical neuroscience.” To do that, she suggests attending to the conceptualization of culture in the design and interpretation of experiments, taking into account the historical contexts of the phenomenon under scrutiny, considering the meanings experimental categories may have in different cultures, and identifying how cultural biases and beliefs may influence the design and results of experiments (see also Choudhury, Nagel, Slaby, 2009; Choudhury, Slaby, 2012b). Such suggestions may generate convergences between cultural neuroscience, neuroanthropology and critical neuroscience (Lende, Downey, 2012b, p.411).

As for the concept of culture itself, neuroanthropologists counter the psychologism of cultural neuroscience by emphasizing that culture is socially created and transmitted as “shared structures of meaning” through which people interact with each other (Domínguez Duque et al., 2010, p.139; Domínguez Duque, 2012). Such criticism of the notion of culture implicitly used by the “first generation” of cultural neuroscientists, as well as the emphasis on the contested and evolving nature of the concept, are accompanied by proposals to incorporate an anthropological understanding of culture into experimental settings. Those laudable goals,

however, are not specific to the “neuro” in “neuroanthropology” or “neuroethnography,” the two fields Domínguez Duque is engaged in creating. Rather, as he writes, they can be achieved by complementing various qualitative and quantitative methods with critical theory and reflexive ethnography, and by “historically, socially and politically contextualizing the circumstances under which enquiry takes place” (Domínguez Duque et al., 2010, p.144).

From a similar perspective, German scholars Ruth Denkhaus and Mathias Bös propose to replace the “entity conception of culture” underlying the homogenizing and essentializing tendencies of cultural neuroscience by a notion of culture as “patterns of representations, actions and artifacts that are distributed or spread by social interaction” (Denkhaus, Bös, 2012, p.445). Reference to “actions and artifacts” implies that culture is not in people’s head but is simultaneously in the individuals, their brains and minds, and the world they inhabit (p.450). Han et al. (2013, p.353) have also underlined that brains are “biosocial” and culture is “sociobiological.” Thus, some cultural neuroscientists have proposed to redefine culture as that which is manifest in “the direct dependence of the brain’s neural activity” on context (Northoff, 2013, p.95), and others intend to integrate factors such as socioeconomic status, unemployment rate, residential mobility or population density in their definition of cultural influences as a way to address variation within nations (Ng, Morris, Oishi, 2013).

Although such critical perspectives may help to give cultural neuroscience a more solid foundation, they do not seem to alter its basic assumption, which is that neuroscience provides “the most fundamental perspective yet available” on how people appropriate culture (Domínguez Duque et al., 2010, p.140). Indeed, so far the declarations of intention about the co-construction of brain and culture have not had a major impact on how experimental and field work are conducted, nor have they prevented neuroanthropologists from claiming that “the shared webs of signification that make up culture are primarily the product of the activity of the PFC [prefrontal cortex]” (Domínguez Duque et al., 2009, p.60).

Culture?

If this is the case, what, then, is “culture” for the neurodisciplines of culture? The concept was notoriously elastic by the time anthropologists Alfred Kroeber and Clyde Kluckhohn enumerated over 150 definitions (Kroeber, Kluckhohn, 1952), and has remained so (Shweder, 2001). In *Primitive culture*, Edward Tylor (1871, p.1) defined “culture or civilization” as “that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society.” Since then, many others more or less followed his lead, seeing in culture “the complex of values, customs, beliefs and practices which constitute the way of life of a specific group” (Eagleton, 2000, p.34). Different emphases are also to be found, with a range and overlap of meanings, as illustrated in Raymond Williams’s observation that “in archaeology and in cultural anthropology the reference to ‘culture’ or ‘a culture’ is primarily to material production, while in history and cultural studies the reference is primarily to signifying or symbolic systems” (Williams, 1985, p.91; emphasis in the original).

