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Research paper

Self-construal differences in neural responses to negative social cues

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ABSTRACT

Cultures differ substantially in representations of the self. Whereas individualistic cultural groups emphasize an independent self, reflected in processing biases towards centralized salient objects, collectivistic cultures are oriented towards an interdependent self, attending to contextual associations between visual cues. It is unknown how these perceptual biases may affect brain activity in response to negative social cues. Moreover, while some studies have shown that individual differences in self-construal moderate cultural group comparisons, few have examined self-construal differences separate to culture. To investigate these issues, a final sample of a group of healthy participants high in trait levels of collectivistic self-construal (n = 16) and individualistic self-construal (n = 19), regardless of cultural background, completed a negative social cue evaluation task designed to engage face/object vs context-specific neural processes whilst undergoing fMRI scanning. Between-group analyses revealed that the collectivistic group exclusively engaged the parahippocampal gyrus (parahippocampal place area) – a region critical to contextual integration – during negative face processing – suggesting compensatory activations when contextual information was missing. The collectivist group also displayed enhanced negative context dependent brain activity involving the left superior occipital gyrus/cuneus and right anterior insula. By contrast, the individualistic group did not engage object or localized face processing regions as predicted, but rather demonstrated heightened appraisal and self-referential activations in medial prefrontal and temporoparietal regions to negative contexts – again suggesting compensatory processes when focal cues were absent. While individualists also appeared more sensitive to negative faces in the scenes, activating the right middle cingulate gyrus, dorsal prefrontal and parietal activations, this activity was observed relative to the scrambled baseline, and given that prefrontal and occipital regions were also engaged to neutral stimuli, may suggest an individualistic pattern to processing all social cues more generally. These findings suggest that individual differences in self-construal may be an important organizing framework facilitating perceptual processes to emotionally salient social cues, beyond the boundary of cultural group comparisons.

1. Introduction

Emerging cultural models are challenging the traditional notion that emotion is governed by universal neural and psychological processes: rather, these models suggest that cultural factors play a significant role in the emotional lives of individuals (Engelmann and Pogosyan, 2013; Ford and Mauss, 2015; Mesquita, 2001; Rogers, Schröder, & von Sheve, 2014). Recent neuroimaging evidence demonstrates that cultural factors modulate the neural substrates of perception, attention, memory and social processing (Han and Ma, 2014; Han et al., 2013). Less is known about how culture might influence the engagement of the neural systems underpinning negative emotion or threat-related perception. It is well established that negatively valenced or threat-related cues are processed with priority in order to aid survival, modulating attentional and perceptual neural resources (LeDoux, 2012; Liddell et al., 2005; Vuilleumier, 2005; Williams, Palmer, Liddell, Song, & Gordon, 2006), yet it is unknown the extent to which cultural factors guide these processes (Han et al., 2013). Indeed, the current evidence-base of the emotional brain in humans draws upon research conducted mostly in Western-based cultural contexts (e.g. North America, Western Europe, Australia), relying on participant cohorts that adhere to an individualistic world-view. Few studies have examined how emotional processing systems are engaged amongst groups with collectivistic value systems. Given the centrality of threat processing models to the

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understanding of the neural substrates of anxiety and fear circuitry disorders (LeDoux, 2014), and the high prevalence of these disorders cross-culturally (Hofmann and Hinton, 2014), it is essential to investigate whether cultural constructs shape the negative social processing in the brain.

Cultures fundamentally differ in regards to representation of the self in relation to others – varying along an individualism-collectivism dimension of self-construal (Cross, Hardin, & Gercek-Swing, 2011; Markus and Kitayama, 2010; Oyserman, Coon, & Kemmelmeier, 2002). Individualistic self-construal is associated with an independent self valuing autonomy and achievement, reliance on an analytical cognitive style, (Markus and Kitayama, 1991), and is dominant in Western-based cultural groups; whereas collectivistic self-construal emphasizes an interdependent self, holistic thinking, social harmony and relatedness, and is prevalent in East Asian and other social-based cultural groups (Cross et al., 2011; Markus and Kitayama, 2010). Cultural models suggest that self-construal as represented at the population level is a key determinant of how culture as a whole shapes brain function to influence cognition, behavior, and emotion (Chiao and Immordino-Yang, 2013; Han and Humphreys, 2016; Han and Northoff, 2008; Han et al., 2013; Kitayama and Uskul, 2011). However, self-construal can also vary substantially at the individual level within cultural groups (Oyserman et al., 2002). Indeed, individual differences in self-construal have been found to moderate the influence of cultural group on brain activity during attention, cognitive and self-referential tasks (for a summary see Han and Humphreys, 2016). However, these studies appear to neglect the possibility that individual differences in self-construal may be the central factor driving brain function, beyond the traditional boundaries of cultural background. In this study, we consider the specific influence of individualistic vs collectivistic self-construal measured at the individual level on brain activity during a specially-designed negative social cue processing task. Since few studies have directly examined the influence of self-construal outside of cultural group on brain function (Han and Humphreys, 2016), we have relied on the cultural neuroscience literature to inform our hypotheses.

