Perspective taking reduces group biases in sensorimotor resonance

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Abstract

Similar neural circuits are activated during action and the observation of action and such sensorimotor resonance is said to support action understanding and empathy. Previous research, however, shows that group biases can restrict sensorimotor resonance to the social ingroup. Here we test whether an empathic mindset can alleviate such group biases in sensorimotor resonance. Participants adopted either an objective mindset or a perspective taking mindset while writing about a day in the life of a racial outgroup member. Participants in an objective mindset resonated with ingroup members, indicated by significant suppression of the 8-13 Hz EEG mu-rhythm recorded over sensorimotor areas during action observation compared to baseline, but did not show significant mu-suppression in response to outgroup members. In contrast, participants in a perspective taking mindset resonated with both ingroup and outgroup members and significantly more so with outgroup members. Moreover, mindset uniquely affected resonance in response to outgroup members but not in response to ingroup members, with participants who previously took the perspective of an outgroup member later responding with more resonance to the actions of other outgroup members. Together these findings suggest that taking the perspective of a racial outgroup member can reduce group biases in sensorimotor resonance, potentially fostering an intuitive understanding across groups.

Neuroscience supports the popular notion that understanding comes from taking another's perspective and walking around in their shoes. The mere perception of others' actions (Bowman et al., 2017; Braadbaart, Williams, & Waiter, 2013; Oberman, Ramachandran, & Pineda, 2008), facial expressions (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Enticott, Johnston, Herring, Hoy, & Fitzgerald, 2008), or pain (Perry, Troje, & Bentin, 2010; Singer et al., 2004) produces similar neural activity as would occur if one were to actually engage in action, express emotions, or feel pain. Such neural resonance is associated with emotional empathy (Moore & Franz, 2017; Pineda & Hecht, 2009) and potentially facilitates an intuitive understanding of another's actions, intentions and emotions (Fogassi et al., 2005; Gallese & Sinigaglia, 2014; Michael et al., 2014; Ulloa & Pineda, 2007).

Neural resonance, however, can be biased. For example, people resonate more with the pain of those they like (Singer, et al., 2006) and those they perceive as similar to themselves (Perry, Bentin, Bartal, Lamm, & Decety, 2010). Neural resonance can also be biased in systematic ways. For instance, participants show more activation in neural pain networks when they see members of their own ethnic group in pain compared to when they see ethnic outgroup members in pain (Cao, Contreras-Huerta, McFadyen, & Cunnington, 2015; Contreras-Hauerta, Baker, Reynolds, Batalha, & Cunnington, 2013; Xu, Zuo, Wang, & Han, 2009). Similarly, participants show more activation in sensorimotor areas when observing pain in people of the same versus different ethnicities (Avenanti, Sirigu, & Aglioti, 2010; Gutsell & Inzlicht, 2010; Levy et al., 2016). Thus, the kind of social target matters. How much we resonate with others, however, might also depend on our state of mind. The right mindset might be able to override limiting characteristics of the target. Here we ask whether being in a perspective taking mindset could increase neural resonance for ethnic outgroup members – in other words: can perspective taking decrease the ingroup bias in neural resonance?

Neural Sensorimotor Resonance

Action and the mere perception or imagination of the same action share common neural representations (Preston & de Waal, 2002). In the brain, this action-perception link is implemented by sensorimotor resonance – activity in an observer's neural sensorimotor areas in response to the perception of action in a target, which has been suggested to contribute to an embodied and intuitive understanding of actions and intentions. Indeed, sensorimotor resonance seems to map the function and goal of the action; people resonate even when they can see an action only partially (Simon & Mukamel, 2016; Umilta et al., 2001) or not at all (Kohler et al., 2002), and sensorimotor resonance is more pronounced for goal-directed action (Aragón, Sharer, Bargh, & Pineda, 2014; Cattaneo, Caruana, Jezzini, & Rizzolatti, 2009). Finally, sensorimotor resonance to observed action even predicts subsequent changes in performance of the observed movement (Aridan, Ossmy, Buaron, Reznik, & Mukamel, 2018). In addition to action understanding, sensorimotor resonance is thought to contribute to affect sharing and empathy (e.g. Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; de Waal & Preston, 2017; Iacoboni, 2009) as it predicts performance in tasks that require empathy (Pineda & Hecht, 2009), leads to greater subjective experience of empathy (Lamm, Decety, & Singer, 2011), and seems to facilitate pro-social behavior (Endedijk, Meyer, Bekkering, Cillessen, & Hunnius, 2017).

Unfortunately, resonance is affected by prejudice and group identity. On a behavioral level, people show less facial mimicry (Bourgeois & Hess, 2008) and less automatic imitation (Müller et al., 2011) of ethnic outgroup members compared to ethnic ingroup members. On a neural level, people resonate more with culturally specific gestures when they share the cultural background of the target (Molnar-Szakacs, Wu, Robles, & Iacoboni, 2007). They also show less neural resonance to the actions (Avenanti et al., 2010; Gutsell & Inzlicht, 2010) and pain (Avenanti et al., 2010; Riečanský, Paul, Kölble, Stieger, & Lamm, 2015) of racial outgroup members relative to racial ingroup members, and these biases are aggravated by prejudice (Avenanti et al., 2010; Gutsell & Inzlicht, 2010). Moreover, such resonance biases negatively predict face-to-face hostile behavior toward outgroup members (Levy et al., 2016), suggesting their importance to cross-group interactions and cross-group empathy.

To the extent that perceivers' general outlook on the world shapes how much and with whom they resonate, changing perceivers' mindset might be a powerful tool to influence sensorimotor resonance. In this study, we examine how experimental changes to the perceiver's mindset can influence sensorimotor resonance. Specifically, we ask if having people take the perspective of someone else could enhance sensorimotor resonance.

