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Running head: closeness and empathy

The closer you feel, the more you care: positive associations between closeness, **pain intensity rating, empathic concern and personal distress to someone in pain**

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Abstract

Previous research revealed inconsistent findings regarding affective responses when facing someone in pain (i.e., empathic concern and/or personal distress). In this paper, we suggest that the degree of closeness between the observer and the person in pain may account for these contradictory results, such that greater closeness towards this person leads to higher personal distress. To test this hypothesis, we induced either low or high closeness with a confederate in 69 randomly assigned participants. Following the closeness induction, participants evaluated their affective **responses** (empathic concern and personal distress) and rated the confederate's pain intensity after watching the confederate undergoing a painful cold pressure task. Results showed that, despite the non-significant effect of closeness induction, closeness across both conditions (low and high) was positively correlated with **pain intensity rating, empathic concern and personal distress**. This study thus suggests that closeness is associated with higher **cognitive and affective responses to** a person in pain.

Keywords

Closeness; empathy; pain; personal distress; **empathic concern**; perspective taking

Introduction

The empathy literature suggests that we generally experience two main vicarious emotional responses when facing others' misfortune (Batson et al., 1987), namely empathic concern and personal distress (usually referring to "affective empathy" (Davis, 1983)). Empathic concern refers to other-oriented feelings of warmth and sympathy whereas personal distress is related to self-oriented feelings of discomfort and anxiety. In addition, the former leads individuals to focus on the well-being of the other person and to altruistic behaviors (i.e., when helping others results from caring about fulfilling others' needs (Konrath & Tian, 2017)) while the latter leads to the willingness to reduce one's own distress by avoiding the person when it is possible (Batson et al., 1981).

Pain, defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (IASP Task Force on Taxonomy, 1994), has been suggested to be associated with both vicarious emotions (Goubert et al., 2009). According to the authors, pain would trigger personal distress associated with withdrawal motivation (i.e. avoid the external potential threat) which may afterwards lead to empathic concern associated with the willingness to give help. Research that examined affective responses when facing someone in pain have revealed inconsistencies in both the personal distress and empathic concern responses to other's pain (Grynberg & Maurage, 2014; Lamm et al., 2007; Yamada & Decety, 2009) as well as in the extent to which they correlate with the activation of brain regions involved in processing other's pain (Moriguchi et al., 2007; Saarela et al., 2007; Singer et al., 2004). For instance, during an empathy for pain task, Singer and collaborators (2004) found that the activation of the anterior insula positively correlated with empathic concern whereas other studies showed a positive correlation between activation of the insula (anterior and posterior) and personal distress (Moriguchi et al., 2007; Saarela et al., 2007).

In this paper, we suggest that the degree of closeness between the observer and the individual in pain may account for these contradictory results. For instance, the study of Singer et al. (2004) tested the empathic responses of women towards their male partner whereas Moriguchi et al. (2007) and Saarela et al. (2007) tested empathic responses towards strangers, suggesting that closeness may modulate empathic responses and their cerebral correlates. Closeness is defined as "*including in one's self another person's resources, perspectives, and identities*" (Mashek & Aron, 2004, p. 4). It thus refers to including others in the self, such that individuals are interconnected (Aron et al., 1997). The experience of closeness is usually

measured through two circles i.e. named “self” and “other” (Inclusion in the Self, IOS) which overlap to different degrees in order to describe the extent to which others become part of the self, from totally disconnected to an almost complete self-other merging (Aron et al., 2004).

To our knowledge, only one study has specifically probed the link between closeness and affective reactivity (López-Solà et al., 2017), showing that greater closeness predicts higher report of unpleasantness when seeing the partner undergoing pain. It is worth mentioning that another study examined the effect of similarity (vs dissimilarity) between the participant and the confederate-target in a painful (vs non painful) situation on how unpleasant it was for them to witness the target (affective response), on prosocial behaviors (i.e., how electric shocks should be distributed over the participant and the target) and on a mentalizing task (i.e., deciding whether a statement described the mental states of the target) (Majdandžić et al., 2016). Results showed that although the similar (vs dissimilar) condition was associated with higher ratings of interpersonal closeness, it did not lead to higher ratings of unpleasantness, more prosocial behaviors, nor higher activation in any brain region when seeing the target in a painful situation. However, mentalizing with a dissimilar vs similar target was associated with higher activation in the mid-ventrolateral prefrontal cortex which has been previously associated with the ability to inhibit the dominant response. This result suggests that dissimilar vs similar condition forces participants to resist the interference from their own dominant perspective (self-inhibition). Other studies focused only on the effect of closeness on the ability to understand or evaluate other’s mental states and more specifically the other’s pain (Bucchioni et al., 2015; Cheng et al., 2010; Pillai Riddell & Craig, 2007). For instance, participants report higher pain when imagining the most loved one in a painful situation (vs self, the most hated one, the most loved one or a stranger) (Bucchioni et al., 2015). At the cerebral level, greater closeness has been associated with greater activation in the pain matrix network when watching a friend being socially excluded (Beeney et al., 2011) and when perceiving the partner undergoing pain (López-Solà et al., 2017).

