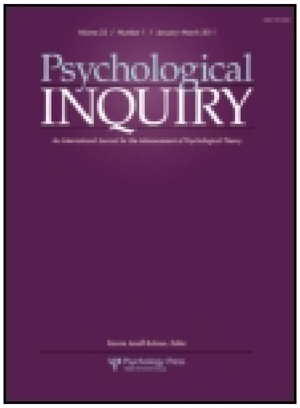

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Refining Concepts and Uncovering Biological Mechanisms for Cultural Neuroscience

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Introduction

We agree that cultural neuroscience is a promising research direction. This field is but in its infancy, and many future studies will likely follow. There are, however, tremendous difficulties in terms of definitions, methodologies, and interpretations that must be brought to the forefront before meaningful progress can be made. Here, we highlight these issues and point to potential solutions (including promising databases that can address these issues). Overall, it seems that an important next step is to generate better refined and specified research questions, as well as further elaborating the mechanisms for how culture operates to influence neural, and behavioral, function.

What Is "Culture"?

As the study of culture progresses, it becomes more important to specify what "culture" means. At the broadest level, it may be thought of as the external or exogenous experiences that impact an individual's psychological and biological development (see Park & Gutchess, 2002), as opposed to the operation of endogenous, potentially even inborn, factors that guide development. Indeed, there are many ways of conceptualizing culture along these lines (see Martinez Mateo, Cabanis, Cruz de Echeverria Loebell, & Krach, 2012, for another treatment of this issue). From an experience-based perspective, virtually anything can constitute culture, from large geographic distinctions such as East versus West, nationality, or regions (e.g., North or South in the United States; urban vs. rural), to connections among individuals based on common practices, customs, or languages, to shared experiences such as childrearing practices or educational philosophies. Experiences seemingly restricted to a single event (e.g., living in the United States during the 9/11 tragedy), an isolated domain in one's life (e.g., choice of occupation, such as London taxi drivers; Maguire et al., 2000) or a unique period (e.g., growing up during World War II) can also indelibly shape an individual's development as a function of culture.

Although we caution against crafting an operational definition that severely limits what counts as the study of culture, it seems necessary to carefully consider and explicitly state what aspects of culture are essential for any given context. In our view, useful distinctions to operationally define the scope of culture include the following.

Geography

This is likely the most common division used in the literature, for example, contrasting individuals raised in Eastern versus Western societies, or specific nations (e.g., China vs. United States). Despite being due more to convenience sampling rather than strict selection criteria, such practical approaches have generally been successful at finding meaningful culture-related differences in psychological processing. Nevertheless, there is increasing awareness of the need to move beyond the dichotomy of comparisons between East versus West. Comparisons of more diverse cultural identities are needed that focus on more local subdivisions of geography, such as comparing the U.S. South to the North (Cohen, Nisbett, Bowdle, & Schwarz, 1996).

Immigration is another aspect of culture relevant to the concept of geography, with complex and dynamic cultural identities possible given the number of parameters that impact relocation (e.g., age at immigration; number of years of exposure to different geographical locations; extent to which one assimilates into a new geographical region). For example, biculturals hold two cultural frames and differently engage neural regions across tasks, depending on which aspect of their cultural identity (e.g., Asian or American) has been primed (Chiao et al., 2009). Moreover, differences in the extent to which one's bicultural identities are highly integrated (i.e., blended), as opposed to poorly integrated (i.e., alternating), also determines the way in which individuals approach tasks and engage neural regions (Huff, Yoon, Lee, Mandadi, & Gutchess, 2013). It is important to note, as seen in Chiao et al.'s model, that geography presumably creates the opportunity for shared biology, with genes later influencing the development of neural modules.

