Manipulations of cognitive strategies and intergroup relationships reduce the racial bias in empathic neural responses

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Social relationships affect empathy in humans such that empathic neural responses to perceived pain were stronger to racial in-group members than to racial out-group members. Why does the racial bias in empathy (RBE) occur and how can we reduce it? We hypothesized that perceiving an other-race person as a symbol of a racial group, rather than as an individual, decreases references to his/her personal situation and weakens empathy for that person. This hypothesis predicts that individuating other-race persons by increasing attention to each individual's feelings or enclosing other-race individuals within one's own social group can reduce the RBE by increasing empathic neural responses to other-race individuals. In Experiment 1, we recorded event related brain potentials from Chinese adults as they made race judgments on Asian and Caucasian faces with pain or neutral expressions. We identi ed the RBE by showing that, relative to neutral expressions, pain expressions increased neural responses at 128 188 ms after stimulus onset over the frontal/central brain regions, and this effect was evident for same-race faces but not for other-race faces. Experiments 2 and 3 found that paying attention to observed individual's feelings of pain and including other-race individuals in one's own team for competitions respectively eliminated the RBE by increasing neural responses to pain expressions in other-race faces. Our results indicate that the RBE is not inevitable and that manipulations of both cognitive strategies and intergroup relationships can decrease RBE-related brain activity.

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Introduction

How sel sh soever man may be supposed, there are evidently someInc.Johnson et al., 2002), and pro-white empathy biases to patients' pain expressions predicted pro-white pain treatment biases (Drwecki et al., 2011). These ndings indicate a racial bias in empathy (RBE) that may lead to noteworthy social consequences.

What are the neural mechanisms underlying the RBE in humans? Recent brain imaging studies of empathy for pain have associated the RBE with speci c patterns of brain activity (e.g., Avenanti et al., 2010; Mathur et al., 2010; Xu et al., 2009). Early brain imaging research aimed to identify the neural activity related to the key components of empathy, i.e., understanding and sharing of others' feelings (Decety and Jackson, 2004; Batson, 2009). Functional magnetic resonance imaging (fMRI) studies showed that perception of others' body parts in painful versus non-painful situations or perception of pain versus neutral expressions activated the affective node of the pain matrix, including the anterior cingulate cortex (ACC) and anterior insula (Gu and Han, 2007; Gu et al., 2010; Han et al., 2009; Jackson et al., 2005; Saarela et al., 2007). Moreover, ACC activity to perceived pain was correlated with subjective feelings of others' pain intensity (e.g., Jackson et al., 2005) or individual differences in empathy as assessed by questionnaire measurements (Singer et al., 2004). Event-related potential (ERP) studies also found that perceived body parts in painful versus non-painful situations induced positive activity over the frontal/central area around 150 ms after stimulus onset (Decety et al., 2010; Fan and Han, 2008; Han et al., 2008; Li and Han, 2010). In addition, the increased activity in the same time window was correlated with subjective feelings of both perceived pain intensity and self-unpleasantness induced by the perceived pain (Fan and Han, 2008; Li and Han, 2010). The fMRI and ERP ndings indicate that the brain activity can differentiate between painful and non-painful internal mental states of others. This, together with subjective reports, provides evidence that the human brain is able to understand others' feelings. Moreover, the brain activity elicited by perceived pain of a target person is overlapped with the brain activity underlying the rst hand pain experience and is associated with an observer's own distress at witnessing another person's suffering. These suggest that an observer feels the same emotion that a target person feels or shares others' feelings.

Interestingly, recent research showed that empathy-related brain activity was modulated by racial intergroup relationships between an

Experiment 1 in the current study examined the time course of neural responses to pain versus neutral expressions and whether differential neural responses to pain versus neutral expressions were modulated by racial group relationship between observers and perceived targets. Participants in Experiment 1 were also asked to perform race judgments on a set of inverted Asian and Caucasian faces in order to control for effects produced by perceptual feature differences between Asian and Caucasian faces though the luminance level was matched for the two sets of stimuli.

Most importantly, Experiments 2 and 3 investigated whether enhanced attention to another individual's feelings of pain or including other-race individuals in one's own team during a competitive situation can eliminate RBE-related brain activity. Experiment 2 asked participants to perform both race judgments and pain judgments on racial in-group and out-group faces. If enhanced attention to an individual's feelings increases empathy for others' pain, we would expect that, relative to race judgments, pain judgments increase empathy-related neural activity to racial out-group faces and lead to reduction of the RBE. Experiment 3 manipulated intergroup relationships between participants and perceived faces. Participants were assigned to the blue or green team for a competitive game and both the fellow-team and opponent-team consisted of half Asians and half Caucasians. ERPs were recorded during race judgments on faces of fellow-team and opponent-team members. If in-group relationships increase empathy for other-race individuals of the fellow-team, we would expect increased empathy-related neural activity to Caucasian faces of the fellow-team and this may also lead to reduction of the RBE for Caucasian faces of the fellow-team compared to Caucasian faces of the opponent-team.

