Research Paper

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Racial disparities in observers' attention to and estimations of others' pain

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Abstract

Research has demonstrated racial disparities in pain care such that Black patients often receive poorer pain care than White patients. Little is known about mechanisms accounting for the emergence of such disparities. The present study had 2 aims. First, we examined whether White observers' attentional processing of pain (using a visual search task [VST] indexing attentional engagement to and attentional disengagement from pain) and estimation of pain experience differed between White vs Black faces. Second, we examined whether these differences were moderated by (1) racially biased beliefs about pain experience and (2) the level of pain expressed by Black vs White faces. Participants consisted of 102 observers (87 females) who performed a VST assessing pain-related attention to White vs Black avatar pain faces. Participants also reported on racially biased beliefs about White vs Black individuals' pain experience and rated the pain intensities expressed by White and Black avatar faces. Results indicated facilitated attentional engagement towards Black (vs White) pain faces. Furthermore, observers who more strongly endorsed the belief that White individuals experience pain more easily than Black individuals had less difficulty disengaging from Black (vs White) pain faces. Regarding pain estimations, observers gave higher pain ratings to Black (vs White) faces expressing high pain and White (vs Black) faces expressing no pain. The current findings attest to the importance of future research into the role of observer attentional processing of sufferers' pain in understanding racial disparities in pain care. Theoretical and clinical implications are discussed, and future research directions are outlined.

Keywords: Pain, Attention, Estimation, Observer bias, Race

1. Introduction

Receiving quality pain care is a fundamental human right. Nonetheless, differences exist between racial minorities relative to racial majorities in their ability to fully experience this right. Indeed, extant research conducted in countries where most healthcare providers are White[46] shows that Black patients often receive poorer pain care than White patients.[1,3,8,16,31,41] Such disparities are reflected in Black patients receiving less pain medication for similar conditions,[7,28,38,43] less potent analgesic drugs,[2,18,31] and less opioids for comparable levels of pain.[7,36] The pervasiveness of these disparities is further corroborated by their existence across different contexts (eg, emergency and postoperative care units[2,40,43]) and various types of pain (eg, acute and chronic pain[16]).

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Notwithstanding the role that patient (eg, underreporting of pain[2]) and societal (eg, social–economic inequalities[32]) factors may play in accounting for these disparities, observer responses to others' pain may also constitute an important explanatory mechanism. Observer attentional processing of others' pain might be particularly relevant in this regard. Indeed, the ability of pain to capture the attention of observers is considered an essential prerequisite for the adequate care of sufferers' pain.[47,49] Corroborating this notion, Vervoort et al.[50,51] demonstrated that observers (ie, parents) who are more attentive to others' (ie, their child's) pain more accurately detect sufferers' pain and increasingly engage in protective behaviors. Moreover, recent work has demonstrated that White observers have a lower threshold for detecting facial pain expressions of White individuals as opposed to Black individuals.[30] These perceptual biases are, in turn, associated with White observers prescribing less analgesics to Black compared with White patients.[30] Based on these premises, one may expect White observers' attentional processing of pain to be enhanced for White relative to Black individuals. This idea, however, has not yet been directly examined. Furthermore, recent findings suggest that racial disparities in pain care may also be predicted by White observers' tendency to underestimate the pain experience of Black compared with White patients and that such biased estimations may be enhanced by racially biased beliefs such as the belief that Black patients experience less pain than White patients [see [Ref.19] but also [Refs.13,45]].

The current study had 2 aims. First, we examined whether White observers' attentional processing of pain (using a visual search task (VST)[34,48] indexing attentional engagement to and attentional disengagement from pain) and estimation of pain experience differs between White vs Black faces. Second, we examined whether these differences are moderated by (1) racially biased beliefs about pain experience and (2) the level of pain expressed by Black vs White faces. Based on the previous work,[30] we expected enhanced attentional engagement to and impaired attentional disengagement from White relative to Black pain faces. Furthermore, in line with the previous work, we predicted higher pain estimations for White relative to Black faces.[19,30,42] Finally, we explored whether White observers' pain-related beliefs about White vs Black individuals and varying levels of sufferer pain expressiveness moderate observer attentional processing and estimations of pain shown by Black vs White individuals.

2. Method

2.1. Participants

The current study is part of a larger investigation amongst parent-child dyads that comprised several research objectives including the examination of child attention to pain, pain education, memory bias, and parental responses to child pain. Examination of these objectives (within parent–child dyads) occurred before the research objectives of the current article were assessed. The procedures used during the current study occurred independently (ie, during a separate session) from those used during the other phases of the larger study and as such are not expected to have interfered with the current findings. The current study was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences of Ghent University.

