

**INDIVIDUAL DIFFERENCES IN PERSONALITY AND EMOTION
PROCESSING INFLUENCE PERCEPTIONS OF PAINFUL FACIAL
EXPRESSIONS**

by

Danielle Schwartz

A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Bachelor of Science in Psychology with Distinction

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ABSTRACT

Previous research has shown systematic racial, gender, and status disparities in pain perception and treatment. Examining how personality and emotion-related factors influence pain perception may shed light on possible approaches that could improve treatment. In Study 1, participants rated face-morphs between neutral and completely painful expressions, and judged how much non-narcotic analgesic cream each should receive as treatment. Participants then answered a series of personality measures. Subsequent analyses revealed that participants with higher empathic concern scores had lower thresholds for seeing pain on targets, and participants with higher extraversion scores showed less racial bias in pain perception. Participants with higher extraversion and agreeableness scores prescribed more pain reliever overall.

Study 2 had a similar set-up, except participants rated how much pain the target was “feeling” or “expressing”. Analyses revealed that participants with lower race pain sensitivity bias scores and higher total trait empathy scores had lower thresholds for seeing pain on target faces. Participants with higher perspective taking and total trait empathy scores showed less racial bias in pain perception during “feel” judgments. Participants with higher perspective taking and total trait empathy scores showed less racial bias in treatment recommendations. This research highlights the importance of empathy in pain care and treatment and discusses its implications.

Chapter 1: INTRODUCTION

Persistent pain is a universal phenomenon that presents itself across all groups of people, characterized by physical, emotional, cognitive, and social suffering (Linton & Shaw, 2011). Pain can take many forms—for example, acute pain, chronic pain, nerve pain, phantom pain, and soft tissue pain—and is experienced by all cultures and ages (Free, 2002). Pain is the most common reason that Americans utilize the health care system and is the leading cause of disability (Von Korff, Dworkin & LeResche, 1990). The Center for Disease Control and Prevention estimates that 50 million Americans, or 20% of the adult population experiences chronic pain (Anson, 2018). Therefore, the ability for the patient and health care professional to effectively communicate with one another is imperative for proper treatment.

Pain can be communicated through both verbal and nonverbal messages. Verbal messages include pain descriptions as well as moaning or gasping, while non-verbal messages include changes in facial expression and body posture (Prkachin & Craig, 1995). The ability for a health care professional to correctly interpret the type, location, and severity of pain from these verbal and non-verbal cues, can be the difference between a life filled with pain, versus not. Therefore, it is crucial to determine what individual difference factors predict the recognition of pain. This manuscript will focus on the visual perception of painful facial expressions. In particular, I will detail two investigations examining the contribution of individual

differences in personality traits to both the overall perception of pain, as well as biased perception of pain as a function of target race, as well as target gender.

Causes and Consequences of Biases in Pain Care

Despite the millions of people that experience pain every day, treatment type and intensity widely varies across the population. Preexisting data has shown that two individuals describing the exact same lower back pain, for example, would not be given the same amount of medication or physical therapy (Anderson, Green & Payne, 2009). This discrepancy in treatment goes beyond differences in health care providers, and may stem from sociodemographic factors associated with the patients themselves. For example, factors such as race, gender, and socioeconomic status have each been linked to inconsistencies in pain treatment (Hoffmann & Tarzian, 2001; Trawalter, Hoffman & Waytz, 2012).

In particular, systematic racial disparities in healthcare may lead to the under-diagnosis and under-treatment of Black patients' pain (Anderson et al., 2009). Black patients are less likely than white patients to be prescribed medication and more specifically, opioids for their pain (Green, Baker, Sato, Washington, & Smith, 2003). For example, one prominent investigation examined treatment of 217 emergency room bone fracture patients, of whom 127 were black and 90 were white, over a 40-month period (Todd, 2000). White patients were significantly more likely than black patients to receive analgesics despite similar records of pain complaints in the medical record.

The risk of receiving no analgesic while in the emergency room was 66% greater for black patients than for white patients (Todd, 2000).

In another study, sixty-five percent of minority patients did not receive guideline-recommended analgesic prescriptions for severe cancer-related pain, compared with fifty percent of non-minority patients (Cleeland, Gonin, Baez, Loehrer, & Pandya, 1997). In more recent work, Goyal and colleagues (2015) examined these gaps in care in children admitted to hospitals for emergency appendectomy procedures. Black patients, compared to white patients, were found to not be given any analgesia more often. Black patients with severe pain were less likely to be prescribed opioid analgesia than white patients in severe pain (12.2% vs 33.9%; Goyal, Kupperman, Cleary, Teach, & Chamberlain, 2015). These data clearly demonstrate the inequalities in pain care across race.

In addition to these racial disparities, the healthcare system has historically exhibited a gender bias, which has led to the misdiagnosis and under-treatment of millions of women. Healthcare professionals hold high levels of implicit gender bias, highlighting the areas where these disparities need to be addressed (FitzGerald & Hurst, 2017). For example, men with coronary artery disease who present the same symptoms as women, are more likely to be treated with urgency and receive an emergency cardiology consult, as well as receive related medications (Lehmann, Wehner, Lehmann, & Savory, 1996). In other, more recent work examining gender bias in treatment recommendations for patients with chronic musculoskeletal pain, interdisciplinary teams in musculoskeletal treatment were found to prescribe

physiotherapy and radiological examination to women significantly less (Stalnacke et al., 2015). Moreover, large gender disparities in pain care (e.g., Chen et al., 2008; Hirsh, Hollingshead, Matthias, Bair, & Kroenke, 2014) exist even though women seek pain care and report pain symptoms *more* often than males (Hamberg, Risberg, Johansson, & Westman, 2002; Hoffmann & Tarzian, 2001).

Finally, socioeconomic status has proven to be another prominent contributing factor in terms of biases in healthcare in general, and pain care in particular. For example, healthcare professionals demonstrate more attention to pain control for those of high status (Pettit et al., 2017). Physical signals of this bias include maintaining a distance with and avoiding eye contact with those of a low status (McConnell & Leibold, 2001). In turn, across race, patients of low socioeconomic status are prescribed less opioid-based pain reliever after accounting for pain-level, age, and injury-status (Joynt, Train, Robbins, Halterman, & Fortuna, 2013). Overall, the well-defined inequality in pain treatment across race, gender and status, has led to inquiries about this disparity and what leads to accurate and inaccurate pain perception.

