Body Swapping with a Black Person Boosts Empathy: Using Virtual Reality to Embody Another

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Complete List of Authors:	Thériault, Rémi; McGill University, Psychiatry; Chapman University, Institute for Interdisciplinary Behavioral and Brain Sciences Olson, Jay; McGill University, Psychiatry Krol, Sonia; McGill University, Psychology Raz, Amir; McGill University, Psychiatry; McGill University, Psychology; Lady Davis Institute for Medical Research, Jewish General Hospital; Chapman University, Institute for Interdisciplinary Behavioral and Brain Sciences
Keywords:	perspective-taking, empathy, intergroup relations, implicit bias, prejudice

Abstract

Perspective-taking, whether through imagination or virtual-reality interventions, seems to improve intergroup relations; however, what intervention leads to better outcomes remains unclear. This pre-registered study collected measures of empathy and race bias from 90 participants, split into one of three perspective-taking conditions. We drew on virtual-reality technology alongside a Black confederate across all conditions. Only in the embodied perspective-taking condition, participants got to exchange real-time viewpoints with the confederate and literally "see through the eyes of another." In the two other conditions, the mental perspective-taking condition and control group, participants either imagined a day in the life of the Black confederate or in their own life, respectively. Our findings show that, compared to a control group, the embodied perspective-taking group scored higher on empathy sub-components. On the other hand, both perspective-taking interventions differentially affected neither explicit nor implicit race bias. Our study suggests that body-swap improves intergroup relations by increasing empathy.

Keywords: perspective-taking, empathy, intergroup relations, implicit bias, prejudice

Body Swapping with a Black Person Boosts Empathy:

Using Virtual-Reality to Embody Another

Cultivating and sustaining harmonious and positive intergroup relations remains a substantial challenge for many increasingly-multicultural countries, especially given the growing refugee crisis (Esses et al., 2017). Prejudice and discrimination, in particular, represent central threats to intergroup harmony ("Consequences of prejudice.," 2007). Research also suggests that prejudice based on race seems deeply embedded within the human brain (Amodio, 2014; Kubota et al., 2012; Molenberghs, 2013). And yet, evidence also shows that such attitudes—even unconscious or implicit—are malleable; they can change with interventions such as diversity education (Dasgupta, 2013; Forscher et al., 2019; Rudman et al., 2001). Whereas explicit attitudes refer to conscious or deliberately reported positive (or negative) evaluations, implicit attitudes refer to more unconscious or automatic forms (Gawronski & Bodenhausen, 2006; Rydell & McConnell, 2006). One meta-analysis identified a small correlation of .24 between implicit and explicit attitudes, although more spontaneous self-reports and more conceptual correspondence between measures strengthen this relationship (Hofmann et al., 2005). Implicit and explicit attitudes also show incremental predictive validity—they contribute to behaviour in different and complimentary ways (Greenwald et al., 2009; Kurdi et al., 2019). For these reasons, it is important to measure both implicit and explicit attitudes.

Researchers seek strategies to successfully reduce both explicit and implicit prejudice as well as increase empathy, tolerance, and understanding of others. To this end, empathy serves as a remedy to prejudice because of its capacity to improve attitudes (Finlay & Stephan, 2000), and link with a wide range of interindividual benefits, including altruism (Krebs, 1975), cooperation in social dilemmas (Rumble et al., 2010), and prosocial behavior (Batson & Ahmad, 2009;

Eisenberg & Miller, 1987; Hoffman, 2008; Zaki, 2018). Despite globally concerted efforts to achieve these goals, therefore, researchers persist in their attempt to identify the most effective and sustainable procedures to reduce implicit prejudice and improve intergroup relations (e.g., Lai et al., 2014; Lai et al., 2016). The current study investigates the impact of two different perspective-taking strategies on empathy and the reduction of racial prejudice.

Perspective-Taking

Perspective-taking, or "seeing through the eyes of another," has emerged as a promising intervention to reduce prejudice (Stephan & Finlay, 1999; Todd & Galinsky, 2014). Interventions based on perspective-taking might, for example, ask participants to imagine a day in the life of an outgroup individual displayed in a photograph. Researchers have shown perspective-taking to reduce conscious and non-conscious stereotypes, in-group favoritism (Dovidio et al., 2004; Galinsky & Moskowitz, 2000), and implicit race bias (Todd et al., 2011; Todd & Burgmer, 2013; see Forscher et al., 2019, for a recent meta-analysis). Scientists have also shown perspective-taking to increase self-other merging (how much of your sense of self overlaps with the other person), one of the hypothesized mechanisms through which perspective-taking interventions reduce prejudice (Galinsky et al., 2005; Maister et al., 2015; Todd & Burgmer, 2013). Finally, studies have also shown perspective-taking to increase empathy (Batson, Early, et al., 1997; Batson, Polycarpou, et al., 1997; Crabb et al., 1983; Erera, 1997; Pacala et al., 1995; Pinzone-Glover et al., 1998; Todd & Burgmer, 2013).

Other researchers have questioned whether perspective-taking can remedy prejudice. For example, researchers analyzed 492 implicit bias reduction studies involving 87,418 participants and found widespread publication bias on the topic (Forscher et al., 2019). Similarly, in a seminal replication effort, drawing on 17,021 participants, 15 labs proposed interventions of their

choice; only 8 out of the 17 interventions successfully changed implicit attitudes (Lai et al., 2014). The most perspective-taking-like conditions were ineffective: (a) perspective taking itself (Cohen's d = -.04), (b) training empathic responding (d = -.02), and (c) imagining interracial contact (d = .01). Historically, furthermore, researchers construed perspective-taking as an intentional, controlled process, mobilizing imagination and other higher cognition (*mental perspective-taking* [MPT]; Davis, Conklin, Smith, & Luce, 1996; Roxβnagel, 2000). In some situations, insufficient motivation to engage in this mental effort typically makes even more challenging the act of taking the perspective of another person (Gehlbach et al., 2012; Hodges & Klein, 2001; Webster et al., 1996; Zaki, 2014). This pattern serves as a limiting factor to practical utility, reliability, and applicability. Whether perspective-taking effectively reduces prejudice and increases empathy, remains unclear.

As an intervention, alterations in body-ownership may carry fewer limitations than mental perspective-taking. In the case of specific body parts, inducing ownership over fake parts of the anatomy has made for an important discovery (Botvinick & Cohen, 1998). For example, concurrent stimulation instigates the illusion of ownership over an artificial (rubber) limb, or a digital face, even with incongruent skin color (Farmer et al., 2014; Farmer et al., 2012; Fini et al., 2013; Maister, Sebanz, et al., 2013). Processing such multisensory stimulation, the human brain rapidly integrates the foreign part into the body schema, albeit that spurious article may associate with an outgroup (Maister et al., 2015). Going beyond specific body parts, with virtual reality equipment, individuals can experience the illusion of embodying a virtual character (e.g., a computer-generated person). Again, this robust phenomenon persists even with a range of incongruent features, including skin color (Banakou et al., 2016; Groom et al., 2009; Peck et al.,

2013). As a result, scientists can lead White participants to identify with, view the world through the lens of, and experience the virtual image (*avatar*) of a Black individual (Peck et al., 2013).

This *embodied perspective-taking* (EPT) methodology affords probing the visuo-spatial perspective of an outgroup individual in a more embodied and automatic form. Moreover, information concerning the perspective of the other person feeds from the senses and, in contrast to traditional perspective-taking interventions, feels natural and requires little conscious effort. Importantly, such interventions affect social cognition and outgroup attitudes (Farmer & Maister, 2017). To be sure, EPT effectively reduces *implicit* race bias (Banakou et al., 2016; Farmer et al., 2014; Farmer et al., 2012; Maister, Banissy, et al., 2013; Peck et al., 2013; but see Groom et al., 2009) and even increases empathy (Herrera et al., 2018; van Loon et al., 2018). Collectively, these findings suggest that parameters related to body ownership shape outgroup attitudes by overlapping the sense of self with that of the other on an unconscious level (Maister et al., 2015). At least one study showed that EPT reversed an in-group bias effect, based on mimicry, regardless of implicit attitudes (Hasler et al., 2017) whereas most other studies found no or little effect on *explicit* bias (Ahn et al., 2013; Groom et al., 2009; Oh et al., 2016; Peck et al., 2013; Yee & Bailenson, 2006). The dissociation of explicit and implicit attitudes may uncover distinct underlying mechanisms: implicit attitudes may rely more on automatic, associative processes, while explicit ones may depend on evaluative, propositional reasoning processes (Gawronski & Bodenhausen, 2006; Rydell & McConnell, 2006). It remains unclear whether, how, and to what extent these perspective-taking interventions rely on such mechanisms, and whether we can practically change attitudes. The present piece represents our effort to address this question.

Mental Perspective-Taking versus Immersive Embodiment Experiences

Whereas researchers have independently shown both MPT and EPT methodologies to reduce prejudice (with some conflicting findings), they have only recently directly compared the effects of traditional MPT with virtual reality-based immersive embodiment experiences on prosocial and intergroup cognition and behaviour. This kind of comparison matters because it can inform the development of future interventions aimed at maximizing potential effects and help understand the contribution of the mechanisms of these methods. For instance, researchers have on the one hand shown an advantage of EPT over MPT on self-other merging, attitudes and dehumanization (delayed improvement), empathy (empathic concern and personal distress), intention to communicate with the outgroup, likelihood to sign a petition, and amount of time spent helping (Ahn et al., 2013; Herrera et al., 2018; Oh et al., 2016). On the other hand, researchers have also found that EPT and MPT hardly differed in terms of the positivity of the relationship with a virtual character, implicit or explicit bias, reading emotions of other people accurately, behaviour in a negotiation task, or donation amount (Ahn et al., 2013; Gehlbach et al., 2015; Groom et al., 2009; Herrera et al., 2018; Oh et al., 2016).

Although the few studies comparing EPT and MPT suggest a modest advantage of EPT in promoting prosocial cognition and behaviour, they have several limitations. Few of these studies specifically compared the effects of EPT and MPT on empathy as well as implicit and explicit bias. Thus, the effect of MPT versus EPT on these measures of empathy and prejudice remains unclear. Furthermore, none of these studies used a high-realism, real-time body exchange methodology, as well as a closely matched, procedurally similar control group. The most realistic methodology normally used involves a computer-generated virtual body. Yet, we might expect a more realistic illusion of embodiment, for example through the embodiment of

the real body of another person, to yield a stronger impact on prosocial cognition and behaviour. Indeed, body prostheses with more realistic hand structure or skin texture produce stronger illusions of embodiment (Kilteni et al., 2015; Tsakiris et al., 2010) and greater immersion links to greater empathy (van Loon et al., 2018).

Present Study

In this study, we aimed to address the limitations of the literature to compare the effects of MPT and EPT on empathy and prejudice. To this end, we compared three conditions: (a) traditional MPT, (b) a highly realistic form of EPT, and (c) a control group. Importantly, the new EPT methodology used in this study, the "body-swap illusion" (Petkova et al., 2008), rests on the real-time exchange of the viewpoint of the participant with another person—here, a Black confederate (see Method section for details). This project used a system developed by The Machine to Be Another group allowing two individuals to exchange their visual perspective (Bertrand et al., 2014). Using virtual reality headsets and cameras, this international group of artists, activists, and scientists, applies this technology to pursue interdisciplinary projects (beanotherlab.org). To our knowledge, no other study has experimentally examined whether this body-swap paradigm can increase empathy and reduce prejudice. Following the perspective-taking intervention, participants completed measures of empathy and explicit and implicit race attitudes. Our research questions were thus: Can MPT and EPT, compared to a control group, foster empathy as well as reduce explicit and implicit prejudice? If so, which perspective-taking method most effectively achieves these goals? Answering these questions will help guide the development of future interventions and the theory behind perspective-taking and prosocial cognition.

Hypotheses

Given the evidence that higher simulation realism and immersion increases the strength of bodily illusions (Kilteni et al., 2015) as well as the benefits of perspective-taking (Ahn et al., 2013; van Loon et al., 2018), we hypothesized that embodiment methodologies characterized by more realism and immersion should be more efficient at increasing empathy and reducing prejudice compared to traditional perspective-taking. Furthermore, given the distinct mechanisms of explicit and implicit attitude change (Gawronski & Bodenhausen, 2006; Rydell & McConnell, 2006), we reasoned that the deliberate and effortful processing involved in cognitively taking the perspective of someone else in MPT should affect explicit attitudes by engaging more propositional reasoning processes. Further, the perceptually induced shared body representation in EPT should affect implicit attitudes by engaging more associative processes (Kilteni et al., 2015; Maister et al., 2015). We therefore predicted that: (a) both the EPT and MPT groups would show more empathy as well as lower implicit and explicit prejudice, compared to the control group; (b) the EPT group would show greater empathy and lower implicit prejudice compared to the MPT group, and (c) the MPT group would show lower explicit prejudice compared to the EPT group.