What exactly goes into “culture” has been long discussed. Kroeber and Kluckhohn identified different types of definitions (descriptive, historical, normative, psychological,

structural, and genetic in the sense of developmental), and came up with a lengthy list of the conceptual elements that went into them, from acts and activities to feelings, language and traditions. They themselves proposed a very encompassing definition, but recognized that there is no way to proceed normatively. Nonetheless, two things emerge. One is that students of culture tend to characterize their object as “the organization of human experience and action by symbolic means” (Sahlins, 2000, p.158). The other is that those organizations and means are neither static, nor do they form systematic and homogenous totalities. Early twentieth-century anthropologists sometimes did regard culture in that way, producing what Marshall Sahlins (2000, p.159) critically called “anthropology-cultures.” In that framework, it is always possible to, somehow, dig out the authentic native who reflects the culture. Indeed, as James Clifford (1988, p.338) noted, the very idea of culture “carries with it an expectation of roots, of a stable, territorialized existence” (see also the neuroanthropological point of view in Roepstorff, Niewöhner, Beck, 2010).

Such bounded, functionally integrated, coherent units operating as a consistent totality probably never existed, and if they did, they certainly no longer do in the context of what has been famously characterized as “locally lived lives in a globally interconnected world” (Gupta, Ferguson, 1992, p.11). Two points about this context are especially relevant here. One is the possibility of internal contradiction. The debate around Margaret Mead’s 1928 *Coming of age in Samoa* is illuminating. Mead offered the image of a harmonious society with a liberal attitude towards sexuality. Her book had a huge social impact, and became the bible of an entire generation. Then, in 1983, Derek Freeman published *Margaret Mead and Samoa: the making and unmaking of an anthropological myth*, where he argued (on bases that were later questioned) that Mead was misled by native informants and ignored evidence contrary to her depiction of Samoan life (see Mead, 2001, and Freeman, 1983).

Details aside, a major lesson of this controversy is that Samoan culture contains paradoxes and contradictions, which are, as Nancy Scheper-Hughes (1984, p.90) put it, “culturally structured but never actually resolved.” Aggressive and harmonious behavioral poles and values may function in the same individuals and groups depending on circumstances. Mead therefore captured “a” Samoan truth, not “the” Samoan truth. Anthropologists have thus given up the idea “that everything in a society must adhere to a single configuration or pattern,” and no longer “think of ‘culture’ as a single integrated reality” (Scheper-Hughes, 1984, p.90, 91). And yet, whenever cultural neuroscience draws on tools such as the self-construal scale, it invokes exactly such a view of culture, according to which any one factor (being “independent” or “interdependent”) must necessarily correlate with some basic principle or attitude considered definitive of the culture (such as individualism or collectivism). Like neuroaesthetics trying to establish the neural correlates of beauty, but incapable of taking into account the fact that one same stimulus could be judged both ugly and beautiful (Vidal, 2011), cultural neuroscience can only identify the supposed neural correlates of isolated factors, under the postulate that these correlates represent the cerebral embodiment of culture. The definition of “culture” as “factors that affect the biological and psychological processes that shape beliefs and norms shared by groups of individuals” illustrates precisely that (Hyde et al. 2015, p.76).

The second consequence of lives being “locally lived” in an “interconnected world” is that cultural difference is not a basic given which correlates with being or belonging to some form of “people” (Western, Asian), but rather “a product of a shared historical process that differentiates the world as it connects it” (Gupta, Ferguson, 1992, p.16). Cultural neuroscientific practice assumes separate and discrete cultures, which it juxtaposes in its experimental designs. It thereby participates in the processes whereby differences are constructed. This is in itself unproblematic and, perhaps, an inevitable sequel of studying culture. The problem and the challenge lie deeper, and they apply to all the neurodisciplines of culture: their assumption that culture is essentially, both ontologically and causally, a by-product of the brain, does not equip them well to deal with cultural phenomena – while at the same time it gives them a powerful tool for shaping culture itself.