Participants for the current study consisted of 113 Dutch-speaking adults (ie, parents). Eleven participants were excluded from the analyses because their data (ie, demographics or VST data) were not registered (N = 6), they made more than 20% errors during the VST trials (N = 4; see Ref. 39), or they did not self-identify as White (N = 1). Accordingly, the final sample included in the current analyses consisted of 102 White participants (biological sex: N = 87 [85.3%] female and N = 15 [14.7%] male) with a mean age of 42.94 years (SD = 5.33). Participants' contact with Black people was indexed using 5 questions assessing the frequency with which they came in contact with Black people (eg, how often have you been in contact with Black people in your neighborhood) using a scale ranging from 1 ("never") to 7 ("very frequently") ($\alpha = 0.88$) (based on[11]). On average, participants reported having had less than moderate levels of contact with Black people (M = 2.96, SD = 1.41). Most participants (77.5%) were married or cohabiting and had completed higher education (beyond the age of 18 years; 76.5%). Overall, most participants indicated that they were in good to very good health (92.2%, rated on a 5-point scale with the anchors 0 = "excellent," 1 = "very good," 2 = "good," 3 = "moderate," and 4 = "bad"). Most participants (74.5%) reported experiencing pain in the past 6 months for, on average, 3.54 days (SD = 2.25). Overall, participants reported a pain intensity level of M = 2.15 (SD = 2.37) on a scale ranging from 0 (no pain) to 10 (worst possible pain). Each participant received €25 for taking part in this study and had a chance of winning an iPad (by a lottery system).

3. Materials

3.1. Stimulus materials

The stimulus materials (ie, avatars) were taken from the empirically validated Delaware Pain Database (DPD[29]). To create these stimuli, photographs were taken of real Black and White adult faces (age range: 18-35 years). These photographs were then digitized to create avatars, which were used in the visual search task (VST).

3.1.1. Avatars

In total, 12 avatars (6 Black and 6 White; 50% women and 50% men) with neutral facial expressions were selected from the DPD. One hundred and sixty-four participants within the United States (63 women, 100 men, 1 unspecified biological sex; M age = 33.16, SD = 9.38; ethnicity: 97 White/Anglo-American, 33 African American, 14 Asian, 16 Hispanic/Latino, 2 Native American, 1 Pacific Islander, and 1 others) had previously rated these (and 137 other) avatars on a series of social dimensions, emotional content, and demographic features. We selected 12 avatars that did not differ on social evaluations, latent emotional content, and demographic features (apart from their perceived race and gender).[29]

3.1.2. Pain levels, pain expressiveness versions, and task versions

For each selected avatar, 3 levels of expressed pain were presented: no pain, moderate pain, and high pain. The avatars expressing no pain were the baseline avatars (ie, avatars making neutral facial expressions). For each of the avatars expressing pain (ie, moderate pain and high pain), 6 different pain expressions from the DPD that were robustly recognized as communicating physical pain were used, with pairings between avatars and expressions counterbalanced across participants. These 6 expressions were previously normed in terms of their emotional content (for full details, see Ref. 29, Supplementary Materials [Study 2, "Additional information regarding stimulus norming"]) and were each rated above the scale midpoint (1-7 scale) in terms of painfulness (M = 4.97, all M > 4.61) and were rated as resembling pain more than any other emotion.

To create high pain faces and moderate pain faces, we manipulated a subset of over 100 sliders in FaceGen (https://facegen.com/) corresponding to action unit movements, larger scale expressions, and mouth movements associated with specific phonemes (see https://osf.io/2x8r5/for specific slider values for each of the selected pain levels [range: 0-100]). Each slider could be set to a value between 0 and 100. The slider values associated with the norming data of the 6 pain expressiveness versions constituted high pain levels (ie, 100% pain; final slider values). Moderate pain levels (ie, 67% pain) were created by multiplying each of the final slider values by 0.67. Finally, 6 task versions were used in the current study, which counterbalanced the pairing of pain expressions to avatars across participants. In doing so, the possibility that a specific combination of avatar and expression could account for an idiosyncratic pattern of data was reduced.

3.2. Visual search task

To examine potential differences in observer attention to pain expressed by Black vs White faces, participants performed a VST.[34,48,50] We opted for a VST because we wanted to mirror real-life situations where attentional processes often occur in contexts where various stimuli, rather than just 2 stimuli (ie, neutral vs threatening/pain stimulus), compete for attention.[48] During performance of the VST, participants sat in front of a Dell Laptop (Latitude E5530) at a distance of approximately 60 cm from the screen. The VST was programmed using Inquisit 5.0 and consisted of 12 practice trials and 2 blocks of 144 test trials. At the onset of each trial, a black fixation cross was shown at the center of a white screen. After 1000 ms, this fixation cross was replaced by a set of images (arranged in a circle; image size: 2.5 × 2.5 cm) of either Black or White faces displaying one of the 3 pain expressions with a distractor (tilted right or tilted left line) or target stimulus (horizontal or vertical line) superimposed on the foreheads. On each trial, participants were instructed to indicate the direction of the target stimulus as quickly and accurately as possible through a key press ("4" [horizontal line] or "6" [vertical line]). Crucially, half of the practice and test trials consisted of images of only White faces, whereas the other halves of these trials consisted of only Black faces.