Overall, the extent to which closeness modulates affective responses towards other’s pain has thus been only slightly examined. Furthermore, whereas previous studies have emphasized the role of closeness on the ability to understand or evaluate other’s mental states, they were either based on imagination paradigms or lacked a control group (e.g., partner vs stranger). The main objectives of the present research are therefore to (1) examine the effects of closeness on pain intensity rating, empathic concern and personal distress towards someone in pain, (2) manipulate closeness through low vs high levels of self-disclosure, and (3) examine the underlying mechanisms through which closeness impacts pain

intensity rating, empathic concern and personal distress. As presented in Figure 1, the main hypothesis is that participants in the closeness condition will report greater personal distress (at both subjective and physiological levels) and greater pain intensity rating when facing another participant (i.e., a confederate) experiencing pain than participants in the non-closeness induction condition (Hypothesis 1). Secondly, we hypothesize that these effects will be accounted for by a self-perspective taking (Hypothesis 2). It has indeed been shown that higher closeness (i.e., higher self-other overlapping) is associated with higher tendency to project oneself in the others' shoes, which may likely promote personal distress (Batson et al., 1983; Lamm et al., 2007, 2008; Myers et al., 2014). Third, in line with previous findings (Batson et al., 1983), we hypothesize that higher reports of empathic concern will be associated with higher report of altruism towards the partner in pain (Hypothesis 3). Finally, we postulate that dispositional and situational measures of personal distress will be correlated. We expect similar correlations for empathic concern (Hypothesis 4).

Methods

Participants

Seventy-eight undergraduate students (43 females; $M_{age} = 19.78$, $SD_{age} = 2.11$; Range= 17-30) from the Department of Psychology (University of Michigan) were included in the experiment, which took place in the period of 2013-2015. The study was conducted in accordance with the Declaration of Helsinki with the approval of the local ethics committee. All participants gave their written informed consent and received class credits for their participation (Introductory Psychology course). As expected, some participants ($n=9$) have become aware of the deception and were excluded from statistical analysis¹. The final sample was thus composed of 69 participants (38 females; $M_{age} = 19.69$, $SD_{age} = 2.07$; Range= 17-30). Concerning their empathy profiles, the scores of participants on the Interpersonal Reactivity Index (IRI, (Davis, 1983), described in the measures section) have a Mean (Standard Deviation) of 24.06 (5.69) for Perspective Taking, 26.87 (4.62) for Empathic Concern, 18.74 (5.28) for Personal Distress and 25.74 (5.46) for Fantasy. Importantly, there was no significant difference for any IRI factor between high closeness vs low closeness conditions ($ps > .21$) and the assumption of homogeneity was met for each IRI factor ($ps > .074$).

¹ The decision was based on participants' responses to three questions: "1. Different people respond to things in different ways, and we would like to know if you have any comments or thoughts about today's study" "2. Did you find any aspect of the procedure odd, disturbing, or confusing?" "3. Do you think that there may have been more to the study than meets the eye? That is, what do you think we were studying here today?"

The sample size was based on previous research indicating an effect size of 0.57 (Cohen's d) when participants rated their empathic concern towards an ingroup (i.e., high closeness) vs outgroup person (i.e., low closeness) experiencing pain (Hein et al., 2010) and an effect size of 0.46 (Cohen's d) when a parent (i.e., high closeness) vs a pediatrician (low closeness) evaluated infants pain intensity (Pillai Riddell & Craig, 2007). The sample size was also based on a strong correlation between closeness and the willingness to act altruistically (Cohen's $d=1.63$) (Korchmaros & Kenny, 2001). In this latter study based on dilemma scenarios, participants were instructed to rate their willingness to help family members to survive while encountering great risk for themselves (i.e., altruistic behavior). Therefore, based on a mean effect size of 0.88, the number of participants was fixed at 30 per group (low vs high closeness) at a significance level of $\alpha = .05$, a power of $1-\beta = .95$ (G*Power analysis (Faul et al., 2007)).