These robust treatment discrepancies are alarming, and beyond their physical consequences, they may have cognitive and emotional consequences for millions of individuals. For example, those with improperly treated pain experience a lower quality of life (QoL) and are at risk for their acute pain developing into chronic pain (Hadi, Mchugh, Closs, S, 2018). Moreover, chronic pain interferes with patients' careers (a sentiment emulated by 25.3% of participants in a QoL study), and these individuals are also four times more likely to suffer from depression and anxiety

(Lépine & Briley, 2004). Further, they are twice as likely to find it difficult or impossible to return to work (Niv & Kreitler, 2001). The clinical outcomes of untreated or mistreated postoperative pain include increased risk of atelectasis, respiratory infection, myocardial ischemia, infarct or cardiac failure, and thromboembolic disease. In addition, the long-term consequences of untreated and mistreated chronic pain include decreased mobility, impaired immunity, decreased concentration, anorexia, and sleep disturbances (King, 2013).

Given the physical and psychological cost of misdiagnosed pain and the widespread disparities in pain care, it is imperative to identify factors contributing to both biased and accurate pain perception. A comprehensive understanding of these influences will enhance the efficacy of pain care and could improve millions of lives.

Approaches to Examining Biased and Accurate Pain Perception

Previous research has employed a wide range of paradigms to studying pain recognition. For example, some researchers have used written vignettes describing painful situations (e.g., Trawalter, Hoffman, & Waytz, 2012; Mathur et al., 2014). In one study, participants were asked to report the level of pain they themselves would feel across 18 painful scenarios and were then asked to do the same for a same-gender black or white individual. Participants reported lower pain ratings for black vs. white targets (Hoffman, Trawalter, Axt, & Oliver, 2016). This study used self-report

methods to study people's reactions to both pain in general, and group-based biases in pain attribution.

Other work has used photographic or video stimuli of bodily injuries to examine responses to painful experiences (as well as biases in these responses), often in combination with neuroimaging techniques. For example, Akitsuki and Decety (2009) created a stimulus set of 144 multi-image stimuli of hands and feet in painful (e.g., jamming a hand in a drawer) or non-painful situations. Other researchers have used images or videos of neutral faces receiving painful injections from a syringe (versus non-painful touch from a Q-tip; (e.g., Cao, Contreras-Huerta, McFayden, & Cunnnington, 2015; Contreras-Huerta, Baker, Reynolds, Batalha, & Cunnington, 2013; Xu, Zuo, Wang, & Han, 2009), or videos of people experiencing painful injuries (e.g., Ochsner et al., 2008). A meta-analysis of fMRI studies showed a clear link between empathy for pain and the neural structures correlated with the experience of pain. The bilateral anterior insular cortex, and medial and anterior cingulate cortex a network associated with empathy for pain, was activated when an individual directly experienced pain (Lamm, Decety, & Singer, 2011).

While using self-report and neuroimaging yields significant results and informs us of the intricacies of pain, we settled on perceptual approach for the present study, focused on visual perception of facial expressions of pain. Since actual pain, severity of discomfort, and self-report of pain do not correlate with each other and are not consistent across individuals, verbal self-report is not entirely valid (Hadjistavropoulos & Craig, 2002). Pain can leave an individual without the ability to communicate

verbally, leaving non-verbal communication advantageous and often times necessary. Health care professionals would instead need to rely on cues like clenched teeth, grabbing a body part, altered breathing, and eye-brow lowering, for example (Brooker & Haedtke, 2016). The natural ability to detect such cues is inherent and begins early in development (Deyo, Prkachin, & Mercer, 2004), further emphasizing its importance. Moreover, identifying facial expressions of pain, instead of verbal reports, would best aid the patient: Pain display features are distinct from other types of pain behaviors, and may contain unique information (Craig & Prkachin, 1995). Further, since pain expressions are, for the most part, relative automatic and spontaneous, people are less likely to consciously monitor or purposefully change their painful expressions (Craig, Prkachin, & Grunau, 2001). Conversely, self-reports of pain are subjective accounts and may only amount to an individual's interpretation of their own pain (Prkachin, 2009).

Interestingly, studies focusing on the visual perception of painful expressions (e.g., instead of responses to self-report or images/videos of injuries) have consistently shown that white participants perceive pain less readily on black faces versus white faces (Mende-Siedlecki, Qu-Lee, Backer, & Van Bavel, 2019), and that as a result, they “prescribe” less analgesic to black individuals in a subsequent treatment recommendation task. Subsequent analyses revealed that this bias is driven by disruptions in configural face processing, and is not caused by low-level differences in stimulus features, subjective evaluations of social status or strength, or by objective

differences in facial structure or intensity of expression (Mende-Siedlecki et. al., 2019). This study ultimately shows the importance of a perceptual approach.

Individual Differences in Personality and Emotion Related to Pain and Pain Perception

Examining the personality and emotion-related factors influencing both overall and biased pain perception may shed light on possible approaches that could improve treatment. For example, recent work has demonstrated that empathy is not only linked to pain treatment inequalities, but also that empathy-inducing interventions can reduce these differences (Drwecki, Moore, Ward, & Prkachin, 2010). Undergraduate students (Experiments 1 and 2; Drwecki et al., 2010) and nursing professionals (Experiment 3) watched videos of real black and white patients' genuine facial expressions of pain, provided pain treatment decisions, and reported their feelings of empathy for each patient. The effectiveness of an empathy-inducing, perspective-taking intervention was also examined (Experiments 2 and 3). When instructed to deliver patients with the best care, participants exhibited significant pro-white pain treatment biases. However, participants who were engaged in an empathy-inducing, perspective-taking intervention that instructed them to imagine how pain affected patients' lives demonstrated more than 55% reduction in pain treatment bias in comparison to controls. Furthermore, increased empathy for white patients was highly predictive of pro-white pain treatment biases. The magnitude of the empathy bias experienced predicted the magnitude of the treatment bias exhibited (Drwecki et al., 2010). These

findings suggest that empathy plays a crucial role in racial pain treatment disparities in that it appears not only to be one likely cause of pain treatment disparities but also is an important means for reducing racial disparities in pain treatment. Given the effectiveness of this empathy induction, it's possible that individual differences in trait empathy might predict differences in a) participants' visual thresholds for recognizing facial expressions of pain, as well as b) participants' race- and gender-based biases in pain perception and treatment.

