Social Neuroscience

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/psns20

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To cite this article: Emilie A. Caspar, Eva Nicolay, Félix Banderembaho & Guillaume P. Pech (26 Dec 2024): Volition as a modulator of the intergroup empathy bias, Social Neuroscience, DOI: 10.1080/17470919.2024.2446816

To link to this article: https://doi.org/10.1080/17470919.2024.2446816

Published online: 26 Dec 2024.

SOCIAL NEUROSCIENCE
https://doi.org/10.1080/17470919.2024.2446816

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RESEARCH PAPER

Volition as a modulator of the intergroup empathy bias

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ABSTRACT

Neural reactions to others' pain are usually lower when the individual is of a different ethnicity than when they are of the same ethnicity. This suggests that empathy is not only an automatic phenomenon but also a motivated one. In the present study, we tested whether one's willingness to increase or decrease empathy would correspondingly increase or decrease the neural empathic response, as measured with electroencephalography (EEG), irrespective of ethnicity. In Study 1, participants were presented with pictures displaying painful or non-painful stimulations on an individual from a similar or different ethnic group. In Study 2, the procedure was relatively similar but employed a within-subject design and was conducted in two countries: Belgium and Rwanda. Overall, EEG results showed that participants successfully increased their neural response to the pain of others, irrespective of the others' ethnicity in Study 1. However, the within-subject design used in Study 2 revealed additional nuances, as we observed that participants increased their neural pain response selectively toward ingroup individuals. Our findings indicate that observing the pain of a single person, regardless of ethnicity, can heighten one's neural reaction. Yet, when both ingroup and outgroup members are present, the neural response intensifies only for ingroup members.

ARTICLE HISTORY
Received 22 January 2024
Revised 23 October 2024
Published online 27 December 2024

KEYWORDS
Volition; empathy for pain; intergroup bias; EEG; motivation

Introduction

Empathy is an incredible capacity for shaping and coloring our social interactions, as it allows us to understand how others feel. In neuroscience, many studies have shown that seeing another individual's pain triggers activations in the brain of the observer (Decety, 2011; Singer et al., 2004, 2009). Those activations occur especially in the anterior cingulate cortex and the insula (Jauniaux et al., 2019; Timmers et al., 2018) and allow us to experience the emotional component of what it is like to feel pain. Because of these vicarious activations, we generally prefer not to hurt others, as we understand their pain (de Waal & Preston, 2017; Hein et al., 2010; Meffert et al., 2013).

There is a broad consensus in the scientific community that our capacity to feel and imagine the pain of others, hereafter referred to as empathy for pain, is largely automatic (Singer et al., 2004; Zaki & Mitchell, 2013) and deeply ingrained into our biology, likely because of the presence of mirror neurons (Gallese & Goldman, 1998; Gallese et al., 1996, 2004). Yet, past experimental research has shown that empathy, despite being an internal and relatively automatic process, is also context-dependent (Zaki, 2014). Empathy for others' pain is reduced, for instance, when we obey the orders of an authority (Caspar, Ioumpa, et al., 2022; Caspar et al., 2020), when the person experiencing the pain played unfairly in a game (Singer et al., 2006), or when we observe the pain of an outgroup individual (Caspar et al., 2023 ; Cikara et al., 2011; Han, 2018; Hein et al., 2010). Empathy can also be increased, for instance, if we share similar experiences with the person in pain (Hodges et al., 2010), if we receive a reward (Klein & Hodges, 2001) or if we consider the observed pain from a first-person perspective (Bucchioni et al., 2016).

To reconcile the fact that empathy can be both automatic and context-dependent, theoretical work has suggested that empathy could be a motivated phenomenon, where individuals are driven either to experience empathy or to avoid it (Zaki, 2014). A motivational account of empathy would involve volitional processes, allowing individuals to willfully modulate empathy (Achtziger & Gollwitzer, 2018). However, the literature on the extent to which individuals can willfully exert control over their neural response to the pain of others is still scarce (Weisz & Cikara, 2021). A previous study using fMRI showed that intentional empathy relies on different neural substrates, notably

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in the inferior frontal region, than automatic empathy (de Greck et al., 2012). Another study showed that observers can up-regulate or down-regulate empathy by shifting their attention toward or away from affective cues (Todd et al., 2012). Meffert and colleagues further showed that when asked to try to feel the pain of others while visualizing a painful stimulus, individuals with high psychopathy scores had similar activations in empathy-related brain regions as controls (Meffert et al., 2013). This result could suggest that volition can indeed increase the neural empathic response. However, to the best of our knowledge, its interaction with contextual factors that can also lead to a modulation of the empathic response has not been investigated before.

A typical contextual factor that modulates the neural empathic response is the ethnicity of the individual. Extensive literature has shown that seeing the pain of an individual from another ethnicity reduces the neural response to their pain compared to an individual sharing the same ethnicity (e.g., Avenanti et al., 2010; Contreras-Huerta et al., 2013; Han, 2018; Pech & Caspar, 2024; Xu et al., 2009), thus representing a deeply ingrained and robust contextual factor modulating empathy. However, the possibility to voluntarily decrease empathy for pain or to increase it despite facing a different-ethnicity individual has not been investigated yet. Such a finding would advance the theoretical view of a motivated account of empathy and allow us to understand if volition can overcome intergroup biases, a critical aspect in our conflicting world.

In the present study, we thus investigated to what extent individuals can willfully exert control over their neural response to the pain of others, even if these others belong to a different ethnicity. In Study 1, participants were asked in three experimental conditions to voluntarily increase their empathy for the pain of individuals presented on the screen, to decrease it, or to simply look at the pictures without specific instructions (i.e., control condition). In one group, participants witnessed individuals sharing ethnic similarity with them. In a second group, the individuals presented in the pictures were from another ethnicity.

In electroencephalography studies, a recent meta-analysis suggested that the P3 and the Late Positive Potential (LPP) recorded over centro-parietal areas with electroencephalography (EEG) are robust to measure the neural response to the pain of others (Coll, 2018). In many previous studies, it has indeed been observed that the amplitude of the P3 and LPP is higher for painful stimulations, whether presented as pictures or videos, compared to non-painful stimuli (Caspar et al., 2023; Cheng et al., 2014; Ren et al., 2022). Here, we expected to observe a reduced amplitude of the P3 and LPP for the pain of different-ethnicity individuals compared to same-ethnicity individuals, following studies showing intergroup empathy bias (Caspar et al., 2023; Cikara et al., 2011; Hein et al., 2010). We predicted that if volition allows for modulation of empathy, we should observe a higher amplitude of the P3 and LPP in the increase condition compared to the control condition, and a lower amplitude in the decrease condition. Further, if volition allows for modulation of empathy regardless of contextual factors, we should observe a similar effect of condition regardless of the ethnicity of the individuals presented. On the other hand, if contextual factors such as the ethnicity of the individual in pain have a greater influence than volition on the neural response to others' pain, we should observe that people could more easily increase their empathy toward same-ethnicity individuals and more easily decrease their empathy toward different-ethnicity individuals.