Cognitive Perspective Taking

Cognitive perspective taking refers to the active contemplation of others' psychological experiences, and it has long been considered to predict better social skills and empathy. Perspective taking inductions facilitate altruistic behavior (Batson, Sager, Kang, Rubchinsky, & Dawson, 1997), empathy (Batson, Early, & Salvarani, 1997; Cooke, Bazzini, Curtin, & Emery, 2018; Galinsky, Maddux, Gilin, & White, 2008), and cooperation (Batson & Moran, 1999). In addition to these more general benefits, perspective taking can be helpful in an intergroup context (Batson, et al., 1997, Dovidio et al., 2004, Galinsky & Ku, 2004), improving evaluations of specific outgroup members and the outgroup as a whole (Dovidio et al, 2004; Galinsky & Ku, 2004; Shih, Wang, Trahan Bucher, & Stotzer, 2009). For example, nurses who take the perspective of a Black chronic pain patient show less racial bias in decisions for pain treatment than those who do not take the patient's perspective (Drwecki, Moore, Ward, Prkachin, 2011), suggesting that perspective taking might have the potential to alleviate race-based empathy biases. Perspective taking can also increase sensorimotor resonance: people who tend to take the perspective of others also have a tendency to imitate others (Chartrand & Bargh, 1999). Perspective taking increases cognitive co-representation of others' behavior such that after taking the perspective of an outgroup member, participants showed less interference in a joint Simon Task (a measure of co-representation of another's actions; Müller et al., 2011). Electroencephalographic (EEG) research shows that people with high scores on a self-report trait measure of perspective taking show stronger neural activity in the sensorimotor cortex while observing others performing actions (Woodruff, Martin, & Bilyk, 2011), and that putting people in a perspective taking mindset indeed increases neural sensorimotor resonance (Hoenen, Schain, & Pause, 2013).

In sum, we know that cognitive perspective taking can improve interpersonal rapport and facilitate altruistic behavior towards individuals who would otherwise be unlikely targets of empathy. Moreover, these positive effects can generalize beyond the interpersonal domain to encompass intergroup situations as well—taking the perspective of one outgroup individual can affect how one perceives and treats other outgroup members in situations outside of the perspective taking context and at a later time (Todd, Bodenhausen, Richeson, & Galinsky, 2011; Todd & Galinsky, 2014). Given the benefits of perspective taking and the behavioral evidence linking it to increased action representation for outgroup members (Müller et al., 2011), we set out to test whether adopting a perspective taking mindset towards a racial outgroup member can alleviate group biases in sensorimotor resonance extending beyond the specific individual and towards the outgroup in general.

Current Research

The present study directly investigates the effects of a perspective taking mindset on sensorimotor resonance in an intergroup context. We hypothesize that people in a perspective taking mindset will resonate more than will people in an objective mindset, where they are thinking about others' experience in a detached manner. Moreover, we predict that perspective taking will eliminate group biases in resonance. More specifically, we expect participants in the objective mindset condition to resonate more with ingroup members than with outgroup members, indicating a group bias in resonance – a pattern of results previously observed in the absence of a mindset manipulation (Gutsell & Inzlicht, 2010). In contrast, we expect participants in the perspective taking condition to resonate equally with both ingroup and outgroup members.

To test these hypotheses, we measured EEG oscillations over sensorimotor areas in the mu-frequency range while participants watched videos of ethnic ingroup and ethnic outgroup members performing a simple action. The so-called mu-rhythm is a well-established measure of neural activity in the sensorimotor cortex (Kuhlman, 1978). The alpha component of the mu-rhythm (8-13 Hz) seems to originate from primary somatosensory cortex (Hari, 2006), and is usually measured over central electrodes (Fox et al., 2015; Hobson & Bishop, 2017a; Kuhlman, 1978). Sensorimotor neurons show synchronized activity at rest, and desynchronize both during movement and during passive observation of movement, leading to a suppression of mu power (Pineda, 2005) that is particularly pronounced over the contralateral hemisphere of the observed movement (Hari 2006; e.g., suppression at electrode C3 reflects activation within the left somatosensory cortex during the observation of right-hand movements (Braadbaart et al., 2013; Gutsell & Inzlicht, 2010)). Mu-suppression is generally considered to be a good measure of neural resonance in sensorimotor areas (see Fox et al., 2015, for a meta-analysis and Hobson &

Bishop, 2016, for a critical perspective). Sensorimotor resonance plays an important role in empathy for pain (Bastiaansen, Thioux, & Keysers, 2009; Keysers, Kaas, & Gazzola, 2010), and is stronger in response to similar than to dissimilar others (Perry, Bentin, et al., 2010) and ingroup as opposed to outgroup members' pain (Riečanský et al., 2015) and actions (Gutsell & Inzlicht, 2010). This suggests that mu-suppression should be sensitive to changes in neural processing related to a perspective taking mindset manipulation.

Methods

Participants

We originally planned to collect data from 60 participants based on a power analysis for our central hypothesis test, looking for a significant interaction effect in a 2 (mindset condition: perspective taking vs. objective) x 2 (group condition: ingroup vs. outgroup) mixed model ANOVA with the second factor repeated. The power analysis indicated that a total sample size of 52 is needed to detect a small to medium effect size of $f = 0.2$ with a power of .80, with the additional eight participants to account for potential exclusions due to inadequate EEG recordings. Data from seven additional participants were collected for a total sample of 67 participants because seven of the initial sample were missing behavioral data.[1] Of these 67 participants, six were excluded because of excessive EEG artifacts based on visual inspection of the data ($n = 4$) and missing event markers due to equipment failure ($n = 2$). The resulting final sample consisted of 61 participants of various ethnic and racial backgrounds but none identifying as Black (54 with complete datasets; 29/54 female; 27/54 White, 19/54 East Asian, 5/54 Hispanic, 3/54 South Asian; demographic information was missing for the seven incomplete

[1] We repeated all reported analyses on the smaller sample only including participants with complete datasets. The pattern of results stayed the same.

datasets) who were randomly assigned to either the objective (*n* = 29) or perspective taking mindset (*n* = 32) conditions. All participants were undergraduate students between the ages of 18 and 25 (*M* = 20.17 years, *SD* = 1.68, *n* = 54). Participants were compensated with either course credit or money for their participation. The Institutional Review Board approved the study.