Method

Participants

We pre-registered our study design, inclusion and exclusion criteria, sample size, variables, and hypotheses and analyses regarding empathy and explicit and implicit race bias online (https://osf.io/cws8g/?view_only=2f7d72d6ed5e42528b3080c385946d63). We disclose all measures, manipulations, and exclusions in the study, as well as the method of determining the final sample size (collection was not continued after data analysis). Given the resource-

intensive nature of this study, we were only interested in detecting medium to large effect sizes making the effort worthwhile. Accordingly, for feasibility reasons and in line with our pre-registration, we ran 30 participants per group (total of 90), which, along 80% power and a .05 alpha, enables the detection of medium-large effect sizes ($d \geq 0.74$). Because of this limited sample size, although pre-registered, this study represents a somewhat preliminary research effort.

We recruited 98 participants (18-35 years, with normal or corrected-to-normal vision, and without any history of psychiatric or neurological disorders) via social media postings for a "virtual reality and cognition" study. As outlined in the pre-registration, we excluded three participants who displayed faint understanding of the instructions (e.g., being clearly out of sync with the confederate, not understanding English well, or looking excessively tired). We also excluded from the main analysis data collected from five Black participants because the intervention targets prejudice against Black individuals.[1] This left a final sample size of 90 participants with mean age 22.2 years (*SD* = 3.0): 71% female, 29% male; 87% students; 50% White, 26% Asian, 17% South-Asian, 7% other.[2] We included non-White and non-Black participants because they typically show levels of implicit race bias against Blacks comparable to White individuals (Nosek et al., 2002). Due to experimenter error, one participant did not complete one questionnaire (the Interpersonal Reactivity Index) and was excluded from analyses using that variable. The Research Ethics Board had approved this study prior to data collection.

[1] We inadvertently omitted this exclusion criteria from our pre-registration. We provide full results with these five individuals included on the Open Science Framework: https://osf.io/gb2kr/?view_only=f9884633416341568066a4cb020dc8d1.

[2] We provide the final data set on the Open Science Framework: https://osf.io/gb2kr/?view_only=f9884633416341568066a4cb020dc8d1.

Procedure

A White male experimenter (24 years of age) initially welcomed the participant and a sex-matched Black confederate. Participants had no knowledge that the Black person was our research associate for the study. We randomly assigned participants to one of three groups: embodied perspective-taking (EPT), mental perspective-taking (MPT), and a control group. After obtaining consent, we made participants speciously believe that we were taking a photograph of each of them separately, "to use later in the experiment". This move was important for the perspective-taking intervention in the MPT condition (described below). For consistency, participants from all groups went through this ruse.

Participants then entered the testing area and set up their virtual-reality headset with the help of the experimenter. All groups used the same virtual-reality head-mounted display system. Whereas participants in the EPT group saw the visual image captured by the camera on the headset of the confederate, participants in the MPT and control groups simply saw the visual image captured by the camera on their own headset. The experimenter then read a script with instructions about specific motor movements that participants had to perform, and which were identical for all groups (Section S1). These movements were necessary to induce the multisensory illusion for the EPT group; however, again, for consistency, participants from all groups performed these actions. At one crucial point during the instructions (after approximately 5 minutes), the experimenter removed the curtains hiding the mirrors and read the experimental intervention according to the experimental condition (detailed below). This part of the experiment lasted about 10 minutes.

After each group intervention, participants completed the following measures (in this order): experimental intervention check, Implicit Association Test, Inclusion of Other in the Self

Scale, Symbolic Racism Scale, Interpersonal Reactivity Index, and Questionnaire of Cognitive and Affective Empathy. To address a separate research question, participants then completed the Self-Concept Clarity Scale (Campbell et al., 1996) , but these results are reported separately elsewhere (Citation Blinded). Finally, participants reported their understanding of the purpose of the study. In total, the experiment took one hour.

Perspective-Taking Interventions

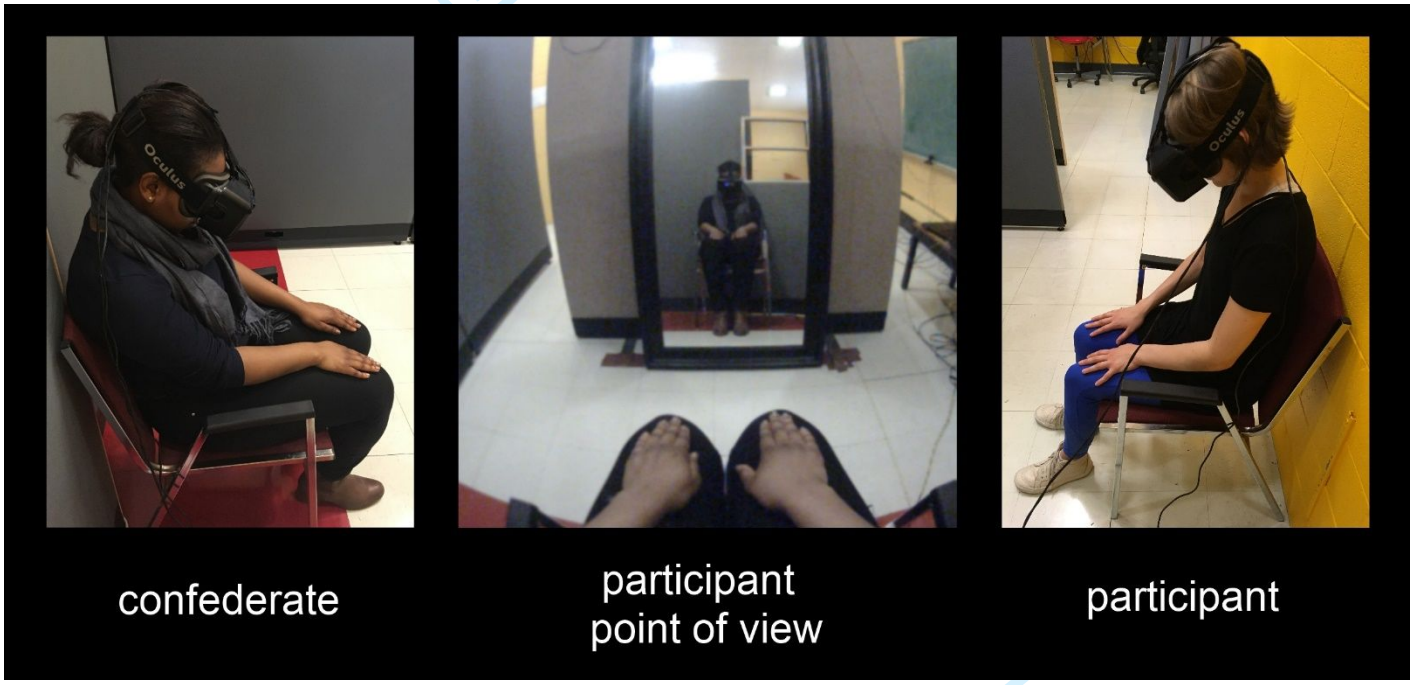
Embodied Perspective-Taking (EPT). Participants in the EPT group experienced a type of illusion originally described as "body swapping" (Petkova et al., 2008). In this methodology, both a participant and a Black confederate wear a virtual-reality headset with a camera attached to the headset at eye level. Critically, the system sends the image from the camera to the headset of the other person, so that the participant "sees through the eyes" of the confederate, and vice-versa (Bertrand et al., 2014; Bertrand et al., 2018; De Oliveira et al., 2016). Synchronized movements from both users result in an illusion of body ownership analogous to other bodily illusions (e.g., Botvinick & Cohen, 1998). Looking down at their hands or straight at a mirror, participants would see the hands or reflection of the Black confederate in place of their own hands or reflection (Figure 1).[3] Using this setup, participants typically experience their body as that of a Black person. Upon revealing the mirrors, the experimenter instructed: "For the next minute, look at yourself in the mirror in front of you." We adapted these instructions from Oh et al. (2016); they closely mirror those given in classic perspective taking interventions (e.g., Galinsky & Moskowitz, 2000).

[3] All individuals whose image appears throughout this paper have given their permission in writing.

The experimenter additionally stated to participants that they were randomly assigned "roles" to make things easier, with the confederate always obtaining the "leader" role and the participant the "follower" role. The experimenter then explained that instructions applied to the both of them, but that the leader (i.e., the confederate) would initiate the movements first, while the follower (i.e., the participant) would need to stay synchronized with the leader.

Figure 1

Body-Swap Setup



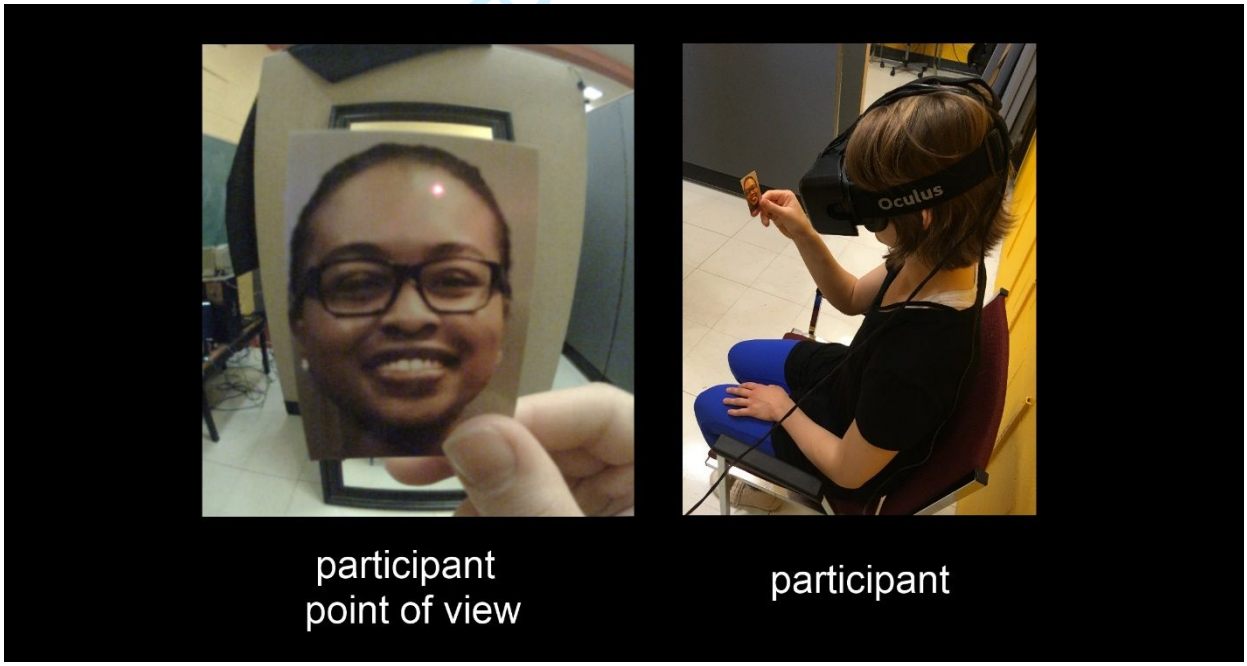
Note. Left: Confederate looking down at her hands. Middle: Participant point of view, seeing the confederate's hands and image reflection, instead of her own. Right: Participant looking down at her hands.

Mental Perspective-Taking (MPT). Upon revealing the mirrors, for participants in the MPT group only, the experimenter handed a photograph of the confederate (Figure 2). The experimenter then instructed: "For the next minute, take the perspective of the individual in the photograph. Imagine a day in the life of this individual as if you were that person, looking at the

world through her/his eyes and walking through the world in her/his shoes" (Galinsky & Moskowitz, 2000). The setup led participants to believe that the confederate engaged simultaneously in the procedure on the other side of the partition. For consistency, we printed all photographs of the confederates in advance. The role of the picture was to act as a visual aid, replicating previous perspective-taking methodologies (Galinsky & Ku, 2004; Galinsky & Moskowitz, 2000; Todd et al., 2011; Todd & Burgmer, 2013).

Figure 2

Mental Perspective-Taking Setup



Note. Participant looking down at the photograph of the confederate, allegedly taken at the beginning of the session.

