Challenging emotional prejudice by changing self-concept: priming independent self-construal reduces racial in-group bias in neural responses to other's pain

Chenbo Wang,[1,2] Bing Wu,[3] Yi Liu,[1,2] Xinhuai Wu,[3] and Shihui Han[1,2]
[1]Department of Psychology, [2]PKU-IDG/McGovern Institute for Brain Research, Peking University, Beijing, China, and [3]Department of Radiology, Beijing Military General Hospital, Beijing, China

Humans show stronger empathy for in-group compared with out-group members' suffering and help in-group members more than out-group members. Moreover, the in-group bias in empathy and parochial altruism tend to be more salient in collectivistic than individualistic cultures. This work tested the hypothesis that modifying self-construals, which differentiate between collectivistic and individualistic cultural orientations, affects in-group bias in empathy for perceived own-race *vs* other-race pain. By scanning adults using functional magnetic resonance imaging, we found stronger neural activities in the mid-cingulate, left insula and supplementary motor area (SMA) in response to racial in-group compared with out-group members' pain after participants had been primed with interdependent self-construals. However, the racial in-group bias in neural responses to others' pain in the left SMA, mid-cingulate cortex and insula was significantly reduced by priming independent self-construals. Our findings suggest that shifting an individual's self-construal leads to changes of his/her racial in-group bias in neural responses to others' suffering.

Keywords: empathy; race; in-group bias; self-construal; fMRI

INTRODUCTION

Social intergroup relationships strongly modulate human behavior and mind. For example, people may contribute to in-group's welfare at the cost of self-interest but to aggress against out-group members (Henrich *et al.*, 2006; Choi and Bowles, 2007). Such behavioral parochial altruism has been associated with empathy, i.e. the ability to understand and share others' emotions. Recent neuroimaging findings indicate that people more strongly share racial in-group members' painful feelings compared with those of out-group members (Xu *et al.*, 2009; Avenanti *et al.*, 2010; Mathur *et al.*, 2010; Sheng and Han, 2012; Azevedo *et al.*, 2013; Contreras-Huerta *et al.*, 2013; Sheng *et al.*, 2014). Perceived painful stimulation applied to own-race compared with other-race individuals or perceived pain expression of own-race compared with other-race individuals elicits greater activity in the anterior cingulate (Xu *et al.*, 2009; Contreras-Huerta *et al.*, 2013; Sheng *et al.*, 2014), anterior insula (Azevedo *et al.*, 2013; Contreras-Huerta *et al.*, 2013; Sheng *et al.*, 2014) and medial prefrontal cortex (Mathur *et al.*, 2010), and induces stronger modulations of the sensorimotor activity (Avenanti *et al.*, 2010), indicating racial in-group bias in neural responses to others' suffering. Because empathic concern produces altruistic motivation (Batson, 2011), in-group bias in empathy may provide a mechanism of behavioral parochial altruism. Indeed, it has been shown that in-group bias in neural responses to perceived pain in others can predict motivations to self-sacrifice to help in-group members (Hein *et al.*, 2010; Mathur *et al.*, 2010).