REFERENCES

- AMBADY, Nalini; BHARUCHA, Jamshed. Culture and the brain. *Current Directions in Psychological Science*, v.18, n.6, p.342-345. 2009.
- AMES, Daniel L.; FISKE, Susan T. Cultural neuroscience. *Asian Journal of Social Psychology*, v.13, p.72-82. 2010.
- ANNALS... *Annals of Anthropological Practice*, v.36, n.1. 2012.
- BEGLEY, Sharon. West brain, East brain: what a difference culture makes. Available at: <http://www.newsweek.com/how-different-cultures-shape-brain-75289>. Accessed: 15 Oct. 2014. 17 Feb. 2010.
- BLAKEMORE, Sarah-Jayne. The social brain in adolescence. *Nature Reviews Neuroscience*, v.9, p.267-277. 2008.
- CACIOPPO, John T.; BERNSTON, Gary G. Social psychological contributions to the decade of the brain: doctrine of multilevel analysis. *American Psychologist*, v.47, p.1019-1028. 1992.
- CHEON, Bobby K. et al. Constraints, catalysts and coevolution in cultural neuroscience: reply to commentaries. *Psychological Inquiry*, v.24, n.1, p.71-79. 2013.
- CHEON, Bobby K. et al. Cultural influences on neural basis of intergroup empathy. *Neuroimage*, v.57, n.2, p.642-650. 2011.
- CHIAO, Joan Y. Cultural neuroscience: visualizing culture-gene influences on brain function. In: Decety, Jean; Cacioppo, John T. (Ed.). *The Oxford handbook of social neuroscience*. Oxford: Oxford University Press. p.742-762. 2011.
- CHIAO, Joan Y. Cultural neuroscience: a once and future discipline. In: Chiao, Jian Y. (Ed.). *Cultural neuroscience: cultural influences on brain function*. New York: Elsevier. p.287-304. 2009.
- CHIAO, Joan Y.; AMBADY, Nalini. Cultural neuroscience: parsing universality and diversity across levels of analysis. In: Kitayama, Shinobu; Cohen, Dov (Ed.). *Handbook of cultural psychology*. New York; London: The Guilford Press. p.237-254. 2007.
- CHIAO, Joan Y.; BLIZINSKY, Katherine D. Culture-gene coevolution of individualism-collectivism and the serotonin transporter gene. *Proceedings of the Royal Society B*, v.277, p.529-537. 2010.
- CHIAO, Joan Y.; CHEON, Bobby K. Cultural neuroscience as critical neuroscience in practice. In: Choudhury, Suparna; Slaby, Jan (Ed.). *Critical neuroscience: a handbook of the social and cultural contexts of neuroscience*. Malden and Oxford: Blackwell. p.287-303. 2012.
- CHIAO, Joan Y. et al. Cultural neuroscience: progress and promise. *Psychological Inquiry*, v.24, n.1, p.1-19. 2013.
- CHIAO, Joan Y. et al. Theory and methods in cultural neuroscience. *Social Cognitive and Affective Neuroscience*, v.5, n.2-3, p.356-361. 2010.
- CHIAO, Joan Y. et al. Neural basis of individualistic and collectivistic views of self. *Human Brain Mapping*, v.30, n.9, p.2813-2820. 2009.
- CHIAO, Joan Y. et al. Cultural specificity in amygdala response to fear faces. *Journal of Cognitive Neuroscience*, v.20, n.12, p.2167-74. 2008.