Examining empathy in particular is essential to the study of pain and pain treatment due to its influence on positive clinical outcomes (Blasi, Harkness, Ernst, Georgiou & Kleijnen, 2001). Empathic physicians prompt more information from patients regarding their symptoms and pain level and elicit higher levels of patient participation in treatment (Berry, 2001). Physicians who took a communication skills training that included empathy increasing components, used significantly more problem-defining and emotion-handling skills than untrained physicians. Patients of the trained physicians reported reduction in emotional stress for as long as six months. These physicians also saw better clinical outcomes, were less likely to receive patients complaints, and less likely to discount the intensity of chronic pain (Tait, 2008; Kaplan, Greenfield & Ware, 1989; Tamblyn, Abrahamowicz, Dauphinee, Wenghofer, Jacques, Klass, Smee, Blackmore, Winslade, Girard, Du Burger, Bartman, Buckeridge & Hanley, 2007; Roter, Hall, Kern, Barker, Cole & Roca, 1995). Moreover, features such as patient-centered care and participatory decision making are regarded as the

ideal approach to chronic pain treatment and are characteristics of an empathic physician (Frantsve & Kerns, 2007).

In addition to empathy, other individual differences such as depression, anxiety, Borderline Personality Disorder (BPD), and the “Big Five” traits of personality may also be crucially related to pain perception and treatment. Depression and anxiety have been shown to alter people’s experience of pain—for example, individuals with depression demonstrate higher thresholds for physical pain (Thompson, Correll, Gallop, Vancampfort & Stubbs, 2016). Similarly, BPD has been shown to alter the physical experience pain perception, such that patients with BPD demonstrate higher pain thresholds and reduced pain sensitivity (Bodmann et al., 2015; Ludäscher et al., 2007; Magerl, Burkart, Fernandez, Schmidt, & Treede, 2012; Schmal et al., 2006). Both neuroticism and openness to experience, two of the “Big Five” traits of personality, positively predict the intensity of pain experience during childbirth, while conscientiousness negatively predicts accurate perception (Yadollahi, Khalaginia, Vedadhir, Ariashekouh, Taghizadeh & Khormaei, 2014).

The present manuscript is primarily focused on the following question: “How do individual differences in personality and emotion processing contribute to both accurate and biased pain perception?” Through this work, we intended to pinpoint which aspects of personality and emotional processing influence overall visual thresholds for pain perception, as well as bias in these thresholds due to race or gender. To answer these questions, we began by recording a battery of individual

difference measures following a standard task examining racial and gender bias in the visual perception of pain (Study 1).

At the outset, we predicted that self-reported empathic concern, personal distress, anxiety, and extraversion will negatively predict overall thresholds for pain perception (across race/gender), while self-reported symptoms of depression and Borderline Personality Disorder will positively predict overall thresholds for pain perception. Moreover, self-reported empathic concern will predict reduced racial and gender bias in pain perception.

Following the conclusion of Study 1, a subsequent study (Study 2) was a conducted a) to see if Study 1's results could be replicated, b) to examine the influence of several other individual difference measures related to theory of mind, dehumanization, and autism spectrum disorder, and c) to better understand what people were basing their perceptual judgements upon. Here, we asked participants to judge (in separate blocks) whether a given target was *feeling* pain or *expressing* pain. This approach allowed us to pinpoint whether individual differences personality and emotional processing were better correlated with thresholds for “feel” or “express” judgments. In particular, we predicted that thresholds for “feel” judgments would be better correlated with trait empathy, versus “express” judgments.

Chapter 2: METHODS

Study 1

Participants

In Study 1, one hundred eleven participants (45.94% female, mean age = 18.86, $SD = 0.84$) were recruited from two sources: 1) undergraduate students from the University of Delaware (UD) student body and 2) undergraduate students from the UD Introduction to Psychology subject pool. Participants from the PSYC100 subject pool received research participation credit as compensation, while all other subjects were compensated with \$10 for one hour of their time. An online questionnaire was used to screen participant eligibility. Subjects were eligible if they were native English speakers.

Procedure

Upon arrival into the lab for Study 1, participants first read and signed a consent form, in accordance with approval from the University of Delaware Institutional Review Board. They then completed a thirty-minute pain rating task adapted from prior work in our lab (Mende-Siedlecki et al., 2019), which was administered in EPrime. Specifically, participants rated face morphs between completely neutral and completely painful facial expressions for 36 individuals (11

morphs per individual; 14 White, 14 Black, and 8 other-race individuals; half male, half female). It is important to note that while we are interested in the effect of Black vs. White targets, other-race targets were also included to distract from the obviousness of this comparison. This inclusion therefore reduces the study's demand characteristics.

On each trial, participants were shown a morphed face representing a weighted combination of neutral and painful content, and asked "How much pain do you think this face is in?", which they answered on a 7-point scale (1 = "definitely not in pain," 7 = "definitely in pain"). In a subsequent treatment recommendation task, participants saw an ambiguously painful expression from each target (a 50% painful/50% neutral morph) and estimated how much non-narcotic analgesic cream each should receive as treatment for their pain (from 0 to 20 grams). This pain-relieving cream was described as "non-narcotic" to ensure that differences in treatment recommendations were independent of participants' stereotypes regarding the likelihood of abuse of an opioid-based pain reliever.

Participants then completed a Qualtrics survey, in which they were asked to self-report their age, gender, race, and political ideology (7-point scale; 1 = "very liberal," 7 = "very conservative"). Participants also made a series of social evaluations of each target they saw in the previous tasks (with presentation order randomly counterbalanced) on a series of 12 questions (from 1 = "not at all" to 7 = "extremely"). Within these items were four items related to status (e.g., *How privileged do you think this person is?*, *How hard do you think their life has been?*, *How lucky do you think*

they have been?, *How much adversity do you think they've overcome in general?*; adapted from Trawalter et al., 2012). The scores on the status questions were averaged within items and across targets within race, and then the Black status average was subtracted from the White status average, resulting in a score representing each participant's racial bias in status judgments. Within these social evaluations, we also included an item for each target measuring judgments of strength.