Materials and methods

Participants

Forty-eight Chinese collegelants werenrolled in thela as paid volunteers. There were 1(la)6 participants (half males) in each experiment (man age ± SD = 2(la)3.la ± 1.la year in Experiment 1; 2(la)1.la ± 1.88 year in Experiment 2; 2(la)1.la ± 1.08 year in Experiment 3). All were right-handed, had normal or corrected-to-normal vision, and response buttons and judgments was also counterbalanced across different blocks of trials.

After the EEG session, participants were asked to rate the intensity of the pain portrayed by each face and their own subjective feelings of unpleasantness induced by each face on a 9 point Likert scale (1 = not at all painful or unpleasant, 9 = extremely painful or unpleasant). To assess explicit subjective attitudes towards Asian and Caucasian faces, participants were asked to rate the likability of each face on a 9-point Likert scale (1 = not at all, 9 = extremely strong). Participants also completed the Interpersonal Reactivity Index (IRI) as a measure of empathy ability (Davis, 1983). The IRI is a questionnaire measure that contains four subscales including the Perspective Taking subscale that assesses the •tendency to spontaneously adopt the psychological point of view of others in everyday life Ž, the Fantasy subscale that estimates the •tendency to imaginatively transpose oneself into ctional situations Ž, the Empathic Concern subscale that assesses the •tendency to experience feelings of sympathy and compassion for unfortunate other Ž, and the Personal Distress subscale that assesses •tendency to experience distress and discomfort in response to extreme distress in others Ž (

performances and ERPs were subjected to ANOVAs with Expression (pain vs. neutral) and models' Race (Asian vs. Caucasian) as within-subjects variables in Experiments 1 and 2. Another within-subjects variable was also included in Experiment 1 (Orientation (upright vs.

scores of pain intensity and self-unpleasantness and the IRI scores. The empathic neural responses in the P2 time window were positively correlated with subjective ratings of self-unpleasantness ($r = 0.506..0.627$, $P < 0.05$) and subjective ratings of the empathic concern subscale ($r = 0.543..0.624$, $Ps < 0.05$, Fig. 5). However, the P2 RBE effect did not correlate with individual's explicit or implicit attitude biases ($r = -0.315..0.031$, $Ps > 0.1$).

Experiment 2: cognitive strategy and racial bias in empathy

Experiment 2 recorded ERPs during race judgments (Asian vs. Caucasian) and pain judgments (pain vs. neutral expression) in separate blocks of trials on Asian and Caucasian faces with pain and neutral expressions. Behavioral performances are shown in Table 4. Response accuracies were high (>91%). ANOVAs of RTs showed signi

1.28..3.37, Ps > 0.05). ANOVAS of the P3 amplitude only showed a significant main effect of Race (F(1,15) = 6.26 ..13.05, Psb 0.05). Relative to Asian faces, Caucasian faces elicited a positive shift of the ERPs at 400..700 ms.

Because actively contemplating others' psychological experiences through perspective taking attenuates automatic expressions of racial bias (Todd et al., 2011), we tested if attention manipulation was more efficient at reducing the RBE in those with better perspective-taking abilities. Indeed, we found that the increased neural responses to pain vs. neutral expressions of Caucasian faces as a function of task (i.e., P2 amplitude to pain vs. neutral expressions during pain judgments

Response accuracies of race judgments were high during EEG recordings (>93%). ANOVAs of RT showed a signi cant main effect of

Fig. 7E). Relative to neutral expressions, pain expressions of fellow team faces elicited a larger P2 amplitude at the frontal/central electrodes (F(1,15) = 18.48 ..31.31, Psb 0.001, Fig. 7C). The P2 amplitude was larger to Caucasian than to Asian faces (F(1,15) = 28.77 ..35.27, Psb 0.001). However, the interaction of Race × Expression was not signi cant (F(1,15) = 0.04 ..2.68, Ps > 0.1, Fig. 7E), suggesting comparable empathic neural responses to Asian and Caucasian faces of the fellow team members. Separate analyses of the P2 amplitude also showed a signi cant interaction of Expression × Team for Caucasian faces (F(1,15) = 8.86 ..13.52, Psb 0.01) but not to Asian faces (F(1,15) = 0.09 … 0.55, Ps > 0.05). Thus the manipulation of intergroup relationships increased empathic neural responses to other-race faces but did not affect empathic neural responses to same-race faces. The sLORETA analysis suggested that the neural activity in the P2 time window that differentiated between pain and neutral expressions of Asian faces from the opponent team (peak MNI coordinates: 5, 35, 25; Fig. 7B) or of both Asian and Caucasian faces from the fellow team (peak MNI coordinates: − 10, 40, 30; Fig. 7D) had potential sources in the dorsal ACC and supplementary motor cortex.