Control group. Upon revealing the mirrors, the experimenter instructed participants in the control: "For the next minute, take the time to let your mind wander. Imagine a day in your life, looking at the world through your eyes and walking through the world in your shoes" (adapted from Galinsky & Moskowitz, 2000).

Materials

We used the Oculus Rift Development Kit 2 (DK2) as virtual-reality headset (head-mounted display). The headset contains two small screens inside, with resolutions of 960 x 1080 per eye and a refresh rate of 75 Hz, resulting in horizontal and vertical fields of view of approximately 100° of visual angle. To generate the body-swap illusion, we used a software called "The Machine to Be Another", developed by *BeAnotherLab* (Bertrand et al., 2018)[4]. We also modified the head-mounted display device by attaching a modified PlayStation 3 camera with a custom 3D printed structure (Figure 3).

Figure 3

Head-mounted display

Note. Oculus Rift Development Kit with PlayStation 3 camera and custom 3D-printed component. Frontal and side views.

[4] Publicly available at: https://github.com/BeAnotherLab/The-Machine-to-be-Another.

Measures

Intervention validity. To confirm the validity of our experimental interventions, we created questionnaires for each condition that assessed the extent to which participants followed instructions and engaged in the experimental task. Participants in the EPT group rated the degree to which they experienced the body-swap illusion by answering a questionnaire assessing the feeling of ownership over the perceived body (Section S2). To this end, we adapted a questionnaire measuring body ownership in the rubber hand illusion (Longo et al., 2008). Example items of this adapted questionnaire include: "It seemed like I was looking directly at my own body, rather than at someone else's body" and "It seemed like I could have moved the body I saw if I had wanted". We created analogous control statements for the two other groups (e.g., "I feel like I was imagining being in the other participant's skin", Section S3; "I imagined living a day in my life", Section S4).

Empathy. We measured empathy via the classic Interpersonal Reactivity Index (IRI; Davis, 1983) as well as with the more recent Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011). We used these measures of empathy because they are well-validated, easy to administer and index intervention outcomes (e.g., Erera, 1997; Pacala et al., 1995; Pinzone-Glover et al., 1998; also see Stepien & Baernstein, 2006; for a review, and Teding van Berkhout & Malouff, 2016, for a meta-analysis) . The IRI has four subscales: *perspective taking* (e.g., "Before criticizing somebody, I try to imagine how I would feel if I were in their place"), *fantasy* (e.g., "I really get involved with the feelings of the characters in a novel"), *empathic concern* (e.g., "I often have tender, concerned feelings for people less fortunate than me"), and *personal distress* (e.g., "When I see someone who badly needs help in an emergency, I go to pieces"). The QCAE measures cognitive empathy, the ability to represent the mental

experiences of other people, and affective empathy, the ability to experience emotions of other people. The QCAE comprises five subscales: *perspective taking* (e.g., "I can sense if I am intruding, even if the other person does not tell me") and *online simulation* (e.g., "I sometimes try to understand my friends better by imagining how things look from their perspective"), which relate to the cognitive empathy component, and *emotion contagion* (e.g., "I am happy when I am with a cheerful group and sad when the others are glum"), *proximal responsivity* (e.g., "I often get emotionally involved with my friends' problems"), and *peripheral responsivity* (e.g., "I often get deeply involved with the feelings of a character in a film, play or novel"), which relate to the affective empathy component.

Inclusion of the Other in the Self Scale (IOS). Participants also rated their levels of self-other overlap and feelings of closeness with the confederate (Aron et al., 1992). In this scale, participants select the instance that best represents their relationship with the confederate from seven variants of two increasingly overlapping circles. The first two circles share no overlap, whereas the last two circles overlap almost completely.

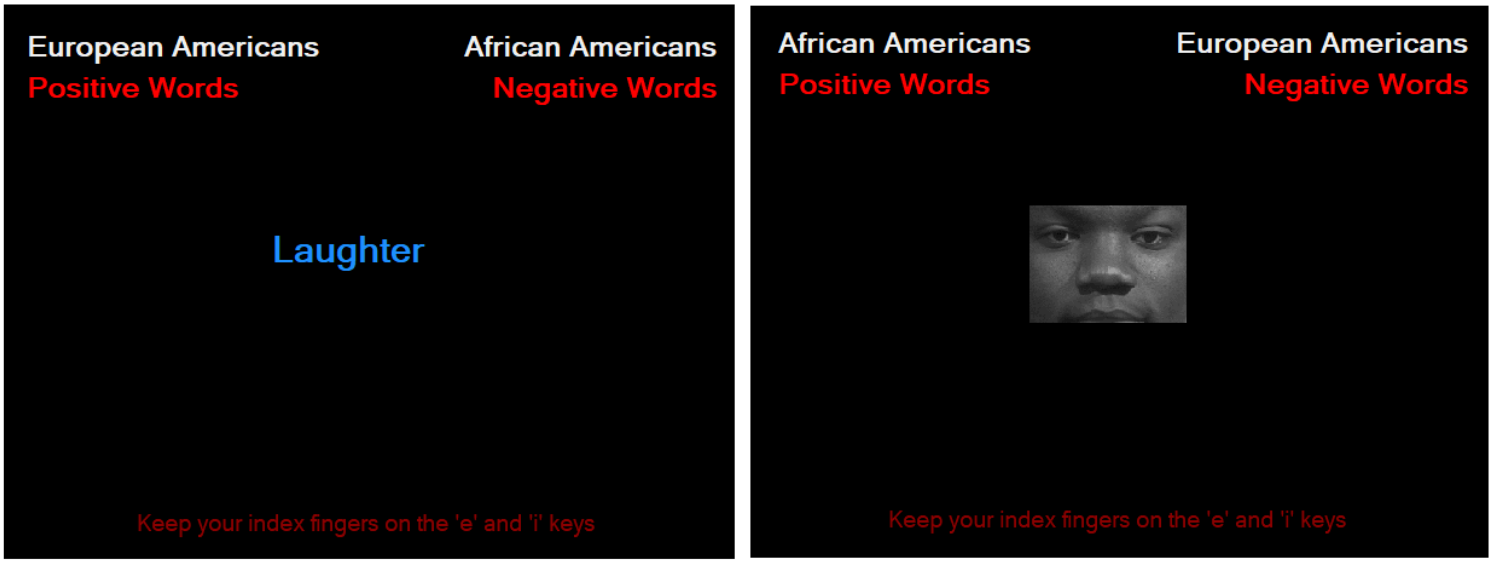
Implicit racial bias. We measured implicit racism with the Implicit Association Test (Greenwald et al., 1998; Greenwald et al., 2003; McConnell & Leibold, 2001), which measures the strength of automatic associations by comparing reaction times to various probes related to ethnicity (see Figure 4). We administered the IAT using the *Free*IAT software (Meade, 2009), without counterbalancing by design (Meade, 2020).[5] We used 50 trials per block (5 blocks) and the words and photo stimuli preloaded with the software. The *Free*IAT software provides an IAT

[5] Available at: https://meade.wordpress.ncsu.edu/freeiat-home/.

score (or *D*-score) using the improved scoring algorithm developed by Greenwald et al. (2003), which we used for our analyses.

Figure 4

Screenshots of sample stimuli from the FreeIAT (Implicit Association Test)



Note. Left: Participants need to categorize the word laughter as a positive word. Right: Participants need to categorize the individual's photograph as 'African American'.

Explicit racial bias. We measured explicit racism with the Symbolic Racism Scale (Henry & Sears, 2002; Sears & Henry, 2005), a psychometrically improved version of the Modern Racism Scale (McConahay, 1986). We changed items 3, 4, and 5 to use a single response scale for all questions (Section S5), so that participants stated their agreement from 1 (strongly agree) to 4 (strongly disagree). We also adapted the wording of certain items to the Canadian context (e.g., "Blacks are responsible for creating much of the racial tension that exists in Canada today").

Statistical Analyses

Confirmatory analyses. We used multiple regression with two-tailed planned contrasts, using group (EPT, MPT, control) as the predictor, and empathy, implicit bias, and explicit bias as separate outcomes, with an alpha threshold of .05 for all significance tests. The planned contrasts compared all pairs of groups and we used a robust version of Cohen's *d* as measure of effect size (Algina et al., 2005). We did not use family-wise type 1 error correction.

Exploratory analyses. We also used multiple regression with planned contrasts with self-other overlap. An exploratory regression table and figures are available in Section S6.

Assumptions. The assumptions were reasonable for most of the tests conducted. There were some violations of the assumptions of normality, homoscedasticity, and autocorrelation of residuals (see Table 1).

Software. We performed all statistical analyses in R version 3.4.2 using the following packages: lsmeans (contrast analyses; Lenth, 2016), bootES (effect sizes and bootstrapped confidence intervals; Kirby & Gerlanc, 2013), psych (internal reliability analyses; Revelle, 2018), as well as ggplot2 (Wickham, 2016), ggsignif (Ahlmann-Eltze, 2019) and ggpubr (Kassambara, 2019) for graphs.

Results

Descriptive Analyses

The self-report intervention check assessed how successfully participants engaged in their respective instructions. The average score was 4.25 across groups (or 61%, based on the maximum score of 7), and it was 4.30, 3.34, and 5.12 for the EPT, MPT, and control groups, respectively (61%, 48%, and 73%). Most primary measures had good reliability (see Table S2 in Section S7 for internal reliability indices for each multi-item questionnaire). Three participants

had relatively extreme values on one test and one participant on two questionnaires, relative to other participants (standard deviation scores ranging from -3.38 to 2.94). Because we had no other reason to exclude these participants, we proceeded with the analyses without further exclusions.

Confirmatory Analyses

We first hypothesized that the MPT and EPT groups would show more empathy as well as lower implicit and explicit prejudice than the control group. Our results supported some of these predictions. Participants in the EPT group generally showed more empathy than those in the control group: they had greater empathic concern (M = 4.21 [4.00, 4.42][6], Figure 5A), personal distress (M = 3.09 [2.80, 3.40], Figure 5B), and peripheral responsivity (M = 3.16 [2.97, 3.32], Figure 5C) than the control group (M = 3.86 [3.64, 4.08]; M = 2.69 [2.48, 2.93]; M = 2.85 [2.64, 3.04]). This suggests that participants in the EPT group saw themselves as having a stronger urge to help someone in need (empathic concern) and tended to experience more negative emotions when seeing someone in distress (personal distress) compared to those in the control group. It also suggests that participants in the EPT group felt they generally had stronger emotional reactions in less socially involving contexts, such as to characters from novels or movies (i.e., peripheral responsivity, a subcomponent of affective empathy) relative to those in the control group. However, the MPT group did not show more empathy than the control group on any of the measures used. Also contrary to our expectations, the two perspective-taking groups showed difference in neither cognitive nor affective empathy as defined by the QCAE. Also, they were comparable to the control group on explicit and implicit prejudice (see Table 1).

[6] Square brackets denote bootstrapped 95% confidence intervals throughout the manuscript.

We had also hypothesized that the EPT group would show greater empathy, lower implicit prejudice, and greater explicit prejudice compared to the MPT group. However, the EPT and MPT groups scantily differed in these dimensions of empathy and explicit and implicit prejudice. Importantly, the implicit prejudice scores were not only similar, but close to zero for all three groups (EPT: 0.06 [-0.03, 0.15], MPT: -0.01 [-0.10, 0.09], CTR: 0.003 [-0.13, 0.13]). Although IAT scores can be negative (i.e., a preference for Black people over White people), practically speaking, these low scores could indicate a type of "floor effect", as it is ostensibly harder to reverse bias than it is to simply reduce it. Indeed, body-illusion interventions only seem to reduce racial bias for those with a negative initial attitude (Farmer et al., 2014), and most interventions that successfully reduce racial bias do not reverse it (e.g, Forscher et al., 2019; Kurdi et al., 2019; Lai et al., 2014; Lai et al., 2016).

Exploratory Analyses

We also looked at the effect of group condition on the inclusion of the confederate in the sense of self of participants ("self-other merging"; see Table 1). Both the EPT (M = 4.00 [3.43, 4.57]) and MPT (M = 3.07 [2.57, 3.57]) group showed greater self-other merging compared to the control group (M = 2.30 [1.81, 2.79]); the EPT group also scored significantly higher on self-other merging than the MPT group (Figure 5D and Figure 6).[7]

[7] We originally intended on testing whether self-other overlap mediated any effects of empathy or prejudice. However, the results suggest our analysis is underpowered: the mediation revealed a total effect of Group on the Empathic Concern and Personal Distress subscales of the IRI, but we were unable to further decompose the effects in direct and indirect effects (see Section S8 for complete results).