Additionally, participants answered a series of personality measures to obtain measures of individual difference scores in depression (Beck Depression Inventory; Beck, 1996), anxiety (State-Trait Anxiety Inventory; Spielberger, 1983), borderline personality disorder (PAI-BOR; Morey, 2007), empathy (Interpersonal Reactivity Index; Davis, 1983), and the "Big Five" traits of personality (BFI-10; John et. al., 1991). The total task run time was one hour.

Stimuli

For Study 1, all stimuli were photographs of real faces selected from the Mende-Siedlecki Lab existing database (Mende-Siedlecki, Qu-Lee, Goharзад, & Drain, 2019). First, a picture of a neutral expression was taken. The actors in the pictures did not endure actual pain and were instead asked to pose expressions corresponding to different types and levels of pain. For example, they were asked to make a pain expression corresponding to an experience of burning pain at a level two, five, and eight on a scale of one to ten and were photographed after each expression. Other types of pain included electrical shock, cold pain, and cut pain. When selecting

stimuli for inclusion in Study 1, pictures were first filtered to ensure that self-identified race matched perceived race, that self-identified gender matched perceived gender. Then, filtered stimuli were balanced in terms of social evaluations of their neutral faces (e.g., attractiveness, competence, age, etc.), perceived race/gender prototypicality of their neutral faces, latent emotional content in their neutral faces (including pain), and most importantly, intensity of their painful expressions to pain, discriminability of the painful expressions from other emotions (e.g. anger, disgust, etc.), and intensity/believability of their painful expressions. While the trustworthiness ($p = 0.23$) and dominance ($p = 0.0007$) dimensions for gender, and the status ($p = 0.0003$) dimension for black targets vs white targets were not as well balanced, the stimuli set overall, met the counterbalancing criteria. After selecting the 36 individuals described above, their neutral and pain expressions were uploaded into a morphing software (Morpheus FaceMorpher Pro 2019, version 3.17) where the pain-morphs were created. These morphs were transformed into a video-like progression from neutral to extremely painful, which was then separated into 11 different levels. These 11 different levels of pain for each individual comprised the stimuli that were ultimately included in the study.

Measures

As stated above, Study 1 included measures for depression, anxiety, borderline personality disorder, empathy, and the “Big Five” traits of personality. From these

measures, we were able to obtain sub-clinical individual differences in these traits, rather than recruiting a clinical population.

Empathy

Individual differences in trait empathy were measured using the Interpersonal Reactivity Index (IRI; Davis, 1983). This scale includes 28 items for which responses are made on a 5-point Likert-type scale ranging from “Does not describe me well” to “Describes me very well”. Specifically, the IRI measures four subscales related to empathic responding: *perspective taking*, which examines the tendency to spontaneously adopt the psychological point of view of others, *fantasy*, which taps respondents' tendencies to transpose themselves imaginatively into the feelings and actions of fictitious characters in books, movies, and plays; *empathic concern*, which assesses "other-oriented" feelings of sympathy and concern for unfortunate others; and *personal distress* which measures "self-oriented" feelings of personal anxiety and unease in tense interpersonal settings. For example, the IRI asks “I sometimes try to understand my friends better by imagining how things look from their perspective.”, “When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me”, “I often have tender, concerned feelings for people less fortunate than me.”, and “Being in a tense emotional situation scares me”, for each subscale respectively.

Depression

Depression was measured using the Beck Depression Inventory (BDI-II; Beck, 1996). The BDI-II assesses depression in individuals older than 13 years, and includes symptoms such as hopelessness, irritability, guilt, feeling punished, fatigue, and weight loss or weight gain. It contains 21 questions and each question is scored on a scale of 0 to 3. Higher total scores indicate more severe depressive symptoms. The standardized cutoffs are as follows: 0–13: minimal depression, 14–19: mild depression, 20–28: moderate depression, 29–63: severe depression.

Anxiety

Anxiety was measured using the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). The STAI tests both state and trait anxiety, however, the present study only examined state anxiety using the STAI: Y-6 item version, because we are concerned with how the participant is feeling in the moment. It can be defined as fear, nervousness, discomfort, and the arousal of the autonomic nervous system caused by perceived dangerous situations. This type of anxiety is temporary and refers to how a person is feeling at the time of a perceived threat. Scores range from 20 to 80, with higher scores indicating more severe anxiety. Questions seen on this measure include, “I feel secure.” And “I feel worried.” There are twenty questions for each type of anxiety, which are rated on a 4-point scale where 1 = not at all, 2 = somewhat, 3 = moderately so, 4 = very much so.

“Big Five” Traits of Personality

Individual differences in personality were measured using an abbreviated Big Five Inventory (BFI-10; John et. AL., 1991). The BFI-10 is a short version of the BFI, often used when there is a time constraint. It is a 10-item scale measuring the Big Five personality traits: extraversion, agreeableness, conscientiousness, emotional stability, and openness. Each trait is represented by two items on the BFI-10 and participants respond on a 5-point scale where 1 = disagree strongly, 2 = disagree a little, 3 = neither agree or disagree, 4 = agree a little, and 5 = agree strongly.

Analysis

My primary hypotheses focus on the relationships between the individual difference measures we collected and both a) overall thresholds for pain perception, as well as b) racial and gender bias in pain perception. To calculate the overall pain perception threshold for each participant, we first calculated pain perception thresholds within each condition in a procedure adapted from other work on mind perception (Hackel et al., 2014; Looser & Wheatley, 2010).

Specifically, participants' 1-7 ratings of pain experience were linearly transformed to a scale from 0 to 1 (0=*not in pain*, 1=*in pain*). Ratings were then separately fit with a cumulative normal function to calculate the point of subjective equality (PSE) in each condition. This PSE represents the point at which a face is equally likely to be perceived as being in pain or not (e.g., pain perception threshold).

