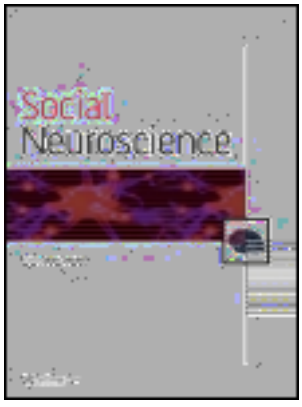

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Distinct effects of self-construal priming on empathic neural responses in Chinese and Westerners

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Distinct effects of self-construal priming on empathic neural responses in Chinese and Westerners

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The present study investigated whether and how self-construal priming influences empathic neural responses to others' emotional states. We recorded event-related brain potentials to stimuli depicting the hands of unknown others experiencing painful or non-painful events from Chinese and Western participants after they had been primed in three conditions (independent self-construal priming, interdependent self-construal priming, and a control condition). Stimuli depicting painful events (as opposed to non-painful ones) elicited a positive shift of the fronto-central activity at 232–332 ms and of the central-parietal activity at 440–740 ms in the control condition. Moreover, neural responses to stimuli depicting painful (vs. non-painful) situations at 232–332 ms were decreased by interdependent self-construal priming among Chinese and by independent self-construal priming among Westerners. Our findings suggest that self-construal priming modulates sensitivity to perceived pain in unknown others and that this effect varies with culture.

Keywords: Culture; Empathy; ERP; Self-construal; Pain.

Self-construal refers to how individuals define and make meaning of the self and how one does so has a number of psychological and behavioral consequences (Cross, Hardin, & Gercek-Swing, 2011). It has been well documented that self-construals vary across cultures such that the self is viewed as bounded and autonomous (an independent self-construal) in Western cultures but is seen as interconnected and overlapping with close others (an interdependent self-construal) in East Asian cultures (Markus & Kitayama, 1991). Different self-construals tend to covary with a suite of cognitive and affective tendencies (Varnum, Grossmann, Kitayama, & Nisbett, 2010), and making different self-construals salient leads to changes in these psychological processes (Oyserman & Lee, 2008) and in neural responses (Han & Northoff, 2008; Han et al., 2013).

For example, neuroimaging studies have shown evidence that self-construal priming (a procedure that asks participants to read essays) with independent (e.g., "I", "mine") or interdependent pronouns (e.g., "we", "ours"), in order to shift their self-construals toward independence or interdependence (Gardner, Gabriel, & Lee, 1999; Oyserman & Lee, 2008), affects neural substrates underlying self-related processes. Wang et al. recorded event-related potentials (ERPs) to painful and non-painful electrical stimulations from adults after self-construal priming (Wang, Ma, & Han, in press). They found that independent (as opposed to interdependent) self-construal priming increased an early somatosensory activity over the frontal/central region in response to painful stimulation applied to participants' hands. Neural responses to images of one's own face are also modulated by

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self-construal priming such that independent (as opposed to interdependent) self-construal priming increases the right frontal activity during perception of one's own face (Sui & Han, 2007).

There is also evidence suggesting that self-construal priming affects neurocognitive processes related to others. For example, a recent transcranial magnetic stimulation (TMS) study found that interdependent self-construal primes superimposed throughout videos depicting others' hand movements (e.g., squeezing a rubber ball) increased motor-evoked potentials recorded from a participant's hand relative to a no-priming baseline condition (Obhi, Hogeveen, & Pascual-Leone, 2011), suggesting self-construal-induced changes in the motor system that may reflect self-construal effects on behavioral mimicry in social settings. In another study, Harada et al. found that the dorsal medial prefrontal cortex showed increased activity during implicit evaluation of information related to one's father (vs. a stranger) when bicultural (i.e., Asian-American) individuals were primed with independent (but not interdependent) self-construals (Harada, Li, & Chiao, 2010). Further, a recent study with Chinese young adults found that priming an interdependent self-construal increased activity in the bilateral ventral striatum in response to winning money for a friend (Varnum, Shi, Chen, Qiu, & Han, in press). Taken together, these findings suggest that self-construal priming modulates neural activity involved in cognitive and affective processing of information about the self and close others.