Interestingly, recent research suggests that parochial altruism is more prevalent in collectivistic societies compared with individualistic societies (Gelfand *et al.*, 2012). Moreover, individuals from collectivistic compared with individualistic cultures show stronger racial in-group bias in neural responses to perceived pain in others. Mathur *et al.* (2010) reported stronger activity in the media prefrontal cortex to perceived pain in racial in-group than out-group individuals and the racial in-group bias in empathic neural response was greater in African compared with Caucasian-American participants. Similarly, Cheon *et al.* (2011) found evidence for racial in-group bias in the neural activity in temporoparietal junction to perceived pain and this effect was stronger in Korean compared with Caucasian-American participants. Although these findings uncovered cultural differences in parochial altruism and in-group bias in empathy, the underlying psychological and neural mechanisms remain unknown. One possibility is that interdependent *vs* independent self-construals that, respectively, dominate collectivistic and individualistic cultures (Markus and Kitayama, 1991) may provide a cognitive basis of inclose other (Harada *et al.*, 2010), empathy for others' pain (Jiang *et al.*, 2014), motor cortical output during an action observation task (Obhi *et al.*, 2011), monetary reward (Varnum *et al.*, 2014), and resting state activity (Wang *et al.*, 2013). These brain imaging results have shown robust evidence for the effect of self-construal priming on human brain activity involved in cognitive/affective processes. Using similar interdependent/independent self-construal priming procedures, this study recorded neural responses to perceived pain in others using functional magnetic resonance imaging (fMRI) as fMRI blood oxygen level dependent (BOLD) signals are much less influenced by social desirability compared with self-report empathy (e.g. Xu *et al.*, 2009). We predicted that racial in-group bias in neural responses to perceived pain in others occurs when interdependent self-construals are promoted and that racial in-group bias in neural responses to perceived pain in others is decreased when independent self-construals are encouraged. Such findings would support a causal relationship between self-construals and racial in-group bias in empathy and suggest that racial emotional prejudice can be reduced by changing self-construals.

MATERIALS AND METHODS

Participants

Thirty-two Chinese university students were recruited as paid volunteers. Two participants were excluded from data analysis due to excessive head movement during scanning. Thus, 30 participants (16 males, 14 females; 18–27 years, mean $\pm$ s.d. $=$ 22.6 $\pm$ 2.4 years) were included in data analyses. This sample size was determined using a statistic estimation (VanVoorhis and Morgan, 2007) before data collection based on the effect size (ES) of self-construal priming (i.e. 0.51, Oyserman and Lee, 2008), a significance criterion of 0.05 and a power of 0.85. All were right handed, had normal or corrected-to-normal vision, and reported no abnormal neurological history. Informed consent was obtained before scanning. This study was approved by a local ethics committee.

Stimuli and procedure

The priming materials, similar to those used in our previous research (e.g. Wang *et al.*, 2013), were four Chinese essays about tours. Two essays contained singular pronouns ('我', Chinese character of 'I' or 'me') as target words to prime independent self-construal and two essays contained plural pronouns ('

pain in others were defined as spheres with a radius of 5 mm centered at MNI coordinates −6/20/46 (mid-cingulate cortex, MCC),[1] −42/18/0 (left insula), 38/24/−2 (right insula), −4/14/54 (left supplementary motor area, SMA) and 6/8/60 (right SMA). Contrast values of painful *vs* non-painful stimuli were extracted from each ROI using the Toolbox of MarsBar, which were then subjected to a repeated measure analysis of variance (ANOVA) with Priming (independent *vs* inter-dependent) and Race (Asian *vs* Caucasian models) as within-subjects independent variables. Furthermore, original ES and standardized ES (