Social and Economic Factors

Socioeconomic status, within a nation, is emerging as a powerful determinant of cognitive style, akin to the influence of culture *across* nations. Working-class individuals, for example, exhibit more context focus than middle-class individuals (Grossmann & Varnum, 2011), analogous to previous findings for Easterners compared to Westerners. Livelihood may exert a similar influence, with individuals from farming and fishing communities within the Black Sea region of Turkey exhibiting more context focus than individuals from herding communities (Uskul, Kitayama, & Nisbett, 2008). Although some social and economic factors, such as socioeconomic status or occupation, may distinguish one individual from another within a restricted geographical region, others may largely operate across nations. A number of such factors were identified in a review by Henrich, Heine, and Norenzayan (2010) highlighting that the vast majority of psychological literature (by their estimate, 96% of research subjects) is based on the study of people hailing from Western, highly educated, industrialized, rich, and democratic (WEIRD) societies. Although some aspects of their so-called WEIRD taxonomy are largely geographic (i.e., Western vs. Eastern), the other aspects emphasize the social and economic implications of a nation's organizational structure and access to resources. Additional socially relevant factors measurable at the level of the individual (e.g., individualism–collectivism, tightness–looseness) are discussed by Chiao et al. (this issue).

Cohort-Specific Factors

Events specific to one period are another important aspect of culture that is rarely considered in the cultural neuroscience studies thus far. That is, to what extent do identified cultural differences reflect transient aspects of culture, such as current events or policies? For example, data from before and after the handover of Hong Kong to the People's Republic of China in 1997 (Fung, Carstensen, & Lutz, 1999), 9/11, and the SARS epidemic (Fung & Carstensen, 2004) illustrate that these culturally significant events altered preferences for spending time with familiar partners, as a function of perceived time limitations. Certainly large-scale events, such as World War II, the Great Depression, the Cultural Revolution, or the SARS epidemic, can lead to cultural shifts and transitions that would have the potential to profoundly influence psychological function.

Studying culture across multiple cohorts, such as across age groups, offers one way to assess the robustness and generalizability of cross-cultural differences. Although it is, of course, impossible to isolate the effects of cultural events to a single generation (e.g., growing up during the Great Depression likely influenced subsequent childrearing practices, thus influencing the next generation), with the trajectory of cultural differences possibly being altered by the aging process itself (see Goh & Park, 2009; Park & Gutchess, 2006), identifying the same pattern of cultural differences across younger and older cohorts provides supportive evidence that cultural differences likely reflect the operation of stable cultural processes rather than specific historical events. Identifying differences across generations will also inform us of the evolutionary timescale within which culture operates. If cultural differences detected with neuroscience measures actually do reflect long-standing evolutionary processes, then cohort differences should be negligible. It is likely, however, that many cultural effects measured in behavioral and neural studies to date largely reflect an individual's own experiences, many of which are shared with others who develop in the same cultural setting. These are empirical questions that ultimately require a combination of longitudinal and cross-sectional studies across various sets of cultural experiences.

It is also possible that this moment in time may be a particularly informative period in which to study the influence of culture across cohorts. As globalization and access to shared media increase, particularly as a result of the widespread availability of the Internet, it may be expected that younger generations may be exposed to more similar influences, and thus many industrialized cultures may be less differentiated over time. This is a particularly interesting question in terms of culture–gene coevolution; whereas relative geographic stability should limit the local distribution of genes, how will the greater convergence of social and cultural influences affect the operation of relevant genes?

Finally, it is important to note that individual differences occur within and between cultures. Distributions of scores on psychological measures or patterns of neural activity typically overlap across cultural groups, be they defined as such by geographical borders or social factors; it is not expected to be the case that cultural groups are entirely nonoverlapping. In fact, individual-level factors and group-level factors do not necessarily correspond, such that constructs and measures that are useful for distinguishing between groups at the level of culture are not necessarily valid for distinguishing among individuals, with low correlations between measures (Na et al., 2010). How genetic differences are expected to affect neural and behavioral function in comparisons among individuals *within* a culture, as opposed to *between* cultures, remains to be specified.

What Is "Cultural Neuroscience"?