Table 1

Results of multiple regression with planned contrasts analyses (confirmatory analyses with the exception of the Inclusion of Other in the Self scale)

	Variable	Comparison	*t*	*p*	d_R	95% CI
Race Bias (df = 87)	Implicit Race Bias[b]	Embodied - Control	0.735	.464	0.301	[-0.281, 0.989]
		Mental - Control	-0.126	.900	0.131	[-0.438, 0.793]
		Embodied - Mental	0.861	.392	0.170	[-0.223, 0.621]
	Symbolic Racism[a]	Embodied - Control	-1.183	.240	-0.307	[-0.873, 0.232]
		Mental - Control	-1.603	.113	-0.414	[-1.023, 0.099]
		Embodied - Mental	0.420	.676	0.107	[-0.402, 0.645]
Questionnaire of Cognitive and Affective Empathy (df = 87)	Cognitive Empathy[a]	Embodied - Control	-0.802	.425	-0.270	[-0.891, 0.313]
		Mental - Control	-0.566	.573	-0.119	[-0.666, 0.424]
		Embodied - Mental	-0.235	.814	-0.151	[-0.746, 0.43]
	Affective Empathy[b]	Embodied - Control	0.912	.364	0.237	[-0.387, 0.889]
		Mental - Control	1.199	.234	0.369	[-0.189, 1.041]
		Embodied - Mental	-0.287	.775	-0.132	[-0.622, 0.342]
	Perspective Taking[a]	Embodied - Control	-1.403	.164	-0.501	[-1.116, 0.03]
		Mental - Control	-0.965	.337	-0.261	[-0.819, 0.279]
		Embodied - Mental	-0.437	.663	-0.240	[-0.829, 0.299]
	Online Simulation	Embodied - Control	0.103	.918	-0.114	[-0.813, 0.461]
		Mental - Control	0.046	.963	-0.019	[-0.496, 0.519]

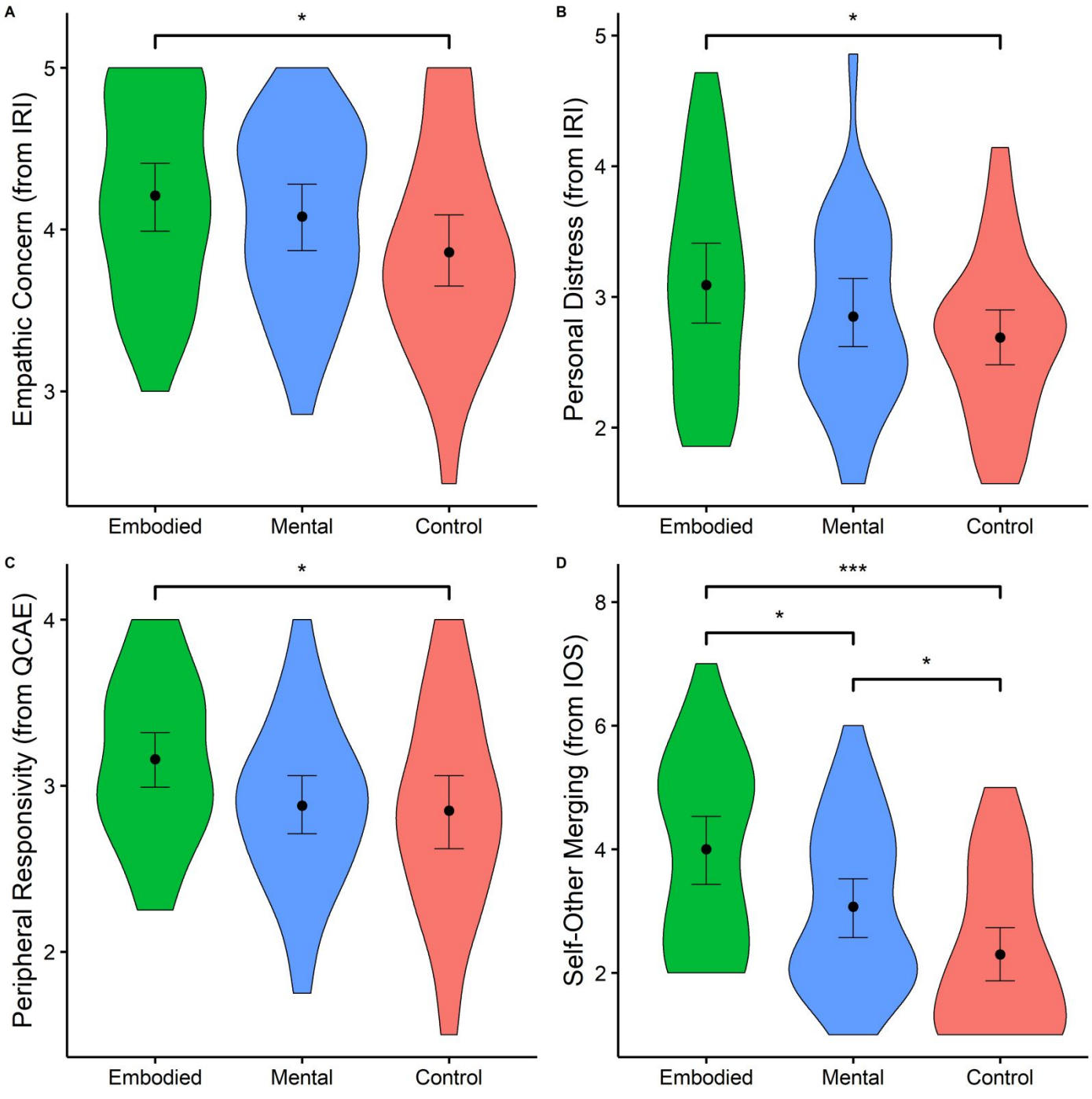
		Embodied - Mental	0.057	.955	-0.095	[-0.662, 0.397]
	Emotion Contagion[a]	Embodied - Control	-0.346	.730	-0.053	[-0.649, 0.613]
		Mental - Control	0.692	.491	0.102	[-0.485, 0.663]
		Embodied - Mental	-1.038	.302	-0.155	[-0.605, 0.33]
	Proximal Responsivity[a,b,c]	Embodied - Control	0.561	.577	0.155	[-0.515, 0.762]
		Mental - Control	1.899	.061	0.482	[-0.105, 1.14]
		Embodied - Mental	-1.338	.184	-0.327	[-0.793, 0.107]
	Peripheral Responsivity[a]	**Embodied - Control**	2.196	.031	0.525	[-0.063, 1.149]
		Mental - Control	0.237	.813	0.036	[-0.55, 0.595]
		Embodied - Mental	1.959	.053	0.489	[-0.016, 1.036]
Interpersonal Reactivity Index (df = 86)	Perspective-Taking[a]	Embodied - Control	0.122	.903	-0.068	[-0.689, 0.492]
		Mental - Control	0.019	.985	-0.174	[-0.738, 0.283]
		Embodied - Mental	0.102	.919	0.106	[-0.441, 0.782]
	Fantasy	Embodied - Control	0.151	.880	0.095	[-0.451, 0.656]
		Mental - Control	-1.386	.169	-0.355	[-0.899, 0.117]
		Embodied - Mental	1.536	.128	0.450	[-0.14, 1.063]
	Empathic Concern[a]	**Embodied - Control**	2.301	.024	0.589	[0.03, 1.253]
		Mental - Control	1.448	.151	0.421	[-0.048, 1.011]
		Embodied - Mental	0.834	.407	0.168	[-0.412, 0.765]
	Personal Distress	**Embodied - Control**	2.130	.036	0.480	[-0.044, 1.12]
		Mental - Control	0.858	.393	0.186	[-0.242, 0.703]
		Embodied - Mental	1.254	.213	0.294	[-0.296, 0.933]

(Exploratory Measure)	**Embodied - Control**	**4.708**	**< .001**	**1.090**	**[0.432, 1.755]**
Inclusion of Other in the Self[a]	**Mental - Control**	**2.123**	**.037**	**0.467**	**[-0.034, 1.026]**
(df = 87)	**Embodied - Mental**	**2.585**	**.011**	**0.623**	**[0.000, 1.259]**

Note. d_R = robust Cohen's *d*; CI = bootstrapped confidence interval. The comparisons were between-groups only (i.e., there were no within-subject pre/post comparisons). One participant did not complete the Interpersonal Reactivity Index. Superscripts indicate these measures had some violation of the assumptions of normal distribution of the residuals[a], of homoscedasticity[b], or of autocorrelation of residuals[c].

Figure 5

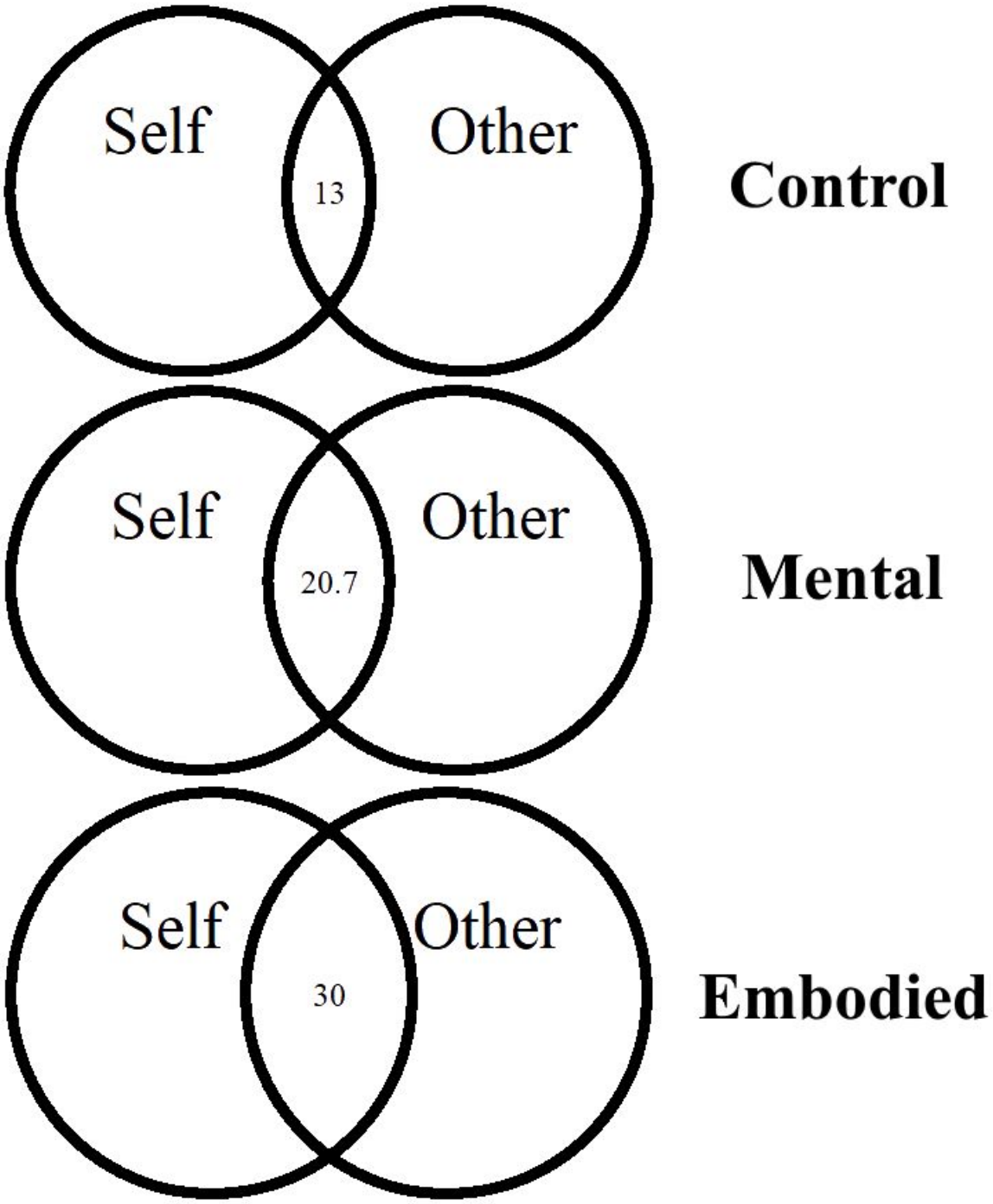
Comparison of Experimental Groups on Empathy and Self-Other Merging



Note. Effects of experimental condition on *Empathic Concern* (A) and *Personal Distress* (B; IRI: Interpersonal Reactivity Index), *Peripheral Responsivity* (C; QCAE: Questionnaire of Cognitive and Affective Empathy), and self-other merging (D; IOS: Inclusion of Other in the Self Scale). Dots = means; error bars = bootstrapped 95% confidence intervals; width = distribution density (frequency). * = $p < .05$; *** = $p < .001$. Empathy was highest in the Embodied Perspective-Taking group.