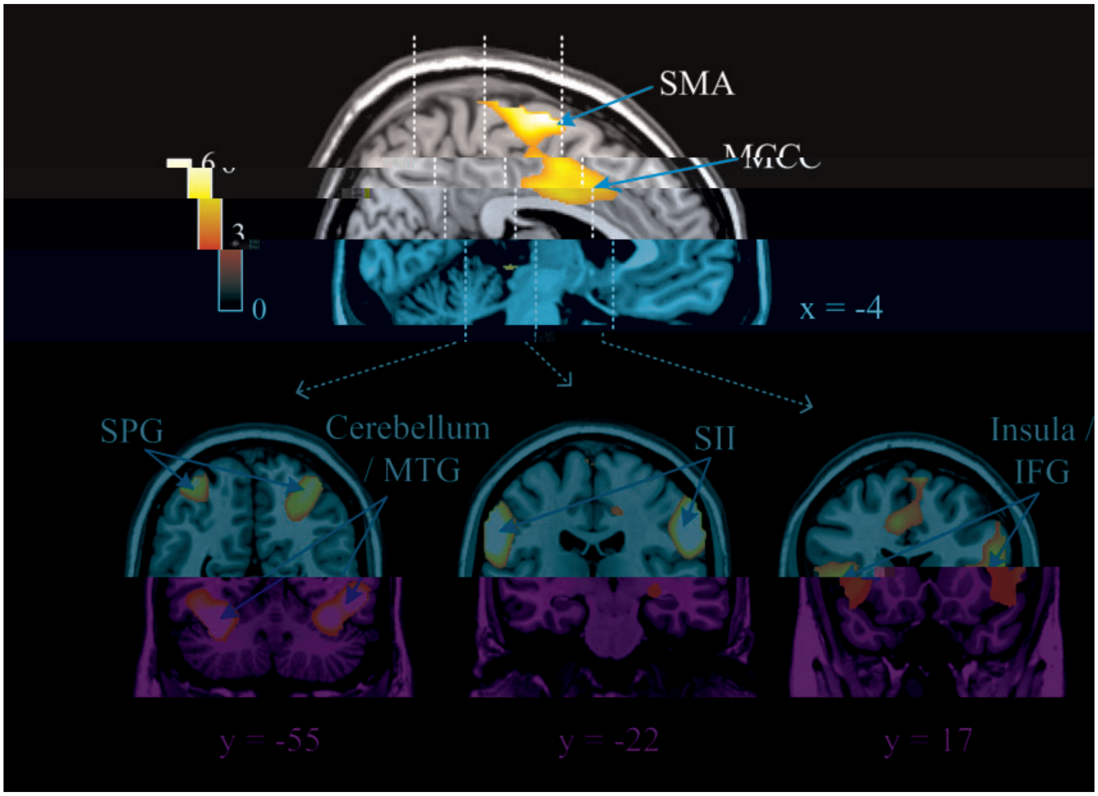

Fig. 1 Illustration of enhanced neural responses to painful compared with non-painful stimuli across all conditions.

Table 2 Neural activations shown in the contrast of painful *vs* non-painful stimuli

Brain region	*k* (voxels)	*t*-value	Peak coordinates		
			x	*y*	*z*
Right SMA	879	7.06	9	2	67
Left SMA		6.46	−3	8	70
MCC		4.65	0	−1	34
Left insula/IFG	2174	9.24	−57	5	1
		7.89	−42	−4	13
Right insula/ IFG	1264	7.37	60	11	7
		7.20	57	11	22
Right MTG	2302	8.61	51	−55	−11
Right SII/SPC		8.13	57	−22	34
Right posterior cerebellum		8.10	36	−52	−23
Left posterior cerebellum	1172	9.57	−33	−61	−26

in the independent relative to interdependent self-construal priming conditions.

We also conducted a whole-brain Priming × Race interaction analysis of the contrast of painful *vs* non-painful stimuli to examine the modulations of racial in-group bias in neural responses to perceived pain in others by self-construal priming. This analysis did not show any activation at a threshold of $P < 0.05$ (FDR cluster-level corrected). However, using a voxel-level threshold of $P < 0.001$ and an extent threshold $k > 20$ voxels (Lieberman and Cunningham, 2009), this analysis revealed significant activations in the left SMA (−3/26/52, $k = 21$), left IFG (−50/17/31, $k = 23$) and right temporo-parietal junction (51/−52/31, $k = 26$). As can be seen in Figure 3, the pattern of modulations of racial in-group bias in neural responses to perceived pain in others in these brain areas by self-construal priming was similar to those observed in the ROI analyses. *Post hoc* analyses revealed significantly stronger activity in all the three brain regions to perceived pain in racial in-group compared with out-group individuals in the interdependent self-construal priming condition ($t = 2.578$–2.787, $P = 0.009$–0.015) but not in the independent self-construal priming condition ($t = -1.181$ and -0.893, $P = 0.081$ and 0.379).

Finally, we calculated correlations between neural responses in all the ROIs related to empathy for pain, racial in-group bias, and priming effects on racial in-group bias and subjective ratings of self-construals, empathy traits and ethnic identity. But these analyses did not show any significant results ($Ps > 0.05$).