Three trial types were presented during the practice and test phase: congruent, incongruent, and neutral trials. On each of these trials, participants always saw 6 faces.[48] Yet the precise compound stimuli that were shown differed between the 3 trial types. During congruent trials, the target stimulus was superimposed on a face expressing either moderate pain or high pain. The remaining 5 images consisted of no pain faces with a superimposed distractor stimulus. During incongruent trials, the target stimulus was superimposed on a face expressing no pain, whereas the remaining 5 faces (1 pain face and 4 no pain faces) contained a superimposed distractor stimulus. Note that during both the congruent and incongruent trials only 1 of the 6 faces expressed pain. Furthermore, during neutral trials, all 6 faces expressed no pain with one of these images containing the target stimulus and the remaining images containing the distractor stimulus. See **Figure 1** for an example of the 3 trial types.

To ensure that participants could not strategically use the pain faces to localize the target stimulus, we used the 1/n procedure which posits that the number of congruent trials within each block should be restricted to 1 divided by the number of possible locations where a pain-related stimulus could be presented (thus here 1/6).[21,48] As such, each of the 2 blocks of the VST consisted of 12 congruent, 60 incongruent, and 72 neutral trials (max. trial duration = 5000 ms, error feedback = 500 ms, and intertrial duration = 500 ms).

To make the pain faces relevant for participants, the following information was presented to the participants on screen and orally repeated by the experimenter before participants initiated the VST.

The task that you will have to complete is a computer task. During this task, you will see images of adults. Some of these images will be of adults who express pain during frequent procedures such as blood tests, administration of vaccinations, and wound care. The precise instructions for this task will be presented onscreen.

During the VST, participants first completed the practice phase. On completing this phase, they were instructed to initiate the test phase and were once again reminded to perform the task as quickly and accurately as possible.

3.3. Pain experience beliefs

Before completing the VST, participants answered a question assessing their beliefs about differences in the pain experience of Black vs White individuals. More specifically, we assessed the extent to which participants endorsed the false belief that "White individuals experience pain more easily than Black individuals" (0 = "not true at all," 1 = "a little true," 2 = "sometimes true," 3 = "usually true," and 4 = "completely true").[5,15,37]

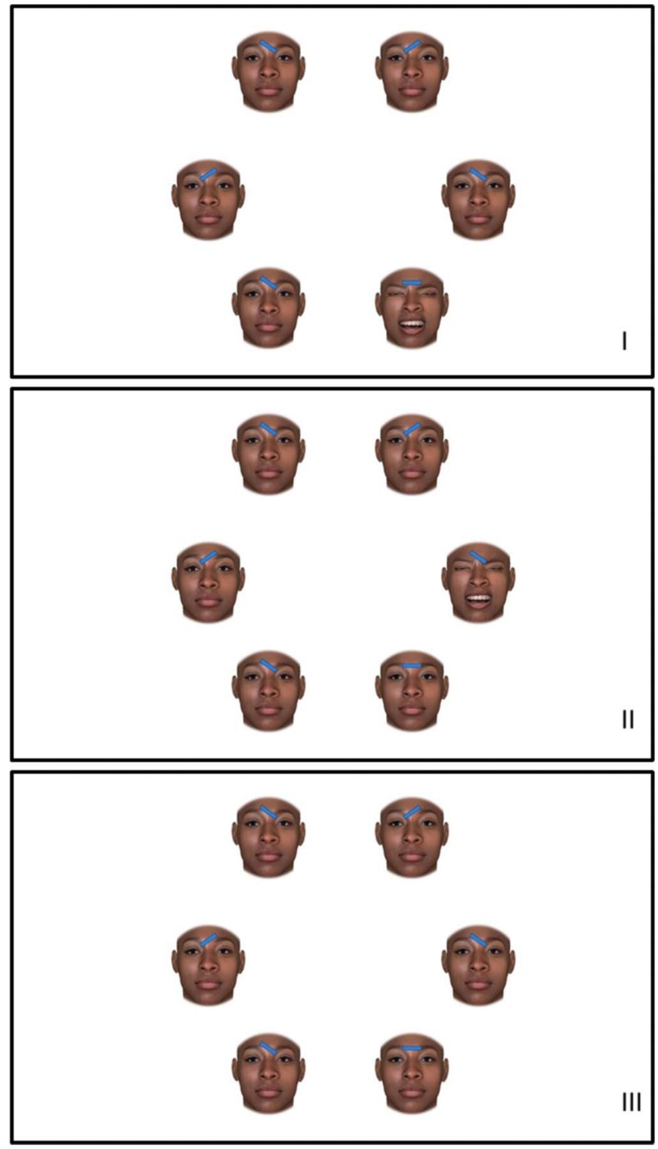

Figure 1. Examples of the 3 trial types (I. congruent trials, II. incongruent trials, and III. neutral trials) during which a Black female avatar was presented.