Measures

Closeness induction: The paradigm was based on a deception as dyads were always formed by one participant and one out of six confederates (3 male and 3 female) who were also undergraduate students from the Department of Psychology². Each dyad was composed of same sex individuals and was randomly assigned to the low or high closeness condition. For 20 minutes, the participant and the confederate sat in front of each other and had to alternatively ask/respond to questions about either small talk topics (low closeness condition; e.g., "*When was the last time you walked for more than an hour? Describe where you went and what you saw*") or more personal topics (high closeness condition; e.g., "*What is the greatest accomplishment of your life?*") (Aron et al., 1992). Dyads from each condition covered the same topics based on the same questions and in the same order. Importantly, because some dyads might have spent more time exchanging on certain questions, they may not have covered all the topics.

After the closeness induction, the participant and the confederate went to separate cubicles. They were then instructed to complete (1) the **Inclusion of Other in the Self scale** (IOS, (Aron et al., 1992)) by circling the picture that best described the relationship between them and the confederate from 1 (not close at all) to 6 (extremely close), (2) the extent to which they experienced **empathic concern** toward the partner (soft-hearted, tender, compassionate, warmth and sympathetic; $\alpha=.87$) on a Likert scale from 1 (not at all) to 7 (extremely), (3) the extent to which they agreed with **proximity statements** on a Likert scale from 1 (strongly disagree) to 9 (strongly agree) "*I would like to have this person as a friend*", "*Overall, I*

² Six confederates were needed to reach the sample size because they all worked for a limited period of time as research assistants in the Department of Psychology. Moreover, because undergraduate participants took part of the study in exchange of class credits, the data collection window was also reduced.

have a positive impression of this person”, *“I feel comfortable with this person*”, and *“I would like to get to know my partner more”* ($\alpha=.79$). A composite score of *closeness* (i.e., average closeness) was computed by averaging the scores of the three sub factors (each one with values ranging from 0 to 1) ($\alpha=.69$).

Empathy for pain task: The participant and the confederate were told that the aim was to evaluate the partner’s pain sensitivity and that this measure had to be done individually because the mere presence of another person might bias pain sensations. They were then told that during a conversation based on a video conferencing program (Skype) they will watch their partner undergoing the painful task and that every 10 seconds they will have to report on a visual analogue scale from “no pain” to “worst imaginable” the intensity of the pain they thought the partner experienced. The confederate was always first chosen to experience the “cold pressure task” (i.e., when the person’s hand is immersed in a tank filled with ice water). Participants were told that they will subsequently switch in order to undergo the same experience. After these instructions, the participant and the confederate were asked to go back to their respective cubicle to start the task.

Importantly, during the Skype conversation, participants watched a video of the confederate previously videotaped during an actual cold pressure task. Participants viewed the recorded videotape displayed on a computer monitor through the video conferencing program camera. At the end of the video, participants had to complete the perspective taking questions and the situational affective **responses** questionnaire.

Pain intensity rating: On a visual analogue scale from “no pain” (=0) to “worst imaginable” (=10), participants had to rate every 10 seconds the intensity of the pain they thought the partner experienced. Because the time spent with their hand in the ice differed across confederates (ranging from 70 to 150 sec), we averaged participants’ pain intensity rating from 0 to 70 sec, based on contrasts from repeated measures analysis indicating the end of the increase of pain rating between 70 and 80 sec ($F(1, 65)=1.93$; $p=.17$).

Perspective taking: participants had to answer two perspective taking questions on a Likert scale ranging from 1 (not at all) to 9 (totally). One was related to **other-perspective** (“*did you imagine how the other felt*”) and the other to **self-perspective** (“*did you imagine how you would have felt if you had been in the place of the other*”).