Procedure

Participants arrived in the laboratory one at a time and provided informed consent. They were then fitted with an electrode cap. Following EEG set-up, participants completed the perspective taking mindset manipulation during which they saw a picture of a Black male university student and were asked to write a short narrative essay describing a day in his life. They were asked to either take the perspective of the student while writing or to remain as objective as possible. After completion of the essay, participants saw a series of videos showing racial ingroup members' and racial outgroup members' (Black) right hands repeatedly squeezing a stress ball while we recorded EEG. To enhance the relevance of these rather uninteresting stimuli, we presented a cover story that these hands belonged to other participants in the study. After watching the videos, participants filled out a series of self-report measures to assess prejudice and trait empathy.

Materials

All stimulus material in this study is available on the study's OSF page at https://osf.io/xeak9/?view_only=0eb0714379f14b0c8e85c8a425aaedfd.

Cover story. Participants began the study by answering mundane questions about themselves, including their age, race, gender, year in school, nationality, number of siblings, hobbies, and favorite television genre. This was done to make it more believable when participants were later provided the same information about the individuals introduced in the sensorimotor resonance task, whom they were told were previous participants.

Mindset manipulation. To manipulate a perspective taking mindset versus an objective mindset towards a racial outgroup, we showed our non-Black participants a picture of a young Black university student. The student was shown sitting on a couch, holding an open book, gazing into the camera with a smile. Participants were asked to write a short essay about a day in his life either taking his perspective or remaining objective. Specifically, in the perspective taking condition participants were asked to: "Take the perspective of the individual in the photograph and imagine a day in the life of this individual as if you were that person, looking at the world through his eyes and walking through the world in his shoes" and to write in the first person. In contrast, participants in the objective mindset condition read the following instructions: "Try to be as objective as possible when imagining what is happening to this individual and what his day is like. Don't get caught up in imagining what this individual might think or how he might feel." They were asked to write the story in the third person (manipulation adapted from Todd, Bodenhausen, Richeson, & Galinsky, 2011) and were given five minutes to write the story.

Action video task. Following the perspective taking mindset manipulation task, we measured participants' sensorimotor resonance. Participants read short descriptions of four targets, two of whom shared their race (e.g. White participants saw White targets and East Asian participants saw East Asian targets; ingroup condition) and two of whom were African American (outgroup condition). So, all participants saw the same Black outgroup targets, but each saw ingroup targets matching their own race. Target gender was balanced for both races such that participants saw one female and one male from each group. The profiles were a list of responses to the same questions participants had answered at the beginning of the study and responses were counterbalanced across conditions so that each profile was sometimes used to describe an ingroup member and sometimes used to describe an outgroup member (only race information stayed consistent across targets to ensure that it matched the actual race of the target hands). Each block started with the description of one of the four targets presented for 15 seconds followed by 50 action trials ostensibly depicting that target's hand, resulting in 100 trials per condition. Within each action trial participants first saw a fixation cross presented in the middle of a blank screen for 500 ms, followed by a 2000 ms long video of a hand repeatedly squeezing a yellow stress ball, followed by a blank screen for 500 – 800 ms. The action videos displayed only the right hand up to the wrist and there were no accessories or obvious scars, tattoos, or nail polish. Both the order of the video blocks and the order of the videos within the blocks were randomized. Genders of the hands in the videos were balanced and matched to the target description.

Prejudice Measure[2]. Prejudice was assessed with the Symbolic Racism 2000 Scale (Henry & Sears, 2002). We included this measure in order to test the perspective taking manipulation's effect on attitudes in addition to resonance and as a manipulation check since previous work had shown our perspective taking manipulation to reduce prejudice (Galinsky & Moskowitz, 2000). The Symbolic Racism scale is an eight-item scale measuring prejudice expressed through self-report about abstract values like justice and order. Responses indicate the

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[2] In addition to the Symbolic Racism 2000 Scale, participants filled out a measure of perceived genetic overlap within and between races. This measure was included to answer an unrelated research question and is not further reported on. Additionally, we included the Interpersonal Reactivity Index (Davis, 1983) as a measure of trait empathy and the Others in the Self measure (adapted from Aron, Aron, & Smollan, 1992) for both the ingroup and the outgroup as potential moderators. None of the measures were correlated with EEG mu-suppression.

extent to which subjects hold African Americans accountable for continued inequality, rather than their direct attitudes towards African Americans. It is therefore both an explicit and subtle measure. Due to an error in programming the study, the first item (“*It’s really a matter of some people not trying hard enough; if blacks would only try harder they could be just as well off as whites”*) was not included, so only seven items were used. While this was unintentional, Cronbach’s alpha of the reduced scale was high ($\alpha = .80$).

EEG recording. EEG was recorded using 33 active electrodes in a stretch-lycra cap (ActiCap, BrainProducts GmbH, Munich, Germany). Electrodes were positioned according to the 10–20 system with impedances kept below 20 kΩ. The EEG was digitized at 500 Hz using BrainAmp amplifiers and BrainVision recorder software (BrainProducts GmbH, Munich, Germany) with an initial reference at FCz and then re-referenced offline to the average of all EEG electrodes. Vertical electrooculogram (VEOG) was recorded with a pair of bipolar electrodes placed above and below the right eye.

EEG processing. The data was filtered through a high pass zero-phase Butterworth filter (24 dB) with a 0.1 low cut off and ocular artifacts were corrected using the VEOG channel and an ICA-based procedure for isolating and removing ocular artifacts (Croft & Barry, 2000). Remaining artifacts exceeding ± 85 μV in amplitude, with a voltage step larger than 50 μV between sample points, or a maximum voltage difference of less than 0.5 μV within a 100 ms interval were rejected for individual channels in each trial. Event-Related Spectral Perturbations (ERSPs) were computed using a continuous Morlet wavelet transform. 3700 ms-long EEG epochs were extracted starting 950 ms before the onset of the video and ending 2750 ms after. This larger interval included the 2000 ms stimulus duration, 200 ms baseline activity, and a 750ms buffer before baseline onset and after the stimulus to allow for removal of edge distortion artifacts induced by the wavelet convolution. Time-frequency transforms were computed for each electrode for frequencies in the 2 – 60 Hz range, using continuous wavelet transformation with 5-cycle Morlet wavelets that logarithmically increased in 25 frequency steps. The absolute power values of the Gabor-normalized wavelet coefficients were taken from the duration of the 2000 ms long video and baseline corrected for each trial using a period from 200 ms pre-stimulus to stimulus onset. Baseline corrected mu-power for each 2000 ms trial was then averaged across the segments for each condition for further analysis. We expected mu-suppression to occur primarily at central electrode C3 between 8 – 13 Hz, located over the contralateral left sensorimotor cortex where we expected right hand movements to be primarily processed by our right-handed participants. We also extracted data from electrodes Cz and C4 to test for lateralization, and O1, Oz, and O2 to differentiate our effects from attention-related occipital alpha. Data from layer 10 to layer 15 (including frequencies: 7.16, 8.25, 9.51, 10.95, 12.62, 14.54 Hz) were extracted from these electrodes so that the mu-frequency band would be fully included in the analysis.