Study 1 - method

Participants

We recruited 83 participants, aged between 18 and 40 years old with no preference for dominance handing. As no previous studies used a similar experimental approach, we used a small-to-medium effect size f of 0.175 to calculate the sample size (Faul et al., 2007). To achieve a power of .85 for this effect size, the estimated sample size was 62 for an interaction between a between-subject factor Group (2 levels) and a within-subject factor Condition (3 levels). We increased the sample size up to 74 to prevent the loss of data. Our participants were indeed recruited via the credits system for university students, and we could not prevent them to participate for any reasons, thus implying the recruitment of participants entering in our exclusion criteria. Exclusion criteria were determined prior the data acquisition. They included: (1) being an afro-descendant, (2) bad signal-to-noise ratio in EEG, (3) and not paying attention to the task by not correctly using the pain scale. Twelve afro-descendant participants were excluded as for them the different- and same-ethnicity individuals were the opposite. Seven participants were excluded due to a bad signal-to-noise ratio in EEG (i.e., head movements, sweat artifact or noisy reference electrode). One additional participant was excluded due to a bug during the data acquisition (i.e., no triggers were registered). Three participants were excluded because they did not use the pain scale correctly, suggesting a lack of attention. For the different-ethnicity group, there were 30 remaining participants (2 male and 28 female participants; mean age: 19.46, SD = 1.92). For

the same-ethnicity group, there were 30 remaining participants (3 male and 27 female participants; mean age: 20.86, SD = 3.82). All participants received credits for their participation. The study was approved by the local ethical committee of the Université libre de Bruxelles (reference number: 169/2021).

Procedure & material

Participants were invited to sit in front of a computer screen. We used a 64-channel EEG system to record their brain activity. Participants were told that they would witness pictures of three different individuals across three different experimental conditions. In the Control condition, participants were instructed to simply look at the pictures displayed on the screen (see Figure 1a). In the Increase condition, participants were asked to focus on what the person in the picture was feeling. They were explicitly instructed to try to increase their empathy for the individual presented in the pictures. In the Decrease condition, participants were asked to avoid feeling what the person in the picture was feeling. They were explicitly instructed to try to block their empathy for the individual presented in the pictures.

We told our participants that we had to preserve the anonymity of the three individuals presented in the pictures. As a consequence, the pictures were centered on the hands of those individuals, with their bodies and the lower part of their faces blurred (see Figure 1b). In the "different-ethnicity" group, the three individuals were Afro-descendant. In the "same-ethnicity" group, the three individuals were of European descent. A between-subject design with two groups was chosen due to the duration of the study. We were concerned that a within-subject design would cause too much cognitive fatigue.

For each of the three individuals presented, we created 8 pictures: 4 with painful tools (e.g., a knife) and 4 with non-painful tools (e.g., a feather). In the pictures, someone was holding the tools in a way that suggested an intention to hurt the individual, but the skin color of that person was concealed by gloves and a long shirt to avoid associating an ethnicity with the person holding the tools. In total, there were 20 trials per category of

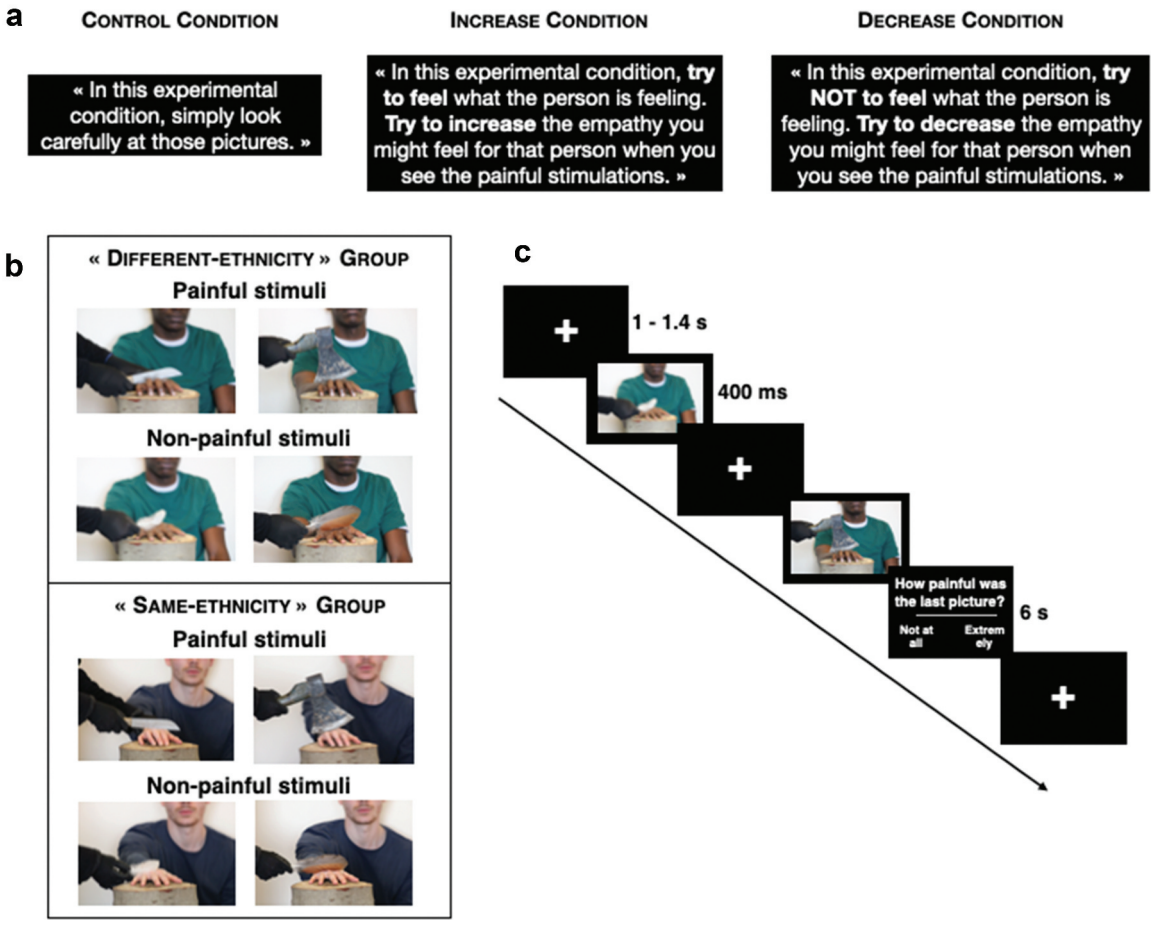

Figure 1. a) precise instructions given for the three experimental conditions. b) examples of pictures presenting either painful or non-painful stimulations in the two experimental groups. c) schematic representation of the task presentation on the screen.