3.4. Pain estimations

On completion of the VST, participants estimated the pain level of each avatar that was used during the VST on a Numerical Rating Scale (ranging from 0 = no pain at all to 10 = a lot of pain). The presentation order of the faces (image size: 6.5 × 6.5 cm) was randomly determined.

3.5. Procedure

On arrival at the laboratory, participants were welcomed by the researcher in a research room and briefly informed about the experimental agenda. Once participants gave their written informed consent (and after completing assessments related to the other research objectives that were described previously; see Participants section), they were seated in front of a research laptop (Dell LATITUDE E5530) to fill out the questionnaires. Thereafter, participants performed the VST. Finally, participants rated the pain intensity of each of the faces. Before each study component, participants were given respective instructions. At the end of the experimental session, participants were debriefed.

3.6. Data reduction

For the VST, trials with incorrect responses (2.68%) and outliers (1.60%) were excluded from further analyses. Outliers were defined as reaction times (RTs) that were 2 and a half SDs faster or slower than a participant's mean RT of the correct responses.[48] Using all remaining data (ie, 95.72% of the trials), 3 categories were obtained during the VST: (1) mean RTs for congruent, (2) mean RTs for incongruent, and (3) mean RTs for neutral trials. Using these RT categories, 8 types of attention indices were calculated for each pain expression (moderate vs high) and race (Black vs White) of the avatar: 4 engagement indices (engagement—high pain—White avatar, engagement—moderate pain—White avatar, engagement—high pain—Black avatar, and engagement—moderate pain—Black avatar) and 4 disengagement indices (disengagement—high pain—White avatar, disengagement—moderate pain—White avatar, disengagement—high pain—Black avatar, and disengagement—moderate pain—Black avatar).[33,34,48] The engagement indices were calculated by subtracting the mean RT on congruent trials from the mean RT on neutral trials, whereby a positive value indicated facilitated attentional engagement to pain faces. Disengagement indices were calculated by subtracting the mean RT on neutral trials from the mean RT on incongruent trials, whereby a positive value indicated difficulty disengaging from pain faces.

3.7. Statistical plan

First, evidence for attention bias was examined by performing a paired-sample *t* test which compared participants' RTs on the congruent trials with that on the incongruent trials. To examine whether there was evidence for an overall engagement and disengagement effect, one-sample *t* tests were performed. Furthermore, evidence for attentional engagement to pain faces or attentional disengagement from pain faces as a function of race or pain expressiveness was assessed using 2 × 2 RM analysis of variances (ANOVAs) with race (Black vs White) and pain expression (high vs moderate) as within-subject factors for each of the dependent variables (engagement and disengagement indices). To examine whether the observed effects for attentional engagement to pain faces and attentional disengagement from pain faces covaried with participants' pain-related beliefs about Black vs White individuals, this variable was added as a covariate to each of the 2 x 2 RM ANOVAs. For all analyses, this covariate was centered.[20] In case of significant interactions, follow-up RM ANOVAs were performed following the procedure outlined by Holmbeck.[20] Using this procedure, conditional effects of the continuous moderator variable on the outcome were examined by manipulating the 0 point of the moderator (ie, by computing low [−1SD below the mean] and high [+1SD above the mean] values of the centered moderator variable). Furthermore, the effects of the faces' race and pain expression on participants' pain estimations were examined using a 2 (race: Black vs White) × 3 (pain expression: high vs moderate vs no pain) RM ANOVA with pain estimations as the dependent variable. To examine whether the observed effects for the pain estimations covaried with participants' pain-related beliefs about Black vs White individuals, this variable was added as a covariate to the 2 × 3 RM ANOVA. Finally, for the first 35 participants, data of the last VST trial were not recorded because of technological failure. As the trial types that were presented during the experiment were randomly determined, we considered these missing data to be missing at random. Sensitivity analyses showed no difference between participants whose data were and were not recorded for the final trial of the VST (for the engagement indices, all F for the interaction effects < 0.09, ns; for the disengagement indices, all F for the interaction effects $<$ 3.90, ns).