DISCUSSION

Our neuroimaging results first revealed reliable neural responses to others' suffering, i.e. viewing others in pain significantly activated the neural circuit consisting of the MCC, SMA, insula/IFG and SII. This replicates the previous fMRI findings (Singer *et al.*, 2004; Jackson *et al.*, 2005; Gu and Han, 2007; Han *et al.*, 2009). More interestingly, our results uncovered that the racial in-group bias in neural responses to perceived pain in others was significantly modulated by self-construal priming. Specifically, we found that viewing racial in-group compared with out-group members in pain elicited stronger responses in the MCC, left SMA and insula when interdependent self-construals were primed. In contrast, the racial in-group bias in neural responses to perceived pain in others was eliminated when independent self-construals were primed. The modulations of racial in-group bias in neural responses to perceived pain in others were confirmed in the ROI, whole-brain and ES analyses, though self-report did not show any racial in-group bias possibly due to the influences of social desirability. Our fMRI results in the condition of

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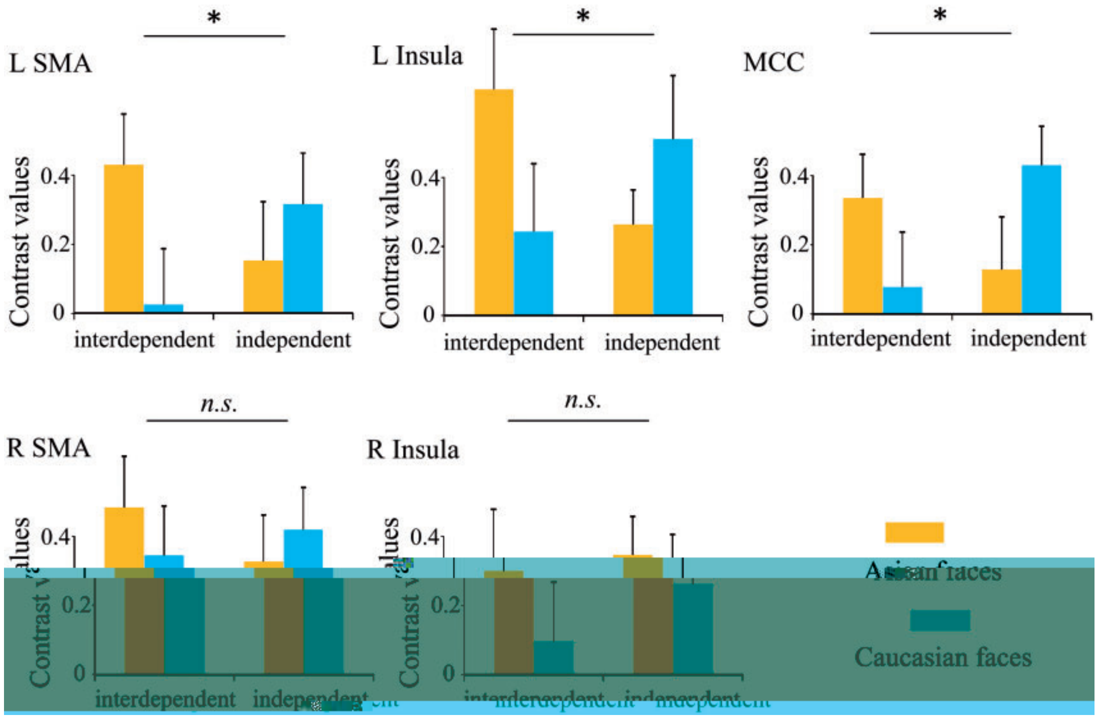

Fig. 2 Contrast values to painful *vs* non-painful stimuli extracted from pre-defined ROIs. Error bars denote standard errors. *Significant interactions of Priming × Race in the brain regions ($P < 0.05$).