ANOVAs of the N2 amplitude also showed a signi cant three-way interaction of Race × Expression × Team at 200 ..300 ms (F(1,15) = 5.38..6.13, Psb 0.05). Separate analyses revealed that pain expressions of opponent team faces elicited a positive shift of the N2 amplitudes at 200..300 ms over the frontal/central area compared to neutral expressions (F(1,15) = 4.60 ..5.50, Psb 0.05, Fig. 7A, see Supplementary Table S7 for N2 amplitudes). Moreover, there was a signi cant interaction of Race × Expression (F(1,15) = 5.03 ..5.89, Psb 0.05) as the positive shift of the N2 amplitude was evident for Asian faces (F(1,15) = 5.81..16.13, Psb 0.05) but not for Caucasian faces (F(1.15) = 0.01 ..1.21, Ps > 0.1). Relative to neutral expressions, pain expressions of fellow team faces elicited a positive shift of the N2 (F(1,15) = 4.73 ..9.33, Psb 0.05, Fig. 7C). However, this effect did not differ between Asian and Caucasian faces (F(1,15) = 0.96…3.05, Ps > 0.1). Separate analyses of the N2 amplitude con rmed a signi cant interaction of Expression × Team for Caucasian faces (F(1,15) = 5.04 ..6.07, Psb 0.05) but not for Asian faces (F(1,15) = 0.97 ..2.56, Ps > 0.1). Similarly, the manipulation of intergroup relationships increased empathic neural responses to other-race faces

