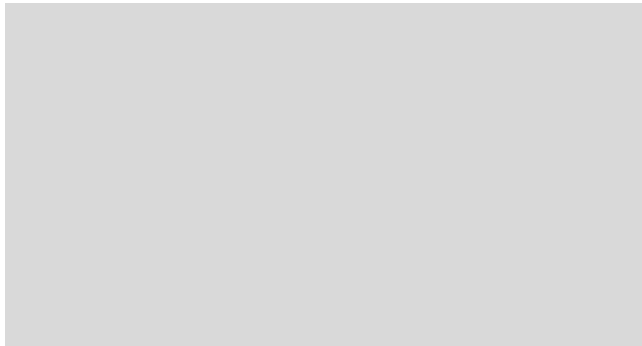




Self-construal: a cultural framework for brain function

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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



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-implicating 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].

Early fMRI studies reported that priming independent compared to interdependent self-construals in Chinese participants induced greater right frontal activity in response to one's own face [32**]. A later study found that priming individualistic vs. collectivistic values in Asian-Americans led to increased activation in self-related mPFC and posterior cingulate cortex (PCC) — a brain region engaged in episodic memory [33] — when participants reflected on their own traits in general [34]. Recent research has extended these early findings by demonstrating effects of self-construal priming on brain activity involved in other cognitive/affective processes. For example, priming East Asian Americans with interdependent values enlarged an N400 response to affective incongruity in the emotional expression of a central face relative to the surrounding faces as participants judged the expression of this central face [35], suggesting that interdependent self-construal facilitates attention to emotional context. Similarly, priming Chinese participants with interdependent self-construals increased the reward activity in the bilateral ventral striatum when winning money for a friend during a gambling game [36**]; in this case, the activation of an interdependent processing mode may enhance reward associated with close

and large-scale emigration may generate more common cultural experiences across the globe. How do these within-lifetime changes modulate culturally-dependent thoughts and brain activity in future? We should not think of culture as a static factor but as an over-arching framework that is constantly evolving. Cultural neuroscience findings allow us to speculate and predict the emerging changes of the functional organization of the brain that provide a neural basis of social adaptation for the next generation.

Conflict of interest statement

Nothing declared.

Acknowledgements

This work was funded by the National Natural Science Foundation of China (Projects 31421003, 31470986, 91332125), the Ministry of Education of China (Project 20130001110049), and the Leverhulme Trust, United Kingdom.

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striatum in response to winning money for the self (vs. for a friend) during a gambling game. However, priming an interdependent self-construal resulted in comparable activation in these regions in response to winning money for the self and for a friend. The findings suggest that interdependence may cause people to experience rewards for a close other as strongly as they experience rewards for the self.

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