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# Intergroup relationships do not reduce racial bias in empathic neural responses to pain

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ABSTRACT

Perceiving the pain of others activates similar neural structures to those involved in the direct experience of pain, including sensory and affective-motivational areas. Empathic responses can be modulated by race, such that stronger neural activation is elicited by the perception of pain in people of the same race compared with another race. In the present study, we aimed to identify when racial bias occurs in the time course of neural empathic responses to pain. We also investigated whether group affiliation could modulate the race effect. Using the minimal group paradigm, we assigned participants to one of two mixed-race teams. We examined event-related potentials from participants when viewing members of their own and the other team receiving painful or non-painful touch. We identified a significant racial bias in early ERP components at N1 over frontal electrodes, where Painful stimuli elicited a greater negative shift relative to Non-Painful stimuli in response to own race faces only. A long latency empathic response was also found at P3, where there was significant differentiation between Painful and Non-Painful stimuli regardless of Race or Group. There was no evidence that empathy-related brain activity was modulated by minimal group manipulation. These results support a model of empathy for pain that consists of early, automatic bias towards own-race empathic responses and a later top-down cognitive evaluation that does not differentiate between races and may ultimately lead to unbiased behaviour.



## 1. Introduction

Empathy can be defined as the ability to vicariously share the affective states of others (De Vignemont and Singer, 2006), thereby facilitating our comprehension of the affections, motivations and actions of others. It is believed that empathy underlies the development of vital skills for social interaction, including moral reasoning and altruistic behaviours (De Waal, 2008). Conversely, lack of empathy towards others is linked to difficulties in establishing interpersonal and intergroup relationships, and can result in poorer social integration (Batson et al., 2002; Hein et al., 2010; Cikara and Fiske, 2011). Thus, empathy is a crucial process in cohesive social interaction.

Within the context of empathy for pain, evidence has favoured a "perception-action" mechanism for empathy, whereby observation of people in painful situations activates the same areas of the brain in which pain is experienced first-hand. This is especially true for the areas which are associated with affective and motivational aspects of pain, in particular, the anterior cingulate cortex (ACC) and anterior insula (AI; for a review see Lamm et al., 2011). Such areas are typically involved not only in the affective aspects of nociception (Singer et al., 2004; Duerden and Albanese, 2013), but a variety of socially driven emotions (Singer et al., 2009; Lavin et al., 2013). Thus, a shared representation for self and other's emotion is believed to be the neural substrate of empathy (Lamm et al., 2011).

The overall empathic response to pain can be modulated by a number of cognitive (Gu and Han, 2007; Fan and Han, 2008), affective (Singer et al., 2006; Cheng et al., 2010) and social factors (Akitsuki and Decety, 2009; Decety et al., 2010a; Hein et al., 2010; Cheon et al., 2011; Guo et al., 2012). Crucially, there appears to be a heightened empathic response to members of one's own race in

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comparison to other races (Xu et al., 2009; Avenanti et al., 2010; Mathur et al., 2010; Forgiarini et al., 2011; Azevedo et al., 2012; Sheng and Han, 2012). Examination of early event related potentials (ERPs) reveals significantly greater amplitudes to the perception of others in pain, but only in response to own-race faces (Sheng and Han, 2012). This same effect is evident in neural activation of the ACC and AI, which is greater in response to the pain of members of one's own race (Xu et al., 2009; Azevedo et al., 2012; Contreras-Huerta et al., 2013). Overall, this indicates that racial information is a contributory factor in determining the level of empathy in response to pain.

It remains unclear whether racial bias is specific to race per se or if it results from a more general in-group bias. In social contexts, members of one's own group are automatically distinguished from members of other groups on the basis of physical and social cues (Cosmides et al., 2003; Van Bavel and Cunningham, 2010). Studies have revealed that group affiliation results in higher empathic neural responses towards in-group members (for a review see Eres and Molenberghs, 2013). For instance, when individuals are asked to give ratings of pain from the perspective of an in-group member, greater empathy is reported (Montalan et al., 2012). This in-group bias is reflected in greater neural activation of the AI, which in turn predicts the frequency of pro-social behaviour towards group members (Hein et al., 2010). Consequently, greater empathy for own-race individuals could be a result of in-group affiliation.

Broader group categorisation that involves mixed-race members may modulate the racial bias seen in empathy for pain. Consistent with this perspective, some studies have shown that racial bias reported in facial recognition and affective implicit measures (Otten and Wentura, 1999; Golby et al., 2001) can be overcome by a broader in-group bias when participants are randomly assigned to interracial groups (Van Bavel et al., 2008; Van Bavel and Cunningham, 2009; Van Bavel et al., 2011). Such findings suggest that mere categorisation with relatively meaningless group assignment may be sufficient to override automatic evaluations of race.