Results

Self-reported prejudice

Conceptually replicating previous work showing that perspective taking can reduce racial bias (Todd et al., 2011), we found that the perspective taking mindset significantly decreased prejudice, $t(52) = 2.27$, $p = .027$, $d = .62$, such that participants in the perspective taking condition scored lower on the Symbolic Racism scale ($M = 3.39$, $SD = 1.51$) than did participants in the objective mindset condition ($M = 4.46$, $SD = 1.95$).[3] This provided a check that our

[3] Seven participants had to end the study early, so they did not fill out the self-report measures. Symbolic Racism data is from the smaller sub-sample ($n = 54$) that did complete the full study.

manipulation was having its intended effect on group bias. Hence, despite different patterns for ingroup and outgroup targets relative to baseline, participants in our objective mindset condition did not show the usual ingroup bias in sensorimotor resonance. Symbolic Racism did not correlate with mu-suppression for outgroup targets, $r(52) = -.00062$, $p = 1.00$; [95% CI = -.27, .27]

EEG Mu-suppression

To test for significant mu-suppression in response to ingroup and outgroup actions for participants in the perspective taking and objective mindset conditions, we first split the dataset along mindset condition and then ran one-sample t-tests on mu-suppression ERSP power values for the ingroup and outgroup conditions (*p*-values FDR adjusted for the four tests). In the objective mindset condition, participants responded to ingroup targets with significant mu-suppression at electrode C3, $M = -.79$, $SD = 1.64$, $t(28) = -2.60$, $p_{adjusted} = .029$, $d = .48$, and outgroup members did not engender mu-suppression, $M = -.51$, $SD = 1.69$, $t(28) = -1.61$, $p_{adjusted} = .12$, $d = .30$, replicating previous findings that suggest an ingroup bias in EEG mu-suppression such that only ingroup members elicit a resonance response (Gutsell & Inzlicht, 2010). Participants in the perspective taking mindset condition, however, did show significant mu-suppression for the ingroup, $M = -.97$, $SD = 2.40$, $t(31) = -2.30$, $p_{adjusted} = .038$, $d = .41$, and for the outgroup, $M = -1.88$, $SD = 2.78$, $t(31) = -3.82$, $p_{adjusted} = .002$, $d = .68$ (please see Figure 1).

To test whether mindset condition and target group may have interacted to affect mu-suppression, we conducted a 2 (mindset condition: perspective taking vs. objective) x 2 (group: ingroup vs. outgroup) mixed model ANOVA on C3 power values (please see Table 1 for means and standard deviations). This analysis showed no main effect of mindset condition, $F(1, 59) = 2.12$, $p = .15$, $\eta^2 = .035$, or of group, $F(1, 59) = 2.67$, $p = .11$, $\eta^2 = .043$. However, there was the predicted interaction of group and mindset condition, $F(1, 59) = 9.89$, $p = .003$, $\eta^2 = .14$ (please see Figure 2). Simple effects analysis showed significant differences in resonance for ingroup and outgroup members in the perspective taking mindset condition, $F(1, 46) = 4.59$, $p < .001$, $\eta^2 = .21$, with greater resonance for the outgroup ($M = -1.88$, $SD = 2.78$) than the ingroup ($M = -.97$, $SD = 2.40$). No group differences were found in the objective mindset condition, $F(1, 46) = .10$, $p = .30$, $\eta^2 = .021$, where participants showed similar amounts of mu-suppression for the ingroup ($M = -.80$, $SD = 1.64$) and the outgroup ($M = -.51$, $SD = 1.69$). Hence the control group did not show the expected ingroup bias in sensorimotor resonance usually found in studies with no manipulation (e.g. Gutsell & Inzlicht, 2010). Nonetheless, the simple effect of condition was significant for the outgroup, $F(1, 59) = 5.29$, $p = .025$, $\eta^2 = .082$, but not for the ingroup, $F(1, 59) = .11$, $p = .74$, $\eta^2 = .002$, so the mindset condition had a unique effect on mu-suppression in response to the actions of outgroup members only.

To investigate the possibility that these effects might be due to differences in attention, we repeated our analysis on alpha-suppression at occipital electrode O1. This analysis revealed no main effect of group ($p = .78$) or interaction effect ($p = .93$), but there was a significant effect of mindset condition, $F(1, 59) = 5.70$, $p = .020$, $\eta^2 = .088$, with participants in the perspective taking mindset condition showing more occipital alpha-suppression than participants in the objective mindset condition, suggesting that it is unlikely that our sensorimotor mu-suppression effects simply represent an extension of occipital activation.

To further test the localization of our effects, we ran a 2 (mindset condition: perspective taking vs. objective) x 2 (group: ingroup vs. outgroup) x 2 (centrality: central vs. occipital) x 3 (lateralization: left vs. central vs. right) mixed model ANOVA with all but mindset repeated. Comparing central to occipital electrodes is a commonly recommended analysis to differentiate central mu-suppression from occipital alpha suppression (e.g. Fox et al., 2015; Hobson & Bishop, 2016). The analysis revealed a significant effect of centrality, $F(1, 59) = 16.23$, $p < 0.001$, $\eta^2 = .22$, with more suppression in the mu/alpha frequency band at occipital than central electrodes (please see Table 1 for means and standard deviations). There was also a significant main effect of condition, $F(1, 59) = 4.45$, $p = .039$, $\eta^2 = .070$, with more mu/alpha suppression in the perspective taking than in the objective mindset condition. No other effects were significant (all *p*-values > .15). Hence, we do not know whether the previous two-way interaction between group and mindset conditions is unique to central electrode locations. When entering the mean activation at O1, Oz, and O2 as individual covariates to 2 (mindset condition: perspective taking vs. objective) x 2 (group: ingroup vs. outgroup) mixed model ANOVA on C3 power values, the observed interaction effect of group and mindset condition on mu-suppression remains significant ($p = .028$, $\eta^2 = .087$), suggesting that, although not completely independent of occipital alpha, our central mu effects cannot entirely be explained by activation picked up from occipital regions. Descriptively, graphing the effect size of the mindset condition-group interaction at each electrode strongly suggests that C3 is the site of the strongest interaction (please see Figure 3), indicating that even if attention is implicated in our findings, we are not just reporting an occipital effect spreading to central electrodes.

