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Self-construal: a cultural framework for brain function

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Humans have created complex cultures that provide frameworks for our lives, guiding our behavior and thoughts. Recent brain imaging studies have uncovered cultural influences on brain activity in multiple tasks. We review recent cultural neuroscience findings that illustrate that (a) self-construal, a cultural trait that differentiates between East Asian and Western societies, mediates group differences in brain activity between East Asians and Westerners; and (b) priming interdependent/independent self-construals modulates brain activity engaged in sensory/motor and cognitive/affective processes. These findings provide new insights on human brain function and suggest that self-construals provide a cultural framework that constrains brain activity underlying multiple cognitive and affective processes.

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Introduction

Culture, consisting of shared beliefs and behavioral scripts, has an enormous influence on human lives by providing a meaning system for both individuals and populations, which motivates their behavior within a particular cultural context. Culture functions as a framework for structuring behavior by setting up social rules and norms. Individuals start to learn specific cultural beliefs/values/norms and practice culturally specific behavioral scripts from early childhood. Cultural learning and experience not only help to formulate routine ways of doing things but also shape styles of mental (cognitive and affective) activity [1,2]. Cultural knowledge and traits are delivered from one generation to the next as an inheritance system that influence social/physical environments [3] and interacts with genes to shape human behavior [4].

Self-construal, that is, how an individual perceives, comprehends, and interprets the self, is one of the most important cultural traits that influences human behavior and has been used to explain cultural differences in behavior and cognition/emotion. Markus and Kitayama [5] proposed that Western culture encourages an independent self-construal that conceptualizes the self as an autonomous and bounded entity, emphasizing the independence and uniqueness of the self. In contrast, East Asian culture promotes an interdependent self-construal that conceptualizes the self as interconnected and overlapping with close others, emphasizing harmony with these close others. Self-construals mediate cultural group differences in emotion and cognition [6,7] and temporary priming of interdependent and independent self construals leads to causal changes of cognition and behavior [8,9].

Interestingly, recent cultural neuroscience studies [10–13] have shown that influences of self-construals go beyond behavioral and psychological effects. By integrating brain-imaging techniques such as functional magnetic resonance imaging (fMRI) and event-related brain potentials (ERPs), researchers compared brain activity from two cultural groups dominated by independence or interdependence or recorded brain activity from one culture group after being primed with independence or interdependence. The results demonstrate that how we view the self and self/other relationships (i.e., self-construals) modulates the brain activity involved in self-referential processing and other cognitive/affective processes. Here, based on recent cultural neuroscience findings, we propose that these self-construals provide a cultural framework for the neural substrates of cognitive and affective processes. We review cross-cultural and self-construal priming imaging findings which indicate that the mode by which people think of the self (as either interdependent or independent), mediates cultural group differences in brain activity and causes changes of brain activity across a variety of tasks. These findings suggest that self-construal is a key cultural trait that activates a cognitive framework that constrains neural strategies and modulates the neural processes underlying cognition and emotion.

Self-construals mediate cultural group differences in brain activity

Early cross-cultural brain imaging studies explored cultural influences on brain activity by searching for cultural group differences in neural activity. fMRI studies have reported distinct patterns of brain activity between participants from East Asian and Western societies in tasks

emphasizing visual perception [14••,15,16], attention [17••], causal attribution [18••], mental calculation [19], self-reflection [20••], and mental state reasoning [21] (see highlights in reference for details). These studies, however, failed to uncover which cultural orientation mediated the observed group differences in brain activity. This is an important issue for cultural neuroscience research because participants from East Asian and Western societies differ across a variety of cultural beliefs and it is necessary to clarify what cultural beliefs underlie the observed group differences in brain activity.