tools, resulting in 160 trials per individual (80 painful and 80 non-painful). The increase, decrease, and control conditions were thus composed of 160 trials each, with each individual randomly assigned to one of the experimental conditions. For example, one participant had to increase their empathy for one individual, while the same individual was assigned to the decrease condition for another participant. The pictures were presented for 400 ms, with a jittered inter-trial interval (ITI) lasting between 1 and 1.4 seconds (see Figure 1c). The 400-ms presentation time for the pictures was chosen based on several EEG studies focusing on the same ERPs, which used presentation times of 250 ms (Vaes et al., 2016), 400 ms (Caspar et al., 2023) or 500 ms (Suzuki et al., 2015). A fixation cross located at the center of the screen was displayed during the ITI.

To ensure that participants were paying attention to the stimuli, on 12 out of 160 trials per condition, we randomly displayed a question asking participants to estimate the pain of the individual on a scale ranging from "0" (not painful at all) to "10" (very painful) based on the last picture shown. Participants could move a cursor on the scale presented on the screen and had 6 seconds to provide their answer. After 6 seconds, the next trial began.

At the end of the experimental session, participants were asked to complete a debriefing questionnaire in which they were asked (1) to what extent they felt they were able to increase or decrease their empathy, and (2) to what extent they were willing to increase or decrease their empathy. The answers were provided on a scale ranging from "0" (not at all) to "10" (extremely).

EEG recordings

Brain activity was recorded using a 64-channels electrode cap with the ActiveTwo system (BioSemi) and data were analyzed using Fieldtrip software (Oostenveld et al., 2011). The activities from the left and right mastoids, as well as from horizontal and vertical eye movements, were also recorded. Amplified voltages were sampled at 2048 hz. Data were referenced to the average signal of the mastoids and filtered (band-pass filter: 0.01–40 hz). The baseline was taken from 250 ms to 50 ms before the presentation of the pictures. To remove artifacts due to eye movements (i.e., saccades and eye blinks), we first ran an Independent Component Analysis (ICA) on 30 components (Mennes et al., 2010). We then selected components corresponding to saccades and eye blinks for removal based on visual inspection. Finally, we removed the remaining artifacts (i.e., muscular twitches, head movements, or flat signals) based on visual inspection. We used spectral interpolation around 50 hz and its harmonics to remove powerline noise, as the study was not conducted in a Faraday cage. All event-related potentials were analyzed across Cz, CPz, and Pz, as the higher neural pain response is typically recorded over centro-parietal sites (Coll, 2018). The timing of the ERPs was determined based on visual inspection of the grand averages. The N1 and the N2 were measured as the most negative peaks within the 110–160 ms and 280–390 ms time windows after picture onset, respectively. The P2 was measured as the most positive peak within the 190–250 ms time window and the 340–440 ms time window after the tone, respectively. The P3, the early LPP, and the late LPP were measured as the mean amplitude between the 390–510 ms, 520–770 ms, and 790–1300 ms time windows after picture onset, respectively.

Study 1 - results

Data were analyzed with both frequentist and Bayesian statistics (Dienes, 2011). Bayesian statistics assess the likelihood of the data under both the null and the alternative hypothesis. In most cases, we report BF_{10}, which corresponds to the $p(\text{data}|H_1)/p(\text{data}|H_0)$. Generally, a BF between 1/3 and 3 indicates that the data is similarly likely under the H_1 and H_0, and that the data thus does not adjudicate which is more likely. A BF_{10} below 1/3 or above 3 is interpreted as supporting H_0 and H_1, respectively. For instance, $BF_{10} = 20$ would mean that the data are 20 times more likely under H_1 than H_0 providing very strong support for H_1, while BF_{10}=.05 would mean that the data are 20 times more likely under H_0 than H_1 providing very strong support for H_0 (Marsman & Wagenmakers, 2017). BF and *p* values were calculated using JASP (Love et al., 2019) and the default priors implemented in JASP (Keysers et al., 2020). Default priors used in JASP depend on the statistical tests performed (for ANOVA, see (Rouder et al., 2012); for t-tests, see (Ly et al., 2016); for correlations, see (Wagenmakers et al., 2016)).

Pain response

A repeated-measures ANOVA was conducted with Condition (neutral, increase, decrease) and Pain (pain, no pain) as within-subject factor and Group (different-ethnicity, same-ethnicity) as between-subject factor on the scores of the pain scale. As expected, we observed strong evidence in favor of H_1 for a main effect of Pain ($F_{(1,56)} = 134.186$, $p < .001$, η^2_p=.706, $BF_{incl} = 7.311e+13$), with painful stimuli being reported as more painful (3.932, CI_{95}: 3.5–4.36) as non-painful stimuli (.903, CI_{95}: .47–1.33). We also observed strong evidence in favor of

H_1 for a main effect of Condition ($F_{(2,112)} = 41.609$, $p < .001$, $\eta^2_p = .426$, $BF_{incl} = 7.311e+13$) and for an interaction Condition*Pain ($F_{(2,112)} = 27.588$, $p < .001$, $\eta^2_p = .330$, $BF_{incl} = 1.578e+8$). Post-hoc comparisons with False Discovery Rate (FDR) corrections with the Benjamini and Hochberg method (Benjamini & Hochberg, 1995) indicated that the difference between painful and non-painful stimuli was significant across all three experimental conditions (all $ps_{FDR} < .001$, all $BFs_{10} \geq 4.8e+7$), suggesting that participants correctly discriminate painful and non-painful tools on the pictures in all conditions. Interestingly, when participants had to estimate subjectively the pain of painful stimuli, they reported the stimuli presented as more painful in the increased condition (4.924, CI_{95}: 4.4–5.4) compared to the neutral condition (4.212, CI_{95}: 3.7–4.7, $t_{(56)} = -3.607$, $p_{FDR} = .006$, Cohen's d = –.380, $BF_{10} = 20.786$) and compared to the decrease condition (2.661, CI_{95}: 2.1–3.1, $t_{(56)} = 11.457$, $p_{FDR} < .001$, Cohen's d = 1.208, $BF_{10} = 1.686e+10$). The neutral condition also significantly differed from the decrease condition ($t_{(56)} = 7.849$, $p_{FDR} < .001$, Cohen's d = .827, $BF_{10} = 304685.58$).