Situational affective responses: participants had to rate their feelings of **empathic concern** (tender, soft-hearted, moved, sympathetic, and compassionate; $\alpha=.84$) and **personal distress** (perturbed, distressed, worried, upset, alarmed, disturbed, and troubled; $\alpha= .90$) on a Likert scale from 1 (very slightly) to 5 (extremely).

Self-reported altruism: participants had to report on a Likert scale from 1 (not at all) to 9 (totally) to what extent they would have decided to take the place of the other participant if they had the possibility to do so during the painful task.

The interpersonal reactivity index: IRI (Davis, 1983) is a multidimensional questionnaire of empathy. It includes four subscales: Perspective taking (PT) evaluates attempts to take into consideration the point of view of others (e.g., *“When I am upset at someone, I usually try to put myself in his shoes for a while”*); Fantasy (F) measures the propensity to identify with fictional characters (e.g., *“When I watch a good movie, I can very easily put myself in the place of a leading character”*); Personal distress (PD) assesses the tendency to feel anxious when confronted with negative situations (e.g., *“Being in a tense emotional situation scares me”*) and Empathic concern (EC) assesses feelings of sympathy and concern for unfortunate others (e.g., *“I often have tender, concerned feelings for people less fortunate than me”*). Perspective taking and Fantasy are generally considered as cognitive dimensions of empathy while empathic concern and personal distress refer to “affective empathy”.

Physiological measures: Participants’ heart rate (HR) was measured with a Polar Watch RS800CX using electrodes contained in a chest belt, in wireless mode. Afterwards, the Polar ProTrainer5 software was used to extract signal information. Polar watches have been used in previous studies and show satisfactory validity and reliability in measuring HR and Heart Rate Variability compared to other mobile or more classic ECG measurements devices (e.g. (Gamelin et al., 2008; Kingsley et al., 2005; Nunan et al., 2008; Quintana et al., 2012; Radespiel-Tröger et al., 2003; Weippert et al., 2010)). We measured participants’ HR in order to examine whether participants in the high closeness condition presented stronger physiological activity following the closeness induction and during the empathy for pain task, compared to participants in the low

closeness condition. We also aimed at testing whether HR during the empathy for pain task was more strongly correlated to personal distress than empathic concern³.

Procedure

Participants were tested individually (see Figure 2). They first signed informed consent mentioning that they could withdraw from this study at any time without any penalty (Time 1). Then, we measured their baseline physiological activity during 5 minutes (heart rate; HR; Baseline 1) and collected a saliva sample (not reported in this study) (Time 2). Afterwards, participants underwent the closeness induction task (Time 3) and a second measure of their HR was conducted for 5 minutes (Baseline 2) (Time 4). After the closeness induction task the experimenter gave the instructions about the pain task to the dyad. Then, participants underwent the empathy for pain task during which their HR was recorded (Time 5) and completed the IRI questionnaire (Time 6). Finally, we collected a second saliva sample (not reported in this study) (Time 7) and provided a debriefing about the purpose of the research (Time 8). The whole experiment lasted 80 min.

Statistical methods

Statistical analyses were performed using the SPSS software package Version 21 (SPSS Inc., Chicago, IL). Univariate ANOVA was used to test the effect of group on closeness measures. Repeated Measures were used to compare empathic concern and personal distress, self and other perspective, and HR during Baseline 1, 2 and empathy induction. Pearson correlations and partial correlations investigated the association between variables. The significance level was set at $p < .05$.

Results

Manipulation check

Group comparisons showed that the two conditions did not differ in terms of gender ($\chi^2=1.11$; $p=.29$) or age ($F(1, 67)=0.91$; $p=.34$). There was no effect of closeness induction (low vs high closeness condition) on any closeness measures (Inclusion of Other in the Self ($F(1, 68)=0.00$; $p=1.00$), Empathic Concern ($F(1, 68)=1.36$; $p=.25$), Proximity ($F(1, 68)=0.46$; $p=.50$), and Average closeness ($F(1, 68)=0.65$; $p=.42$). Therefore, data from both conditions were pooled together.

³ Heart Rate Variability (HRV) was also measured at Baseline 1, Baseline 2 and during the empathy for pain task but the data are not reported in the article. Indeed, there was neither effect of group on HRV measures (LF, HF, ratio LF/HF, and VLF) nor significant correlation between HRV after the closeness induction (Baseline 2) or during the empathy for pain task (controlling for HRV at Baseline 1) and the other variables (closeness, distress and empathic concern responses, imagine self, imagine other or intensity rating).