Use of the term "cultural neuroscience" suggests that the study of culture with neuroscience methods constitutes its own distinct subfield, separate from other parent disciplines such as cognitive neuroscience or social neuroscience. Chiao et al. (this issue) imply some of the features that necessitate a unique subfield, such as the connections across a number of different fields (e.g., psychology, neuroscience, anthropology), and the importance of developmental trajectories over different time spans, from an individual's own lifespan to across generations (as in their Figure 1). However, an explicit discussion of what criteria differentiate "cultural neuroscience" from other fields would be useful. Why should it be its own subfield, and what differentiates it from other fields? What are the boundary conditions that place a topic of investigation into this subfield rather than another? For example, the study of ingroup versus outgroup processes could be a standard topic of investigation for social psychology or social neuroscience. But casting the same topic in terms of specific cultural groups, such as Arabs versus Israelis, could then place the topic within the sphere of "cultural neuroscience."

It is also important to consider the present treatment of "cultural neuroscience" in light of the classical distinction between "cultural psychology" and "cross-cultural psychology" (see Shweder, 1990). Based on our reading, Chiao et al. seem to define cultural neuroscience in a manner akin to cultural psychology, with an emphasis on studying culture, per se, and the ways in which it shapes the mind. Cross-cultural psychology, in contrast, primarily focuses on the psychological processes themselves, investigating the ways in which those processes, such as memory or empathy, are modified by culture or are universals across cultures. It is unclear whether the field of cultural neuroscience encompasses both perspectives or emphasizes only the study of culture itself. The authors of this commentary would consider some of our work to fall within the scope of cultural neuroscience but would consider our approaches to emphasize the ways in which culture modifies attention (e.g., to object vs. background; Gutchess, Welsh, Boduroglu, & Park, 2006; Goh et al., 2007) and the corresponding neural regions supporting these processes, rather than probing at the root of how culture shapes the brain.

It is also important to consider the number of different ways in which culture may shape neural function. In their article, Chiao et al. (this issue) underscore the potential role of culture in sculpting "domain-specific modules or adaptive neural machinery" (p. 3). Yet culture may not exert its influence only by affecting the development or efficiency of distinct modules. Gutchess, Schwartz, and Boduroglu (2011) discussed mechanisms through which culture influences psychological processes with an emphasis on cognitive function, suggesting that cultural differences could reflect (a) the engagement of distinct cognitive *processes*, with individuals from different cultures adopting different strategies (e.g., categorical vs. relational) or processing distinct elements of information (e.g., object vs. context), (b) differences in the *content* of which facts and pieces of information are stored and accessed by individuals from different cultures, or (c) different degrees of *difficulty* across cultures, with one task more challenging and resource-intensive for members of one culture than another. The first mechanism, differences in cognitive processes, has received the most attention in research thus far and seems most consistent with the Chiao et al. emphasis on modules. However, it is also possible that the function of a module depends upon the complexity or amount of content it possess and the speed or efficiency with which one can access it.

Moving beyond an approach focused on modules, it may be the case that culture alters the nature of the computations themselves or affects the connectivity between regions. New approaches to characterizing neurofunctional responses now emphasize, more appropriately, treating the brain as a network rather than as distinct modules (Bullmore & Sporns, 2009). Consequently, the impact of culture on brain neurocognitive processes may not be fully understood when focusing on one or a set of brain regions. Rather, the impact of culture on the whole brain with interregional interactions has to be considered. This issue is compounded when expanded to include cultural influences on the contribution of genetic expressions on neural structure and function, and psychological processes.

Working With Genes, the Brain, and Behavior

The methodological challenges associated with culture–gene coevolution studies are not trivial. Figure 1 illustrates the various measurement domains involved in any such inquiry from which the complexity of these studies can be easily appreciated. Even the most basic associative relationship of interest necessarily involves evaluating individual allele polymorphisms, neurobiological phenotypic expressions in terms of brain structure and function, subsequent psychological processes, individual behaviors, interpersonal social behavioral interactions, and individuals' interactions with the social and physical environment. Culture-related influences on brain and behavior directly operate mainly on the latter two broad domains. At the other end, genetic influences on behavior occur through phenotypic expression in brain structure and function. The confluence of culture-related influences and genetic expression occurs through natural selection vis-à-vis reproduction and survival efficacy.