All data were collected without intermittent data analysis, and analyses were performed in SPSS version 25. Alpha was set at 0.05 for all statistical tests, and effect sizes are reported using either the partial eta-squared statistic or Cohen's *d*. Whenever the sphericity assumption was violated (the Mauchly test of sphericity was $P < 0.05$), Greenhouse–Geisser corrections were performed. Sensitivity analysis were performed using More-Power[6] indicating that a sample size of 102 participants was sufficient to detect a medium size within-subject interaction effect (Cohen's f = 0.28) with a power = 0.80.

4. Results

4.1. Self-reports of pain experience beliefs

Overall, participants in the current sample did not tend to endorse the belief that White individuals experience pain more easily than Black individuals (M = 0.75, SD = 1.00, skewness = 1.14, and kurtosis = 0.58).

4.2. Visual search task analyses

4.2.1. Attention bias

A paired-sample *t* test showed significant differences between the RTs on the congruent (M = 1371.39, SD = 176.22) and incongruent trials (M = 1413.29, SD = 163.44), $t(101) = -41.90$, $P < 0.001$, Cohen's $d_z = 0.39$, indicating an overall attentional bias to pain.

4.3. Overall attentional engagement to and disengagement from pain

One-sample *t* tests revealed that there was evidence for an overall disengagement effect, $t(101) = 2.51$, $P < 0.05$, Cohen's d = 0.25, indicating that participants had significant difficulty disengaging from pain faces (M = 13.56, SD = 54.56), compared with neutral faces. Furthermore, results indicated no overall facilitated engagement for pain vs neutral faces. Indeed, although a positive value (M = 28.34, SD = 110.99) was observed for the overall engagement index, this effect failed to reach significance, $t(101) = 1.63$, $P = 0.11$, Cohen's $d = 0.17$.

4.4. Attentional engagement to pain

A series of 2 × 2 RM ANOVAs with the avatars' race (Black vs White) and pain expression (high vs moderate) as within-subject factors and engagement indices as dependent variables was performed. This test revealed a main effect of the avatars' race, $F(1, 101) = 4.02$, $P < 0.05$, $\eta^2_P = 0.04$, indicating a facilitated attentional engagement to Black pain faces (M = 50.08, SD = 148.53) compared with White pain faces (M = 6.60, SD = 163.05). No other main or interaction effects were significant (all $F < 1$, ns). Furthermore, adding the continuous moderator variable (pain-related beliefs) as a covariate to the 2 × 2 RM ANOVA did not reveal any other significant main or interaction effects (all $F < 2.06$, ns).

4.5. Attentional disengagement from pain

A series of 2 × 2 RM ANOVAs with the avatars' race (Black vs White) and pain expression (high vs moderate) as within-subject factors and disengagement indices as dependent variables was performed. Results revealed a significant main effect of the avatars' pain expression, $F(1, 101) = 4.15$, $P < 0.05$, $\eta^2_p = 0.04$, indicating that participants had significantly more difficulty disengaging from faces expressing high pain (M = 23.06, SD = 73.55) as opposed to moderate pain (M = 4.06, SD = 70.62). No other main or interaction effects were observed (all F < 1, ns). However, adding the continuous moderator variable (pain-related beliefs) as a covariate to the 2 × 2 RM ANOVA revealed a significant 2-way interaction effect between participants' pain-related beliefs about White vs Black individuals and the avatars' race, $F(1, 100) = 5.82$, $P < 0.05$, $\eta^2_p = 0.06$. No other main or interaction effects were found (all F < 3.60, ns).

To interpret the significant beliefs x race interaction, 2 RM ANOVAs were performed with the avatars' race as a within-subjects variable and either high (+1SD above the mean) or low (−1SD below the mean) belief endorsement as covariate. Findings indicated that the impact of the avatars' race was only significant for participants who reported high belief endorsement, $F(1, 100) = 5.69$, $P < 0.05$, $\eta^2_p = 0.05$, indicating that participants who more strongly endorsed the belief that White individuals experience pain more easily compared with Black individuals, demonstrated significantly less difficulty disengaging from Black pain faces compared with White pain faces. No such difference was observed among participants who did not endorse the belief that White individuals experience pain more easily than Black individuals, $F(1, 100) = 1.06$, $P = 0.31$ (**Fig. 2**). Additional analyses for Black pain faces and White pain faces separately revealed that the effect of pain-related beliefs on participants' disengagement from Black pain faces reached significance, $F(1, 100) = 3.83$, $P = 0.05$, $\eta^2_p = 0.04$, suggesting that the more participants believed that White individuals feel pain more easily than Black individuals, the less difficulty they had disengaging from the Black pain faces. No significant effect was found of pain-related beliefs on participants' disengagement from White pain faces, $F(1, 100) = 2.85$, $P = 0.10$.