Table 3 ES of racial in-group bias for each ROI

	L SMA	R SMA	MCC	L insula	R insula
Interdependent					
Original ES	0.35	0.11	0.21	0.33	0.17
95% CI	[0.03, 0.67]	[−0.11, 0.34]	[−0.10, 0.52]	[−0.03, 0.70]	[−0.15, 0.48]
Cohen's *d*	0.49	0.18	0.30	0.38	0.22
Independent					
Original ES	−0.11	−0.05	−0.24	−0.18	0.07
95% CI	[−0.45, 0.22]	[−0.35, 0.24]	[−0.52, 0.05]	[−0.53, 0.16]	[−0.23, 0.37]
Cohen's *d*	−0.18	−0.10	−0.47	−0.23	0.11

interdependent self-construal priming replicated the previous findings of racial in-group bias in empathic neural responses (Xu *et al.*, 2009; Azevedo *et al.*, 2013; Contreras-Huerta *et al.*, 2013; Sheng *et al.*, 2014) and the fMRI results in the independent self-construal priming provide the first evidence that the independent self-construal functions to reduce the in-group bias in empathy.

Our findings are consistent with a social-cognitive model of the link between self-construals and intergroup relationship (Markus and Kitayama, 2010) that suggests that interdependent self-construals induce a strong boundary between in-group and out-group whereas independent self-construals define a strong boundary between the self and any others and lead to a weakened boundary between in-group and out-group. The causal relationship between independent self-construals and decreased racial in-group bias in empathy, as indicated by our fMRI results, suggests a possible mechanism of weakened racial in-group bias in empathic neural responses in individualistic cultures that are characterized with independent self-construals compared with collectivistic cultures that are dominated by interdependent self-construals (Mathur *et al.*, 2010; Cheon *et al.*, 2011; Zuo and Han, 2013). The MCC and left anterior insula (AI) activities are associated with both affective and cognitive processes of empathy (Fan *et al.*, 2011). The in-group bias in the left AI activity also predicts individual differences in helping in-group members (Hein *et al.*, 2010). The right temporoparietal junction (TPJ) and left SMA are, respectively, associated with mental state inference (Cheon *et al.*, 2011; Sheng *et al.*, 2014) and motor motivation (Fan *et al.*, 2011) during empathy. Given the functional roles of these brain regions in empathy, our findings further suggested that self-construals may influence parochial altruism in collectivistic and individualistic societies (Gelfand *et al.*, 2012) by modulating in-group bias in empathy.

The neural activity in all the ROIs showed a similar pattern that, relative to interdependent self-construal priming, independent self-construal priming tended to reduce the neural activity to racial in-group members' pain but to increase the neural activity to racial out-group members' pain, though the cross-priming comparison only confirmed a significant effect on the MCC activity to racial out-group members' pain. Therefore, priming independent *vs* interdependent self-construals may produce opposite effects on neural responses to racial in-group and out-group members' suffering. One possible account is that independent self-construal priming shifted our participants' cultural identity toward Western cultures and Caucasian models were thus treated as in-group members, which in turn enhanced neural responses to their suffering. Alternatively, priming independent self-construals may weaken race-based group affiliation between Chinese participants and Chinese models shown in video clips. In such a context, participants became more sensitive to other-race individuals' pain that may imply a danger signal but less sensitive to own-race individuals' pain that implicates requirement for help. Although these possible accounts should to be verified in future research, the findings of differential neural responses to racial in-group and out-group individuals raise an interesting issue, i.e. does priming independent compared with interdependent self-construals undermine behavioral parochial altruism?

