Current Opinion in Psychology

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 pTm()Tj/F31Tf8.4682008.46/F.6425Tm(cultural)Tj-23.3447-1.3524TD(251.5431266.8.4682008.44nstruan)TTj/F21Tf.566900-.5669151.470

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 rep.566900-.56r615sJ/F21Tf.566900-.5669133.4742423.0897Tm()Tj/F61Tf9.9626009.9626137.9505353.0897Tm(

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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References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- •• of outstanding interest

1. Nisbett RE, Peng K, Choi I, Norenzayan A: **Culture and systems of thought: holistic versus analytic cognition**. *Psychol Rev* 2001, **108**:291-310.

2. Tsai JL: **Dynamics of ideal affect**. In *Changing Emotions*. Edited by Hermans D, Rimé B, Mesquita B. Psychology Press; 2013:120-126.

3. Richerson PJ, Boyd R, Henrich J: **Gene-culture coevolution in the age of genomics**. *Proc Natl Acad Sci* 2010, **107**:8985-8992.

4. Kim HS, Sasaki JY: **Cultural neuroscience: biology of the mind in cultural contexts**. *Ann Rev Psychol* 2014, **65**:487-514.

5. Markus HR, Kitayama S: **Culture and the self: implications for cognition, emotion, and motivation**. *Psychol Rev* 1991, **98**:224-253.

6. Su JC, Lee RM, Oishi S: **The role of culture and self-construal in the link between expressive suppression and depressive symptoms**. *J Cross-Cult Psychol* 2012, **44**:316-331.

7. Ren XP, Lu KW, Tuerdi M: **Uyghur-Chinese and Han-Chinese differences on social orientation**. *Cult Brain* 2014, **2**:141-160.

8. Kühnen U, Oyserman D: **Thinking about the self influences thinking in general: cognitive consequences of salient self-concept**. *J Exp Soc Psychol* 2002, **38**:492-499.

9. Lin Z, Han S: **Self-construal priming modulates the scope of visual attention**. *Quart J Exp Psychol* 2009, **62**:802-813.

10. Han S, Northoff G: **Culture-sensitive neural substrates of human cognition: a transcultural neuroimaging approach**. *Nat Rev Neurosci* 2008, **9**:646-654.

11. Kitayama S, Uskul AK: **Culture, mind, and the brain: current evidence and future directions**. *Annu Rev Psychol* 2011, **62**:419-449.

12. Han S, Northoff G, Vogeley K, Wexler BE, Kitayama S, Varnum MEW: **A cultural neuroscience approach to the biosocial nature of the human brain**. *Ann Rev Psychol* 2013, **64**:335-359.

13. Chiao JY, Cheon BK, Pornpattananangkul N, Mrazek AJ, Blizinsky KD: **Cultural neuroscience: progress and promise**. *Psychol Inq* 2013, **24**:1-19.

14. •• Gutchess AH, Welsh RC, Boduroğlu A, Park DC: **Cultural differences in neural function associated with object processing**. *Cogn Affect Behav Neurosci* 2006, **6**:102-109.

This study scanned American and East Asians when viewing pictures of (1) a target object alone, (2) a background scene with no discernable target object, and (3) a distinct target object against a meaningful background. It was found that Americans, relative to East Asians, activated more regions implicated in object processing, including bilateral middle temporal gyrus, left superior parietal/angular gyrus, and right superior temporal/supramarginal gyrus. These results suggest that cultural experiences subtly direct neural activity, particularly for focal objects, at an early stage of scene encoding.

15. Goh JO, Chee MW, Tan JC, Venkatraman V, Hebrank A, Leshikar ED, Park DC: **Age and culture modulate object processing and object-scene binding in the ventral visual area**. *Cogn Affect Behav Neurosci* 2007, **7**:44-52.

16. Goh JO, Leshikar ED, Sutton BP, Tan JC, Sim SK, Hebrank AC, Park DC: **Culture differences in neural processing of faces and houses in the ventral visual cortex**. *Soc Cogn Affect Neurosci* 2010, **5**:227-235.

17. •• Hedden T, Ketay S, Aron A, Markus HR, Gabrieli JD: **Cultural influences on neural substrates of attentional control**. *Psychol Sci* 2008, **19**:12-17.

This study scanned East Asians and European Americans during performance of simple visuospatial tasks that required absolute judgments (ignoring visual context) or relative judgments (taking visual context into account). Both groups showed activations in frontal and parietal brain regions known to be associated with attentional control was greater during culturally non-preferred judgments than during culturally preferred judgments. The results suggest that the cultural background of an individual moderates activation in brain networks engaged during even simple visual and attentional tasks.

18. •• Han S, Mao L, Qin J, Friederici AD, Ge J: **Functional roles and cultural modulations of the medial prefrontal and parietal activity associated with causal attribution**. *Neuropsychologia* 2011, **49**:83-91.

This study investigated cultural differences in brain activity underlying causal attribution of physical events by scanning American and Chinese subjects. It was found that, while the medial prefrontal activity involved in causality judgments was comparable in the

25. Saxe R, Kanwisher N: **People thinking about thinking people: fMRI investigations of theory of mind**. *NeuroImage* 2003, **19**:1835-1842.

26. Singelis TM: **The measurement of independent and interdependent self-construals**. *Pers Soc Psychol Bull* 1994, **20**:580-591.

27. Kitayama S, Park J: **Error-related brain activity reveals self-centric motivation: culture matters**. *J Exp Psychol Gen* 2014, **143**:62-70.

28. Na J, Kitayama S: **Spontaneous trait inference is culture-specific: behavioral and neural evidence**. *Psychol Sci* 2011, **22**:1025-1032.

29. Lewis RS, Goto SG, Kong LL: **Culture and context east Asian American and European American differences in P3 event-related potentials and self-construal**. *Pers Soc Psychol Bull* 2008, **34**:623-634.

30. Hong Y, Morris M, Chiu C, Benet-Martinez V: **Multicultural minds: a dynamic constructivist approach to culture and cognition**. *Am Psychol* 2000, **55**:709-720.

31. Gardner WL, Gabriel S, Lee AY: **I value freedom, but — we value relationships: self-construal priming mirrors cultural differences in judgment**. *Psychol Sci* 1999, **10**:321-326.

32. •• Sui J, Han S: **Self-construal priming modulates neural substrates of self-awareness**. *Psychol Sci* 2007, **18**:861-866.
This is the first fMRI study that illustrates modulations of brain activity by cultural priming. The authors present fMRI evidence that the right frontal activity in response to one's own face is enhanced by independent vs. interdependent self-construal priming.

33. Cavanna AE, Trimble MR: **The precuneus: a review of its functional anatomy and behavioural correlates**. *Brain* 2006, **129**:564-583.

34. Chiao JY, Harada T, Komeda H, Li Z, Mano Y, Saito D, Iidaka T: **Dynamic cultural influences on neural representations of the self**. *J Cogn Neurosci* 2010, **22**:1-11.

35. Fong MC, Goto SG, Moore C, Zhao T, Schudson Z, Lewis RS: **Switching between Mii and Wii: the effects of cultural priming on the social affective N400**. *Cult Brain* 2014, **2**:52-71.

36. •• Varnum ME, Shi Z, Chen A, Qiu J, Han S: **When — Your reward is the same as — my reward: self-construal priming shifts neural responses to own vs. friends' rewards**. *NeuroImage* 2014, **87**:164-169.
This study manipulated participantTm()Tj/F11Tf7.4718007.427n0105311.3574Tm()Tj/F31Tf7.4718007.4718186.5197311.3574Tm(self-construal)Tj/F21Tf.566900-.5669