One cultural neuroscience approach to solve this issue is to measure the particular cultural values such as independence/interdependence that are potentially mediating cultural effects. Such designs have allowed researchers to test specific hypotheses that the distinct patterns of brain activity in different cultural groups are mediated by self-construals. For example, Ma *et al.* [22••] tested the hypothesis that activity in the medial prefrontal cortex (mPFC) — linked to encoding the self-relevance of stimuli [23,24] — is increased in Western relative to East Asian cultures, whereas activity in the temporoparietal junction (TPJ) — a cortical junction zone at the border of the posterior parts of the temporal lobe and the inferior parts of the parietal lobe, which has been shown to be involved in belief reasoning and perspective taking [25] — is enhanced in East Asian relative to Western cultures. In addition, Ma *et al.* investigated whether cultural group differences in brain activity were mediated by interdependent self-construals. They scanned Chinese and Danish college students as the participants made judgments of social, mental and physical attributes in relation to themselves and to public figures. Self-construals were measured using Singelis's Self-Construal Scale [26]. It was found that judgments of the self compared to a public figure elicited greater mPFC activations in Danes compared with Chinese participants regardless of attribute dimensions for judgments. On the other hand, self-judgments of social attributes induced greater TPJ activity in Chinese compared with Danes. The self-construal measure revealed greater interdependence in Chinese compared to Danish participants. More interestingly, the measure of interdependence was positively correlated with TPJ activity but negatively correlated with the mPFC activity. A mediation analysis further demonstrated that the difference in TPJ activity between Chinese and Danes was fully mediated by the interdependence of self-construal. These findings indicate that group-level differences in TPJ activity can be partially explained by individual differences in interdependence and that self-construals play a key role in mediating cultural group differences in brain activity related to taking others' perspective during self-reflection.

Cross-cultural ERP studies have also shown evidence for the mediating role of self-construal in cognition. Kitayama and Park [27] recorded ERPs from European Americans and Asians while they performed a flanker task to earn reward points assigned either to themselves or a friend. Kitayama and Park found that the error-related negativity (ERN) — a form of brain activity contingent on error responses over the central/parietal region — was greater when participants performed the task for reward to the self relative to when rewards accrued for the friend. However, this self-centric effect was evident in European Americans but not in Asians. Furthermore, it was found that interdependent self-construal mediated the group difference in the ERN self-centric effect. Thus interdependent self-construal can be used to explain group differences in a neural correlate of self-centric motivation.

The mediating role of self-construal is not limited to brain activity underlying explicit self-related tasks. Na and Kitayama [28] reported culture-based variation in the N400, an ERP component sensitive to semantic processing. Presentation of a trait adjective was preceded by a facial photo with trait-implying behavior that was semantically incongruent or congruent with the adjective. This effect was observed in European Americans but not in Asian Americans and the group difference in the N400 incongruity effect was mediated by independent self-construal. An earlier ERP study even reported that the parietal P3 component — a positive potential that peaks around 300–400 ms after stimulus onset with the maximum amplitude over the parietal or frontal scale sites — in response to target objects was larger in amplitude in European Americans than in East Asians and the group difference in the P3 amplitude was mediated by interdependent self-construal [29]. Taken together, these cross-cultural imaging studies indicate that group differences in brain activity engaged in different tasks/stimuli can be similarly mediated by the same cultural value, that is, the type of self-construal adopted by the individual.

Priming interdependent/independent self-construals modulates brain activity

Cultural psychologists propose that an individual may identify with multiple cultural systems and may be able to switch between different cultural systems in response to specific social contexts and interactions [30]. This idea has stimulated investigations of how brain activity is modified by activation (or priming) of specific cultural values and beliefs. Based on an intervention through priming we may infer a causal relationship between culture and brain activity. The most frequent manipulation here has been the priming of interdependent/independent self-construals. A typical procedure to prime interdependent self-construal is to ask participants to read essays containing plural pronouns ('we' or 'us') or to think how the self is different from others. In contrast, to prime independent self-construal, participants read essays containing singular pronouns ('I' or 'me') or to think how the self is similar to others [31].