PSEs were then averaged across conditions (weighted by the number of stimuli per condition) to create an overall average pain threshold for each participant. Subsequently, we subtracted the White PSE from the Black PSE to create a measure of

racial bias in pain perception, and then subtracted the Male PSE from the Female PSE to create a measure of gender bias in pain perception. Finally, individual difference measures were pitted against each other in a series of multiple regressions predicting a) overall pain perception thresholds, b) racial bias in pain perception, and c) gender bias in pain perception.

Secondarily, we created similar overall pain management and pain management bias measures from the treatment recommendations task responses.

Study 2

Participants

In Study 2, one hundred twenty-one participants (70% female, mean age = 18.79, SD = 1.35) were recruited from the Amazon website Mechanical Turk. These participants completed the entirety of the study online, and were compensated monetarily (\$1.25 for approximately 20 minutes of participation). Participants had to be United States residents and native English speakers to participate in Study 2.

Procedure

Experiment 2 was administered online, and lasted about 20 minutes.

Participants read and signed an online consent form and then completed a Qualtrics task similar to the one in Experiment 1, with several key differences. First, in Experiment 2, we manipulated the question wording in the pain rating task.

Participants saw the same set of targets twice and instead of asking “How much pain do you think this face is in?” for each target, participants were asked “Is this person

feeling pain?” for one set and “Is this person expressing pain?” for the second set. This framing was explicitly chosen to tease apart whether bias in pain perception is more associated with judgments of targets’ internal states or external appearances. Participants saw a full block of one set of targets associated with one judgment in its entirety before moving onto the second set. Block order was randomized.

In a second change, we used an abbreviated version of the task (used in previous work; Mende-Siedlecki et al., 2019) in which participants saw targets’ pain expressions in sequential order (beginning with a neutral face), and made binary Yes/No responses to the questions “Is this person [feeling/expressing] pain?” Once a participant responded “Yes” to a given face, the task advanced.

Third, stimuli were digitally-rendered versions of targets from the Delaware Pain Database (see below). Only male targets were selected for Study 2.

The treatment recommendation section of the experiment presented the same question as Experiment 1, but participants saw both sets of stimuli (e.g., targets for whom they made “feel” judgments and targets for whom they made “express” judgments). Moreover, participants once again completed a social evaluations task, in which they rated targets on their status (two items) and strength (two items), among other evaluations.

Finally, the Qualtrics survey concluded with a series of individual difference measures: specifically, measures of empathy (Interpersonal Reactivity Index; Davis, 1983), theory of mind, (Mind in the Eyes; Baron-Cohen, 1997), autistic traits (Autism Spectrum Quotient; Baron-Cohen, 2001), blatant dehumanization (The Ascent of Man

scale; Kteily et.al., 2015), animalistic and mechanistic dehumanization (Human Nature and Uniquely Human traits; Haslam, 2006) and stereotypes about pain sensitivity (Wandner et al., 2012). These new scales were added to assess the degree to which theory of mind capacities, autistic traits, dehumanization, and pain sensitivity stereotypes might be associated with racial bias in pain perception and treatment.

Stimuli

For Study 2 the same 40 individuals were used, however all the pictures were uploaded to the 3-D face generating and 3D modeling software, FaceGen. The real faces were transformed into computer avatar faces, which still resembled the original images, but allowed us more flexibility. Specifically, once imported into FaceGen, sliders were manipulated to equate structure across race, such that both Black and White targets had equivalent, racially neutral structure. Next, we systematically rendered facial expressions of pain onto these imported targets. We used eight different expressions, which were created using FaceGen and then normed. Normed ratings of these expressions suggested that the pain expressions were rated as strongly resembling pain ($M = 5.27$), more so than any other emotion (all M s < 2.73 ; all p s $< .003$) we compared against (e.g., fear, anger, disgust, happiness, surprise, sadness, threat).

Pairings between expressions and faces were counterbalanced across four versions of this task. Using these computerized faces instead of the real faces increased our ability to control specific aspects of these stimuli (e.g., structure,

expression intensity), thus improving this experiment's internal validity. That said, these stimuli look somewhat less lifelike than those presented in Study 1, reducing ecological validity somewhat.

Measures

As stated above, Study 2 included measures for empathy, theory of mind, autistic traits, dehumanization, and stereotypes about pain sensitivity.

Theory of Mind

Individual differences in theory of mind capabilities were measured using the Reading the Mind in the Eyes task (R-MET; Baron-Cohen, 1997). This measure tests an individual's ability to read others' emotions based on a vignette image of their eyes. After viewing images of human eyes taken from photos of faces making emotional expressions, participants are asked to decide which of four adjectives best describes the person's mental state.

Autistic Traits

Individual differences in autistic traits were measured using the Autism Spectrum Quotient (ASQ; Baron-Cohen, 2001). This measure aims to investigate whether adults of average intelligence have autistic symptoms, though it is not intended to be diagnostic of Autism Spectrum Disorder (ASD). The questions cover five different domains associated with the autism spectrum: social skills; communication skills; imagination; attention to detail; and attention switching/tolerance of change. There are 50 statements, to which participants respond

either "definitely agree", "slightly agree", "slightly disagree," or "definitely disagree". Half of the questions are created to produce an “agree” response and half of them were created to produce a “disagree” response, for a high scoring individual. One point is added to the final score for each question that is answered with the autistic-like behavior, either mildly or strongly.

Blatant Dehumanization

Blatant dehumanization was measured using the Ascent of Man scale (Kteily et al., 2015) in order to determine when and why people demonstrate obvious dehumanization, as opposed to subtle dehumanization. Participants saw the popular silhouette “Ascent of Man” image of the evolution of apes to humans. They used sliders to rate how “human-like” Black Americans and White Americans are, intermixed with other social groups including Arabs, Canadians, Chinese, Europeans, and Muslims. Participant responses were translated into a score on a scale of 0 (least evolved) to 100 (most evolved). A racial dehumanization score was calculated by subtracted “Black Americans” slider value from the “White Americans” slider value.