Questions on volition and subjective feeling

On a scale ranging from 0 to 10, participants reported in average that they subjectively felt that they could increase or decrease their empathy, with 5.22 (SD = 1.99) in the increase condition and 7.32 (SD = 1.95) in the decrease condition (see Figure 2(a)). We conducted a repeated-measures ANOVA with Condition (increase, decrease) as within-subject factor and Group (different-ethnicity, same-ethnicity) as between-subject factor on their impression of having successfully modulated their empathy. We found a strong evidence in favor of H_1 for a main effect of Condition ($F_{(1,58)} = 26.174$, $p < .001$, $\eta^2_p = .311$, $BF_{incl} = 521207.581$). The main effect of group and the interaction Group*Condition were inconclusive (all $ps > .1$, all $BFs_{incl} \leq .615$ & $\geq .390$).

On a scale ranging from 0 to 10, participants reported in average that they were willing to increase or decrease their empathy, with 7.90 (SD = 1.78) in the increase condition and 8.13 (SD = 2.1) in the decrease condition (see Figure 2(b)). The same repeated-measures ANOVA revealed that the main effect of Group, Condition, and the interaction Condition*Group were in favor of H_0 (all $ps > .2$, all $BFs_{incl} \leq .233$). Thus, participants' willingness to increase or decrease their empathy did not differ, irrespective of their Group.

We also conducted exploratory Pearson correlations between the estimated pain when witnessing painful tools and the impression and volition to increase or decrease empathy. We observed a significant positive correlation between the estimated pain in the increase condition and the impression to have been able to increase empathy ($r = .623$, $p < .001$, $BF_{10} = 99885.68$) and a negative correlation between the estimated pain in the decrease condition and the impression to have been able to decrease empathy ($r = -.360$, $p < .001$, $BF_{10} = 7.018$). The same correlations between the willingness to increase or decrease empathy and the estimated pain scale were inconclusive or in favor of H_0 ($p > .1$, $BF_{10} = .466$ and $p > .6$, $BF_{10} = .182$, respectively).

Electroencephalography

We first compared the amplitude of the N1, P2, N2, P3, eLPP and lLPP when participants witnessed painful

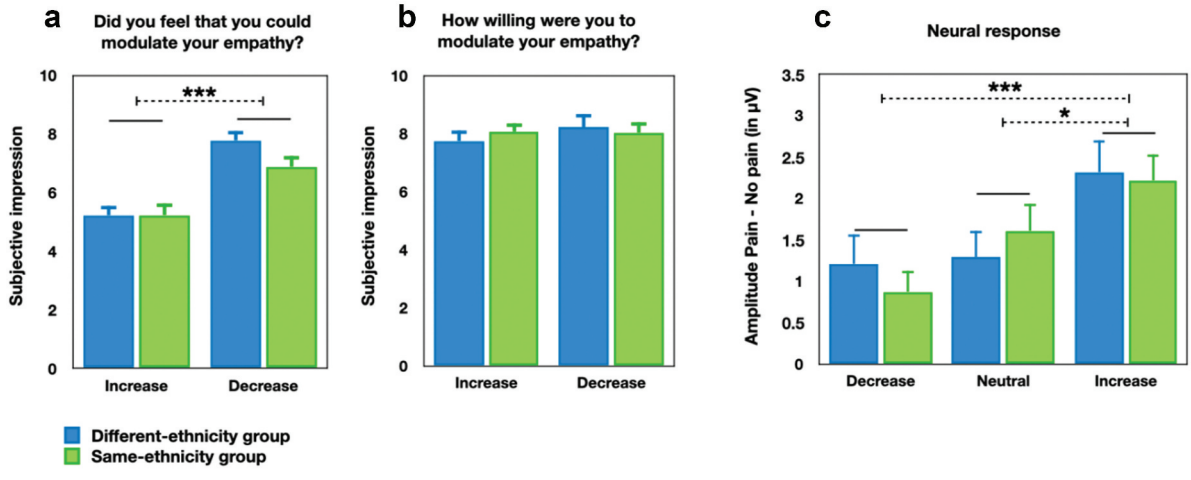

Figure 2. a) graphical representation of the subjective impression of having successfully increase or decrease one's empathy. b) graphical representation of the volition to increase or decrease one's empathy. c) graphical representation of the neural pain response (pain – No pain trials). * represents a $p > .01$ & $BF_{10} > 3$. *** represents a $p < .001$ & $BF_{10} > 3$. Error bars represent standard errors.

pictures *vs* non-painful pictures in order to confirm that these Event-Related Potentials (ERP) are sensitive to the visualization of pain, irrespective of the other independent variables. Consistently with the literature (Coll, 2018), we observed very strong evidences in favor of H_1 for a higher amplitude for Pain trials *vs* No Pain trials for the P3 ($t_{(59)} = 9.211$, $p < .001$, Cohen's d = 1.189, $BF_{10} = 1.548e^{+8}$), the eLPP ($t_{(59)} = 12.809$, $p < .001$, Cohen's d = 1.654, $BF_{10} = 2.623e^{+14}$) and the lLPP ($t_{(59)} = 8.272$, $p < .001$, Cohen's d = 1.068, $BF_{10} = 1.380e^{+8}$). The comparison was in favor of H_0 for the N1 and the P2 (all *p*s>.3, all $BFs_{10} \leq .144$) and in favor of H_1 for the N2 ($p = .003$, $BF_{10} = 3.095$) but in the opposite direction as what was expected (i.e., higher amplitude in No Pain trials compared to Pain trials), suggesting that the results of the N2 are not reliable.

We subtracted the amplitude of the pain response during No Pain trials to Pain trials (i.e., Pain-No pain) and performed our statistical analyses on this new variable. For the sake of clarity of the results section, we computed a global pain response, which corresponded to the averaging of the P3, the eLPP and the lLPP, similar to previous studies (Caspar et al., 2023).