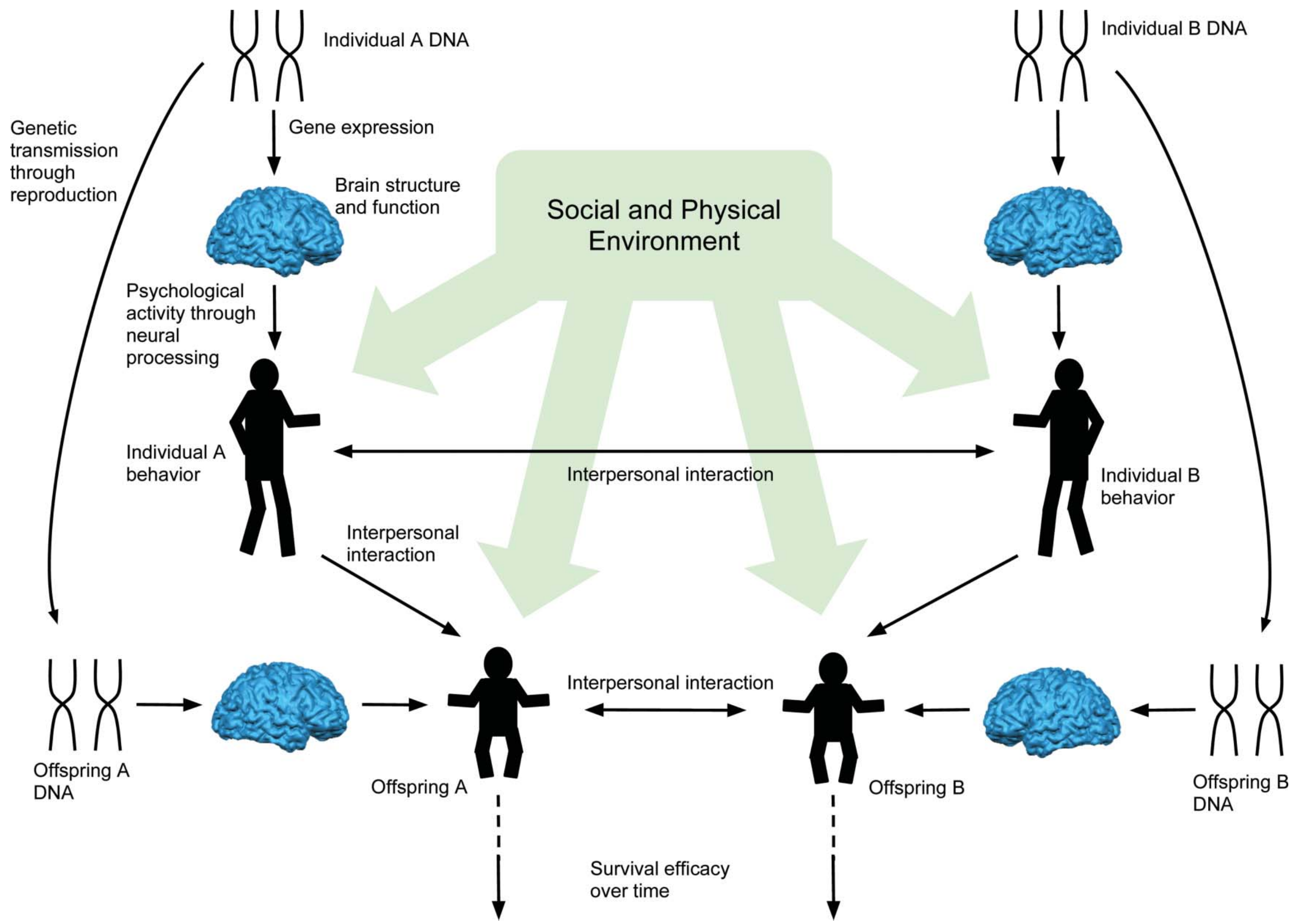

Figure 1. Schematic showing the various associations between measurement domains that have to be considered in culture–gene coevolution studies. *Note.* For simplicity, only associations pertaining to a pair of individuals and offspring are depicted here (color figure available online).