Figure 6

Interpolation of the Inclusion of the Other in the Self Scale by Experimental Group



Note. Circles and numbers represent the average percentage overlap for each group, using linear interpolation from the original Inclusion of the Other in the Self (IOS) scale. Self-other merging was highest in the Embodied Perspective-Taking group, followed by the Mental Perspective-Taking group, followed by the control group.

Discussion

The current investigation aimed to examine which perspective-taking strategy—embodied or mental—most effectively increase empathy and decrease prejudice. We found that participants in the EPT group showed greater empathy and self-other merging toward a Black confederate than those in the control group, while the MPT group similarly showed more self-other merging than the control group. Specifically, participants in the EPT group showed higher empathic concern, personal distress, and peripheral responsivity than those in the control group. Overall, these findings suggest that one can implement brief perspective-taking interventions based on imagination or virtual-reality to increase empathy and feelings of closeness. Even without a direct effect of these interventions on race bias, they may indirectly improve intergroup relations through their effects on empathy and closeness. Whereas a mediation analysis would have been appropriate in this case (e.g., testing whether empathy mediates the effect of experimental condition on implicit prejudice), given our low and homogenous IAT data, such an approach may be less helpful. Future research should investigate this hypothesis.

Empathy

Our EPT intervention led to higher scores of empathic concern, personal distress, and peripheral responsivity compared to the control group. Previous research has shown that perspective-taking generally leads to higher empathy on a variety of measures (Batson, Early, et al., 1997; Batson, Polycarpou, et al., 1997; Crabb et al., 1983; Erera, 1997; Pacala et al., 1995; Pinzone-Glover et al., 1998). Interestingly, although our EPT group showed higher empathy compared to the control group, our MPT group was comparable to the control group, even though it most closely resembled these previous interventions. In contrast to the current project, many of the previous perspective-taking studies required participants to write a narrative essay

about a day in the life of an outgroup individual, beyond simply imaging what it is like to be that person. Since a narrative creation exercise was absent from our MPT intervention, the act of writing may explain the stronger effects observed in these earlier studies, since it may engage deeper processing than simply reflecting on a topic.

The literature on illusions of embodiment reports that EPT and MPT are on par deciphering emotions of other people (i.e., on an "empathic listening" task; Oh et al., 2016). However, one study found that EPT led to higher target-specific empathy than a control group (van Loon et al., 2018) and another that EPT led to higher empathic concern and personal distress (Herrera et al., 2018), a finding we conceptually replicate. Also relevant to these findings, one study showed that imagining how *you* would feel in a given situation ("imagine-self")—and not just imagining how *another* would feel ("imagine-other")—led to higher ratings of personal distress (Batson, Early, et al., 1997). Our EPT intervention probably led to increases in personal distress as well because perceptually embodying the body of the other person from a first-person point of view resembles more closely imagining yourself (it appears, after all, as *your* visual perspective) than imagining another (which may be more conceptual). Of note, our exploratory analyses also showed that participants that first experienced greater embodiment with the confederate then also scored higher on personal distress (Figure S1 in Section S6). Finally, though speculative, we suspect that the observed effect on peripheral responsivity (a subcomponent of affective empathy associated with reacting to novel or movie characters) may be due to a phenomenological feature of the EPT group, whereas the similarity to watching a 3D-movie may have been experienced as a detached social context.

Self-Other Overlap

In this study, both perspective-taking groups showed considerably more self-other merging with the confederate than the control group—that is, they felt closer to the confederate. Furthermore, those from the EPT group also showed more self-other merging than the MPT group. These results replicate past studies looking at self-other merging using perspective-taking (Davis et al., 1996; Galinsky & Ku, 2004; Galinsky et al., 2005; Galinsky & Moskowitz, 2000; Todd et al., 2012) or illusions of embodiment (Herrera et al., 2018; Oh et al., 2016; Paladino et al., 2010). However, researchers find mixed results regarding the benefit of EPT over MPT on self-other overlap, with some finding differences and others not (Ahn et al., 2013; Herrera et al., 2018; Oh et al., 2016).[8] One recent study found that EPT led to increased self-other merging compared to a control group but not compared to MPT (Herrera et al., 2018), though their EPT self-other merging scores were considerably lower, though their EPT self-other merging scores were considerably lower than in the current study (by about a full scale point). Our higher self-other merging scores might be an indication that methodologies that employ more realistic features, such as the body-swap paradigm, can induce more self-other overlap.

In our exploratory analyses, we also found that people who experienced greater self-other overlap with the confederate then also scored higher on empathic concern and personal distress (Figures S2 and S3 in Section S6). A follow-up analysis showed that self-other merging and embodiment specifically correlated with personal distress items relating to feeling helpless or losing control in emotional/emergency situations. Perhaps experiencing higher self-other overlap with the confederate led participants to see themselves as more empathically concerned and more

[8] Ahn et al.'s (2013, study 2) numbers were quite similar to ours: the average self-other merging scores were respectively 3.98 and 4.00 for the EPT group, and 2.39 and 3.07 for the MPT group.

personally distressed (or that their current emotional state influenced their responses), especially since the groups also differed on these measures). Indeed, researchers have found self-other overlap to mediate the relationship between perspective-taking and changes in self-concept (Galinsky et al., 2008; Goldstein & Cialdini, 2007; Laurent & Myers, 2011). However, the correlational nature of this analysis prevents us from excluding the possibility that more empathically concerned and personally distressed people were more disposed to experience greater self-other overlap.

Implicit attitudes

Although we expected our perspective-taking interventions to reduce implicit race bias, this effect was absent (cf. Forscher et al., 2019, for a discussion relevant to statistical power and Type II errors regarding the small effect sizes usually found for changing implicit attitudes). This finding contrasts with previous research showing perspective-taking reduces implicit bias (Todd et al., 2011; Todd & Burgmer, 2013). Again, this result may be explainable by the lack of a narrative essay in the current study. However, our findings also align with other failed replication studies that used perspective-taking (Lai et al., 2014). Our findings also differ from studies based on illusions of embodiment—specifically those that changed implicit bias via the illusory embodiment of a black rubber hand (Farmer, 2014; Farmer et al., 2012; Maister, Sebanz, et al., 2013) or of a full virtual body (Banakou et al., 2013; Groom et al., 2009; Oh et al., 2016; Peck et al., 2013). However, unlike us, most of these studies employed a within-subjects design by examining IAT scores before and after the embodiment intervention. Those studies that used a between-subject design like we did failed to find that EPT reduced implicit race bias compared to their control group (Groom et al., 2009; Oh et al., 2016).

As mentioned earlier, in this study, the average implicit race bias against African-Americans, computed as the *D*-score (Greenwald et al., 2003), approached zero for all our three groups (higher *D*-scores indicate more race bias), and likely represents the primary reason why we haven't found implicit race bias differences across our groups. Such low *D*-scores contrast markedly with the scores reported in other studies, closer to .50 (see Table S4 in Section S9). Even the implicit race bias of our control group approximated zero, although their self-other merging scores were relatively low (normally associated with greater reductions in implicit bias), which could suggest, as mentioned earlier, a practical floor effect. Because of space constraints, we relocate to the supplementary materials (Section S9) a more thorough discussion and investigation, for the interested reader, of the potential factors underlying such low and homogenous IAT scores.

Explicit attitudes

Our interventions scarcely affected explicit race attitudes, unlike several previous studies on perspective-taking (Batson et al., 2002; Batson, Polycarpou, et al., 1997; Dovidio et al., 2004; Galinsky & Ku, 2004; Galinsky & Moskowitz, 2000; Shih et al., 2009; Todd et al., 2011; Vescio et al., 2003). On the one hand, these perspective-taking interventions either involved writing narrative essays (Galinsky & Ku, 2004; Galinsky & Moskowitz, 2000; Todd et al., 2011), or witnessing the misery and suffering of these individuals (Batson et al., 2002; Batson, Polycarpou, et al., 1997) or an injustice perpetrated against the outgroup (e.g., Dovidio et al., 2004; Todd et al., 2011; Vescio et al., 2003). These interventions could thus lead to different or stronger effects since they can also prime values of justice (Finlay & Stephan, 2000), without necessarily isolating the perspective-taking component *per se*. On the other hand, these self-report measures may be particularly susceptible to demand characteristics, especially because

some of these scales were measuring blatant, rather than subtle, prejudice (e.g., Brigham, 1993). Of course, because our questionnaire clearly assessed attitudes toward Black people, there may be an aspect of social desirability across conditions in our study as well, especially since participants were in the presence of another "participant" who was Black.

Although earlier studies did find changes in explicit attitudes following perspective-taking, more recent studies have mostly failed to replicate these findings. Many of them have in fact shown no effect from either EPT or MPT on explicit attitudes (Ahn et al., 2013; Groom et al., 2009; Oh et al., 2016; Peck et al., 2013). Out of three explicit measures of ageism, one study only found an effect of EPT on a word association task (Yee & Bailenson, 2006). Another study found that from the three "engaging with others' perspectives" strategies mentioned earlier, none reduced explicit race bias (Lai et al., 2014). Furthermore, of the eight interventions that successfully changed *implicit* race bias in the first study, none changed *explicit* race bias in a subsequent replication study (Lai et al., 2016), suggesting that explicit attitudes may be robust to lasting change, at least following these types of short-term interventions. Thus, it appears that interventions designed to reduce explicit prejudice produce a mixed bag of outcomes, with many of these findings consistent with ours.

Limitations

This study had several limitations. First, the low IAT scores left little room for further improvement from our interventions and so did not allow to answer our questions regarding racial bias. Second, although our exploratory tests revealed ethnic origin seemed unrelated to implicit race bias scores, our sample composition was rather heterogeneous: only 50% of participants were White (in this regard, this caveat serves as an observation more than a limitation). Third, on average participants reported having only 60% successfully engaged in

their respective instructions, in relation to the maximum scores of the intervention check scales. Fourth, many participants had trouble following the movements of the confederate precisely and synchronously through the head-mounted display in the EPT condition; at times even some of the confederates found it challenging to coordinate perfectly with participants. This coordination difficulty might have limited the strength of the illusory embodiment. Indeed, no participant from the EPT condition reported the maximum embodiment score of seven, and only three reported the second maximum score of six. Perhaps using a regular virtual environment with a virtual avatar and motion detectors would provide more accurate tracking and visuo-proprioceptive feedback. Fifth, using a state empathy measure instead of dispositional ones might have provided a better picture of short-term emotional changes. Thus, readers should interpret these findings with caution given that the scales framed questions as how people are "in general", instead of how they felt immediately following the procedure. Future research could verify our results using picture- or video-based state empathy measures (e.g., Dziobek et al., 2008; Kuypers, 2017; Lindeman et al., 2018). Sixth, there was considerable interindividual variation, so a pre-post within-subject design (repeated measures) might have been more informative regarding the effects of the intervention, though it would have likely increased demand characteristics. Seventh, we only relied on self-report measures (except for the IAT), which might have been subject to demand characteristics as well, so additional, behavioural measures would be appropriate for future research. Finally, our current statistical power, although in line with our pre-registration, did not allow for the detection of small and medium effects. Despite these limitations, our empathy findings are encouraging to improve intergroup relations given the association between empathy, prejudice, and prosocial benefits (Batson &

Ahmad, 2009; Eisenberg & Miller, 1987; Finlay & Stephan, 2000; Hoffman, 2008; Krebs, 1975; Rumble et al., 2010; Zaki, 2018).

Conclusion

Our findings suggest that perspective-taking interventions, based on imagination or illusions of embodiment of an outgroup, unreliably affect conscious and automatic race bias. At the same time, these perspective-taking interventions can increase some aspects of empathy (empathic concern, personal distress, and peripheral responsivity) and make one feel considerably closer to a specific outgroup member. Future research should investigate whether lengthier interventions and using more racially biased populations can lead to stronger effects on explicit and implicit prejudice. Despite their limitations, the current interventions—the EPT intervention based on virtual reality in particular—show potential to improve intergroup relations.