Cultural groups show different psychological and neural correlates of visual perception and attention (Goh and Park, 2009; Han and Northoff, 2008; Han et al., 2013), with some studies also reporting the mediating role of individual differences in self-construal (e.g. Chiao et al., 2009; Hedden, Ketay, Aron, Markus, & Gabrieli, 2008; Ma et al., 2014). Studies have shown that individualistic cultural groups are relatively biased towards attending focal objects or local features of stimuli in visual scenes (Chua, Boland, & Nisbett, 2005; Nisbett and Masuda, 2003). These patterns are consistent with an independent self-construal and analytical thinking prevalent in individualistic cultures. Conversely, those from collectivistic cultural groups preferentially attend to contextual and global features of stimuli, and the inter-relationship between focal objects and background, reflecting an interdependent self-orientation and holistic cognitive style (Chua et al., 2005; Nisbett and Masuda, 2003). These perceptual biases shape brain activity. For example, Gutchess et al. (2006) found that a U.S. Caucasian group (compared to an East Asian group) preferentially engaged object-processing regions (ventral occipitotemporal cortex) when attending to complex visual scenes consisting of a neutral central object (e.g. elephant) in a neutral background scene (e.g. jungle). Another study showed that U.S. participants engaged stronger fusiform face area (FFA) activity compared to East Asian participants to face (object cues), who instead showed greater selectivity in the lingual landmark region during house (i.e. place) processing – a region associated with stimulus binding (Goh et al., 2010). Studies have also reported increased sensitivity to visual stimulus incongruency amongst collectivistic cultural groups, reflected in enhanced lateral occipitotemporal activity (Jenkins, Yang, Goh, Hong, & Park, 2010) and N400 event-related potential amplitude (Goto, Ando, Huang, Yee, & Lewis, 2010), as well as compensatory neural activations when engaging in culturally non-preferred attentional allocation tasks (Hedden et al., 2008). The only study to directly examine self-construal differences found similar compensatory attentional network activations when individualists vs collectivists grouped based on individual differences completed a global vs local attentional shift processing task respectively (Liddell et al., 2015).

There has been little study of how these cultural or self-construal perceptual biases to object vs contextual cues might extend into the emotional realm. The one exception is an eye tracking study, which showed that a collectivistic cultural group (i.e. Japanese) relied more on contextual social cues to appraise the emotional value of centralized target faces compared to a U.S. Caucasian group (Masuda et al., 2008). More broadly, studies are suggesting that culture plays an important role in modulating the neural and psychological systems that underlie emotion processing. Cultural group differences have been observed in the engagement of the amygdala in response to: in-group threat (Chiao et al., 2008; Moriguchi et al., 2005); direct vs averted eye gaze cues (Adams et al., 2010); and the degree of acculturation in bicultural Asian groups (Derntl et al., 2009; Derntl et al., 2012). Other studies have focused on cultural differences in the social domain, and have included a consideration of self-construal as a moderating factor. Activation within brain regions critical to emotion regulation, including the medial prefrontal cortex, appear to be stronger during self-related vs other-related processing or priming in individualistic vs collectivistic cultural groups respectively, with activity modulated by individual differences in self-construal (Chiao et al., 2009; Chiao et al., 2010; Harada, Li, & Chiao, 2010). A meta-analysis showed that during social affective processing, East Asian cultural groups activate brain nodes associated with making social inferences (e.g. temporoparietal junction – TPJ), with activity correlating with level of collectivistic self-construal (Ma et al., 2014) – consistent with a heightened sensitivity to others (Markus and Kitayama, 2010). By contrast, Caucasian groups appear more likely to engage regions involved in self-reflection (e.g. dorsomedial prefrontal cortex (DMPFC) including the anterior cingulate cortex (ACC)) and processing internal changes in body states (e.g. insula) – congruent with a heightened self-focus (Han and Ma, 2014; Ma et al., 2014). These meta-analysis findings however, are contradicted by parallel evidence that suggests collectivistic groups preferentially engage neural systems of empathy when viewing others in distress, including the anterior insula and dorsal anterior cingulate cortex (dACC), with activations being correlated with the degree of self-reported focus on others (Immordino-Yang, Yang, & Damasio, 2014). Such cultural differences in interpersonal reactivity appear to be driven by self-construal (), which may impact on how neural systems are engaged to object vs contextual components of negatively-valenced social cues.

In parallel, there is a growing recognition of the important role of context in influencing the neural correlates of emotion processing irrespective of culture (Barrett, Mesquita, & Gendron, 2011). Emotional (vs neutral) contexts have been found to modulate responses in the amygdala, ACC and temporal regions to object changes (Mobbs et al., 2006). Signals from non-facial head and body cues, non-verbal movements (de Gelder et al., 2006), and spatial contextual cues (Barrett and Kensinger, 2010; Righart and de Gelder, 2008) also influence brain activations to focal face and object stimuli (Barrett et al., 2011). The brain has specialized regions dedicated to face vs context processing. Faces are known to trigger domain-specific activations in the face fusiform area (FFA) situated within the fusiform gyrus (Kanwisher, McDermott, & Chun, 1997), with level of activity modulated by negative affect (Vuilleumier and Pourtois, 2007) and the degree of congruency between the face and its context (Van den Stock, Vandenbulcke, Sinke, Goebel, & DeGelder, 2014). Neural regions involved in scene or place processing include the parahippocampal gyrus (PHG) (Bar, 2004; Epstein and Ward, 2010), with a sub-region known as the place processing area (PPA) specializing in the enhancing contextual associations between stimuli (Bar et al., 2008b), with functioning being modulated by the emotional significance of the perceptual event (Alvarez, Biggs, Chen, Pine, & Grillon, 2008; Van den Stock, Vandenbulcke, Sinke, Goebel, et al., 2014).

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