Uniquely Human and Human Nature Scale

The uniquely human (UH) and human nature (HN) scale (Haslam, 2006) measures dehumanization and examines animalistic dehumanization and mechanistic dehumanization. Animalistic dehumanization is associated with denying out-group members UH traits, such as civility or cognitive aptitude, while mechanistic dehumanization is associated with denying out-group members HN traits, such as warmth and emotionality. Participants rated the extent to which they think Black Americans, White Americans, Asian Americans, and Latino Americans are idealistic,

talkative, conservative, artistic, absentminded, analytical (UH traits), as well as ambitious, curious, determined, emotional, imaginative, passionate, and sociable (HN traits), on a scale of 0 (not all all) to 100 (a very great extent). Participants' score for either UH or HN traits was calculated by subtracting the "Black Americans" score from the "White Americans" score within either dehumanization subscale. The higher the score, the more UH or HN traits they attributed to White Americans, relative to Black Americans.

Pain Sensitivity

We adapted a previous pain sensitivity scale (Wandner et. al., 2012) in order to measure racial, age-based, and gender stereotypes about sensitivity to pain.

Participants were asked questions such as, "What is the typical black person's sensitivity to pain?" and used a slider to rate their answer on a scale of 0 (not at all sensitive) to 100 (most sensitive imaginable). Participants' final score was calculated by subtracting the slider value for black individuals from the slider value for white individuals, where the higher the score, the more pain sensitivity they attributed to white individuals, relative to black individuals.

Internal and External Motivation Scale

The Internal Motivation Scale (IMS) and External Motivation Scale (EMS) look at the internal and external sources of motivation to respond without prejudice. Participants are asked to rate statements such as, "Because of today's politically correct standards I try to appear non-prejudiced toward black people", on a scale of 1 = (strongly disagree) to 9 = (strongly agree). The higher the score for each of the scales, the higher levels of that type of motivation they had (Pant & Devine, 1998).

Analyses

Thresholds for pain perception were calculated following a procedure outlined in our lab's previous work (Mende-Siedlecki et al., 2019). In brief, each target was associated with a 1-to-11 value representing the morph on which a given participant saw its pain. These values were transformed to a 0-to-1 scale and averaged across targets within condition (e.g., Black vs. White targets) separately. The overall pain perception threshold represents an average of the Black and White pain perception thresholds. Racial bias in pain perception was calculated as the Black pain perception threshold minus the White pain perception threshold. Treatment recommendations (and bias in treatment) was calculated as in Study 1.

Finally, individual difference measures were pitted against each other in a series of multiple regressions predicting a) overall pain perception thresholds, and b) racial bias in pain perception.

Chapter 3: RESULTS

Study 1

Preliminary analyses conducted included a 2x2 ANOVA examining the effects of target race and gender on pain perception, a 2x2 ANOVA examining effects of target race and gender on pain treatment, and multiple regressions examining the influence of race- and gender-based biases in perception on biased treatment. However, since the main focus of this project is on how individual differences predict overall and biased pain perception and treatment, only results of the multiple regressions described in Methods above are presented below.

Correlations Between Individual Difference Measures & Overall Pain Perception Thresholds

When examining overall thresholds for perceiving pain, we observed that participants with higher empathic concern scores had lower thresholds for seeing pain on target faces ($B = -.02$, $t(151) = -3.19$, $p = .002$; **Figure 1**). No other measures were significantly related to overall pain perception thresholds (all $ps > .082$).

While it was not one of our primary hypotheses, we also assessed the effects of target gender and observed that female participants had lower thresholds for seeing pain than male participants did ($t(150) = 3.09$, $p = .002$; **Figure 2**).

Correlations Between Individual Difference Measures & Biased Pain Perception

We observed that participants with higher extraversion scores showed less racial bias in pain perception ($B = -.01$, $t(151) = -2.57$, $p = .011$). No other measures were significantly related to racial bias in pain perception (all $ps > .100$), and no measures were significantly related to gender bias in pain perception, either across the sample or when looking separately within male or female participants (all $ps > .199$).

Correlations Between Individual Difference Measures & Overall Treatment Recommendations

When analyzing data from the treatment recommendations task, participants with higher extraversion ($B = .32$, $t(151) = -2.10$, $p = .038$) and agreeableness scores ($B = .38$, $t(151) = -2.29$, $p = .023$) prescribed more pain reliever overall. We also observed a marginally positive relationship between empathic concern and overall treatment recommendations ($B = .17$, $t(151) = 1.84$, $p = .068$). No other measures were significantly related to overall treatment recommendations (all $ps > .124$).

Correlations Between Individual Difference Measures & Biased Treatment Recommendations

While no individual difference measures were correlated with gender bias in treatment recommendations across the sample (all $ps > .071$), some results emerged when we split by participant gender. Female participants with higher anxiety ($B = -.14$, $t(79) = -2.56$, $p = .013$) and agreeableness ($B = -.28$, $t(79) = -3.16$, $p = .002$) showed reduced gender bias in treatment, as did male participants with higher fantasy seeking

scores ($B = -.11$, $t(71) = -2.12$, $p = .039$). No measures were significantly associated with racial bias in treatment (all $ps > .090$).