4.6. Pain estimation analyses

A 2 × 3 RM ANOVA with the avatars' race (Black vs White) and pain expression (high, moderate, or no pain) as within-subject factors, and pain estimations as a dependent variable revealed a significant main effect of the pain expression, $F(1.65, 166.28) = 858.09$, $P < 0.001$, $\eta^2_p = 0.90$. Follow-up contrast analyses showed significantly higher pain estimations for faces expressing high pain (M = 6.33, SD = 1.67) compared with moderate pain (M = 3.67, SD = 1.77), Cohen's $d_z = 2.57$; high pain compared with no pain (M = 0.51, SD = 0.68), Cohen's $d_z = 3.61$; and moderate pain compared with no pain, Cohen's $d_z = 2.48$ ($t > 20.62$ and $P < 0.001$ for all contrasts).

Furthermore, a significant race by expression interaction was observed, $F(2, 202) = 15.97$, $P < 0.001$, $\eta^2_p = 0.14$ (**Fig. 3**). Follow-up contrast analyses demonstrated significant differences in pain estimations between White and Black faces expressing high pain, $t(101) = -3.62$, $P < 0.001$, Cohen's $d_z = 0.36$, indicating that participants rated the pain intensity of Black avatars expressing high pain as significantly higher than that of White faces expressing high pain. The opposite pattern was observed for White and Black faces who expressed no pain. Specifically, participants provided significantly higher pain estimations for White no pain faces compared with Black no pain faces, $t(101) = 3.91$, $P < 0.001$, Cohen's $d_z = 0.40$. No difference was observed in pain estimations between White and Black faces expressing moderate pain, $t(101) = 0.83$, $P = 0.41$. Furthermore, within each racial group, significant increases in pain estimations were found with increasing pain levels (ie, Black faces: high pain vs moderate pain [Cohen's $d_z = 2.50$], high pain vs no pain [Cohen's $d_z = 3.72$], and moderate pain vs no pain [Cohen's $d_z = 1.95$]; White faces: high pain vs moderate pain [Cohen's $d_z = 2.09$], high pain vs no pain [Cohen's $d_z = 3.22$], and moderate pain vs no pain [Cohen's $d_z = 1.89$]; $t > 19.25$ and $P < 0.001$ for all contrasts).

Adding the continuous moderator variable (pain-related beliefs) as a covariate to the 2 × 3 RM ANOVA revealed no other significant main and interaction effects (all F < 0.91, ns).

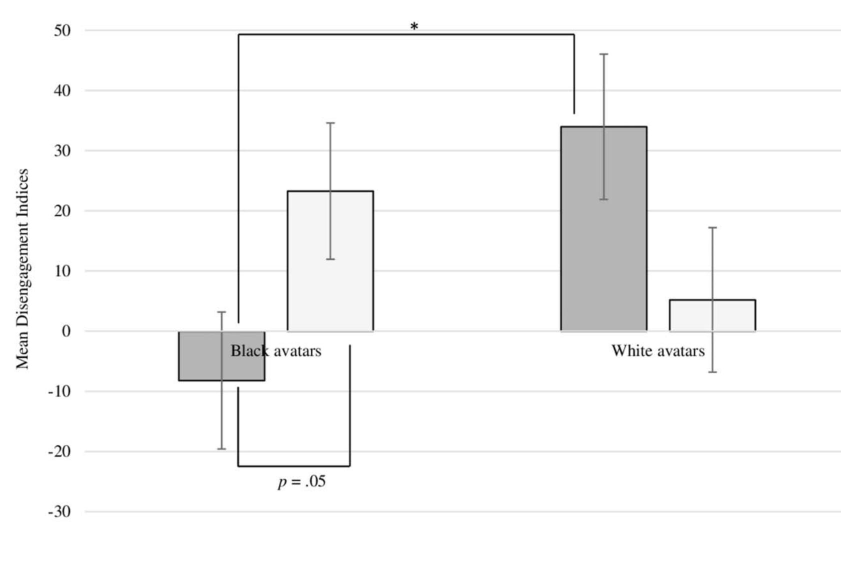

Figure 2. Mean disengagement indices for Black and White pain faces, as a function of high (+1SD above the mean) and low (−1SD below the mean) values of participants' false pain experience beliefs. The error bars refer to the standard errors.