Discussion

Previous research shows that people resonate less with others if they are not part of their own ethnic group (Avenanti et al., 2010; Gutsell & Inzlicht, 2010). Using an electrophysiological indicator of neural resonance, we investigated how a perspective taking mindset influences resonance with others in general and with the outgroup in particular. We found that after participants took the perspective of an outgroup member, they showed a reduction in rhythmic mu-oscillations over sensorimotor cortex when later observing other outgroup members performing actions. Thus, when people are in a perspective taking mindset, they resonate more with the actions of outgroup members – something they do not usually do.

Moreover, our perspective taking mindset manipulation seems to have uniquely affected resonance for the outgroup: taking the perspective of an outgroup member led to a significant increase in neural resonance for other outgroup members, while resonance for the ingroup was not affected.

This increase in resonance for the outgroup did not merely alleviate the usual group bias in resonance, but seems to have flipped it, such that participants in the perspective taking condition resonated more with outgroup members compared to ingroup members. Please note, however, that our perspective taking mindset manipulation involved writing about a day in life of an outgroup member only and did not include an equivalent condition during which participants took the perspective of an ingroup member. This focus on the outgroup is likely the reason for why we found a bias in favor for the outgroup in our study rather than just a reduction in anti-outgroup bias.

Group biases in sensorimotor resonance might ultimately translate into misunderstandings and impaired social rapport, empathy, and social coordination. The current study and previous work show that perspective taking successfully reduces prejudice (Batson, Sager, et al., 1997; Todd, Bodenhausen, Richeson, & Galinsky, 2011b; see Todd & Galinsky, 2014 for a review). Perspective taking also builds social bonds and increases empathy and helping (Batson et al., 1997). Alleviating group biases in sensorimotor resonance might be yet another important benefit.

Sensorimotor resonance helps people gain an intuitive understanding of others' actions and intentions (Fogassi et al., 2005; Pomiechowska & Csibra, 2017), aids in learning (van der Helden, van Schie, & Rombouts, 2010), and might even contribute to basic social processes such as emotional contagion (Pineda & Hecht, 2009), empathy (Woodruff & Klein, 2013; Woodruff et al., 2011), and prosocial behavior (Gallo et al., 2018). Such embodied understanding may be essential for smooth interactions and accurate empathy (Ong, Desmond, Zaki, & Perry, unpublished pre-print), meaning biased responses could have negative consequences. Putting people in a perspective taking mindset appears to be an effective means of reducing prejudice and group biases in sensorimotor resonance, potentially resulting in improved empathic processing.

The role of attention

A challenge when measuring EEG mu-suppression is to differentiate sensorimotor mu from attention-related occipital alpha. Alpha activity at occipital electrode sites might reflect attention processes and it might lead to spurious mu-suppression effects at central sites (Bowman et al., 2017; Fox et al., 2015; Hobson & Bishop, 2017b). The lack of an interaction between electrode location, group, and condition is thus problematic as our effects seem not to be limited to central sites. Our analyses did reveal distinct patterns of results for occipital alpha- and central mu-suppression; without the interaction, however, it is unclear whether these patterns are truly distinct. Still, when entering the mean activation at occipital electrodes as individual covariates, the observed interaction effect of group and mindset condition on mu-suppression remained significant and the interaction looked to be strongest at electrode C3 (see Figure 3) suggesting that our effects cannot entirely be explained by activation picked up from occipital regions.

Nevertheless, attention could be contributing to our effects: occipital alpha decreases with increased attention (Stadler et al., 2005; Yamagishi et al., 2003) and we found that people in the perspective taking condition showed stronger alpha suppression at occipital electrodes, suggesting that participants in the perspective taking condition might have paid more attention to both ingroup and outgroup members' actions. According to the functional/motivational perspective on social processing and empathy (Ackerman et al., 2006a; Zaki, 2014), the amount of cognitive and perceptional resources allocated to a social target is determined by goal instrumentality – the utility of a target to the achievement of a goal (Waytz, Schroeder, & Epley, 2014). As such, humans consider the coalitional value of others, which is determined by social and genetic closeness, past collaboration, and the status of potential interaction partners (Tomasello, Carpenter, Call, Behne, & Moll, 2005; Zaki, 2014), all things disproportionally contributing to the motivational relevance of ingroup members. Indeed, research participants show less neural activity in areas of social perception and social cognition in response to outgroup members (Harris & Fiske, 2006; Van Bavel, Packer, & Cunningham, 2008) and they allocate fewer attentional resources to outgroup member's faces (Ackerman et al., 2006b) and experiences of pain (Sessa, Meconi, Castelli, & Dell'Acqua, 2014), at least during early processing. It is thus possible that sensorimotor resonance would be equally affected by the selective allocation of attention. While it is important to ensure that observed changes in mu-power are not simply the result of occipital alpha being picked up at central electrodes, concordant changes in occipital alpha and central mu might be an opportunity to observe the interplay between attention and sensorimotor resonance. In the current study, the observed main effect of condition on occipital alpha suppression suggests increased attention to others' actions by those in a perspective taking mindset. This increased attention might have allowed these participants to differentially process actions based on group membership in their sensorimotor systems while a potential attentional disengagement of participants in the objective mindset condition might have prevented such group-based differentiation. Unfortunately, the current study is not adequately powered to investigate these relationships.