- CHOUDHURY, Suparna.
Culturing the adolescence brain: what can neuroscience learn from anthropology? *Social Cognitive and Affective Neuroscience*, v.5, n.2-3, p.159-167. 2010.
- CHOUDHURY, Suparna; KIRAMAYER, Laurence J.
Cultural neuroscience and psychopathology: prospects for cultural psychiatry. In: Chiao, Joan Y. (Ed.). *Cultural neuroscience: cultural influences on brain function*. New York: Elsevier. p.261-281. 2009.
- CHOUDHURY, Suparna; NAGEL, Saskia Kathi; SLABY, Jan.
Critical neuroscience: linking science and society through critical practice. *BioSocieties*, v.4, n.1, p.61-77. 2009.
- CHOUDHURY, Suparna; SLABY, Jan (Ed.).
Critical neuroscience: a handbook of the social and cultural contexts of neuroscience. Oxford: Blackwell. 2012a.
- CHOUDHURY, Suparna; SLABY, Jan.
Introduction: critical neuroscience – between lifeworld and laboratory. In: Choudhury, Suparna; Slaby, Jan (Ed.). *Critical neuroscience: a handbook of the social and cultural contexts of neuroscience*. Oxford: Blackwell. p.1-26. 2012b.
- CIKARA, Mina; VAN BAVEL, Jay J.
The neuroscience of intergroup relations: an integrative review. *Perspectives on Psychological Science*, v.9, n.3, p.245-274. 2014.
- CLIFFORD, James.
The predicament of culture: twentieth-century ethnography, literature, and art. Cambridge, MA: Harvard University Press. 1988.
- DENKHAUS, Ruth; BÖS, Mathias.
How cultural is cultural neuroscience? Some comments on an emerging research paradigm. *BioSocieties*, v.7, n.4, p.433-458. 2012.
- DOMÍNGUEZ DUQUE, Juan F.
Toward a neuroanthropology of ethics: introduction. In: Clausen, Jens; Levy, Neil (Ed.). *Handbook of neuroethics*. Dordrecht: Springer. p.289-298. 2015.
- DOMÍNGUEZ DUQUE, Juan F.
Neuroanthropology and the dialectical imperative. *Anthropological Theory*, v.12, n.1, p.5-27. 2012.
- DOMÍNGUEZ DUQUE, Juan F. et al.
Neuroanthropology: a humanistic science for the study of the culture-brain nexus. *Social Cognitive and Affective Neuroscience*, v.5, n.2-3, p.138-147. 2010.
- DOMÍNGUEZ DUQUE, Juan F. et al.
The brain in culture and culture in the brain: a review of core issues in neuroanthropology. In: Chiao, Joan Y. (Ed.). *Cultural neuroscience: cultural influences on brain function*. New York: Elsevier. p.43-64. 2009.
- DOWNEY, Greg.
Neuroanthropology. In: Fardon, Richard et al. (Ed.). *The SAGE handbook of social anthropology*. v.2. London: Sage. p.243-260. 2012a.
- DOWNEY, Greg.
Culture variation in rugby skills: a preliminary neuroanthropological report. *Annals of Anthropological Practice*, v.36, n.1, p.26-44. 2012b.
- DOWNEY, Greg.
Balancing across cultures: equilibrium in capoeira. In: Lende, Daniel H.; Downey, Greg (Ed.). *The encultured brain: an introduction to neuroanthropology*. Cambridge, MA: MIT Press. p.169-194. 2012c.
- DOWNEY, Greg; LENDE, Daniel H.
Neuroanthropology and the encultured brain. In: Lende, Daniel H.; Downey, Greg (Ed.). *The encultured brain: an introduction to neuroanthropology*. Cambridge, MA: MIT Press. p.23-65. 2012.
- DUXBURY, Nancy; GARRETT-PETTS, Will; MACLENNAN, David (Ed.).
Cultural mapping as cultural inquiry. London: Routledge. 2015.
- EAGLETON, Terry.
The idea of culture. Malden, MA: Blackwell Publishers. 2000.
- FREEMAN, Derek.
Margaret Mead and Samoa: the making and unmaking of an anthropological myth. Cambridge, MA: Harvard University Press. 1983
- FREEMAN, Jonathan B.
Within cultural variation and the scope of cultural neuroscience. *Psychological Inquiry*, v.24, p.26-30. 2013.
- GALLAGHER, Shaun; ZAHAVI, Dan.
The phenomenological mind: an introduction to philosophy of mind and cognitive science. New York: Routledge. 2008.
- GOH, Joshua O.S. et al.
Culture differences in neural processing of faces and houses in the ventral visual cortex. *Social Cognitive and Affective Neuroscience*, v.5, p.227-235. 2010.
- GUPTA, Akhil; FERGUSON, James.
Beyond “culture:” space, identity, and the politics of difference. *Cultural Anthropology*, v.7, p.6-23. 1992.