Descriptive data

Table 1 shows that participants reported moderate closeness towards the confederate. It also shows that they reported more empathic concern than personal distress ($F(1,61)=17.98$; $p<.001$) and similar tendency to take self and other-perspective ($F(1, 64)=0.76$; $p=ns$). At a physiological level, participants showed higher HR at baseline (Baseline 1) compared to HR after the closeness induction task (Baseline 2) ($F(1, 56)=12.51$; $p=.001$) and during empathy induction ($F(1, 56)=5.43$; $p=.023$), whereas these two latter measures did not differ ($F(1, 56)=2.56$; $p=.12$).

Age did not correlate with any of these measures ($ps>.12$). However, age tended to correlated with the HR during the empathy for pain ($r= -.26$; $p=.053$). Female participants reported higher average closeness ($F(1, 68)=4.58$; $p=.036$), situational personal distress ($F(1, 61)=6.22$ $p=.015$), situational empathic concern ($F(1, 62)=8.34$; $p=.005$) and a tendency for self-perspective ($F(1, 64)=3.85$; $p=.054$) than male participants. There were no other effect of sex.

Correlations

Hypothesis 1: Table 2 reveals that greater closeness with the confederate is associated with higher perceived pain, and higher reports of empathic concern and distress.

At a physiological level, higher closeness was associated to higher HR following closeness induction (Baseline 2). Moreover, partial correlations support this association when controlling for the first HR Baseline 1 ($r=.40$; $p=.002$). However, closeness was not associated with HR during empathy induction even when controlling for HR Baseline 2 ($r=-.06$; $p= ns$).

Hypothesis 2: Table 2 reveals that greater closeness is associated with higher tendency to imagine oneself in the situation. However, taking a self-perspective (i.e., imagine oneself) was not significantly correlated with neither personal distress nor pain intensity ratings. Therefore, higher closeness does not lead to higher personal distress and pain intensity ratings through a greater tendency to take a self-perspective.

Hypothesis 3: self-reported altruism (i.e., willing to take the place of the confederate if they had the possibility to do so during the painful induction) was not significantly correlated with empathic concern. However, taking a self-perspective and an other-perspective positively correlated with self-reported altruism.

Hypothesis 4: results showed that higher reports of dispositional empathic concern (IRI-EC) are associated with higher reports of closeness, empathic concern during the empathy task, tendency to take a self- and other-perspective and higher self-reported altruism. Results also showed that dispositional personal distress (IRI-PD) is associated with higher reports of closeness, pain intensity, empathic concern and personal distress during the empathy task. Finally, dispositional perspective taking (IRI-PT) is associated with higher reports of empathic concern during the empathy task, tendency to take a self-perspective and higher self-reported altruism.

Discussion

In this paper, we tested the main hypothesis that greater closeness towards another person experiencing pain leads to higher reports of affective responses (and particularly personal distress) and higher pain intensity rating. We also tested the hypothesis that this effect would be accounted for by a greater tendency to project oneself in the other's position (i.e., taking a self-perspective). To this aim, participants were randomly assigned to a low or high closeness condition with a confederate before reporting pain intensity rating, empathic concern and personal distress when watching the confederate experiencing pain.

In terms of pain intensity rating, results showed that higher closeness is associated with higher ratings of pain intensity. This is in line with previous findings that imagining or perceiving a loved-one (vs a stranger) in a pain situation is associated with report of higher pain and unpleasantness (Bucchioni et al., 2015; Cheng et al., 2010; Pillai Riddell & Craig, 2007). We also showed that higher ratings of other's pain was associated with reporting more dispositional personal distress, supporting previous findings that pain-catastrophizing individuals (i.e., presenting an exaggerated negative orientation toward noxious stimuli (Sullivan et al., 1995)) rate painful pictures as more painful than non-catastrophizing individuals (Fallon et al., 2015). The present results thus revealed that individuals who experience more closeness after a self-disclosure experience and who generally report more distress in response to other's misfortune are more prone to rate other's pain as more intense.