The objective mindset as control condition

In past research, the objective mindset manipulation we used here was assumed to be a neutral state and thereby served as a control condition (e.g. Galinsky, Wang, & Ku, 2008; Todd, Bodenhausen, Richeson, & Galinsky, 2011). We wonder, however, if this is a fair assumption given that in the present study, being in an objective mindset did not seem to be a neutral state. In a neutral state, research participants tend to show significant mu-suppression in response to social ingroup members but less mu-suppression or even none at all in response to social outgroup members (Avenanti et al., 2010; Gutsell & Inzlicht, 2010), a pattern that we also find in the objective mindset condition. However, this previous research also found significantly more mu-suppression for the ingroup compared to the outgroup, while participants in our objective mindset condition did not show such a difference. Hence, despite different patterns for ingroup and outgroup targets relative to baseline, participants in our objective mindset condition do not show the usual ingroup bias in sensorimotor resonance. A possible explanation for the lack of a significant ingroup bias in the objective mindset condition is that participants in both conditions were asked to think and write about an outgroup member and that this exposure alone could work as an intervention that, at least somewhat, alleviates biases. Mere exposure to outgroup faces reduces prejudice (Zebrowitz, White, & Wieneke, 2008) and merely thinking about an outgroup member's day might have a similar effect. A no-outgroup-exposure control condition would be necessary to address this question.

Perspective taking

Being in a perspective taking mindset has been shown to improve social interactions. Research participants who had previously completed the perspective taking mindset manipulation utilized in the current study later liked an outgroup interaction partner better, displayed more friendly nonverbal behavior, and were judged to be more pleasant interaction partners than those who took a control or an objective mindset (Todd et al., 2011; Todd & Galinsky, 2014). As in the current study, most previous work compared perspective taking to an objective mindset condition during which participants would take an objective mindset of a Black individual, but did not include a condition during which participants would take the perspective of an ingroup member (Ku, Wang, & Galinsky, 2010; Todd et al., 2011; Wang, Kenneth, Ku, & Galinsky, 2014). Such a design somewhat occludes the exact mechanism underlying the perspective taking manipulation: Is it about taking the perspective of an outgroup member specifically or would simply entering a perspective taking mindset suffice? What would happen if participants took the perspective of an ingroup member instead? We can derive some clues from existing literature that uses a similar perspective taking manipulation. Imagining how participants themselves would experience a typical day in the life of an outgroup member leads to similar effects as the perspective taking condition leading to a reduction in automatic ingroup bias (Todd et al., 2011). Perspective taking also lead to more positive interaction experiences and more approach-oriented nonverbal behaviors during intergroup encounters compared to both adopting an objective mindset and a no-instructions control group (Todd et al., 2011; Wang et al., 2014). Finally, taking the perspective of an outgroup member leads to increased action-co-representation to outgroup but not ingroup members compared to taking the perspective of an ingroup member (Müller et al., 2011a). Together these findings suggest that it might indeed be about taking the perspective of an outgroup member rather than adopting an objective mindset towards the experiences of an outgroup member, merely writing about outgroup experiences, or taking the perspective of an ingroup member that seems to reduce group biases. Future research should include a variety of control conditions including a no-instructions and an ingroup-perspective taking control to further investigate the mechanisms behind the effects of perspective taking on sensorimotor resonance.

Increasing sensorimotor resonance, as the perspective taking mindset did for outgroup targets, could potentially contribute to positive intergroup interactions. It is, however, important to investigate these potential benefits within actual face-to-face interactions. Previous research suggests that trying to perspective take while interacting with an outgroup member can have disruptive effects on the interaction because the perspective taker exerts less effort towards their interaction partner (Vorauer, Martens, & Sasaki, 2009; Vorauer & Sasaki, 2009). Sensorimotor resonance is a basic process that does not require much conscious awareness or effort (Rizzolatti & Graighero, 2004) and thus should not draw cognitive resources away from other important processes such as impression management and conversational skills. By facilitating social understanding, coordination, and rapport in an unobtrusive way, the increase of sensorimotor resonance could facilitate smooth intergroup encounters. Future research should investigate such potential contributions by looking at sensorimotor resonance before and during intergroup interactions.

Conclusions

As a default, people tend to resonate less with the actions of outgroup members and consequently they might have difficulty intuitively grasping outgroup member’s actions, intentions and other inner states. The current research provides evidence for the utility of perspective taking as a strategy for combating this subtle consequence of racial bias. Adopting a perspective taking mindset has been shown to be conducive for smooth and pleasant intergroup interaction experiences. The findings reported here suggest a potential contributing factor: when in a perspective taking mindset, people are more likely to resonate even with outgroup members, which could provide them with richer, more intuitive understandings of others’ actions and intentions.

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Tables

Table 1

Table 1: Descriptive Statistics by Electrode

Statistic	Mean	St. Dev.	Min	Max
C3	-1.06	2.24	-11.44	6.01
C4	-1.23	2.57	-11.49	9.21
Cz	-1.22	1.71	-8.08	1.98
O1	-3.19	5.07	-30.01	7.06
O2	-3.38	6.38	-40.64	11.74
Oz	-2.53	3.62	-16.22	5.30

Figure captions

Figure 1: Grand average Event-Related Spectral Perturbations (ERSP). The ERSP images show the time-frequency results during the observation of ingroup and outgroup actions for participants in the perspective-taking and control conditions. The onset of the action video clip is at 0 ms, lasted for 2000 ms (light grey bar) and was directly preceded by the 200 ms baseline period (dark grey bar). Depicted are differences in EEG power from baseline.

Figure 2: EEG mu-suppression at the left central scalp location (C3) during the observation of ingroup and outgroup members for participants in a perspective taking mindset and for participants in an objective mindset. Negative numbers denote more mu-suppression (i.e. more neural activity) at C3.

Figure 3: To show the localization of our effects despite strong occipital alpha suppression, this shows the general η^2 for the interaction of condition and target group on 8-13 Hz baseline-corrected power at every electrode. Only 57 participants are in this analysis, due to missing data, and electrode values more than 10 standard deviations from the overall mean are excluded for plotting ($<$0.0001% of data).