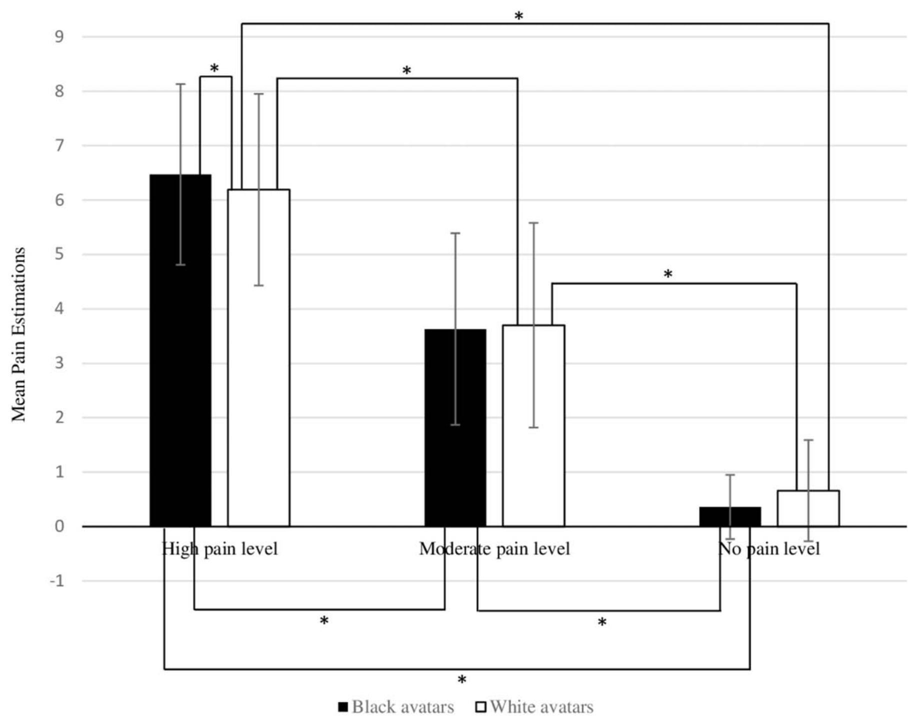

Figure 3. Mean pain estimations for Black and White faces, as a function of the faces' pain level (ie, high pain, moderate pain, and no pain). The error bars refer to the SDs.

5. Discussion

The current study aimed to examine potential differences in White observers' attentional processing (ie, attentional disengagement and attentional engagement) and estimations of the pain expressed by White vs Black faces. Furthermore, we aimed to examine whether White observers' attentional processing and pain estimations were modulated by their beliefs about race differences in the experience of pain and the pain levels expressed by Black vs White faces. The results can be summarized as follows. First, observers attended more easily to pain on Black vs White faces. This effect was not moderated by observers' pain-related beliefs or by the level of pain expressed on the faces. Second, observers with stronger false pain-related beliefs (that White individuals feel pain more easily than Black individuals) had less difficulty disengaging from Black vs White pain faces. This effect was not influenced by the level of pain that was expressed. Third, observers gave higher pain ratings to Black vs White faces expressing high pain and to White vs Black faces expressing no pain.

Despite the fact that we expected observers' attention to be generally more directed toward White vs Black pain faces, the pattern of results differed across attentional indices. Among White observers who more strongly endorsed the false belief that White people experience pain more easily than Black people, there was impaired attentional disengagement from White vs Black pain faces. Interestingly, the opposite effect was found for attentional engagement: observers, regardless of their pain-related beliefs, more readily attended to Black vs White pain faces. This initial attentional prioritization of Black pain faces, however, was unaffected by the level of pain expressed on these faces, suggesting that pain expressions did not differently influence observers' initial attention. Several tentative explanations may account for these results. First, as White individuals are generally less familiar with faces of Black individuals[52] and our sample reported to have had less than moderate levels of contact with Black people, Black pain faces may have been more salient stimuli for participants in the current study.[17] Apart from these stimulus-driven features, observer-driven mechanisms may also influence attentional processing.[17] Observers' threat perceptions may be particularly relevant. Evidence shows that threatening stimuli, such as facial expressions of pain, draw one's initial attention.[35,50] Relatedly, observers who associate Black individuals with danger tend to direct their attention more to Black relative to White faces.[12] Furthermore, when observing another in pain (ie, a potential signal of threat), neural representations of one's own pain[23,24] may be activated as well as self-oriented aversive emotions.[4] According to recent findings, these self-oriented aversive emotions may result in more initial attention to sufferers' facial expressions of pain,[35] if observers focus on the potential threats of pain to themselves (self-oriented perspective taking [PT]) rather than the pain sufferer (other-oriented PT). Drawing on these findings, in the current study, observers' attention may have been initially drawn more to Black pain faces because these faces elicited more concerns about potential threats to the observer rather than the sufferer. However, because we did not examine the perceptual saliency of Black vs White pain faces, observers' threat perceptions of Black vs White individuals, or observers' self-vs other-oriented PT, future inquiry is warranted to examine whether and how they might account for the current results.