One may hypothesize that higher closeness prevented individuals to reappraise the pain experienced by the confederate. This would be in line with a previous study probing whether reappraisal might influence participants' empathic responses in response to painful facial expressions of individuals undergoing medical treatment (Lamm et al., 2007). Results of this study showed that participants who were told that the (painful) treatment was not effective judged the experience of the

person as being more painful (and reported more personal distress) compared to participants who were told that the treatment was effective. Therefore, higher closeness and the subsequent personal distress might have prevented participants to reappraise other's pain, leading to greater pain intensity ratings. The effect of stress on the effectiveness of reappraisal has been shown previously in a fear-conditioning task (Raio et al., 2013).

Concerning affective **responses**, results revealed that closeness is associated with higher reports of empathic concern and personal distress. These findings are in line with the hypothesis that "top-down" factors modulate affective responses to someone in pain (Azevedo et al., 2013; Goubert et al., 2005). Specifically, we hypothesized that closeness may account for inconsistencies in previous findings. The literature indeed revealed contradictory results about the association between feelings of distress and/or empathic concern and other's pain (Grynberg & Maurage, 2014; Moriguchi et al., 2007; Saarela et al., 2007; Singer et al., 2004; Yamada & Decety, 2009). In this paper, we aimed at testing the hypothesis that these contradictory findings may result from the influence of closeness such that higher closeness will lead to higher personal distress than empathic concern. To our best knowledge, our study is the first to show that closeness does impact **affective responses**. However, the degree of proximity between the observer (i.e., the participant) and the person in pain (i.e., confederate) was similarly associated with higher reports of personal distress and empathic concern.

This may be accounted for by a high correlation between these two dimensions, suggesting that we might have measured a common latent factor, that is emotional reactivity (i.e., emotional response). This would be in line with the hypothesis that the two dimensions may share more features than argued or previously demonstrated (Barraza & Zak, 2009; Batson et al., 1987; Grynberg & López-Pérez, 2018). Impossibility in differentiating empathic concern and personal distress have been supported by psychophysiological studies showing that sympathetic activity (e.g., skin conductance) has been associated with empathy (Balconi & Bortolotti, 2012) whereas other research failed to find an effect or found negative association (Rijn et al., 2014). In respect to HR, there was no significant correlation with reports of affective **responses**, which is consistent with the absence of correlation between HR and neither empathic concern nor personal distress in previous studies (Engert et al., 2014). Therefore, one may suggest that personal distress and empathic concern may not differ from one another in terms of physiological reactivity.

In respect to the underlying mechanisms, we hypothesized that the effect of closeness on empathy could be mediated by the tendency to project oneself in the other's shoes (self-perspective).

This hypothesis was based on findings showing that imagining oneself in the other person's situation leads to greater overlap with another person (IOS) than imagining the target's situation (Myers et al., 2014). It was also based on previous findings showing that imagining oneself during an empathy for pain task leads to more intense facial pain expression in the observer as well as higher report of personal distress compared to imagining other (Lamm et al., 2007, 2008). However, although we showed that higher reports of closeness were associated with taking a self-perspective, self-perspective was not associated with personal distress, suggesting that taking a self-perspective in an active way may only modulate empathic responses.

Alternatively, one might suggest that high levels of progesterone account for the association between closeness and affective responses as this hormone has been involved in interpersonal functioning. For instance, prior research has found a positive correlation between a need for affiliation and progesterone among women (Schultheiss et al., 2003; Wirth & Schultheiss, 2006). Higher progesterone is also associated with an increased use of bond-centered justifications in moral reasoning in women (Thomas et al., 2011) and with higher affective responsiveness when imagining being in a sad situation (e.g., "your best friend has to move abroad"). Besides direct correlational evidence, female participants experiencing interpersonal closeness via a social interaction task showed increases in their progesterone levels compared to participants who did not benefit from this task (Brown et al., 2009) leading to greater altruistic motivation towards others. Altogether, these findings suggest that progesterone is a social emotion that may lead to higher affective responses, possibility accounting for the association between closeness and affective responses.