- GUTCHESS, Angela H. et al.
Neural differences in the processing of semantic relationships across cultures. *Social Cognitive and Affective Neuroscience*, v.5, p.254-263. 2010.
- GUTCHESS, Angela H.; GOH, Joshua O.S.
Refining concepts and uncovering biological mechanisms for cultural neuroscience. *Psychological Inquiry*, v.24, p.31-36. 2013.
- HAN, Shihui.
Culture and brain: a new journal. *Culture and Brain*, v.1, n.1, p.1-2. 2013.
- HAN, Shihui et al.
A cultural neuroscience approach to the biosocial nature of the human brain. *Annual Review of Psychology*, v.64, p.335-359. 2013.
- HAN, Shihui; MA, Yina.
Cultural differences in human brain activity: a quantitative meta-analysis. *NeuroImage*, v.99, p.293-300. 2014.
- HAN, Shihui; NORTHOFF, Georg.
Culture-sensitive neural substrates of human cognition: a transcultural neuroimaging approach. *Nature Reviews Neuroscience*, v.9, p.646-654. 2008.
- HAN, Shihui; PÖPPEL, Ernst (Ed.).
Culture and neural frames of cognition and communication. Berlin: Springer. 2011.
- HANAWAKA, Takashi et al.
Neural correlates underlying mental calculation in abacus experts: functional magnetic resonance imaging study. *NeuroImage*, v.19, p.296-307. 2003.
- HANSEN, Helena; SKINNER, Mary E.
From white bullets to black markets and greened medicine: the neuroeconomics and neuroracial politics of opioid pharmaceuticals. *Annals of Anthropological Practice*, v.36, n.1, p.167-182. 2012.
- HEDDEN, Trey et al.
Cultural influences on neural substrates of attentional control. *Psychological Science*, v.19, p.12-17. 2008.
- HEINZ, Andreas et al.
The uncanny return of the race concept. *Frontiers in Human Neuroscience*, v.8, art. 836. 2014.
- HYDE, Luke W. et al.
Cultural neuroscience: new directions as the field matures. What do cultural neuroscience findings mean? *Culture and Brain*, v.3, p.75-92. 2015.
- KELLEY, William M. et al.
Finding the self? An event-related fMRI study. *Journal of Cognitive Neurosciences*, v.14, p.785-794. 2002.
- KIM, Heejung S.; SASAKI, Joni Y.
Cultural neuroscience: biology of the mind in cultural contexts. *Annual Review of Psychology*, v.65, p.487-514. 2014.
- KITAYAMA, Shinobu et al.
Perceiving an object and its context in different cultures: a cultural look at new look. *Psychological Science*, v.14, p.201-206. 2003.
- KITAYAMA, Shinobu; PARK, Jiyoung.
Cultural neuroscience of the self: understanding the social grounding of the brain. *Social Cognitive and Affective Neuroscience*, v.5, n.2-3, p.111-129. 2010.
- KROEBER, Alfred L.; KLUCKHOHN, Clyde.
Culture: a critical review of concepts and definitions. New York: Random House. 1952.
- LENDE, Daniel H.; DOWNEY, Greg (Ed.).
The encultured brain: an introduction to neuroanthropology. Cambridge, MA: MIT Press. 2012a.
- LENDE, Daniel H.; DOWNEY, Greg.
The encultured brain: toward the future. In: Lende, Daniel H.; Downey, Greg (Ed.). *The encultured brain: an introduction to neuroanthropology*. Cambridge, MA: MIT Press. p.391-419. 2012b.
- LEVINE, Timothy R. et al.
Self-construal scales lack validity. *Human Communication Research*, v.29, n.2, p.210-252. 2003.
- LITTLEFIELD, Melissa M.; JOHNSON, Jenell M. (Ed.).
The neuroscientific turn: transdisciplinarity in the age of the brain. Ann Arbor: University of Michigan Press. 2012.
- MACKINNON, Katherine C.
Contemporary biological anthropology in 2013: integrative, connected, and relevant. *American Anthropologist*, v.116, n.2, p.352-365. 2014.
- MAGUIRE, Eleanor A. et al.
Navigation-related structural change in the hippocampi of taxi drivers. *PNAS [Proceedings of the National Academy of Sciences]*, v.97, p.4398-4403. 2000.
- MALABOU, Catherine.
What should we do with our brain? Translated by S. Rand. New York: Fordham. 2008.
- MARCUS, Joseph A.
Neuroanthropology. In: Barfield, Thomas (Ed.). *The dictionary of anthropology*. Malden, MA: Blackwell. p.340-342. 1997.
- MARTINEZ MATEO, Marina et al.
Essentializing the binary self: individualism and collectivism in cultural neuroscience. *Frontiers in Human Neuroscience*, v.7, p.1-4. 2013.