References

Ahlmann-Eltze, C. (2019). ggsignif: Significance brackets for 'ggplot2'. https://CRAN.R-project.org/package=ggsignif Version = 0.6.0.

Ahn, S. J., Le, A. M. T., & Bailenson, J. (2013). The effect of embodied experiences on self-other merging, attitude, and helping behavior. *Media Psychology, 16*(1), 7-38. 10.1080/15213269.2012.755877

Algina, J., Keselman, H. J., & Penfield, R. D. (2005). An alternative to Cohen's standardized mean difference effect size: A robust parameter and confidence interval in the two independent groups case. *Psychological Methods, 10*(3), 317-328. 10.1037/1082-989X.10.3.317

Amodio, D. M. (2014). The neuroscience of prejudice and stereotyping. *Nature Reviews Neuroscience, 15*(10), 670-682. 10.1038/nrn3800

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology, 63*(4), 596-612. 10.1037/0022-3514.63.4.596

Banakou, D., Groten, R., & Slater, M. (2013). Illusory ownership of a virtual child body causes overestimation of object sizes and implicit attitude changes. *Proceedings of the National Academy of Sciences of the United States of America, 110*(31), 12846-12851. 10.1073/pnas.1306779110

Banakou, D., Hanumanthu, P. D., & Slater, M. (2016). Virtual embodiment of White people in a Black virtual body leads to a sustained reduction in their implicit racial bias. *Frontiers in Human Neuroscience, 10*(601). 10.3389/fnhum.2016.00601

Batson, C. D., & Ahmad, N. Y. (2009). Using empathy to improve intergroup attitudes and relations. *Social Issues and Policy Review, 3*(1), 141-177. 10.1111/j.1751-2409.2009.01013.x

Batson, C. D., Chang, J., Orr, R., & Rowland, J. (2002). Empathy, attitudes, and action: Can feeling for a member of a stigmatized group motivate one to help the group? *Personality and Social Psychology Bulletin, 28*(12), 1656-1666. 10.1177/014616702237647

Batson, C. D., Early, S., & Salvarani, G. (1997). Perspective taking: Imagining how another feels versus imaging how you would feel. *Personality and social psychology bulletin, 23*(7), 751-758. 10.1177/0146167297237008

Batson, C. D., Polycarpou, M. P., Harmon-Jones, E., Imhoff, H. J., Mitchener, E. C., Bednar, L. L., Klein, T. R., & Highberger, L. (1997). Empathy and attitudes: Can feeling for a member of a stigmatized group improve feelings toward the group? *Journal of Personality and Social Psychology, 72*(1), 105. 10.1037/0022-3514.72.1.105

Bertrand, P., Gonzalez-Franco, D., Cherene, C., & Pointeau, A. (2014). *'The Machine to Be Another': Embodiment performance to promote empathy among individuals*. http://doc.gold.ac.uk/aisb50/AISB50-S16/AISB50-S16-Bertrand-paper.pdf

Bertrand, P., Guegan, J., Robieux, L., McCall, C. A., & Zenasni, F. (2018). Learning empathy through virtual reality: Multiple strategies for training empathy-related abilities using body ownership illusions in embodied virtual reality. *Frontiers in Robotics and AI, 5*, 26. 10.3389/frobt.2018.00026

Botvinick, M., & Cohen, J. (1998). Rubber hands 'feel' touch that eyes see. *Nature, 391*(6669), 756-756. https://doi.org/10.1038/35784

Brigham, J. C. (1993). College students' racial attitudes. *Journal of Applied Social Psychology, 23*(23), 1933-1967. 10.1111/j.1559-1816.1993.tb01074.x

Campbell, J. D., Trapnell, P. D., Heine, S. J., Katz, I. M., Lavallee, L. F., & Lehman, D. R. (1996). Self-concept clarity: Measurement, personality correlates, and cultural boundaries. *Journal of Personality and Social Psychology, 70*(1), 141. 10.1037/0022-3514.70.1.141

Consequences of prejudice. (2007). In R. C. Hanes, S. M. Hanes, K. Rudd, & S. Hermsen (Eds.), *Prejudice in the modern world reference library*. https://www.encyclopedia.com/social-sciences/news-wires-white-papers-and-books/consequences-prejudice

Crabb, W. T., Moracco, J. C., & Bender, R. C. (1983). A comparative study of empathy training with programmed instruction for lay helpers. *Journal of Counseling Psychology, 30*(2), 221. 10.1037/0022-0167.30.2.221

Dasgupta, N. (2013). Implicit attitudes and beliefs adapt to situations: A decade of research on the malleability of implicit prejudice, stereotypes, and the self-concept. *Advances in Experimental Social Psychology, 47*, 233-279. 10.1016/B978-0-12-407236-7.00005-X

Davis, M. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology, 44*(1), 113-126. 10.1037/0022-3514.44.1.113

Davis, M. H., Conklin, L., Smith, A., & Luce, C. (1996). Effect of perspective taking on the cognitive representation of persons: A merging of self and other. *Journal of Personality and Social Psychology, 70*(4), 713. 10.1037/0022-3514.70.4.713

De Oliveira, E. C., Bertrand, P., Lesur, M. E. R., Palomo, P., Demarzo, M., Cebolla, A., Baños, R., & Tori, R. (2016). Virtual body swap: A new feasible tool to be explored in health

and education. 2016 XVIII Symposium on Virtual and Augmented Reality (SVR), Gramado, Brazil.

Dovidio, J. F., Ten Vergert, M., Stewart, T. L., Gaertner, S. L., Johnson, J. D., Esses, V. M., Riek, B. M., & Pearson, A. R. (2004). Perspective and prejudice: Antecedents and mediating mechanisms. *Personality and Social Psychology Bulletin, 30*(12), 1537-1549. 10.1177/0146167204271177

Dziobek, I., Rogers, K., Fleck, S., Bahnemann, M., Heekeren, H. R., Wolf, O. T., & Convit, A. (2008). Dissociation of cognitive and emotional empathy in adults with Asperger syndrome using the Multifaceted Empathy Test (MET). *Journal of Autism and Developmental Disorders, 38*(3), 464-473. 10.1007/s10803-007-0486-x

Eisenberg, N., & Miller, P. A. (1987). The relation of empathy to prosocial and related behaviors. *Psychological Bulletin, 101*(1), 91-119. 10.1037/0033-2909.101.1.91

Erera, P. I. (1997). Empathy training for helping professionals: Model and evaluation. *Journal of Social Work Education, 33*(2), 245-260. 10.1080/10437797.1997.10778868

Esses, V. M., Hamilton, L. K., & Gaucher, D. (2017). The global refugee crisis: Empirical evidence and policy implications for improving public attitudes and facilitating refugee resettlement. *Social Issues and Policy Review, 11*(1), 78-123. 10.1111/sipr.12028

Farmer, H. (2014). *Incorporating the other: Investigating body representation and social cognition* University of London]. Royal Holloway. https://pure.royalholloway.ac.uk/portal/files/18894603/HarryFarmer_Thesis.pdf

Farmer, H., & Maister, L. (2017). Putting ourselves in another's skin: Using the plasticity of self-perception to enhance empathy and decrease prejudice. *Social Justice Research, 30*(4), 323-354. 10.1007/s11211-017-0294-1

Farmer, H., Maister, L., & Tsakiris, M. (2014). Change my body, change my mind: The effects of illusory ownership of an outgroup hand on implicit attitudes toward that outgroup. *Frontiers in Psychology, 4*, 10, Article 1016. 10.3389/fpsyg.2013.01016

Farmer, H., Tajadura-Jimenez, A., & Tsakiris, M. (2012). Beyond the colour of my skin: How skin colour affects the sense of body-ownership. *Consciousness and Cognition, 21*(3), 1242-1256. https://dx.doi.org/10.1016%2Fj.concog.2012.04.011

Fini, C., Cardini, F., Tajadura-Jiménez, A., Serino, A., & Tsakiris, M. (2013). Embodying an outgroup: The role of racial bias and the effect of multisensory processing in somatosensory remapping. *Frontiers in Behavioral Neuroscience, 7*, 165.

Finlay, K. A., & Stephan, W. G. (2000). Improving intergroup relations: The effects of empathy on racial attitudes. *Journal of Applied Social Psychology, 30*(8), 1720-1737. 10.1111/j.1559-1816.2000.tb02464.x

Forscher, P. S., Lai, C. K., Axt, J. R., Ebersole, C. R., Herman, M., Devine, P. G., & Nosek, B. A. (2019). A meta-analysis of procedures to change implicit measures. *Journal of Personality and Social Psychology*. 10.1037/pspa0000160

Galinsky, A. D., & Ku, G. (2004). The effects of perspective-taking on prejudice: The moderating role of self-evaluation. *Personality and Social Psychology Bulletin, 30*(5), 594-604. 10.1177/0146167203262802

Galinsky, A. D., Ku, G., & Wang, C. S. (2005). Perspective-taking and self-other overlap: Fostering social bonds and facilitating social coordination. *Group Processes & Intergroup Relations, 8*(2), 109-124. 10.1177/1368430205051060

Galinsky, A. D., & Moskowitz, G. B. (2000). Perspective-taking: Decreasing stereotype expression, stereotype accessibility, and in-group favoritism. *Journal of Personality and Social Psychology, 78*(4), 708. 10.1037/0022-3514.78.4.708

Galinsky, A. D., Wang, C. S., & Ku, G. (2008). Perspective-takers behave more stereotypically. *Journal of Personality and Social Psychology, 95*(2), 404-419. 10.1037/0022-3514.95.2.404

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin, 132*(5), 692. 10.1037/0033-2909.132.5.692

Gehlbach, H., Brinkworth, M. E., & Wang, M.-T. (2012). The social perspective taking process: What motivates individuals to take another's perspective? *Teachers College Record, 114*(1), 197-225.

Gehlbach, H., Marietta, G., King, A. M., Karutz, C., Bailenson, J. N., & Dede, C. (2015). Many ways to walk a mile in another's moccasins: Type of social perspective taking and its effect on negotiation outcomes. *Computers in Human Behavior, 52*, 523-532. http://dx.doi.org/10.1016/j.chb.2014.12.035

Goldstein, N. J., & Cialdini, R. B. (2007). The spyglass self: A model of vicarious self-perception. *Journal of Personality and Social Psychology, 92*(3), 402-417. 10.1037/0022-3514.92.3.402

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: The Implicit Association Test. *Journal of Personality and Social Psychology, 74*(6), 1464. 10.1037/0022-3514.74.6.1464

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology, 85*(2), 197. 10.1037/0022-3514.85.2.197

Greenwald, A. G., Poehlman, T. A., Uhlmann, E. L., & Banaji, M. R. (2009). Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity. *Journal of Personality and Social Psychology, 97*(1), 17-41. 10.1037/a0015575

Groom, V., Bailenson, J. N., & Nass, C. (2009). The influence of racial embodiment on racial bias in immersive virtual environments. *Social Influence, 4*(3), 231-248. 10.1080/15534510802643750

Hasler, B. S., Spanlang, B., & Slater, M. (2017). Virtual race transformation reverses racial in-group bias. *PloS One, 12*(4), e0174965. 10.1371/journal.pone.0174965

Henry, P. J., & Sears, D. O. (2002). The Symbolic Racism 2000 Scale. *Political Psychology, 23*(2), 253-283. 10.1111/0162-895X.00281

Herrera, F., Bailenson, J., Weisz, E., Ogle, E., & Zaki, J. (2018). Building long-term empathy: A large-scale comparison of traditional and virtual reality perspective-taking. *PloS One, 13*(10), e0204494. 10.1371/journal.pone.0204494

Hodges, S. D., & Klein, K. J. (2001). Regulating the costs of empathy: The price of being human. *The Journal of socio-economics, 30*(5), 437-452. 10.1016/S1053-5357(01)00112-3

Hoffman, M. L. (2008). Empathy and prosocial behavior. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 440-455). Guilford Press.

Hofmann, W., Gawronski, B., Gschwendner, T., Le, H., & Schmitt, M. (2005). A meta-analysis on the correlation between the Implicit Association Test and explicit self-report

measures. *Personality and Social Psychology Bulletin, 31*(10), 1369-1385. 10.1177/0146167205275613

Kassambara, A. (2019). ggpubr:"ggplot2" based publication ready plots. https://CRAN.R-project.org/package=ggpubr Version = 0.2.2.