Finally, it is worth mentioning that this study presents one main limitation, namely no effect of closeness manipulation. We argue that this results from two related factors. First, there was a large variability across the six confederates. Non-parametric tests (Kruskal Wallis test) showed that the effect of closeness went in the right direction for one confederate (closeness > non-closeness; $p=.046$), in the opposite direction for another confederate (closeness < non-closeness $p=.028$) while the differences were not significant for the four others ($ps > .41$). Second, although all dyads had to cover a maximum of topics based on the same questions, one can hypothesize that limiting the disclosure procedure to 20 minutes (vs 45 minutes in the original version (Aron et al., 1997)) did not enable all dyads to cover every topic and therefore to induce enough closeness. This is in line with Majdandžić's (2016) conclusion that it might be necessary to use more extreme social manipulations to significantly impact empathic responses. Third, we did not measure affective sharing, defined as the

tendency to share another's emotional state and which differ from empathic concern and personal distress in terms of the degree of isomorphism (de Vignemont & Singer, 2006), and brain activity. Indeed, one study examined the neural modification after training participants to "empathize with the other person" (affective sharing) vs "show compassion" (Klimecki et al., 2014). The results indicated higher activity in the insula (anterior, middle and posterior) and the medial cingulate cortex in the first condition (affective sharing) and in the medial orbitofrontal cortex, the posterior anterior cingulate cortex and the ventral striatum in the second condition (compassion). The authors posited that these two conditions do not rely on the same neural network, suggesting that they should be examined complementarily. In the present study, one might hypothesize that the association with closeness would have been particularly stronger for affective sharing. Finally, one might suggest that our results are influenced by interpersonal differences. For instance, it has been shown that experiential avoidance increases social anxiety in the closeness (vs non-closeness) condition (Kashdan et al., 2014), a factor that might have accounted for the non-significant effect of closeness manipulation in the present study. Nevertheless, the groups did not differ in terms of their IRI scores, such that empathy profiles of the participants cannot account for the non-significant effect of closeness manipulation.

In conclusion, the present findings support the importance to consider top down factors when examining empathy. Specifically, this research highlights closeness as one top-down factor that modulates pain intensity rating, empathic concern and personal distress for someone in pain.

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Figure 1: Conceptual diagram describing variables and the hypotheses (H1, H2, H3, and H4)

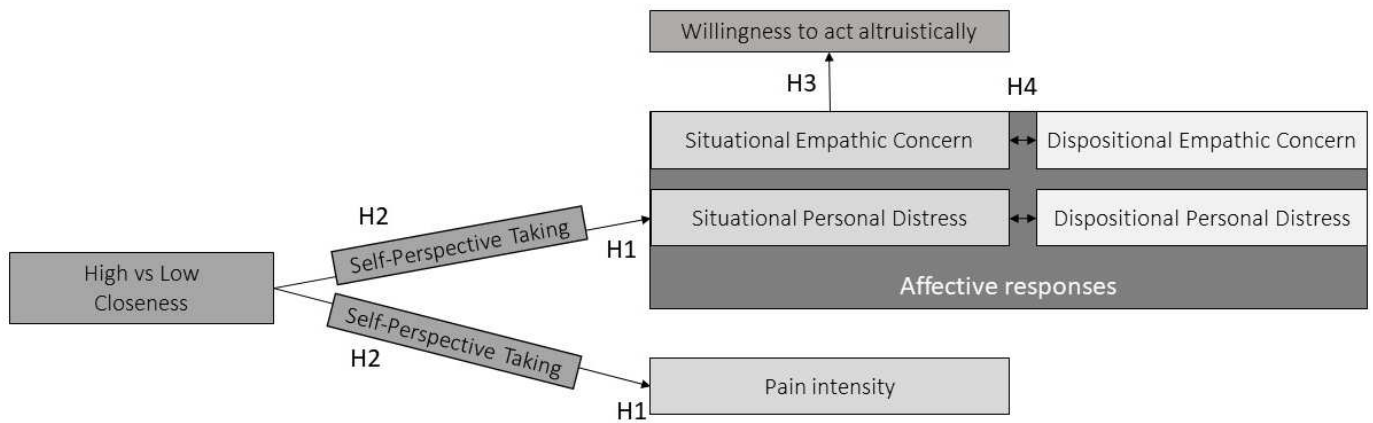


Figure 2: Procedure

| 10 min | 10 min | 20 min | 5 min | 10 min | 10 min | 10 min | 5 min |
|--|--------------------------|---------------------|--------------------------|--------------------------------|---------------|---------|------------|
| 10 min | 20 min | 40 min | 45 min | 55 min | 65 min | 75 min | 80 min |
| Time 1 | Time 2* | Time 3 | Time 4 | Time 5 | Time 6 | Time 7* | Time 8 |
| Introduction Informed consent Setting up | Baseline 1 Heart Rate | Closeness induction | Baseline 2 Heart Rate | Empathy for pain Heart Rate | Questionnaire | | Debriefing |