At present, most existing studies can address associations between at most two or three domains simultaneously. For example, a typical study may be able to conclude that certain alleles are associated with specific neural structures that are in turn associated with specific cognitive behaviors. Very few studies simultaneously acquire data across all domains within the same individual. Thus, relating alleles to particular types of interpersonal interactions or interactions with the social or physical environment in those cases heavily rely on the assumption that all other unmeasured factors are constant or do not interact with the effects of interest.

A cautionary note should also be raised that pertains to the contribution of single alleles toward complex human behaviors. Chiao et al. highlight the example of SLC6A4 (solute carrier family 6, member 4; also known as 5-HTTLPR), which is a gene that mitigates the formation of a cell membrane protein involved in serotonin reuptake into the presynaptic neuron (see the PubMed Gene database: http://www.ncbi.nlm.nih.gov/gene/6532) and has been implicated in clinical anxiety and depression disorders in humans (Lesch et al., 1996). It is unlikely, however, that the membrane protein formed from SLC6A4 is involved only in depression or has only one locus of action in the brain. In addition, the vast majority of genes do not have clear links with psychological processes and behavior, and most behaviors are also likely modulated by multiple gene–gene interactions. That is, the average contribution of each single allele to human behavior is very small and, as with a more network view of brain function, intergene widespread contributions also need to be considered.

Moreover, to determine if culture-related factors shape allelic frequencies across different groups of people, it is critical that the same domains additionally be considered for offspring over several generations (see Figure 1). This requirement for simultaneous measures is further restricted by ethical issues surrounding the manipulation of genes in humans and selecting individuals with different genetic makeup and implanting them in different cultural environments. In terms of analysis, this is essentially a large-scale, many-to-many problem, and it is critical to have strong theoretically based approaches for parsimony and to filter out the many associations that will be observed but are not meaningful.

Contributions From Studies on Aging Neurobiology

The need for large-scale data with multiple measures may seem insurmountable, but some existing studies may provide initial platforms for examining gene–brain–culture interactions as just outlined. These studies are the Aging Culture and Cognition Study (http://agingmind.utdallas.edu/research/view/agingculture-and-cognition-project), Baltimore Longitudinal Study on Aging (http://clinicaltrials.gov/show/NCT00233272), Alzheimer's Diseases Neuroscience Initiative (http://adni.loni.ucla.edu/), Dallas Lifespan Brain Study (http://agingmind.utdallas.edu/research/view/dallas-lifespan-brain-study), Betula Project (http://w3.psychology.su.se/betula/en/index.html), Berlin Aging Study (http://www.base-berlin.mpg.de/Introduction.html), and Singapore Longitudinal Aging Brain Study (http://www.cogneuro-lab.org/DynamicPage.aspx?u=6).

This list is by no means exhaustive, but it can be seen that all of these are studies on aging. It is the authors' view that such studies are the most ideal at present for investigating the effect of culture because both exogenous and neurobiological effects can potentially be accounted for within such datasets. The data from these studies capture multivariate aspects of individual differences that involve genes, brain structure and function, psychological processes, and behavior and can also relate them to sociocultural factors based on geography as well as demographic information. Moreover, in the longitudinal studies, it is possible to examine the trajectories of these effects within the same individual over time. Such data are necessary to dissociate individual differences that reflect endogenous phenotypes from those that arise because the same endogenous phenotypes were modulated by exogenous influences.

Conclusion

Better specification and understanding of the mechanisms that underlie culture are much needed, and Chiao et al.'s emphasis on culture–gene coevolution provides a plausible account of how culture can shape biological and neural function. Chiao et al. note a number of challenges for this field, including limited access to resources and training in low- to middle-income countries, ethical issues across nations, and the difficulties inherent to large-scale team science. We also raise a number of challenges to this endeavor, not only in terms of the methodology for studying genetic influences but also regarding definitions and assumptions of key concepts. However, it is important to establish a sound biological basis for how culture can shape neural activity, particularly in light of recent critiques that the study of culture may be unnecessarily "biologized" (Martinez Mateo et al., 2012). We intend for our response to highlight a few of the countless ways in which cultural experiences can shape neural function, rather than suggesting that culture simply operates in a fixed, preprogrammed biological fashion. With their culture-gene coevolution framework, Chiao et al. (this issue) take an important step in specifying a precise mechanism through which culture may influence brain and behavior.