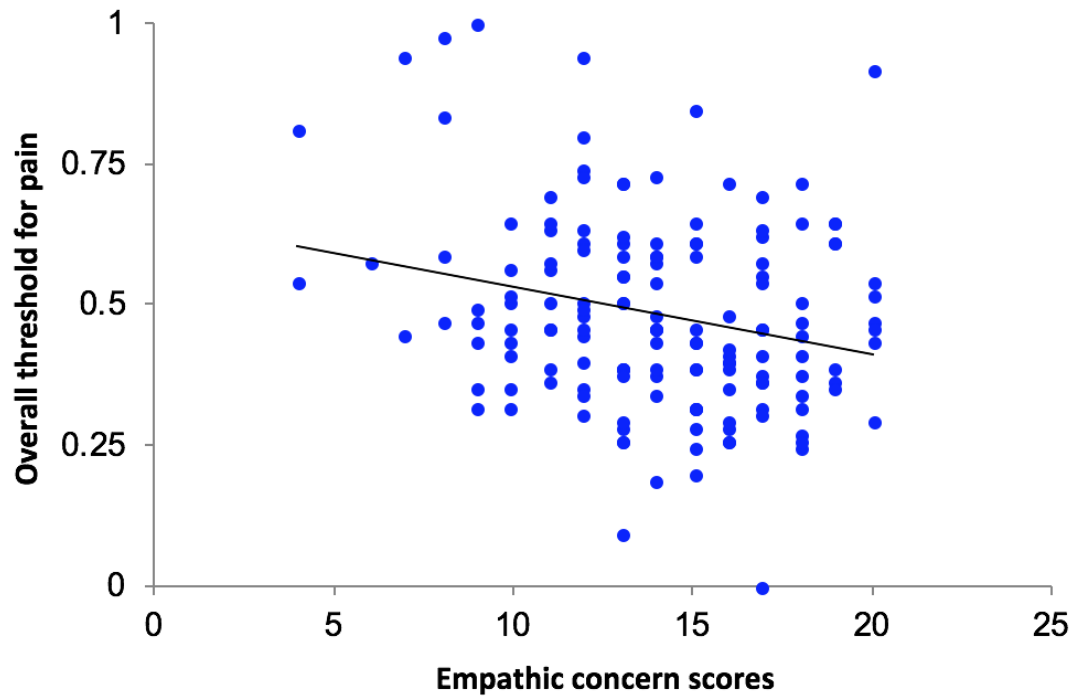


Figure 1 Relationship between empathic concern and overall thresholds for perceiving pain.

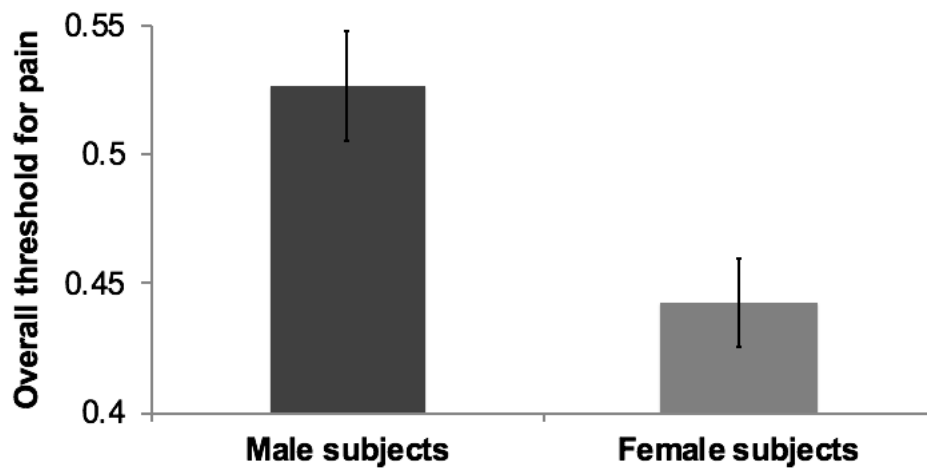


Figure 2 Effect of participant gender on overall thresholds for perceiving pain.

Study 2

Analyses of “Feel” Judgments During Pain Rating Task

Correlations between Individual Difference Measures & Overall Pain Perception Thresholds

When examining overall thresholds for perceiving pain during “feel” judgments, we observed that participants with higher total trait empathy (e.g., a sum across the subscales of the Interpersonal Reactivity Index) scores had lower thresholds for seeing pain on target faces ($B = .341$, $t(116) = .885$, $p = .034$), as did those with lower race pain sensitivity bias ($B = -.20$, $t(116) = -2.002$, $p = .032$). Those with higher fantasy seeking scores ($B = -.012$, $t(116) = -.059$, $p = .064$), and higher personal distress scores ($B = .051$, $t(116) = .348$, $p = .067$) also had marginally lower thresholds for seeing pain on target faces. No other measures were significantly related to overall pain perception thresholds during “feel judgments” (all $ps > .152$).

Correlations between Individual Difference Measures & Racial Bias in Pain Perception

We observed that participants with higher total trait empathy (e.g., a sum across the subscales of the Interpersonal Reactivity Index) scores ($B = -.463$, $t(116) = -1.186$, $p = .045$) showed less racial bias in pain perception during “feel” judgments. Those with lower ascent bias scores ($B = .105$, $t(116) = 1.08$, $p = .082$) marginally showed less racial bias in pain perception during “feel” judgments. No other measures were significantly related to racial bias in pain perception (all $ps > .158$).

Analyses of “Express” Judgments During Pain Rating Task

Correlations between Individual Difference Measures & Overall Pain Perception Thresholds

We did not observe any individual difference measure to have a significant relationship with overall pain perception thresholds during “express” judgments (all $ps > .115$).

Correlations between Individual Difference Measures & Racial Bias in Pain Perception

We observed that participants with higher EMS scores ($B = -.223$, $t(116) = -1.838$, $p = .052$) and higher fantasy seeking scores ($B = .325$, $t(116) = 1.64$, $p = .102$) showed marginally less racial bias in pain perception during “express” judgments. No other measures were significantly related to racial bias in pain perception (all $ps > .227$).

Treatment Recommendations

Correlations between Individual Difference Measures & Overall Treatment Recommendations

We did not observe any individual difference measure to have a significant relationship with overall treatment recommendations (all $ps > .170$).

Correlations between Individual Difference Measures & Racial Bias in Treatment Recommendations

We observed that participants with higher perspective taking scores ($p = .041$) and higher total trait empathy scores ($p = .045$) showed less racial bias in treatment recommendations. No other measures were significantly related to racial bias in pain perception (all $ps > .113$).

Chapter 4: DISCUSSION

Previous work has examined how perceivers infer pain experience, as well as the causes and consequences of the misperception and mistreatment of pain. A great deal of this work has identified disparities in pain perception and treatment, showing a significant racial bias against black individuals and women. However, perceiver individual differences in personality and emotion processing have not been studied as a possible moderating factor. The present studies aim to identify which personality and emotion processing characteristics are associated with both overall pain perception, as well as biased pain perception. Further, as a secondary question, we tested how these factors might be differentially related to framing pain judgments in terms of a target's inner experience versus their outward expression.