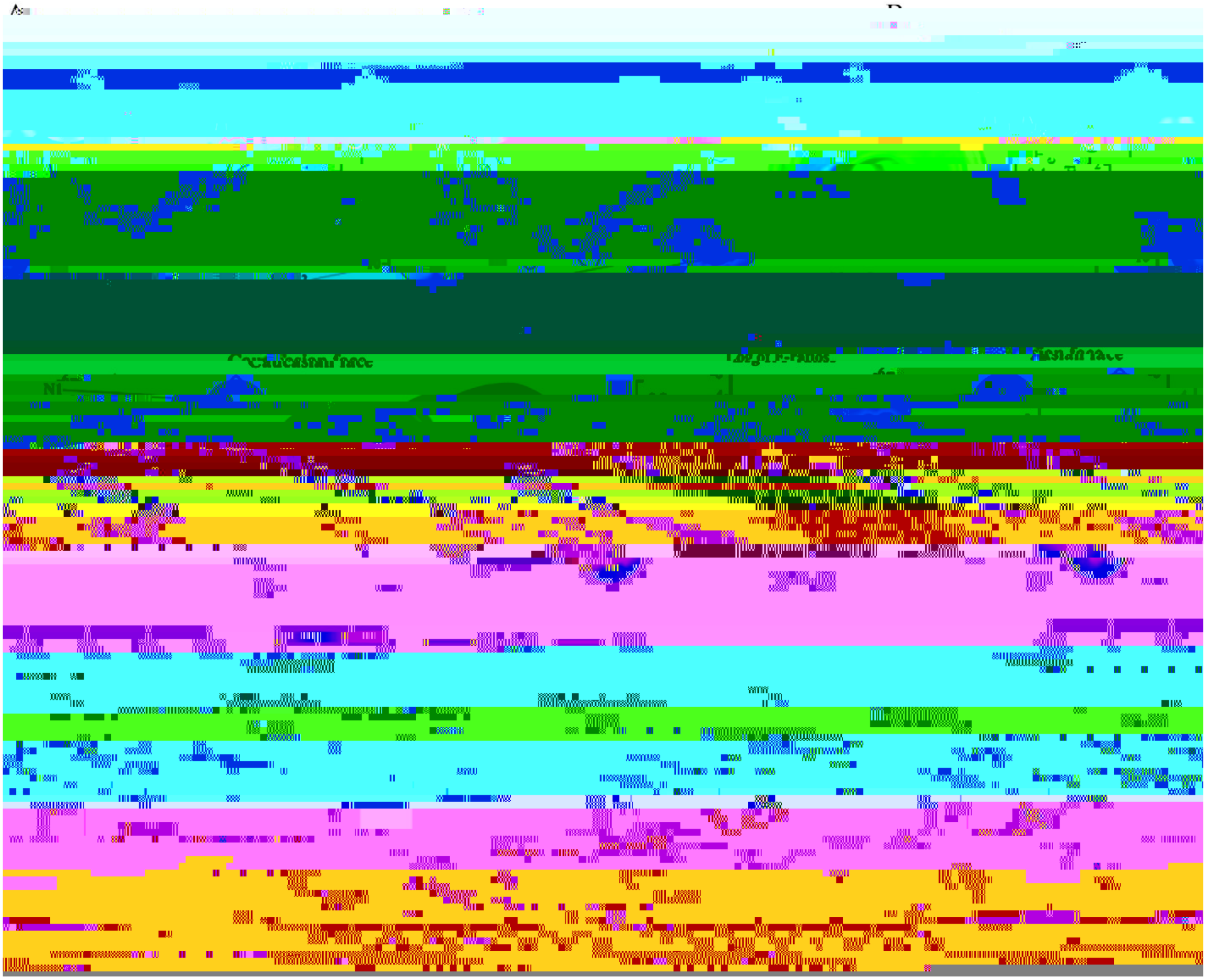

Fig. 7. ERP results in Experiment 3. (A) Grand-averaged ERPs to opponent team faces recorded at FCz. (B) Source estimation of the neural activity that differentiated between pain and neutral expressions of Asian faces from the opponent team faces at 156 ms. (C) Grand-averaged ERPs to fellow team faces recorded at FCz. (D) Source estimation of the neural activity that differentiated between pain and neutral expressions of fellow team faces at 148 ms. (E) The differential P2 amplitudes at 128..188 ms to pain vs. neutral expressions at FCz. Error bars are standard errors. (F) The correlation between differential RTs (mean RTs to fellow team faces minus mean RTs to opponent team faces) and the differential empathic responses in the P2 time window at FCz ((pain-neutral)$_{\text{fellow team}}$ minus (pain-neutral)$_{\text{opponent team}}$

2008). It is well known that pain perception is modulated by attention such that focusing on pain enhances pain perception (see Villemure and Bushnell, 2002 for a review). Attention-related modulations of nociceptive responses have been observed in both sensory and limbic cortical areas, including SI, SII, ACC and insular cortices (Bushnell et al., 1999; Petrovic et al., 2000; Peyron et al., 1999). However, the effect of attention on empathic neural responses to pain expression remains unclear. Several fMRI studies similarly observed activation in the affect nodes of the pain matrix (e.g., the ACC) regardless of task demand. Attentively viewing video clips (Botvinick et al., 2005; Lamm et al., 2007) or photographs (Saarela et al., 2007) that showed pain vs. neutral expressions increased the activity in the ACC and bilateral insula. Viewing video clips of pain expression similarly activated the ACC even though participants' attention was distracted from pain expression by being asked to perform gender discrimination of painful faces (Simon et al., 2006). Our ERP results suggest that, similar to rst-person pain perception, empathy for others' pain expression can be enhanced by attention in a social context where racial in-group and out-group members are present simultaneously and such effect occurs mainly to the racial out-group members.

Experiment 3 showed that changing the intergroup relationships between observers and targets by enclosing other-race models into one's own team eliminated RBE-related brain activity due to increases of empathic neural responses to other-race faces. By assigning participants to novel groups and providing equal exposure to fellow and opponent team faces, Experiment 3 minimized the roles of familiarity and novelty as causal variables in the modulation of RBE-related neural activity. Moreover, decreasing RBE-related brain activity via manipulations of intergroup relationships did not require explicit attention to team membership since race judgments rather than team membership judgments were conducted in Experiment 3.

Together, our ndings support the proposal that manipulations of cognitive strategies and intergroup relationships may increase references to an individual's personal situation when perceiving painful expressions in other-race faces and, consequently, lead to increased empathic neural responses to other-race individuals. Our ndings demonstrate that the RBE is not inevitable and that manipulations of cognitive strategies and intergroup relationships can reduce RBE-related brain activity effectively.

The results of Experiment 3 indicate that, while the novel in-group favoritism increased empathic neural responses to other-race faces, the novel out-group derogation did not reduce empathic responses to same-race faces as the P2 effect to same-race faces was comparable for the fellow and opponent teams. Prior fMRI research also showed that fusiform and amygdala activity increased when observing neutral faces of one's own mixed-race (black and white) team compared to observing neutral faces of a mixed-race opponent team in white participants (Van Bavel et al., 2008), suggesting enhanced processing of in-group members due to greater individuation (Rhodes et al., 2004) of in-group relative to out-group members. It appears that the temporary group relationships built through team assignment can overcome the effect of racial-group relationships on the fusiform and amygdala activity to other-race faces (Golby et al., 2001; Lieberman et al., 2005). Our ERP results suggest that the temporary group manipulation did not in uence empathic neural responses to same-race faces. Thus the affective processing of same-race faces, which may occur early and automatically during face processing (Ito and Bartholow, 2009

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.neuroimage.2012.04.028 .

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