- MARTINEZ MATEO, Marina et al.
Concerns about cultural neuroscience: a critical analysis. *Neuroscience and Biobehavioral Reviews*, v.36, n.1, p.152-161. 2012.
- MEAD, Margaret.
Coming of age in Samoa: a psychological study of primitive youth for western civilization. New York: HarperCollins. 2001.
- MRAZEK, Alissa J.; HARADA, Tokiko; CHIAO, Joan Y.
Cultural neuroscience of identity development. In: McLean, Kate C.; Syed, Moin (Ed.). *The Oxford handbook of identity development*. Oxford: Oxford University Press. p.423-436. 2014.
- NAN, Yun et al.
Cross-cultural music phrase processing: an fMRI study. *Human Brain Mapping*, v.29, p.312-328. 2008.
- NG, Brandon W.; MORRIS, James P.; OISHI, Shigehiro.
Cultural neuroscience: the current state of affairs. *Psychological Inquiry*, v.24, p.53-57. 2013.
- NG, Sik Hung et al.
Dynamic bicultural brains: fMRI study of their flexible neural representation of self and significant others in response to culture primes. *Asian Journal of Social Psychology*, v.13, n.2, p.83-91. 2010.
- NOË, Alva.
Out of our heads: why you are not your brain, and other lessons from the biology of consciousness. New York: Hill and Wang. 2009.
- NORTHOFF, Georg.
What is culture? Culture is context-dependence! *Culture and Brain*, v.1, n.2-4, p.77-99. 2013.
- ORTEGA, Francisco.
Toward a genealogy of neurogenesis. In: Ortega, Francisco; Vidal, Fernando (Ed.). *Neurocultures: glimpses into an expanding universe*. Frankfurt: Peter Lang. p.27-44. 2011.
- ORTEGA, Francisco.
The cerebral subject and the challenge of neurodiversity. *Biosocieties*, v.4, n.4, p.425-445. 2009.
- ORTEGA, Francisco; VIDAL, Fernando (Ed.).
Neurocultures: glimpses into an expanding universe. Frankfurt: Peter Lang. 2011.
- PAINTER, Neil Irvin.
The history of white people. New York: W.W. Norton. 2010.
- PITTS-TAYLOR, Victoria.
The plastic brain: neoliberalism and the neuronal self. *Health*, v.14, n.6, p.635-652. 2010.
- RAY, Rebecca D. et al.
Interdependent self-construal and neural representations of self and mother. *Social Cognitive and Affective Neuroscience*, v.5, p.318-323. 2010.
- REES, Tobias.
Being neurologically human today: life and science and adult cerebral plasticity (an ethical analysis). *American Ethnologist*, v.37, n.1, p.150-166. 2010.
- ROEPSTORFF, Andreas.
Culture: a site of relativist energy in the cognitive sciences. *Common Knowledge*, v.17, p.37-41. 2011.
- ROEPSTORFF, Andreas; FRITH, Chris.
Neuroanthropology or simply anthropology? Going experimental as method, as object of study, and as research aesthetic. *Anthropological Theory*, v.12, n.1, p.101-111. 2012.
- ROEPSTORFF, Andreas; NIEWOHNER, Jorg; BECK, Stefan.
Enculturing brains through patterned practices. *Neural Networks*, v.23, p.1051-1059. 2010.
- ROEPSTORFF, Andreas; VOGELY, Kai.
Contextualising culture and social cognition. *Trends in Cognitive Science*, v.13, p.511-516. 2009.
- SAHLINS, Marshall.
Sentimental pessimism and ethnographic experience: or why culture is not a disappearing object. In: Daston, Lorraine (Ed.). *Biographies of scientific objects*. Chicago: University of Chicago Press. p.158-202. 2000.
- SCHEPER-HUGHES, Nancy.
The Margaret Mead controversy: culture, biology and anthropological inquiry. *Human Organization*, v.43, n.1, p.85-93. 1984.
- SCHLEIM, Stephan; ROISER, Jonathan P.
fMRI in translation: the challenges facing real-world applications. *Frontiers in Human Neuroscience*, v.3, n.63. 2009.
- SHWEDER, Richard A.
Culture: contemporary views. In: Smelser, Neil J.; Baltes, Paul B. (Ed.). *International Encyclopedia of the Social & Behavioral Sciences*. v.5. Oxford: Elsevier. p.1351-1358. 2001.
- SHWEDER, Richard A.
Thinking through culture: expeditions in cultural psychology. Cambridge, MA: Harvard University Press. 1991.
- TAN, Li Hai et al.
Neuroanatomical correlates of phonological processing of Chinese characters and alphabetic words: a meta-analysis. *Human Brain Mapping*, v.25, n.1, p.83-91. 2005.

