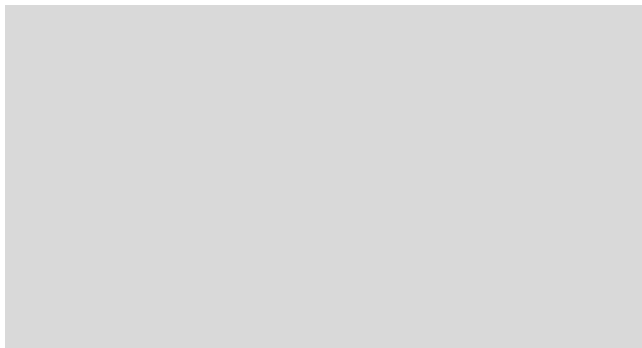




Self-construal: a cultural framework for brain function

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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



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' 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.

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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 others. Priming self-construals also modulated empathic neural responses to strangers' physical pain that were decreased by interdependent self-construal priming among Chinese (possibly due to exclusion of strangers from ingroup by interdependent self-construal priming) but increased by independent self-construal priming among Westerners (possibly due to exclusion of any others from ingroup by independent self-construal priming) [37]. In addition, priming of independent self-construal, which possibly weakened ingroup/outgroup concept can reduce racial in-group biases in empathic neural responses within the anterior cingulate and insular [38].

Self-construal priming also modulates sensorimotor activity. Priming independent self-construals increased the amplitude of frontal EEG activity at about 130 ms after a painful electric shock was applied to the left hand of Chinese participants [39]. Here, the temporary shift in self-construal can affect pain perception by modulating the neural activities in early somatosensory processing of physical pain, suggesting that increased self-focus enhances pain experience. Priming interdependent self-construal compared to a no-priming baseline condition increased motor-evoked potentials induced by transcranial magnetic stimulation applied to the motor cortex [40], possibly due to that reminding the connections between oneself and others modulates the mirror system to tune the individual to social input. Self-construal priming even modulates the brain activity during a resting state (e.g., to keep eyes open and try not to think of anything particular). Wang *et al.* [41] first identified that, relative to a calculation task that required simple addition

and multiplication, both interdependent and independent self-construal priming increased activity in the ventral mPFC and PCC. They further revealed that interdependent compared to independent self-construal priming increased local synchronization of spontaneous activity in the dorsal mPFC but decreased local synchronization of spontaneous activity in the PCC during the resting state. These findings suggest that the interdependent self-construal priming may facilitate

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.

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