Table 1: Descriptive Statistics by Electrode

Statistic	Mean	St. Dev.	Min	Max
C3	-1.06	2.24	-11.44	6.01
C4	-1.23	2.57	-11.49	9.21
Cz	-1.22	1.71	-8.08	1.98
F3	-1.26	2.43	-13.10	6.13
F4	-1.92	3.44	-19.52	2.54
Fz	-1.68	2.79	-16.25	5.76
O1	-3.19	5.07	-30.01	7.06
O2	-3.38	6.38	-40.64	11.74
Oz	-2.53	3.62	-16.22	5.30

Figure 1 Click here to access/download;Figure;Figure 1_PT.png

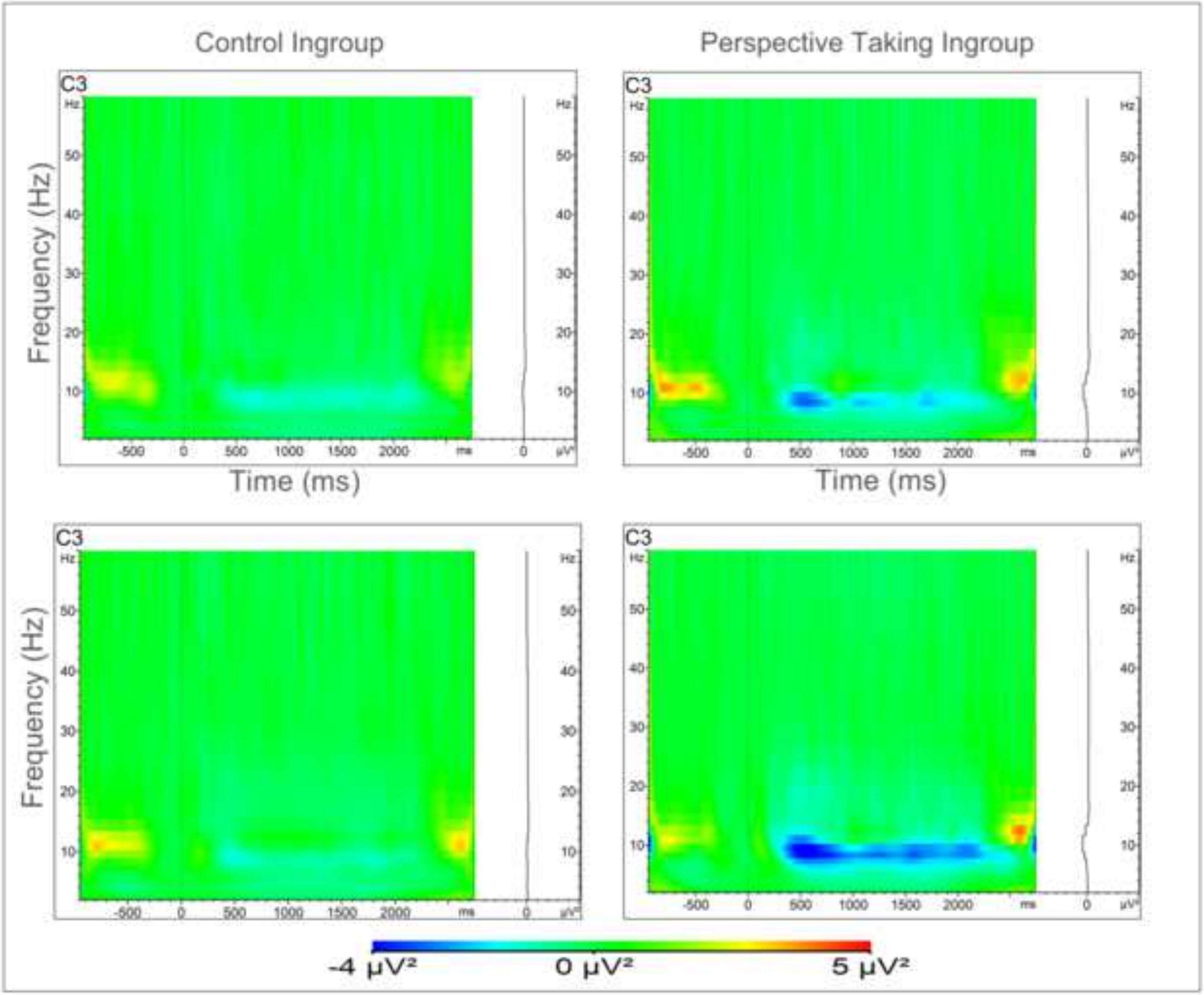

Figure 2

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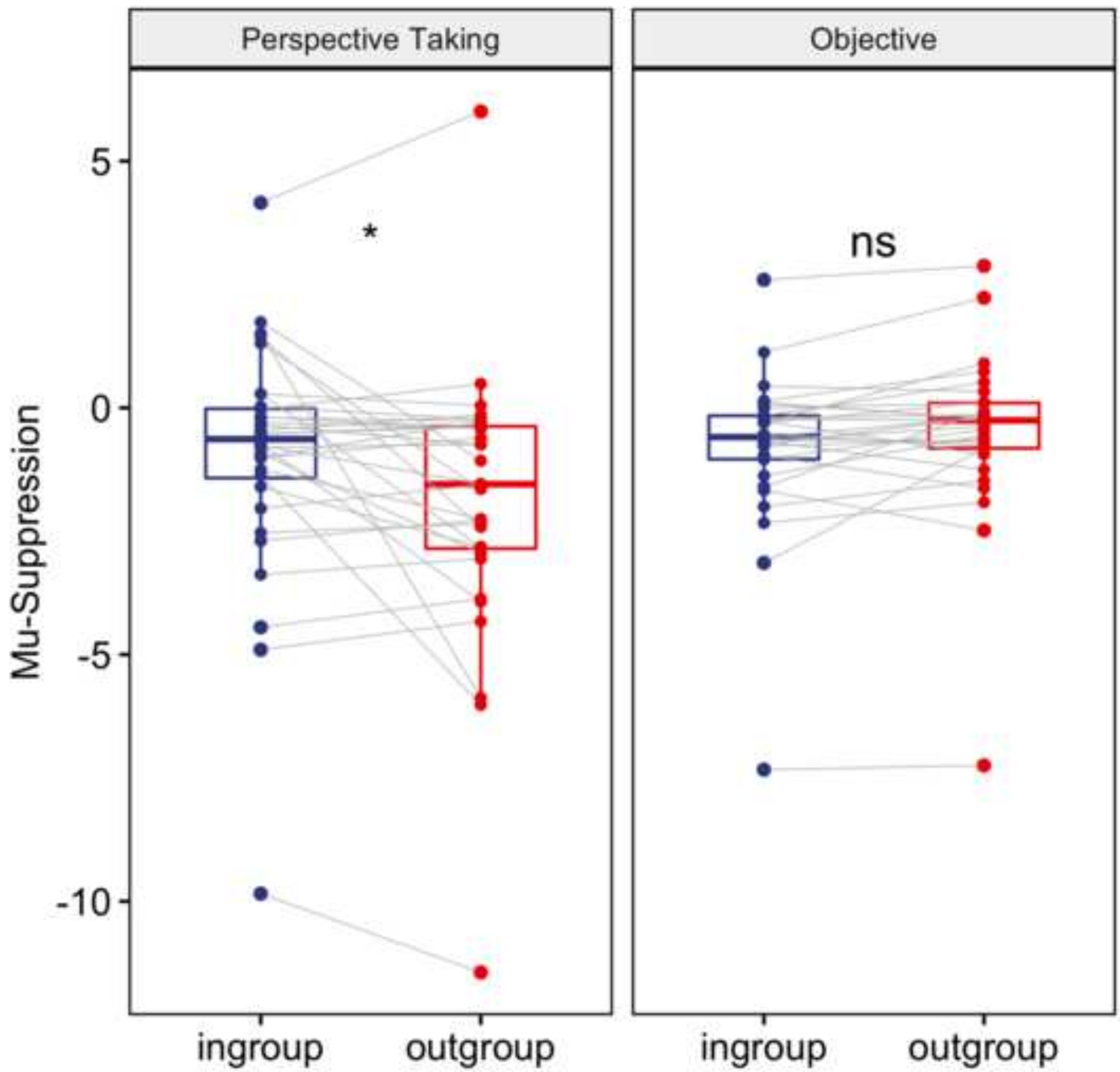
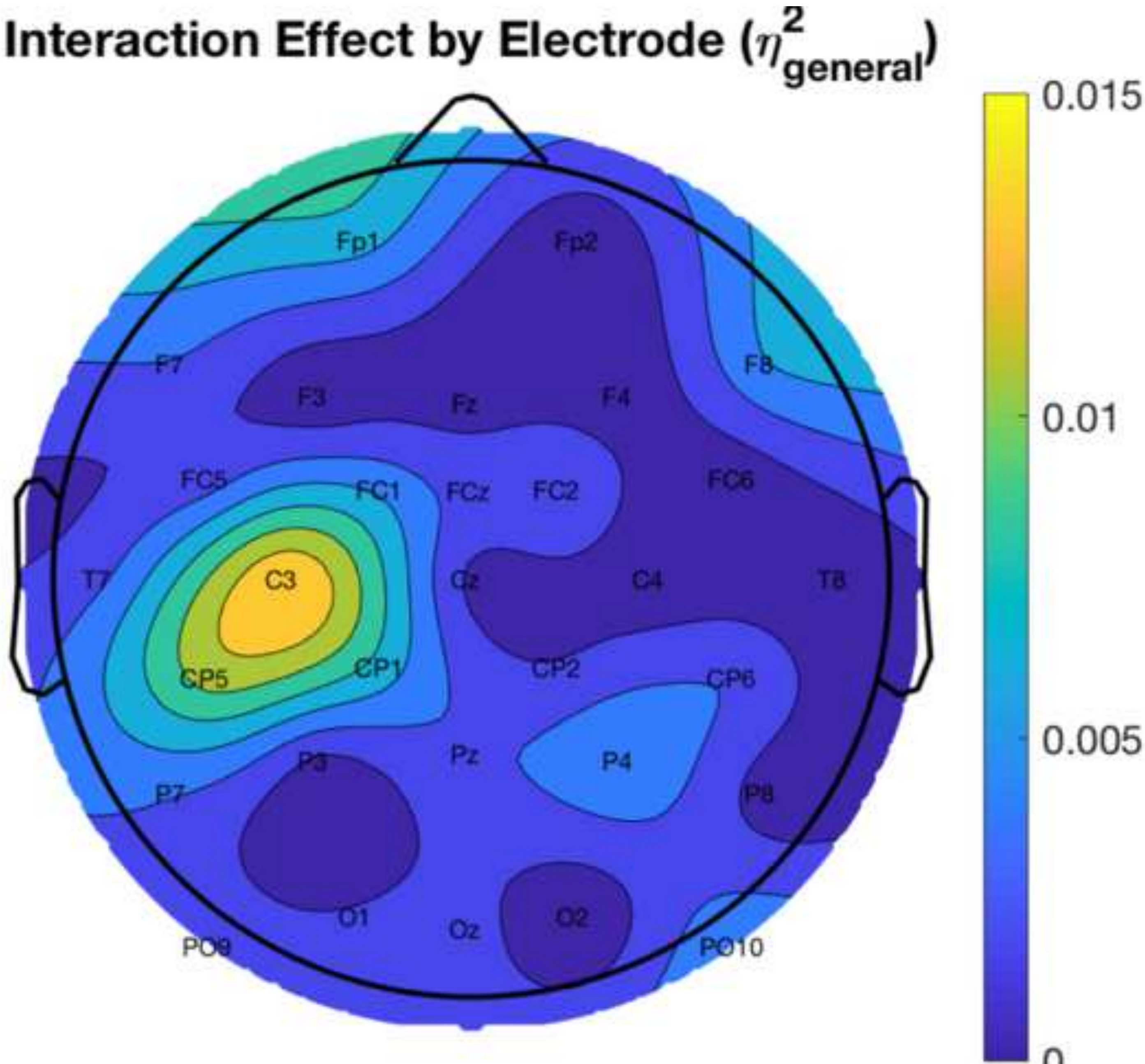


Figure 3


Interaction Effect by Electrode ($\eta^2_{general}$)
Fp1
Fp2
F7
F3
Fz
F4
F8
FC5
FC1
FCz
FC2
FC6
T7
C3
Cz
C4
T8
CP5
CP1
CP2
CP6
P7
P3
Pz
P4
P8
PO9
O1
Oz
O2
PO10
0.015
0.01
0.005
0