* saliva sample was collected but analyses are not reported in this study

Table 1. Descriptive statistics (Mean, SD, Min-Max, N) of closeness, pain intensity, affective empathy, perspective taking, altruism and physiological responses

| | Min | Max | Mean | SD | N |
|--|-------|--------|-------|-------|----|
| Closeness | | | | | |
| Inclusion of Other in the Self | .33 | .83 | .56 | .14 | 69 |
| Empathic Concern | .23 | 1.00 | .68 | .16 | 69 |
| Proximity | .50 | 1.00 | .83 | .11 | 69 |
| Average closeness | .41 | .93 | .69 | .11 | 69 |
| Empathy | | | | | |
| Situational Empathic Concern | .20 | .88 | .50 | .18 | 63 |
| Situational Personal distress | .20 | .94 | .43 | .18 | 62 |
| Pain intensity mean (10 to 70 sec) | 0.45 | 8.51 | 3.86 | 1.69 | 66 |
| Perspective taking | | | | | |
| Other-perspective | .22 | 1.00 | .85 | .18 | 65 |
| Self-perspective | .22 | 1.00 | .84 | .19 | 65 |
| Altruism | | | | | |
| Take the place of the confederate | .11 | 1.00 | .68 | .22 | 65 |
| Physiological responses (Heart Rate: beat per minute) | | | | | |
| Baseline (Baseline 1) | 55.00 | 185.00 | 88.63 | 28.25 | 60 |
| After closeness induction (Baseline 2) | 56.00 | 149.00 | 78.52 | 17.45 | 58 |
| Empathy for pain | 56.00 | 163.00 | 81.25 | 18.80 | 57 |

Table 2. Correlations between closeness, pain intensity, affective empathy, perspective taking, altruism, heart rate (HR) responses and dispositional empathy

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|-------------------------------|-----------|--------|--------|--------|--------|------------------|--------|--------|--------|--------|-------|-------|--------|
| Average Closeness | 1 | - | .73*** | .81*** | .83*** | .24* | .44*** | .40** | .23 | .30* | .17 | .33** | .20 |
| <i>IOS</i> | 2 | | - | .29* | .48*** | .33** | .33** | .32* | .22 | .20 | -.08 | .32* | .20 |
| <i>Compassion</i> | 3 | | | - | .57*** | .07 | .28* | .27* | .04 | .20 | .24 | .24 | .10 |
| <i>Proximity</i> | 4 | | | | - | .21 | .48 | .41*** | .33** | .34** | .23 | .21 | .17 |
| Pain intensity | 5 | | | | | - | .14 | .02 | .25* | .06 | .03 | .02 | .08 |
| Empathic Concern | 6 | | | | | | - | .73*** | .18 | .24 | .17 | .11 | -.03 |
| Personal Distress | 7 | | | | | | | - | .24 | .20 | .14 | .18 | .11 |
| Imagine Other | 8 | | | | | | | | - | .63*** | .31* | .10 | .08 |
| Imagine Self | 9 | | | | | | | | | - | .33** | .09 | .15 |
| Self-reported altruism | 10 | | | | | | | | | | - | -.04 | .10 |
| Baseline 2 HR | 11 | | | | | | | | | | | - | .72*** |
| Empathy for Pain HR | 12 | | | | | | | | | | | | - |
| IRI-PT | | .08 | .01 | .04 | .18 | -.01 | .29* | .00 | .18 | .29* | .34** | -.09 | -.04 |
| IRI-F | | .32** | .24* | .22 | .31** | .16 | .34** | .25* | .20 | .41*** | .27* | -.08 | -.03 |
| IRI-EC | | .42*** | .25* | .29* | .48*** | .15 | .36** | .18 | .47*** | .38** | .28* | -.01 | -.05 |
| IRI-PD | | .25* | .17 | .21 | .21 | .23 ^ε | .29* | .35** | .06 | .12 | .03 | .10 | .00 |

Note. IOS. Inclusion of the Other in the Self. IRI= Interpersonal Reactivity Index; PT = perspective taking; F = fantasy; EC = empathic concern; PD= personal distress. ^ε $p < .06$. * $p < .05$. ** $p < .01$; *** $p \leq .001$