The present study examined whether self-construal priming modulates brain activity underlying the processing of strangers' emotional states. Specifically, we investigated the effect of self-construal priming on the neural activity elicited by perceived pain in others. We recorded ERPs from healthy adults when they perceived painful versus. non-painful stimuli applied to hands of unknown others. Recent ERP studies have shown that perception of painful versus non-painful stimuli applied to others' body parts (e.g., hands) induces positive shift of ERP amplitudes in a large time window (from 140 to 660 ms after stimulus onset) over the frontal/central/parietal regions (Decety, Yang, & Cheng, 2010; Fan & Han, 2008; Han, Fan, & Mao, 2008; Li & Han, 2010). Viewing others' pain versus neutral expressions also elicits increased positivity at 128–188 ms poststimulus over the frontal regions (Sheng & Han, 2012; Sheng, Liu, Zhou, Zhou, & Han, 2013). In addition, the amplitudes of these neural responses are correlated with subjective reports of the degree of others' pain and with subjective reports of one's own discomfort (Fan & Han, 2008; Li & Han, 2010; Sheng & Han, 2012). Thus, these neural responses are associated with understanding and sharing others' pain (or empathy for others' pain). We were interested in whether self-construal priming that temporarily highlights different self-construals (e.g., independence or interdependence) modulates differential ERP amplitudes elicited by painful versus non-painful stimuli.

In the current study, we recruited both Chinese and Westerners for two reasons. First, it is well documented that interdependent self-construals are predominant in China (de Greck et al., 2012; Li, Zhang, Bhatt, & Yum, 2006; Ma et al., in press), whereas independent self-construals are predominant in Western cultures (Thomsen, Sidanius, & Fiske, 2007, see Markus & Kitayama, 1991; Oyserman, Coon, & Kemmelmeier, 2002 for review). Second, in a recent ERP study we found that priming interdependent self-construals decreased a frontal/central activity to one's own face for British participants, whereas priming independent self-construals suppressed this activity to a friend's face for Chinese participants (Sui, Hong, Liu, Humphreys, & Han, 2013). This finding suggests that the effects of self-construal priming on neural responses may be constrained by participants' long-term cultural experiences. Thus, we were interested in whether self-construal priming produces similar effects on empathic neural responses in individuals from different cultures. As the previous research has shown that empathic neural responses in male and female participants are differentially sensitive to attitude toward others and task modulations (Han et al., 2008; Singer et al., 2006), the current work only tested females in order to exclude potential effects of gender differences in empathic neural responses.

METHODS

Participants

Eighteen Chinese females (aged between 19 and 26 years, mean = 20.50, SD = 1.46, all native Chinese speakers and right-handed) and eighteen Westerner females (aged between 19 and 31 years, mean = 21.83, SD = 3.17, 16 native English speakers, 1 native German speaker, 1 native Spanish speaker, 16 right-handed) participated in the study as paid volunteers. All participants were undergraduate or graduate students at the time of testing. Chinese participants had not spent any time outside China and Western participants had been in China for less than 1 month. Chinese participants were proficient in English and Western participants had not studied Chinese at the time of testing. All

participants had normal or corrected-to-normal vision and were not color-blind. Informed consent was obtained prior to the study. This study was approved by a local ethic committee at the Department of Psychology, Peking University.

Self-construal priming

The materials for self-construal priming consisted of six short essays that described trips to the countryside and were used in our prior studies (Lin & Han, 2009; Sui & Han, 2007; Sui et al., 2013). Each essay consisted of 300–350 words and was presented in Chinese for Chinese participants and in English for Western participants. The priming materials contained independent pronouns (e.g., "I", "mine") during independent self-construal priming and interdependent pronouns (e.g., "we", "ours") during interdependent self-construal priming. The materials used for the control priming did not contain either type of pronoun. After reading each essay, participants had to indicate the number of occurrences of independent (or interdependent) pronouns or specific nouns (e.g., "lake," "park").