TANG, Yijuan et al.
Arithmetic processing in the brain shaped by cultures. *PNAS [Proceedings of the National Academy of Sciences]*, v.103, n.28, p.10775-10780. 2006.

TYLOR, Edward B.
Primitive culture: researches into the development of mythology, philosophy, religion, art, and custom. London: John Murray. 1871.

VIDAL, Fernando.
La neuroesthétique, un esthétisme scientifique. *Revue d'histoire des sciences humaines*, v.25, p.239-264. 2011.

WAJMAN, José Roberto et al.
Culture as a variable in neuroscience and clinical neuropsychology: a comprehensive review, *Dementia & Neuropsychologia*, v.9, n 3, p.203-218. 2015.

WARNICK, Jason E.; LANDIS, Dan (Ed.).
Neuroscience in intercultural contexts. New York: Springer. 2015.

WILLIAMS, Raymond.
Keywords: a vocabulary of culture and society. Rev. ed. London: Fontana. 1985.

ZHOU, Haotian; CACIOPPO, John.
Culture and the brain: opportunities and obstacles. *Asian Journal of Social Psychology*, v.13, p.59-71. 2010.

ZHU, Ying; HAN, Shihui.
Cultural differences in the self: from philosophy to psychology and neuroscience. *Social and Personality Psychology Compass*, v.2, n.5, p.1799-1811. 2008.

ZHU, Ying et al.
Neural basis of cultural influence on self-representation. *NeuroImage*, v.34, p.1310-1316. 2007.