Across both studies, we calculated values representing thresholds for overall pain perception, as well as racial and gender bias in pain perception. In Study 1, we observed that individuals with more empathic concern, calculated in the IRI, saw pain earlier on targets' faces, collapsing across race and gender. Moreover, female participants also saw pain earlier on faces than males did, and thus gender may be an influencing factor on the interaction of individual differences in empathy and pain perception. As for other factors influencing biased pain perception, individuals with higher levels of extraversion showed less racial bias in pain perception. In addition, participants who had higher extraversion and agreeableness scores prescribed more pain reliever to black targets than those with lower scores. There was a marginal

relationship between empathy on treatment recommendations, such that those with higher scores on empathic concern also prescribed more pain reliever to black targets than those with low scores. Additionally, females with higher levels of anxiety and agreeableness displayed reduced gender bias in treatment, as did males with higher fantasy seeking scores. No measures were significantly associated with racial bias in treatment. This finding suggests that perceivers' levels of empathy for example, while important for perceiving pain, was not significantly associated with racial bias in either perceiving targets' pain, or subsequently treating it.

In Study 2, specifically within “feel” judgments, participants with higher trait empathy scores, saw pain earlier overall, and similar trends were observed for participants scoring higher on the fantasy seeking and personal distress subscales (though these latter trends were not significant). Notably, participants with higher trait empathy scores showed less racial bias in pain perception as well. In particular, the participants with higher perspective taking scores, showed less racial bias during “feel” judgments.

While there are some consistencies across the two datasets (specifically, a positive role for trait empathy in perceiving painful facial expressions more quickly), there's a great deal of discrepancy, as well. A meta-analysis was conducted to compare the results of Study 1 and Study 2 in aggregate with other studies conducted in the lab. Overall, the results seen in the present two studies were not replicated across the majority of the others, suggesting that this project may be outlier. That being said, other factors (the faces used, the populations sampled from, etc.) may be acting as moderators.

While many of the initial hypotheses were largely not supported, we observed that factors related to trait empathy could positively influence perceivers' thresholds for recognizing and treating pain. These results have obvious implications for the health care field and should be further studied in populations of medical health professionals.

That being said, these results may have applications in other contexts as well—potentially any situation in which physical pain and other's judgement of it, is relevant. Along with the healthcare system, the judicial system could also be impacted by these results. For example, consider the possible implications for the courtroom. If images of people in pain from a murder case are shown as evidence, the way that it is perceived may vary across the members of the jury, the judge, and lawyers present. Those individuals with higher trait empathy would recognize that this person was in a lot of pain more quickly (and potentially more accurately) than those with lower levels of empathy. Indeed, in other work using a mock-courtroom task, participants who scored higher on the perspective taking and empathic concern subscales of the IRI, both showed a negative correlation with the stringency of punishment they gave in the fictional case (Sjoberg, 2015). Consequently, this could influence whether or not someone is convicted of a crime, the subsequent punishment, and could have lifelong impacts on the lives of everyone involved. Ultimately, a more comprehensive understanding of how empathy and other personality characteristics impact pain perception may have considerable applications in hospitals, courtrooms, and beyond.

Limitations and Future Directions

Although the stimuli in Study 1 had high ecological validity as pictures of real faces, they also lacked internal validity because they varied considerably on structure

or skin tone. Even though they were balanced on subjective ratings on pain intensity, ultimately, each target was making a different facial expression of pain. While this was reconciled in Study 2 by using computer-rendered images that could be standardized in terms of structure and expression, the balance between these two validities could be improved. It should also be noted that a perceptual bias is not the only significant contributor to racial bias in pain perception. Explicit stereotypes regarding status (Trawalter et al., 2012), pain tolerance (Hoffman et al., 2016), drug abuse (Upshur, Luckmann, & Savageau, 2006), and implicit racial bias (Sabin, Nosek, Greenwald, & Rivara, 2009) also likely contribute to this bias.

These studies should be replicated with a larger participant pool, as well as with medical professionals as the participants. Assessing this bias in the population in which it may have the most societal impact is key. The most accessible population to begin testing these effects within could be undergraduate pre-med, pre-physical therapy, and nursing students.

Future investigations should also test whether increased levels of empathy decrease biases in the visual perception of pain, for real expressions of pain. Since our targets were just imitating painful expressions, we cannot truly know if the results are applicable to genuine painful faces. However, it is also important to note that the stimuli were highly rated on their believability and that perceivers typically have great difficulty detecting differences between real and faked pain expressions (Poole & Craig, 1992; Hill & Craig, 2002).

Due to the obvious implications for the healthcare field, designing and testing an intervention to flexibly enhance empathic concern toward other-race individuals to reduce racial bias in pain perception and treatment could be an important next step.

Communication skills courses have already been developed aimed to better help patients express themselves to providers. However, the impact of these courses has seen vary in their effectiveness (Tait, 2008). Some have seen positive changes in physician behavior that have improved their clinical practice, whereas others have not had an impact (Roter et. al., 1995; Brown, Boles, Mullooly & Levinson, 1999). A possible explanation for the mixed results is that communication skills alone is not enough to see a true impact on the patient level, and that physicians have to use patient-centered care and put in “emotional labor” to see a positive outcome (Gallagher, 2006). Patient-centered care revolved around three items: 1) assessing both the illness and the patient’s experience of illness; 2) understanding the patient as a person, including his or her family, job, and social network; and 3) engaging in participatory decision making with the patient (Fiscella, Meldrum, Franks, Shields, Duberstein, McDaniel & Epstein, 2004). Empathy would best fit the second principle of patient-centered care and any potential future interventions should, therefore, focus on that second component. Based on the results from Study 2, this intervention should focus on how the patient feels internally, rather than on the pain they are externally expressing. This could possibly lead to patients of color being diagnosed and treated more accurately, with the same precision given to their white counterparts. Using this intervention on current medical professionals, and well as individuals who are going through schooling would be equally important. Taking this intervention at the start of your medical training could possibly increase its positive impacts, since trained individuals would be able to start their career with these techniques (Kelm, Womer, Walter & Feudtner, 2014). It is also important to implement this intervention throughout all medical professions, not just general physicians. Having physical

therapists, ophthalmologists, and neurologists, for example, receive this intervention would widen the scope and chances that the widespread disparities in treatment problem will begin to be reduced (Kelm et. al., 2014).

This project began to bridge the gap in the existing literature concerning the influence of individual differences in personality and emotion processing on both overall and biased pain perception. By understanding the positive influence that empathy can have on pain perception, more work can be done to improve equality of pain care and treatment across patients from all walks of life.

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