Visual stimuli

Visual stimuli consisted of 40 color pictures showing hands in painful situations and 40 color pictures of hands in non-painful situations (illustrated in Figure 1), similar to those used in our previous work (Fan & Han, 2008; Gu & Han, 2007). The pictures were shot from the first-person perspective and described accidents that may happen in everyday life. Painful stimuli included situations such as a hand trapped in a door or cut by scissors. The stimuli

RESULTS

Behavioral performance

Both behavioral and ERP data were subject to a 3 × 2 × 2 repeated-measures analyses of variance (ANOVA) with Priming (independent, interdependent, or control) × Pain (Painful vs. Non-painful) as within-subjects variables and Group (Westerners vs. Chinese) as a between-subjects variable. The ANOVA of reaction times (RTs) only showed a significant main effect of Pain, as participants responded faster to painful than to non-painful stimuli, $F(1, 34) = 10.343$, $p < .005$. Analysis of response accuracy data did not reveal any significant effects, ps > .1 (Table 1). There were no group differences on IRI subscales with the exception of personal distress. Chinese reported greater personal distress ratings compared to Westerners, $t(1,34) = –3.651$, $p < .001$ (Table 2).

ERP results

Grand-averaged ERPs to painful and non-painful stimuli are illustrated in Figure 2. ANOVAs of the mean ERP amplitudes at 232–332 ms, which covered both the N2 and N320 components, showed a significant main effect of Pain at fronto-central electrodes, (Fs(1,34) = 7.28–24.36, ps < .01), such that painful stimuli induced a positive shift of ERP amplitude relative to non-painful stimuli. Importantly, there were significant three-way—