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Note

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References

Bullmore, E., & Sporns, O. (2009). Complex brain networks: Graph theoretical analysis of structural and functional systems. *Nature Reviews Neuroscience*, *10*, 186–198.

Chiao, J. Y., Harada, T., Komeda, H., Li, Z., Mano, Y., Saito, D., . . . Iidaka, T. (2009). Dynamic cultural influences on neural representations on the self. *Journal of Cognitive Neuroscience*, *22*, 1–11.

Cohen, D., Nisbett, R. E., Bowdle, B., & Schwarz, N. (1996). Insult, aggression, and the southern culture of honor. *Journal of Personality and Social Psychology*, *70*, 945–960.

Fung, H., & Carstensen, L. L. (2004). Motivational changes in response to blocked goals and foreshortened time: Testing alternatives to socioemotional selectivity theory. *Psychology and Aging*, *19*, 68–78.

Fung, H. H., Carstensen, L. L., & Lutz, A. (1999). The influence of time on social preferences: Implications for life-span development. *Psychology and Aging*, *14*, 595–604.

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

Goh, J. O., & Park, D. C. (2009). Culture sculpts the perceptual brain. *Progress in Brain Research*, *178*, 95–111.

Grossmann, I., & Varnum, M. E. W. (2011). Social class, culture, and cognition. *Social Psychological and Personality Science*, *2*, 81–89.

Gutchess, A. H., Schwartz, A. J., & Boduroglu, A. (2011). The influence of culture on memory. In D. D. Schmorrow & C. M. Fidopiastis (Eds.), *Lecture notes in artificial intelligence, lectures notes in computer science, 6780* (pp. 67–76). Berlin, Germany: Springer-Verlag.

Gutchess, A. H., Welsh, R. C., Boduroglu, A., & Park, D. C. (2006). Cross-cultural differences in the neural correlates of picture encoding. *Cognitive, Affective, and Behavioral Neuroscience*, *6*, 102–109.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*, 61–83.

Huff, S. E., Yoon, C., Lee, F., Mandadi, A., & Gutchess, A. H. (2013). *Self-referential processing and encoding in bicultural individuals*. Poster presented at the Culture Preconference at the Society for Personality and Social Psychology conference, New Orleans, LA.

Lesch, K. P., Bengel, D., Heils, A., Sabol, S. Z., Greenberg, B. D., Petri, S., . . . (1996). Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. *Science*, *274*, 1527–1531.

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

Martinez Mateo, M., Cabanis, M., Cruz de Echeverria Loebell, N., & Krach, S. (2012). Concerns about cultural neurosciences: A critical analysis. *Neuroscience and Biobehavioral Reviews*, *36*, 152–161.

Na, J., Grossmann, I., Varnum, M. E., Kitayama, S., Gonzalez, R., & Nisbett, R. E. (2010). Cultural differences are not always reducible to individual differences. *Proceedings of the National Academy of Sciences of the United States of America*, *107*, 6192–6197.

Park, D. C. & Gutchess, A. H. (2002). Aging, cognition, and culture: A neuroscientific perspective. *Neuroscience and Biobehavioral Reviews*, *26*, 859–867.

Park, D. C. & Gutchess, A. H. (2006). The cognitive neuroscience of aging and culture. *Current Directions in Psychological Science*, *15*, 105–108.

Shweder, R. A. (1990). Cultural psychology: What is it? In J. W. Stigler, R. A. Shweder, & G. Herdt (Eds.), *Cultural psychology: Essays on comparative human development* (pp. 1–43). Cambridge, UK: Cambridge University Press.

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