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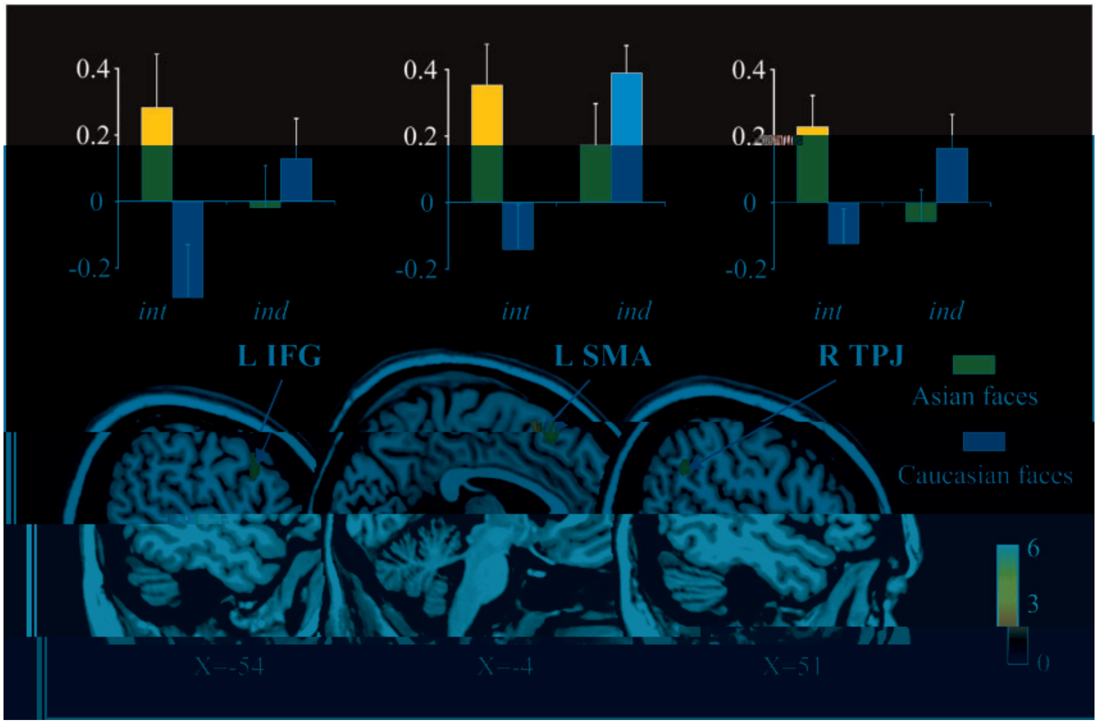

Fig. 3 Illustration of activated brain regions in the whole-brain interaction analysis. Contrast values to painful *vs* non-painful stimuli in each brain region are shown in the upper panel. int, interdependent self-construal priming; ind, independent self-construal priming.

Chronic self-construals measured from participants in this study did not correlate with patterns of their racial in-group bias in neural activity. One possible account is that the chronic interdependent self-construal style did not vary significantly across our participants who were all educated in China. Another possibility is that empathic neural responses were measured in the current experiment after participants had been primed with independent or interdependent self-construals. The priming procedure may reduce the effect of chronic self-construals.

Our finding that independent self-construal priming reduced the racial bias in neural responses to perceived pain in others in the MCC/SMA and insula does not necessarily indicate the absence of racial in-group bias in individuals from Western cultures. Behavioral studies have reported evidence for racial in-group favoritism in Westerners (Johnson *et al.*, 2002; Drwecki *et al.*, 2011). Brain imaging studies also reported evidence for racial in-group bias in neural responses to perceived pain in others in Westerners (e.g. Xu *et al.*, 2009; Avenanti *et al.*, 2010). The findings of this study raised an interesting question, i.e. does interdependent self-construal priming increase Westerners' racial in-group bias in empathic neural responses to others' suffering? To address this issue would help us to understand the opposite effects of independent/interdependent self-construal priming on racial in-group bias in empathy. Previous studies have revealed that multiple factors influence neural activity in response to others' suffering, including attention and stimulus reality (Gu and Han, 2007; Fan and Han, 2008), ones' expertise (Cheng *et al.*, 2007), perceived fairness (Singer *et al.*, 2006), emotional contexts (Han *et al.*, 2009) and mortality salience (Luo *et al.*, 2014), and personal experiences (Zuo and Han, 2013). Therefore, how the human brain responds to perceived pain in others depends on both social contexts/experiences and perceivers' psychological traits, which in turn produces strong impact on human social behaviors.

In conclusion, our neuroimaging results provide new insight into the causal relationship between self-construals and racial in-group bias in empathy. Our findings that self-construals modulate cognitive/affective processes involved in empathy for in-group and out-group members' emotional states suggest a mechanism of cultural differences in parochial altruism (Gelfand *et al.*, 2012).

Conflict of Interest

None declared.

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