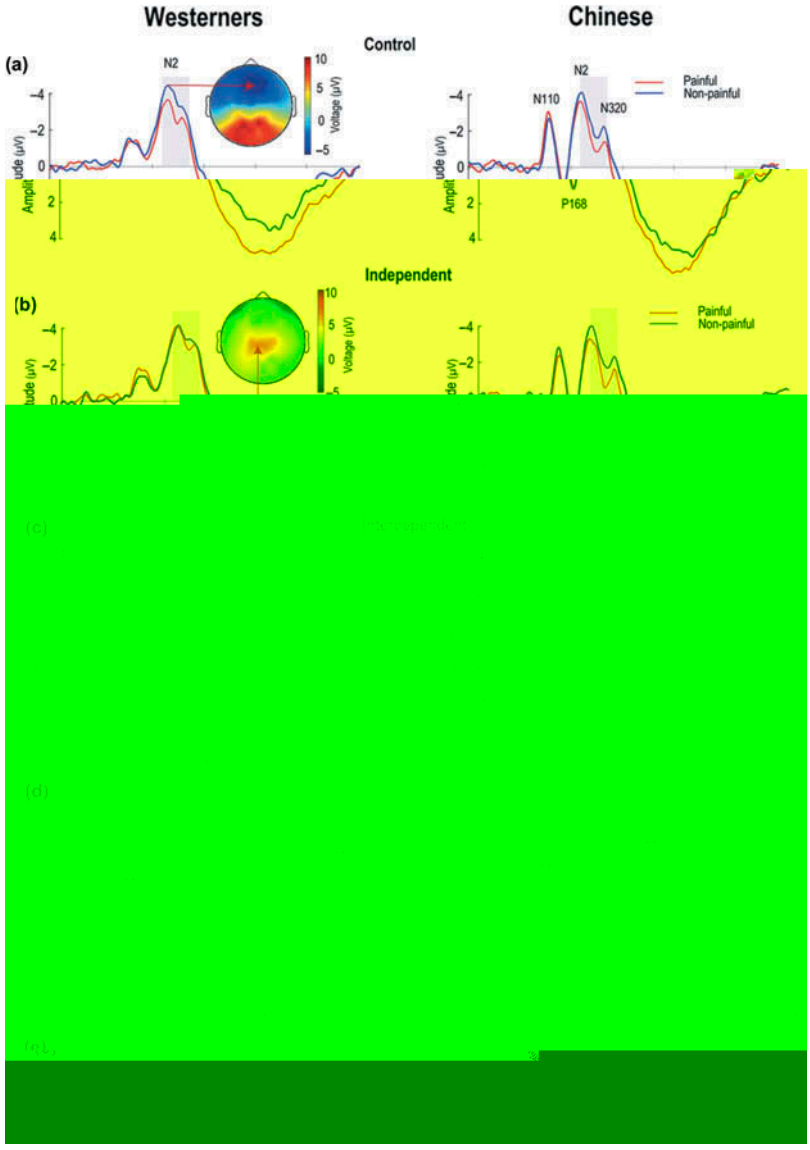

Figure 2. Illustration of ERP results in the current study. ERPs to painful and non-painful stimuli recorded at electrode F4 are illustrated in (a) the control priming condition, (b) independent self-construal priming condition, and (c) interdependent self-construal priming condition. The grey bars indicate the time window in which the ANOVA of mean ERP amplitudes showed significant 3-way interactions. (d) The mean amplitudes and standard deviations of difference waves to painful vs. non-painful stimuli at 232–332 ms post-stimulus at electrode F4 are illustrated in different priming conditions. (e) The voltage topographies illustrate the scalp distributions of the difference wave to painful vs. non-painful stimuli at 232–332 ms poststimulus in each priming condition. ** $p < .01$.

There was a main effect of Pain on mean P3 amplitudes at 440–740 ms (Fs(1,34) = 20.87–37.11, ps < .001). However, there was no significant interaction between Group, Priming, and Pain (ps > .1). Thus, self-construal priming did not significantly affect empathic neural responses in this time window.

Finally, to examine whether an individual's trait empathy can predict the effect of self-construal priming on empathic neural responses, we calculated the difference in neural responses at 232–332 ms to images of others' hands receiving painful versus non-painful stimuli between independent (or interdependent) self-construal priming and the control conditions across all participants. We then examined the correlation between IRI scores and the differential ERP amplitudes in this time window. However, correlations were not significant (ps > .5), suggesting that the effect of self-construal priming on empathic neural responses does not vary significantly as a function of individuals' trait empathy.

DISCUSSION

The current work examined the effect of self-construal priming on empathic neural responses to others' pain. Our ERP results in the control condition showed that painful stimuli elicited a positive shift in neural activity over the fronto-central regions in an early time window and over the parietal region in a later time window in both Chinese and Westerners. These results replicate previous findings (Decety et al., 2010; Fan & Han, 2008; Han et al., 2008; Li &

participants, the relationship between chronic self-construal and empathy remains a matter for further investigation.

One possible alternative interpretation of our results is that different routes to reduced empathy are more easily activated in different cultural contexts. Previous research suggests that while some degree of self–other overlap is necessary for empathy to occur, a strong sense of self–other overlap may actually

recorded ERPs in response to others' hands, it remains unknown whether self-construal priming modulates neural responses to others' facial expressions of pain in a way similar to what we observed here. These questions can be clarified in future research.

In sum, our findings shed new light on the relationship between self-construals and empathy for pain. Together with previous research (e.g., Sui et al., 2013), our findings suggest that self-construal priming may produce significant effects on neurocognitive processes of the self and others, and these effects may vary across cultures (e.g., Chinese and Westerners). Future research may investigate what effects such priming might have on empathy for close others, given that the previous study of Chinese showed differential neural activity in response to witnessing a friend or a stranger experiencing social pain (Meyer et al., 2013). It would also be interesting to examine the effect of self-construal priming on empathy for other emotions since de Greck et al. (2012) have found that culture influences neural correlates of empathy for anger.

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