The repeated-measures ANOVA was conducted with Condition (neutral, increase, decrease) as within-subject factor and Group (different-ethnicity, same-ethnicity) as between-subject factor on the pain response. We found a strong evidence in favor of H_1 for a main effect of Condition ($F_{(2,116)} = 7.352$, $p < .001$, $\eta^2_p = .112$, $BF_{incl} = 64.963$), see Figure 2(c). Post-hoc comparisons corrected with the FDR approach indicated that the amplitude of the pain response was higher in the increase condition (2.264 µv, CI_{95}: 1.80–2.73) compared to the neutral condition (1.452 µv, $CI_{95} = .98–1.91$, $t_{(58)} = -2.498$, $p_{FDR} = .013$, Cohen's d = −.447, $BF_{10} = 3.974$) and compared to the decrease condition (1.039 µv, $CI_{95} = .57–1.50$, $t_{(58)} = 3.768$, $p_{FDR} = .003$, Cohen's d = .674, $BF_{10} = 40.023$). The difference between the neutral and the decrease condition was in favor of H_0 ($p_{FDR} > .2$, $BF_{10} = .185$). The main effect of Group and the interaction Group*Condition were in favor of H_0 (all *p*s > .6, all $BFs_{incl} \leq .154$).

Study 1 - discussion

In Study 1, participants reported that they were equally willing to increase or decrease their empathy in the two experimental conditions, indicating that their volition was similar in both conditions. Participants also subjectively reported that they felt they successfully increased or decreased their empathy, though they felt they were more able to decrease it. However, EEG data indicated that the decrease condition was not statistically different from the neutral condition. Interestingly, EEG results further indicated that participants were able to increase their neural response to the pain of others compared to the neutral condition.

Past literature has indicated that empathy can be a costly process that people tend to avoid if they can (C. D. Cameron et al., 2019). Yet, our results suggest that people can voluntarily increase their neural response to the pain of others, even more so than decreasing it. A common strategy to reduce empathy is to turn attention away (Gu & Han, 2007). However, here, participants still had to maintain a minimal attention level because they had to respond to the pain scale. Attention levels appeared to be similar in Study 1, as participants reliably used the pain scale that appeared at random times in all experimental conditions. Thus, a possible explanation for our results is that participants were able to voluntarily boost their empathy as much as possible when requested to do so.

Crucially, this result was not influenced by the ethnicity of the individuals in the pictures, suggesting a similar ability to increase empathy even when facing an individual from a different ethnicity. Furthermore, we did not observe an inter-ethnicity empathy effect, which typically involves a reduced neural response to the pain of individuals from a different ethnicity compared to the pain of individuals from the same ethnicity (Avenanti et al., 2010; Contreras-Huerta et al., 2013; Han, 2018; Xu et al., 2009). The testing location could have accounted for such results. The testing took place in Brussels, a highly culturally diverse city (Bousetta et al., 2018). Previous studies have suggested that frequent contact with "outgroup" individuals diminishes intergroup biases (Beelmann & Heinemann, 2014; L. Cameron et al., 2011; Crisp & Turner, 2009; Kang et al., 2021). However, in a previous study conducted in Brussels (Pech & Caspar, 2024), we did observe intergroup biases toward an individual from another ethnicity, including a reduced empathic neural response, although admittedly the effect was not very strong.

However, a limitation of Study 1 is the between-subjects design we used for the same-ethnicity and different-ethnicity groups. Indeed, individual differences between participants in each group could have confounded our results. Therefore, we decided to conduct a second study to address some of the unresolved questions. First, we introduced "ethnicity" as a within-subject variable to evaluate whether a similar group of participants would show consistent effects of volition on empathy for pain, regardless of the ethnicity of the person experiencing pain. Second, we introduced a novel between-subjects variable by conducting the study in two different countries where individuals were either of European descent or Afro-descendants. More

precisely, the study was conducted in Brussels, Belgium, similar to Study 1, and in Kigali, Rwanda. It has been previously shown that ethnic and cultural diversity in Belgium is approximately 40% higher than in Rwanda (Fearon, 2003). Furthermore, according to the World Population Review, Brussels ranks within the top 15 most culturally diverse cities in the world.

Study 2 - method

Participants

Such as in Study 1, we used a small-to-medium effect size f of 0.175 to calculate the sample size (Faul et al., 2007) with G*Power. To achieve a power of 0.85 for this effect size, the estimated sample size was 42 for an interaction between a between-subject factor Group (2 levels) and a within-subject factor ConditionType (32 levels). Participants received financial compensation or course credit. Again, we could not prevent students from participating without any specific reason. The same post-hoc exclusion criteria were used as in Study 1. They included: (1) being an Afro-descendant or of European descent, depending on the testing location, (2) a bad signal-to-noise ratio in EEG, and (3) not paying attention to the task by incorrectly using the pain scale. In Rwanda, all the participants were native Rwandans, studying at the university and living in or around Kigali. They were recruited via an email sent to all students after receiving approval from the administration. In Belgium, the sample was more diverse regarding the ethnicity of the participants, and we had to test 71 participants to obtain our final sample. They were mostly university students living in or around Brussels and were recruited through online platforms for studies. Seven participants were excluded due to a bad signal-to-noise ratio in EEG (i.e., head movements, sweat artifacts, or a noisy reference electrode). Two additional participants were excluded due to a bug during the data acquisition (i.e., one had no triggers registered, and one had empty data for the neutral condition). Two participants did not correctly use the pain scale, but these participants were already among those rejected for a bad signal-to-noise ratio. Therefore, no further participants were rejected based on this criterion. For the group tested in Rwanda, there were 23 remaining participants (14 male and 9 female participants; mean age: 23.30, SD = 1.60). For the group tested in Belgium, there were 24 remaining participants (2 male and 22 female participants; mean age: 20.45, SD = 5.08). The study was approved by the local ethical committee of the Université libre de Bruxelles (reference number: 169/2021) for the study conducted in Belgium and by the Rwandan National Ethics Committee (reference number: 424/RNEC/2023) for the study conducted in Rwanda.

Procedure & material

The procedure and materials were globally similar to Study 1. However, in Study 2, we introduced an additional within-subject variable: the type of individuals they saw pictures of. Half of the individuals presented in the pictures were Afro-descendant, and the other half were of European descent. Of note, in Rwanda, the concept of ethnicity carries deep historical significance, particularly in light of the country's tragic past. Discussions of ethnicity are highly sensitive and carry strong connotations, particularly between people from different ethnic groups within Rwanda. For this reason, the words "ethnicity" or "race" were never used during the study, but our stimuli presented people with a clear difference in skin color.

The task consisted of 6 blocks, including two repetitions of a block with a similar experimental condition. In other words, there were 2 blocks in the increase condition, 2 blocks in the decrease condition, and 2 blocks in the control condition. The order of the first three blocks was randomized, with each experimental condition presented once. Then, the next three blocks followed the same order as the first three blocks to ensure a similar time elapsed between the two blocks of each experimental condition. Within each block, half of the individuals presented were Afro-descendant, and the other half were of European descent, in a randomized order. In total, there were 15 trials per category of tools, resulting in 120 trials per individual (60 painful and 60 non-painful) for each individual presented. The increase, decrease, and control conditions were thus composed of 240 trials each, with 120 trials with an individual from the same ethnicity and 120 trials with an individual from another ethnicity.