Kilteni, K., Maselli, A., Kording, K. P., & Slater, M. (2015). Over my fake body: Body ownership illusions for studying the multisensory basis of own-body perception. *Frontiers in Human Neuroscience, 9*, 20, Article 141. https://doi.org/10.3389/fnhum.2015.00141

Kirby, K. N., & Gerlanc, D. (2013). BootES: An R package for bootstrap confidence intervals on effect sizes. *Behavior Research Methods, 45*(4), 905-927. 10.3758/s13428-013-0330-5

Krebs, D. (1975). Empathy and altruism. *Journal of Personality and Social Psychology, 32*(6), 1134-1146. 10.1037/0022-3514.32.6.1134

Kubota, J. T., Banaji, M. R., & Phelps, E. A. (2012). The neuroscience of race. *Nature Neuroscience, 15*(7), 940-948. 10.1038/nn.3136

Kurdi, B., Seitchik, A. E., Axt, J. R., Carroll, T. J., Karapetyan, A., Kaushik, N., Tomezsko, D., Greenwald, A. G., & Banaji, M. R. (2019). Relationship between the Implicit Association Test and intergroup behavior: A meta-analysis. *American Psychologist, 74*(5), 569-586. 10.1037/amp0000364

Kuypers, K. P. C. (2017). Emotional empathic responses to dynamic negative affective stimuli is gender-dependent. *Frontiers in Psychology, 8*(1491). 10.3389/fpsyg.2017.01491

Lai, C. K., Marini, M., Lehr, S. A., Cerruti, C., Shin, J. E., Joy-Gaba, J. A., Ho, A. K., Teachman, B. A., Wojcik, S. P., Koleva, S. P., Frazier, R. S., Heiphetz, L., Chen, E. E., Turner, R. N., Haidt, J., Kesebir, S., Hawkins, C. B., Schaefer, H. S., Rubichi, S., Sartori,

G., Dial, C. M., Sriram, N., Banaji, M. R., & Nosek, B. A. (2014). Reducing implicit racial preferences: I. A comparative investigation of 17 interventions. *Journal of experimental psychology. General, 143*(4), 1765-1785. 10.1037/a0036260

Lai, C. K., Skinner, A. L., Cooley, E., Murrar, S., Brauer, M., Devos, T., Calanchini, J., Xiao, Y. J., Pedram, C., Marshburn, C. K., Simon, S., Blanchar, J. C., Joy-Gaba, J. A., Conway, J., Redford, L., Klein, R. A., Roussos, G., Schellhaas, F. M., Burns, M., Hu, X., McLean, M. C., Axt, J. R., Asgari, S., Schmidt, K., Rubinstein, R., Marini, M., Rubichi, S., Shin, J. E., & Nosek, B. A. (2016). Reducing implicit racial preferences: II. Intervention effectiveness across time. *Journal of experimental psychology. General, 145*(8), 1001-1016. 10.1037/xge0000179

Laurent, S. M., & Myers, M. W. (2011). I know you're me, but who am I? Perspective taking and seeing the other in the self. *Journal of Experimental Social Psychology, 47*(6), 1316-1319. https://doi.org/10.1016/j.jesp.2011.05.018

Lenth, R. V. (2016). Least-squares means: The R package lsmeans. *Journal of Statistical Software, 69*(1), 1-33. 10.18637/jss.v069.i01

Lindeman, M., Koirikivi, I., & Lipsanen, J. (2018). Pictorial Empathy Test (PET): An easy-to-use method for assessing affective empathic reactions. *European Journal of Psychological Assessment, 34*(6), 421-431. 10.1027/1015-5759/a000353

Longo, M., Schüür, F., Kammers, M., Tsakiris, M., & Haggard, P. (2008). What is embodiment? A psychometric approach. *Cognition, 107*(3), 978-998. https://doi.org/10.1016/j.cognition.2007.12.004

Maister, L., Banissy, M. J., & Tsakiris, M. (2013). Mirror-touch synaesthesia changes representations of self-identity. *Neuropsychologia, 51*(5), 802-808. 10.1016/j.neuropsychologia.2013.01.020

Maister, L., Sebanz, N., Knoblich, G., & Tsakiris, M. (2013). Experiencing ownership over a dark-skinned body reduces implicit racial bias. *Cognition, 128*(2), 170-178. 10.1016/j.cognition.2013.04.002

Maister, L., Slater, M., Sanchez-Vives, M. V., & Tsakiris, M. (2015). Changing bodies changes minds: Owning another body affects social cognition. *Trends in Cognitive Sciences, 19*(1), 6-12. 10.1016/j.tics.2014.11.001

McConahay, J. B. (1986). Modern racism, ambivalence, and the Modern Racism Scale. In J. F. D. S. L. Gaertner (Ed.), *Prejudice, discrimination, and racism* (pp. 91-125). Academic Press.

McConnell, A. R., & Leibold, J. M. (2001). Relations among the Implicit Association Test, discriminatory behavior, and explicit measures of racial attitudes. *Journal of Experimental Social Psychology, 37*(5), 435-442. 10.1006/jesp.2000.1470

Meade, A. (2020). *FreeIAT: FAQ and issues*. Retrieved February 6 from https://meade.wordpress.ncsu.edu/freeiat-home/freeiat-faq-and-issues/

Meade, A. W. (2009). FreeIAT: An open-source program to administer the Implicit Association Test. *Applied Psychological Measurement, 33*(8), 643-643. 10.1177/0146621608327803

Molenberghs, P. (2013). The neuroscience of in-group bias. *Neuroscience and Biobehavioral Reviews, 37*(8), 1530-1536. 10.1016/j.neubiorev.2013.06.002

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Harvesting implicit group attitudes and beliefs from a demonstration web site. *Group Dynamics: Theory, Research, and Practice*

Group Dynamics: Theory, Research, and Practice, 6(1), 101-115. 10.1037/1089-2699.6.1.101

Oh, S. Y., Bailenson, J., Weisz, E., & Zaki, J. (2016). Virtually old: Embodied perspective taking and the reduction of ageism under threat. *Computers in Human Behavior, 60*, 398-410. 10.1016/j.chb.2016.02.007

Pacala, J. T., Boult, C., Bland, C., & O'Brien, J. (1995). Aging game improves medical students' attitudes toward caring for elders. *Gerontology and Geriatrics Education, 15*(4), 45-57. 10.1300/J021v15n04_05

Paladino, M.-P., Mazzurega, M., Pavani, F., & Schubert, T. W. (2010). Synchronous multisensory stimulation blurs self-other boundaries. *Psychological Science, 21*(9), 1202-1207. 10.1177/0956797610379234

Peck, T. C., Seinfeld, S., Aglioti, S. M., & Slater, M. (2013). Putting yourself in the skin of a black avatar reduces implicit racial bias. *Consciousness and Cognition, 22*(3), 779-787. 10.1016/j.concog.2013.04.016

Petkova, V. I., Ehrsson, H. H., & Harris, J. (2008). If I were you: Perceptual illusion of body swapping. *PloS One, 3*(12), e3832. 10.1371/journal.pone.0003832

Pinzone-Glover, H. A., Gidycz, C. A., & Jacobs, C. D. (1998). An acquaintance rape prevention program: Effects on attitudes toward women, rape-related attitudes, and perceptions of rape scenarios. *Psychology of Women Quarterly, 22*(4), 605-621. 10.1111/j.1471-6402.1998.tb00180.x

Reniers, R. L., Corcoran, R., Drake, R., Shryane, N. M., & Vollm, B. A. (2011). The QCAE: A questionnaire of cognitive and affective empathy. *Journal of Personality Assessment, 93*(1), 84-95. 10.1080/00223891.2010.528484

Revelle, W. (2018). psych: Procedures for personality and psychological research. Northwestern University, Evanston, Illinois, USA, https://CRAN.R-project.org/package=psych Version = 1.8.12.

Rudman, L. A., Ashmore, R. D., & Gary, M. L. (2001). "Unlearning" automatic biases: The malleability of implicit prejudice and stereotypes. *Journal of Personality and Social Psychology, 81*(5), 856-868. 10.1037/0022-3514.81.5.856

Rumble, A. C., Van Lange, P. A. M., & Parks, C. D. (2010). The benefits of empathy: When empathy may sustain cooperation in social dilemmas. *European Journal of Social Psychology, 40*(5), 856-866. 10.1002/ejsp.659

Rydell, R. J., & McConnell, A. R. (2006). Understanding implicit and explicit attitude change: A systems of reasoning analysis. *Journal of Personality and Social Psychology, 91*(6), 995. 10.1037/0022-3514.91.6.995

Sears, D. O., & Henry, P. J. (2005). Over thirty years later: A contemporary look at symbolic racism. *Advances in Experimental Social Psychology, 37*, 95-150. 10.1016/S0065-2601(05)37002-X

Shih, M., Wang, E., Trahan Bucher, A., & Stotzer, R. (2009). Perspective taking: Reducing prejudice towards general outgroups and specific individuals. *Group Processes & Intergroup Relations, 12*(5), 565-577. 10.1177/1368430209337463

Stephan, W. G., & Finlay, K. (1999). The role of empathy in improving intergroup relations. *Journal of Social Issues, 55*(4), 729-743. 10.1111/0022-4537.00144

Stepien, K. A., & Baernstein, A. (2006). Educating for empathy. *Journal of General Internal Medicine, 21*(5), 524-530.

Teding van Berkhout, E., & Malouff, J. M. (2016). The efficacy of empathy training: A meta-analysis of randomized controlled trials. *Journal of Counseling Psychology, 63*(1), 32-41. 10.1037/cou0000093

Todd, A. R., Bodenhausen, G. V., & Galinsky, A. D. (2012). Perspective taking combats the denial of intergroup discrimination. *Journal of Experimental Social Psychology, 48*(3), 738-745. 10.1016/j.jesp.2011.12.011

Todd, A. R., Bodenhausen, G. V., Richeson, J. A., & Galinsky, A. D. (2011). Perspective taking combats automatic expressions of racial bias. *Journal of Personality and Social Psychology, 100*(6), 1027-1042. 10.1037/a0022308

Todd, A. R., & Burgmer, P. (2013). Perspective taking and automatic intergroup evaluation change: Testing an associative self-anchoring account. *Journal of Personality and Social Psychology, 104*(5), 786. 10.1037/a0031999

Todd, A. R., & Galinsky, A. D. (2014). Perspective-taking as a strategy for improving intergroup relations: Evidence, mechanisms, and qualifications. *Social and Personality Psychology Compass, 8*(7), 374-387. 10.1111/spc3.12116

Tsakiris, M., Carpenter, L., James, D., & Fotopoulou, A. (2010). Hands only illusion: Multisensory integration elicits sense of ownership for body parts but not for non-corporeal objects. *Experimental Brain Research, 204*(3), 343-352. 10.1007/s00221-009-2039-3

van Loon, A., Bailenson, J., Zaki, J., Bostick, J., & Willer, R. (2018). Virtual reality perspective-taking increases cognitive empathy for specific others. *PloS One, 13*(8), e0202442. 10.1371/journal.pone.0202442

Vescio, T. K., Sechrist, G. B., & Paolucci, M. P. (2003). Perspective taking and prejudice reduction: The mediational role of empathy arousal and situational attributions. *European Journal of Social Psychology, 33*(4), 455-472. 10.1002/ejsp.163

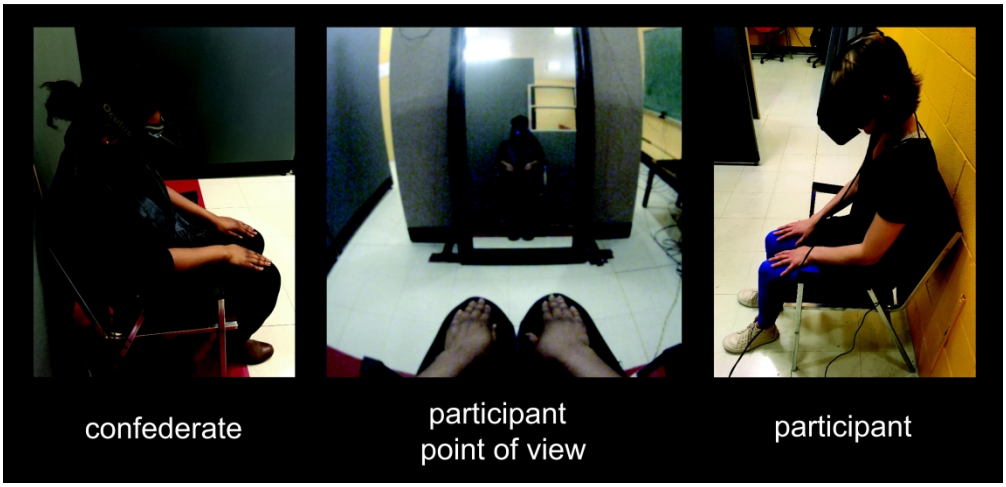
Webster, D. M., Richter, L., & Kruglanski, A. W. (1996). On leaping to conclusions when feeling tired: Mental fatigue effects on impressional primacy. *Journal of Experimental Social Psychology*. 10.1006/jesp.1996.0009

Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. Springer-Verlag.