More specifically, in a recent study by Sheng and Han (2012), the original racial bias found in early ERP components elicited by the observation of painful facial expressions was abolished following arbitrary mixed-race group assignment, as evident by increased neural empathic responses to other-race faces belonging to the in-group. However, in our own recent study (Contreras-Huerta et al., 2013), participants displayed more implicit positive evaluations toward in-group than out-group members regardless of race, but neural responses were still greater when viewing own-race faces in pain compared with other-race faces. In this case, group membership had no effect on the neural responses. Taken together, these results suggest that behavioural attitudes may be readily adapted with arbitrary group membership, but these behavioural responses are not necessarily consistent with the neural responses to observed pain in others.

These discrepancies emphasise the fact that early neural empathic responses constitute only one of probably many processes that contribute to behavioural attitudes or responses to pain in others associated with empathy. In order to understand the origin of racial bias in neural empathic responses, the analysis of ERPs can be used to elucidate the temporal dynamics of neural empathic activation. It has been shown that the perception of painful compared with non-painful stimuli induces a larger early ERP at approximately 110 ms (N1) over the frontal lobes, followed by a long latency empathic response starting around 300 ms (P3) over the centroparietal regions (Fan and Han, 2008; Han et al., 2008; Decety et al., 2010a; Li and Han, 2010; Ibáñez et al., 2011; Sheng and Han, 2012). This is in accordance with a model of empathy for pain involving two key processes: an early, automatic (bottom-up) process related to perception-action coupling and a later, cognitively controlled (top-down) process (Decety and Lamm, 2006). According to the distinction put forward by Zaki and Ochsner (2012), these two processes may correspond to an experience-sharing system, in which there is a "neural resonance" between the person experiencing the emotion and the empathizer, and a mentalizing system related to cognitively understanding the affective state of the other (Zaki and Ochsner, 2012). Evidence from previous studies suggests that race has an effect in the early and automatic processing stages of empathy (Sheng and Han, 2012; Sessa et al., 2014), whereas the later and more cognitive stage remains unbiased by race (Sheng and Han, 2012; Sessa et al., 2014).

Separate from empathy, a number of ERP components also appear to differentiate between faces of own- and other-race (Ito and Urland, 2003, 2005; Kubota and Ito, 2007). These include peaks in frontal brain regions at 120 ms (N1), 180 ms (P2) and 250 ms (N2) (Ito and Urland, 2003; Ito et al., 2004; Ito and Urland, 2005; Willadsen-Jensen and Ito, 2006; Dickter and Bartholow, 2007; Kubota and Ito, 2007; Willadsen-Jensen and Ito, 2008; Lipp et al., 2011). A specific structural face recognition component in the occipital region, the N170, and its positive frontocentral component, the vertex positive potential (VPP), are also sensitive to detection of race (Ito and Urland, 2005; Herrmann et al., 2007; Caharel et al., 2011). The association between these ERP markers of face-processing and neural empathy to pain, however, are not known.

In the present ERP study, we investigated the time-course of neural responses to painful versus non-painful touch to faces of own- versus other-race individuals. We specifically examined neural empathic responses over early visual processing stages (N1) and over later cognitive stages (P3), as well as examining differentiation between races in typical face-processing components (N170/VPP and P2). We also examined the effect of broader group association, using a minimal group paradigm to assign participants to one of two mixed-race teams. In contrast to the paradigm used by Sheng and Han (2012), we did not associate group members with any physical cues, so that in-group and out-group members could not be identified by low-level visual features alone. Participants learnt to recognise the identities of members of in-group and out-group members by their facial features. In this way, we could examine the influence of group association particularly on early stages of ERPs to observed pain without any differences in low-level visual features used to define groups.

Our previous fMRI study showed differences in neural empathic responses to pain in own- compared with other-race faces that were not manifest in behavioural measures, suggesting that racial bias may be an early effect that is overcome by later top-down control processes. We therefore expect that race effects in neural empathy would be found in the early stages of ERPs, although this has been inconsistent in previous studies (Sheng and Han, 2012; Sessa et al., 2014). We further examined whether these neural empathic responses and racial biases were influenced by minimal group inclusion.

## 2. Material and methods

### 2.1. Participants

21 Caucasian- Australian participants (9 males; mean age=21.9, SE=.42 years, 5 left-handed) were recruited through the University of Queensland Research Participation Scheme, and received AU$30 dollar as reimbursement. The criteria for inclusion were being Caucasian, born in Australia, and having Australian or Anglo-Saxon parents. All had normal or corrected-to-normal vision and reported no abnormal neurological history. The procedures outlined in this study were approved by the University of Queensland's Medical Research Ethics Committee.

### 2.2. Procedure

Each participant attended two experiment sessions. In session 1, participants were assigned to a group and photographed so that their pictures could be included in the