Importantly, we used the exact same computers and electroencephalograms in both countries to avoid any effect of the equipment (e.g., delays, different electrodes, etc.) on our results. The equipment was sent via the diplomatic bag system of the Belgian Embassy. It is also worth noting that we conducted two studies in Rwanda with students. The other study, which investigated the effect of social influence on prosocial intentions, was unrelated to the present study (E. Caspar & Pech, 2024). Participants in Rwanda were randomly assigned to one of the two studies when they arrived.

EEG recordings

In Study 2, brain activity was recorded using a 32-channel electrode cap with the ActiveTwo system (BioSemi)

instead of 64 electrodes. The recordings and analyses were exactly the same as in Study 1, with the exception that event-related potentials were analyzed across Cz and Pz, for the same reasons as in Study 1.

Study 2– results

Pain scale

We conducted a repeated-measures ANOVA with Condition (neutral, increase, decrease), Pain (Pain, No Pain), and Type (same-ethnicity; different-ethnicity) as within-subject factors, and Group (Belgium; Rwanda) as a between-subject factor on the differences in the pain scale. As expected, we observed strong evidence in favor of H1 for a main effect of Pain ($F_{(1,45)} = 278.499$, $p < .001$, η^2 $p = .861$, $BF_{incl} = 1.445e + 14$), with higher scores reported on the pain scale for pain trials (6.67, CI95: 6.17–7.18) compared to non-pain trials (1.76, CI95: 1.42–2.10). We also found strong evidence in favor of H_1 for a main effect of Condition ($F_{(2,90)} = 22.130$, $p < .001$, η^2 $p = .330$, $BF_{incl} = 2.896e + 10$), and a Condition*Pain interaction ($F_{(2,90)} = 19.452$, $p < .001$, η^2 $p = .302$, $BF_{incl} = 188838.37$). Post hoc comparisons indicated that the scores reported on the pain scale were higher on pain trials than on non-pain trials in all experimental conditions (all $p_{FDR} < .001$, all $BF_{10} \geq 231103$). Additional comparisons showed that non-pain trials did not differ from each other (all $ps_{FDR} > .1$, all $BF_{10} \leq 0.27$). However, for pain trials, the scores were higher in the increase condition (7.67, CI95: 7.25–8.10) and in the neutral condition (7.23, CI95: 6.59–7.87) compared to the decrease condition (5.11, CI95: 4.33–5.90; $t_{(45)} = -6.967$, $p_{FDR} < .001$, Cohen's d = 1.230, $BF_{10} = 1756759.55$ and $t_{(45)} = 5.968$, $p_{FDR} < .001$, Cohen's d = 1.017, $BF_{10} = 62707.83$, respectively). The difference between the increase condition and the neutral condition was inconclusive ($p_{FDR} = .086$, $BF_{10} = 0.40$). All other main effects or interactions were in favor of H0 or were inconclusive (all $ps \geq .070$, all $BF_{incl} \leq 1.190$).

Electroencephalography

Similar to Study 1, we first compared the amplitude of the N1, P2, N2, P3, eLPP, and lLPP when participants witnessed painful pictures vs non-painful pictures to confirm that these Event-Related Potentials (ERPs) are sensitive to the visualization of pain, irrespective of the other independent variables. Consistent with the literature (Coll, 2018), we observed very strong evidence in favor of H_1 for a higher amplitude for Pain trials vs No Pain trials for the P3 ($t_{(46)} = 5.407$, $p < .001$, Cohen's d = .789, BF10 = 7876.62), the eLPP ($t_{(46)} = 8.425$, $p < .001$, Cohen's d = 1.229, $BF_{10} = 1.413e + 8$), and the lLPP (t(46) = 5.228, $p < .001$, Cohen's d = .763, $BF_{10} = 4464.762$). The comparisons for the N1, P2, and N2 were in favor of H0 or were inconclusive (all $ps > .090$, all BF10 between .166 and .629).

We subtracted the amplitude of the pain response during No Pain trials from Pain trials (i.e., Pain – No Pain) and performed our statistical analyses on this new variable. For clarity in the results section, we computed a global pain response, which corresponded to the average of the P3, eLPP, and lLPP, similar to previous studies (Caspar, Gishoma, et al., 2022).

The repeated-measures ANOVA was conducted with Condition (neutral, increase, decrease) and Type (same-ethnicity; different-ethnicity) as within-subject factor and Group (Belgium; Rwanda) as between-subject factor on the pain response. We found a strong evidence in favor of H_1 for a main effect of Condition ($F_{(2,90)} = 10.710$, $p = .032$, $\eta^2_p = .073$, $BF_{incl} = 99.531$). Post Hoc comparisons indicated that the amplitude of the pain response was higher in the increase condition (1.244 µv, CI_{95}: .92–1.56) compared to the decrease condition (0.606 µv, CI_{95} = .254–.957, $t_{(45)} = 2.906$, $p_{FDR} = .018$, Cohen's d = .377, $BF_{10} = 5.867$). The difference between the increase condition and the neutral condition was inconclusive with the Bayesian approach and marginal with the frequentist approach (0.734 µv, $CI_{95} = .33–1.13$, $t_{(45)} = -2.105$, $p_{FDR} = .061$, Cohen's d = –.301, $BF_{10} = 1.034$). The difference between the neutral and the decrease condition was in favor of H_0 ($p_{FDR}>.6$, $BF_{10} = 0.128$). The main effect of Type was in favor of H_1 with the Bayesian approach, but not significant with the frequentist approach ($p = .093$; $BF_{incl} = 84.54$). We also observed an interaction Condition*Type ($F_{(2,90)} = 9.437$, $p < .001$, $\eta^2_p = .173$, $BF_{incl} = 301.31$), see Figure 3. Post Hoc comparisons indicated that the pain response was not different for different-ethnicity and same-ethnicity individuals in the neutral ($p_{FDR} > .8$, $BF_{10} = 0.17$) and in the decrease condition ($p_{FDR} > .8$, $BF_{10} = 0.12$). However, in the increase condition, we observed evidence in favor of H_1 for a higher amplitude of the pain response for same-ethnicity individuals (1.963 µv, CI_{95}: 1.60–2.32) compared to different-ethnicity individuals (0.606 µv, CI_{95} = .07–.98, $t_{(45)}$ = -5.69, $p_{FDR} < .001$, Cohen's d = –.849, $BF_{10} = 20386.92$). Taken differently, the amplitude of the pain response was not different between the three experimental conditions for different-ethnicity individuals (all $ps_{FDR} > .3$, all $BFs_{10} \leq 0.19$). However, for same-ethnicity individuals, the amplitude of the pain response was higher in the increase condition (1.963 µv, CI_{95}: 1.60–2.32) compared to the decrease condition (0.647 µv, CI_{95} = .18–1.10, $t_{(45)} = 4.48$, $p_{FDR} < .001$, Cohen's d = –.849, $BF_{10} = 444.28$) and the neutral