Findings of the current study corroborated those of prior research indicating that explicit beliefs—such as the self-reported beliefs about race differences in pain assessed herein—are more associated with controlled rather than automatic processes.[14] Indeed, although no evidence was found for a moderating effect of observers' pain-related beliefs on their attentional engagement to White vs Black pain faces (ie, more automatic attentional processing), these beliefs did modulate observers' attentional disengagement from these faces (ie, more controlled attentional processing). Specifically, observers who more strongly endorsed the belief that White individuals experience pain more easily than Black individuals had less difficulty disengaging from Black vs White pain faces. This effect, however, did not seem to be influenced by the level of pain expressed on these faces, despite the fact that observers experienced increasing difficulty disengaging from increasing levels of expressed pain.[35,48] As a possible clinical implication of this race difference in attentional disengagement, healthcare providers—especially those who hold the aforementioned racially biased belief about pain—may attend less to Black vs White patients' pain complaints, which may in turn result in the former receiving worse pain treatments than the latter. However, because ours was a convenience sample that did not include healthcare providers, this implication remains speculative and should be explored in future research. One way in which this could be performed is by using patient avatars and a simulated clinical setting to examine whether providers' pain-related beliefs and attentional processing of pain account for racial disparities in their pain care decisions.

Furthermore, in line with our expectations, higher pain estimations were observed for White vs Black faces expressing no pain, suggesting that White observers had a lower threshold for detecting pain among members of their racial ingroup relative to members of a racial outgroup.[30] Two different patterns were observed for faces expressing moderate and high pain. Although no racial differences were found for moderate pain expressions, for faces expressing high pain, observers rated Black faces as experiencing more pain than White faces. Furthermore, although recent findings suggest that racial differences in observers' pain estimations may be associated with observers' endorsement of racially biased beliefs,[19] such a relationship was not observed in the current study [see also Refs. 13,45].

Although recent findings indicate that participants tend to show lower thresholds for seeing pain on White (versus Black) faces,[30] no main effect of target race on pain estimations was found in this study. One possibility is that the pain estimations in the present task were somewhat more explicit (and therefore more regulable) measures of bias, compared with the perceptual measures used in the previous work. Indeed, data from Mathur et al.[27] suggest that racial biases in the context of pain may be driven by automatic (rather than deliberate) processes. Drawing on the contextual approach to human behavior,[44] a possible alternative explanation for the divergent finding on pain ratings for Black vs White individuals depending on the level of pain expressiveness may be that, depending on the context (ie, levels of expressed pain), observers' pain estimations are governed by other pain beliefs about distinctions between Black vs White individuals. For instance, when individuals expressed no pain, it may be that false beliefs about racial differences in the pain expressivity of White vs Black individuals (eg, "compared with Black individuals, White individuals are more inclined to express that they are in pain") informed observers' pain estimations, leading observers to make more false alarms. If pain sufferers expressed high pain, however, it may be that this functioned as a threatening situation in which[10] false threat beliefs about Black vs White individuals (eg, "Black individuals are more threatening than White individuals")[22,26] were more readily activated and deployed to estimate pain. However, as an assessment of the precise beliefs contributing to observers' varying pain estimations of Black vs White faces expressing no pain, moderate pain, and high pain was beyond the scope of the current study, we recommend that future research examines the validity of the above-described possibility.

The current study has several limitations. First, observers' beliefs about race differences in pain were assessed in a one-sided manner (ie, White individuals experience pain more easily than Black individuals). Future research may include double-barreled items to more thoroughly assess these beliefs. Second, RT data were used to index attentional processing. These data only provide indirect rather than direct (eg, as by eye tracking) insight into attentional processes. Third, given the novelty of the current research, we used a convenience sample and not healthcare providers, which limits the generalizability of our findings. Fourth, to enhance experimental control, we opted for computer-rendered images (ie, avatars) of photographs of real individuals, which allowed us to rigorously manipulate facial expressions. Although these images have been validated and successfully used in previous research,[25,30] they may not fully capture the richness and complexity of real humans.[9] Fifth, given that our sample was predominantly female, we could not examine potential sex or gender effects. Although recent meta-analytic findings suggest that observers' sex or gender do not moderate their visual processing of the pain of Black vs White people,[25] future research is warranted to replicate our findings using a sample that is more balanced for sex or gender. Sixth, as many of our effect sizes were small, caution is warranted when interpreting some of our findings, and future research is needed to assess their replicability.

Nonetheless, this study remains instructive as it offers novel insights regarding when and how racial differences emerge in observers' attentional processing and estimations of others' pain. Moving forward, we recommend future research to directly investigate the extent to which the current findings predict behavioral indices of pain care (eg, inclination to recommend analgesics). Such work will not only serve to improve our understanding of the mechanisms underlying racial disparities in pain care but may also offer useful ways of preventing and eradicating such disparities.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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