Yee, N., & Bailenson, J. N. (2006). *Walk a mile in digital shoes: The impact of embodied perspective-taking on the reduction of negative stereotyping in immersive virtual environments*. http://www.nickyee.com/pubs/Yee%20%26%20Bailenson%20-%20Digital%20Shoes%20(2006).pdf

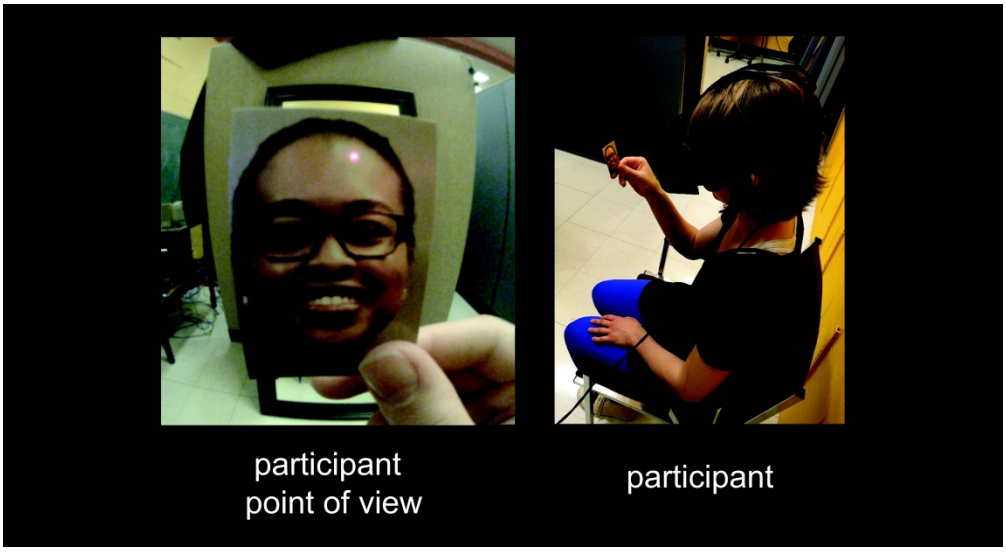
Zaki, J. (2014). Empathy: A motivated account. *Psychological Bulletin, 140*(6), 1608-1647. 10.1037/a0037679

Zaki, J. (2018). Empathy is a moral force. In Kurt Gray & J. Graham (Eds.), *Atlas of moral psychology* (pp. 49-58). Guilford Press.



Note. Left: Confederate looking down at her hands. Middle: Participant point of view, seeing the confederate's hands and image reflection, instead of her own. Right: Participant looking down at her hands.

649x310mm (300 x 300 DPI)

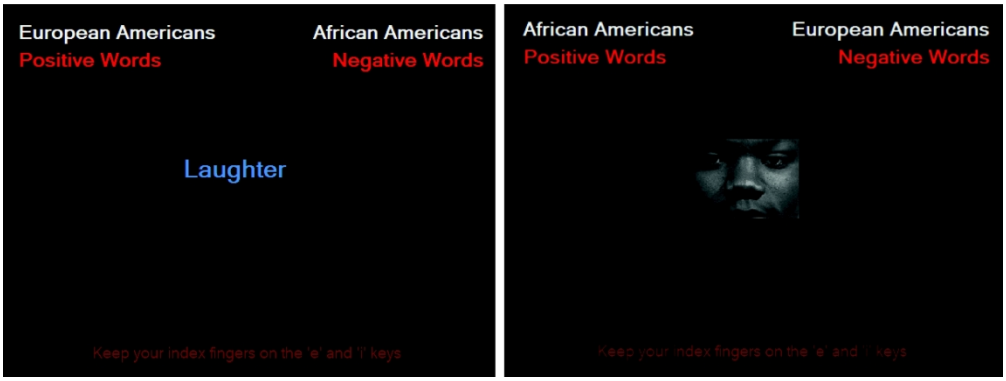


Note. Participant looking down at the photograph of the confederate, allegedly taken at the beginning of the session.

607x329mm (300 x 300 DPI)

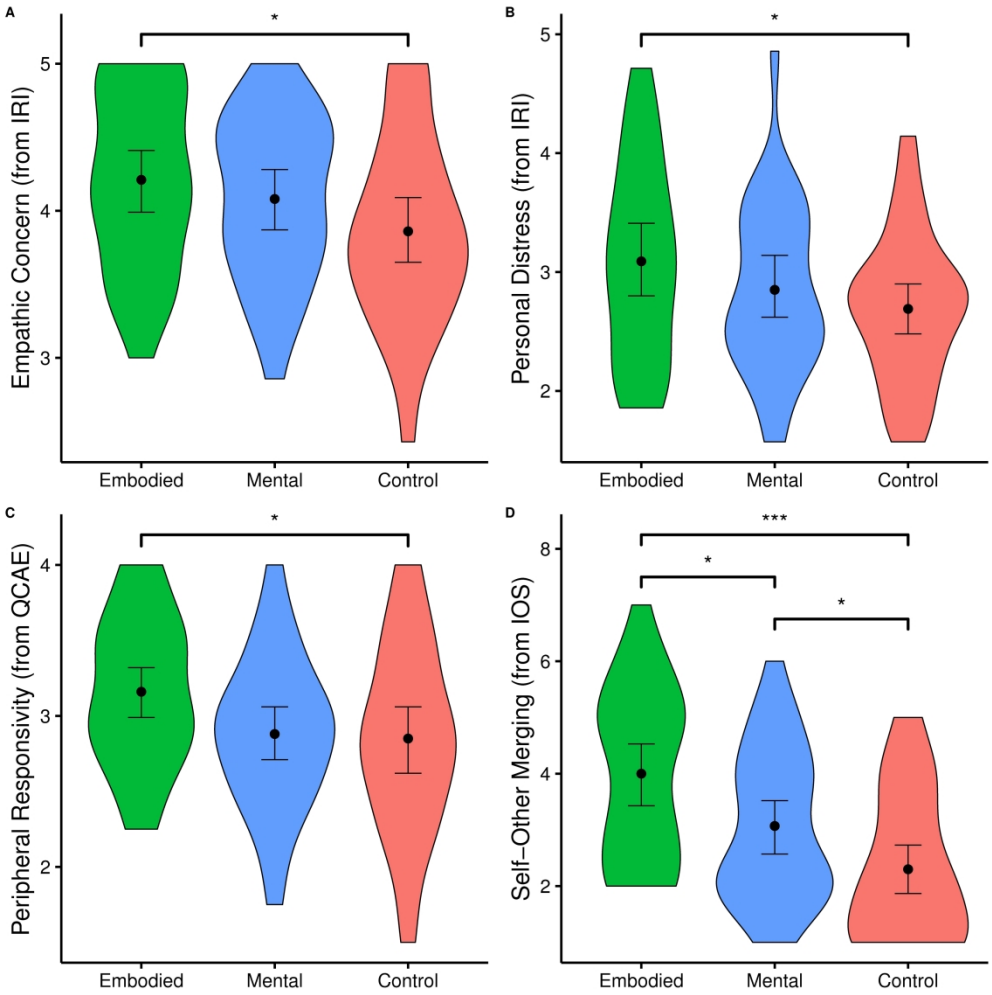
Note. Oculus Rift Development Kit with PlayStation 3 camera and custom 3D-printed component. Frontal and side views.

974x430mm (600 x 600 DPI)



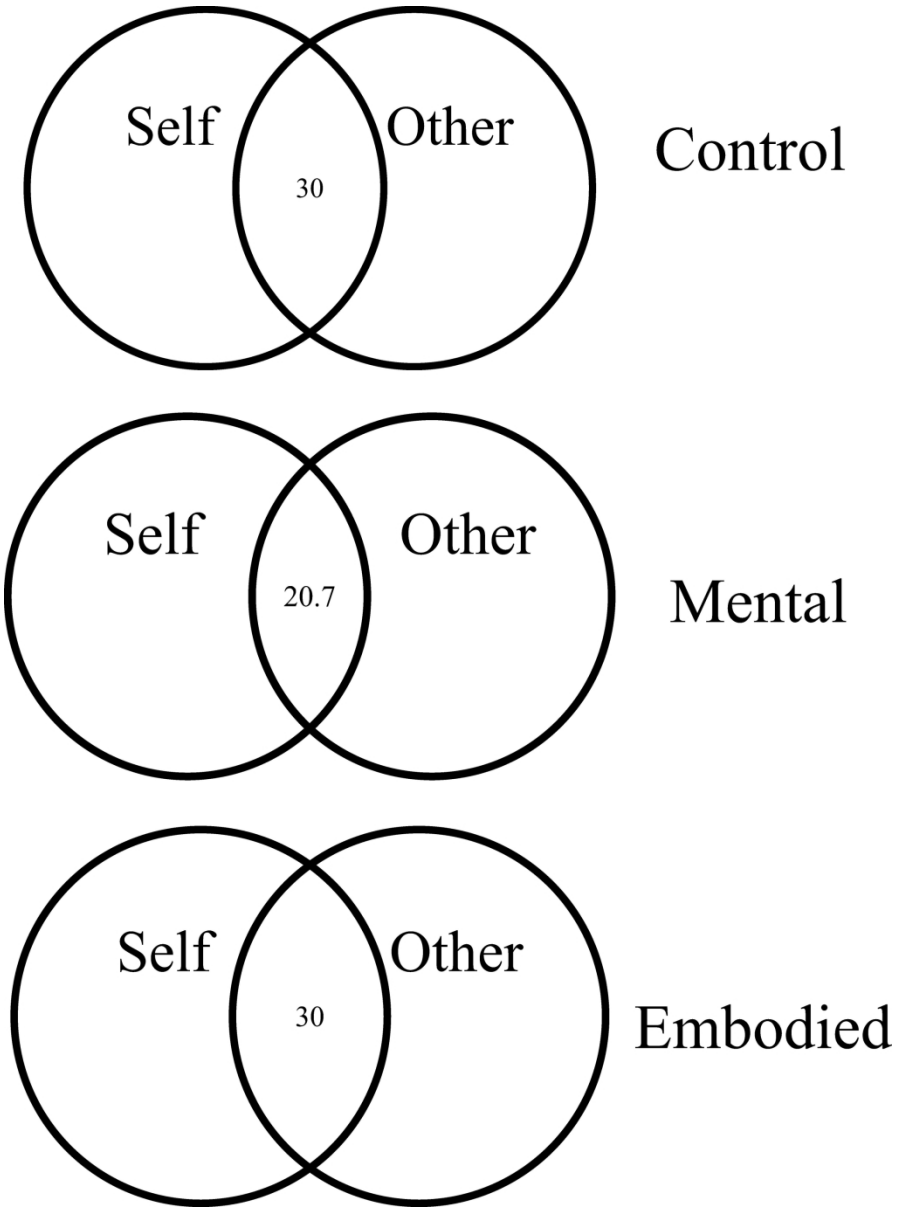
Note. Left: Participants need to categorize the word laughter as a positive word. Right: Participants need to categorize the individual's photograph as 'African American'.

325x121mm (300 x 300 DPI)



Note. Effects of experimental condition on Empathic Concern (A) and Personal Distress (B; IRI: Interpersonal Reactivity Index), Peripheral Responsivity (C; QCAE: Questionnaire of Cognitive and Affective Empathy), and self-other merging (D; IOS: Inclusion of Other in the Self Scale). Dots = means; error bars = bootstrapped 95% confidence intervals; width = distribution density (frequency). * = $p < .05$; *** = $p < .001$. Empathy was highest in the Embodied Perspective-Taking group.

355x355mm (300 x 300 DPI)



Note. Circles and numbers represent the average percentage overlap for each group, using linear interpolation from the original Inclusion of the Other in the Self (IOS) scale. Self-other merging was highest in the Embodied Perspective-Taking group, followed by the Mental Perspective-Taking group, followed by the control group.

199x269mm (300 x 300 DPI)