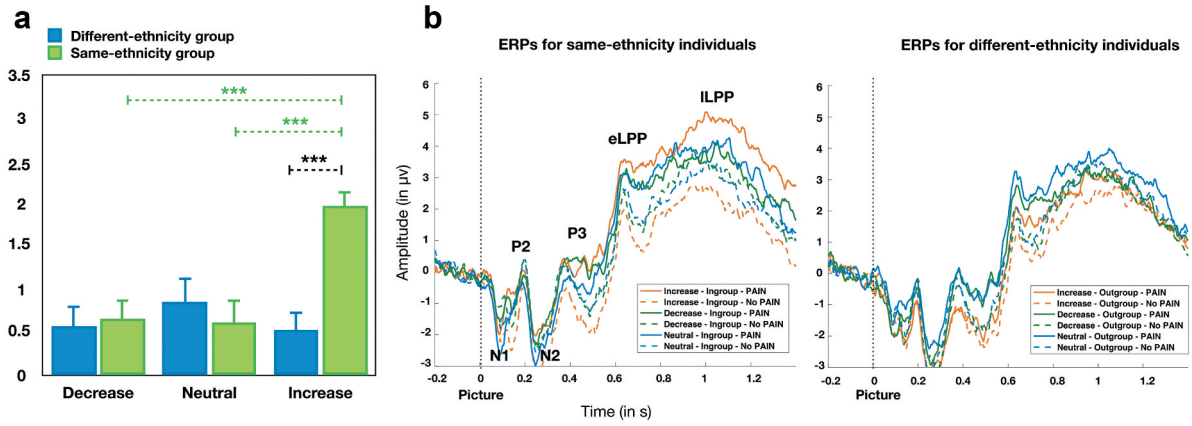

Figure 3. a) graphical representation of the neural pain response (Pain – No pain trials). *** represents a $p < .001$ & $BF_{10} > 3$. Error bars represent standard errors. b) graphical representation of the Event-Related Potential associated with the pain response in the three experimental conditions, for both same-ethnicity individuals (i.e., "ingroup", plot on the left) and different-ethnicity individuals (i.e., "outgroup", plot on the right).

condition (0.607 µv, CI_{95} = .02–1.19, $t_{(45)}$ = -4.42, p_{FDR} < .001, Cohen's d = −.801, BF_{10} = 386.46). The difference between the decrease and the neutral condition was in favor of H_0 ($p > .9$, $BF_{10} = 0.13$). All other main effects or interactions were in favor of H_0 (all *ps* > .093, all $BFs_{incl} \leq .177$).

Discussion study 2

In Study 2, the pain scale data indicated that participants rated the stimuli as more painful in both the increase and neutral conditions compared to the decrease condition. Furthermore, this effect was not modulated by the individuals' identity (i.e., different-ethnicity vs. same-ethnicity members) and was not influenced by the country in which the study was conducted. This suggests that, overall, participants were relatively stable in their subjective estimation of pain but more easily lowered this estimation in the decrease condition.

Regarding the pain response, we observed, as in Study 1, a main effect of condition on the amplitude of the ERPs. We found that ERPs associated with the pain response were higher in the increase condition compared to the decrease condition. Additionally, after correcting for multiple comparisons, we observed a trend toward a higher pain response in the increase condition relative to the neutral condition. This effect, however, was slightly less pronounced than in Study 1, perhaps due to mixing ingroup and outgroup individuals as a within-subject factor. It was indeed observed that the effect of condition was influenced by the identity of the individuals from whom participants witnessed the pain. While participants had a higher amplitude of the pain response for ingroup individuals in the increase condition compared to both the neutral and decrease conditions, this effect was in favor of the null hypothesis (H_0) for outgroup individuals. This finding contrasts with Study 1, where no difference between the same-ethnicity and different-ethnicity groups was observed. However, since Study 2 relied on a within-subjects factor for the effect of individual identity, the results may be considered more robust and reliable.

Interestingly, we did not observe an inter-ethnicity empathy effect, which typically displays a lower neural empathic response to outgroup members compared to ingroup members (Amodio & Cikara, 2021; Caspar et al., 2023; Hein et al., 2010). One possible interpretation is that our experimental design, which mixed both same-ethnicity and different-ethnicity individuals within the same experimental block, may have influenced this result. However, this interpretation is somewhat undermined by the fact that we did observe an effect in the increase condition depending on the individual's identity. We chose a non-block design to prevent artificially amplifying the intergroup effect, as a block design could make it easier for participants to infer the study's purpose or engage different cognitive resources compared to a mixed design. Nevertheless, it remains possible that participants exerted no specific effort in the neutral condition, resulting in no observable differences between same-ethnicity and different-ethnicity groups, while they may have attempted to engage more cognitive effort to feel empathy, but only when viewing a picture of an ingroup individual.

General discussion

In the present study, we aimed to understand if volition could modulate the neural response to others' pain. Furthermore, we evaluated whether this modulation

was consistent for individuals belonging to the same group or a different group. Based on the literature, we defined group identity in terms of ethnicity, which is frequently cited as a typical target for intergroup biases.

Overall, in Study 1, we observed that people could increase their neural response to others' pain, regardless of the others' ethnic similarity. However, Study 2 partially contradicted these results. We noted that the increase in neural empathic response was influenced by the individual's identity, despite also observing a main effect of condition, which was mostly driven by the increase condition. Specifically, there were higher ERPs in response to individuals of the same ethnicity compared to those of a different ethnicity in the increase condition, but not in the two other experimental conditions. These findings suggest that people may enhance their neural response to the pain of others, even from different ethnicities, when that person is the sole individual they observe. In this regard, and confirming previous studies, the racial empathy bias may not be inevitable and could be reduced by cognitive strategies (Sheng & Han, 2012). n Study 1, however, participants witnessing the pain of individuals from a different ethnicity had only a single within-subject factor: the experimental conditions. In Study 2, participants had to engage in the same volitional process, and when presented with both same- and different-ethnicity individuals, they might show a preference for ingroup members. This assumption implies that individuals could choose to direct more resources to augment empathy when witnessing an ingroup individual's pain. To what extent this process occurs consciously or unconsciously remains, however, to be determined.

One point for consideration is why, in both studies, the pain response remained consistently low in both the neutral and decrease conditions, contrary to expectations of a more diminished pain response in the decrease condition compared to the neutral condition. As discussed in Study 1, a common method for diminishing empathy is to divert attention away from the observed pain (Gu & Han, 2007; Li, Liu, et al., 2020; Li, Li, et al., 2020). This result was replicated in Study 2, suggesting some robustness. In both Studies 1 and 2, participants were asked to rate pain at unpredictable intervals, which may have sustained a general level of attention, thereby inhibiting further attentional disengagement that could lead to a reduced neural empathic response. This outcome might imply that individuals cannot entirely overlook a fundamental neural response to another's pain.

A crucial aspect of our study is that our stimuli were designed to elicit both painful and non-painful nociceptive pain with tools, but also depicted hands holding these tools, which may invoke threat sensitivity in addition to empathy for pain. The literature defines empathic pain as arising from observing actual or threatened tissue damage in another person (Zaki et al., 2016). Our stimuli fit this definition, as the perceived threat could potentially activate the nociceptors of the person receiving the pain, since the tools were applied to the hand, causing it to tense. A previous fMRI study supports our hypothesis that our design effectively triggered empathy for pain, as the researchers used threatening visual stimuli to investigate cognitive and emotional empathy and observed activations in brain regions traditionally linked with the pain network (Jauniaux et al., 2019). Future research could investigate whether volitional effects on empathy for pain are influenced by nociceptive pain, both in the presence and absence of an additional perceived threat.

In Study 1, we hypothesized that the absence of differences based on individual identity might be related to the highly multicultural and multi-ethnic context of the city where the testing occurred. Yet, Study 2 did not reveal a distinct effect between participants from Kigali and those from Brussels. Inspired by the contact hypothesis (Pettigrew, 1986), it has been mentioned in the literature that intergroup relationships can reduce the racial bias in empathic neural responses (Sheng & Han, 2012; Zuo & Han, 2013). For instance, an fMRI study showed that Chinese individuals raised in Western countries do not display racial bias in their neural empathic responses, as evidenced by greater neural activity in the anterior cingulate and anterior insula in response to the pain of both Chinese and European faces (Zuo & Han, 2013). However, a previous EEG study found no evidence that empathy-related brain activity was modulated by minimal group manipulation (Contreras-Huerta et al., 2014). Furthermore, in a study conducted in Rwanda that measured intergroup empathy bias among former genocide perpetrators, survivors, and their children, a negative impact associated with living in reconciliation villages was observed (Caspar et al., 2023). In these villages, former perpetrators and survivors, along with their families, are encouraged to cohabit and participate in joint activities to foster group contacts and promote reconciliation. Yet, EEG results indicated that residing in a Reconciliation Village, as opposed to not, adversely affected the neural response to others' pain in children of both former perpetrators and survivors. This may suggest that beyond mere contact between outgroup members, the willingness to engage in such interactions may be a crucial factor.

A limitation of the current study is the omission of a volition questionnaire in Study 2, which would have helped to replicate Study 1's findings. However, the consistency of our EEG results across conditions in both

studies could indicate that participants could effectively voluntarily modulate their empathic response. Furthermore, we could have questioned participants to understand if they were motivated to modulate empathy for any particular reason, or rather if they were voluntarily willing to modulate their empathy. Another experimental option that could have been taken was to treat each experimental condition (i.e., increase, decrease, or neutral) as a between-subject factor instead of a within-subject factor. However, observing differences in a between-subject design, which was one of the limitations of Study 1, does not allow for separating the effects of the experimental manipulation from individual differences. This is important because the amplitude of ERPs associated with empathy has also been shown to be modulated by individual differences (van Dongen et al., 2018).

In animal behavioral neuroscience, the emphasis is on learning and conditioning processes, using primary incentives (food, liquid, and sexual stimuli) and measuring simple behaviors (physiological reflexes, response rates, and stimulus preferences). In social and personality psychology, the emphasis is on the pursuit of temporally extended goals involving high-level incentives (power, achievement, and affiliation) and assessing self-reported beliefs and goal-striving behaviors. In cognitive neuroscience and adolescent developmental research, the emphasis is on neural representations of incentive value, typically using monetary rewards, and assessing how these modulate effortful cognitive processing. Conceptually, motivation refers to the process that initiates, guides, and maintains goal-oriented behaviors. In both animal and human research, motivation can be reached by primary incentives, such as food, liquid, and sexual stimuli. In humans, high-level incentives can also be at play, such as power, achievement, and affiliation (Braver et al., 2014). In the case of empathy research, previous studies indeed suggested that empathy can be motivated, for instance, by a monetary reward (Klein & Hodges, 2001). However, in the present study, we intentionally did not use any incentives to motivate participants. We simply provided participants with instructions, which they could ultimately choose to follow or not, without any detrimental consequences. In our study, we thus targeted volition, or willpower – the cognitive process by which individuals decide on and commit to a particular course of action (Ghoshal & Bruch, 2003). While both motivation and volition can modulate empathy, it may be beneficial for future research to establish a conceptual distinction between these two terms in order to investigate their convergences and differences.

A critical scientific and societal challenge consists in better understanding how prejudice toward individuals considered as outgroup can be reduced. Previous scientific papers have shown that some interventions can help reduce the intergroup empathy bias (Cao et al., 2015; Pech & Caspar, 2024; Stevens & Abernethy, 2018), which usually involves a reduced neural response to the pain of outgroup individuals compared to ingroup individuals. The present study contributes to this literature by showing that volition can successfully modulate the neural response to the pain of others. Such effects may also be observed toward outgroup members but must be influenced by the willingness of participants. Volition could be a critical factor in evaluating how different interventions may contribute to reducing the intergroup empathy bias toward outgroup individuals.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The project has been funded by a Fond d'Encouragement à la Recherche (FER) ULB grant.

Authors contribution

E.A.C. developed the study concept. G.P. and E.A.C. created the study design. E.A.C. and G.P. conducted the experiment and analyzed the results. E.N. helped in the recruitment and testing in Brussels. F.B. helped us in the administrative recruitment and testing in Kigali. E.A.C. drafted the first draft of the manuscript and G.P., F.B. and E.N. provided comments. All the authors agree on the final version of the manuscript.

Data availability

Data are made available on OSF (https://osf.io/kvgxz/).

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