The Connections between Personality Traits, Pain Threshold, and Pain Tolerance

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Grace Kim joined Professor Pressman's Lab in 2017. There, she developed a passion for psychology research aimed at developing novel intervention techniques to be used in clinical settings. She believes that the results of this project can help open the way for future pain management and personalized interventions. Grace credits her experience with helping her grow as a lifelong learner with boundless curiosity and has particularly enjoyed the opportunities she has had to bond with her fellow researchers. After graduation, Grace plans to attend medical school and become a physician.

Key Terms

- Big Five Personality Traits
- Cold Pressor
- Pain Threshold
- Pain Tolerance
- Pressure Algometert

Abstract

This study examined the connections between the Big Five personality traits, pain threshold, and pain tolerance during acute stress induced by standardized laboratory stressors. The correlations between the Big Five personality traits and pain threshold, the point at which an individual first begins to feel pain, and pain tolerance, the maximum level of pain that an individual is able to tolerate, were studied to investigate how personality can influence the pain experience. In this study, 78 participants engaged in two acute pain tasks during which pain threshold and tolerance were measured. Participants also completed a questionnaire to assess the Big Five personality traits (agreeableness, conscientiousness, extraversion, openness, and neuroticism). Results indicated that the Big Five personality traits were not correlated with either pain threshold or pain tolerance during either the pressure algometer or cold pressor tasks. This study reveals that there may not be connections between the Big Five personality traits and the threshold and tolerance aspects of the individual pain experience. Understanding the effect of personality on pain responses is important so that interventions and therapy for pain can be further personalized based on these characteristics. Further research on the relationship between personality traits and the pain experience could be useful in potentially improving pain therapy.

Faculty Mentor

This project investigates an important question regarding whether our personalities can affect the pain experience. Both acute pain and chronic pain conditions are exceedingly common in the U.S., so it is necessary that we further our understanding of factors that contribute to these symptoms and conditions. Faculty-mentored undergraduate research is vital to the education of our students. By helping them to engage in the research process, we can teach them to be discerning consumers of science. The opportunity to learn about research methods in a more hands-on way can give our students a deeper appreciation for the intricacies of the process that go on behind the scenes.

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Introduction

Experiences of stress and pain are inevitable parts of life, and personality traits can drastically influence an individual's response to and endurance during these experiences (Childs et al., 2014). Understanding the effects of certain personality traits in the experience of acute pain is not only beneficial in helping people gain awareness of their personal experiences, but is also useful in studying individual susceptibility to chronic stress-related diseases. Although there are many aspects of the acute pain experience, we chose to focus on pain threshold, the point at which an individual first begins to feel pain, and pain tolerance, the maximum level of pain that an individual is able to tolerate. These important variables were chosen in order to analyze the individualized perception and response to painful experiences. The following study investigates the relationship between the Big Five personality traits, pain threshold, and pain tolerance during painful tasks.

The Big Five Personality traits, which include agreeableness, conscientiousness, extraversion, openness, and neuroticism, outline the broad dimensions of personality in which more specific personality characteristics may lie (John and Srivastava, 1999). There is a large amount of literature investigating the relationship between these personality traits and health- relevant outcomes, although some personality traits have been examined in this context more than others. Conscientiousness, a personality dimension that encompasses dependability and self- discipline, is the most studied of these traits in the context of health. It has been connected with a number of positive health outcomes, such as lower blood pressure, lower likelihood of having a stroke, and lower levels of mortality (Goodwin and Friedman, 2006; Weiss and Costa, 2005). Past research has also connected agreeableness with lower levels of mortality (Weiss and Costa, 2005), but neuroticism is related to higher levels of mortality (Murberg et al., 2001). Findings such as these indicate that certain personality dimensions can affect long-term health and well-being.

One specific health-relevant context in which personality traits have been found to play a role is stress. Continuous stress exposure has been found to induce long-term health complications (Kopp and Réthelyi, 2004), so previous studies have investigated the connections between the Big Five personality traits and immediate physiological responses to stress to explore methods in reducing long-term health complications (e.g., Bibbey et al., 2013; Brickman et al., 1996). One such study by Xin and colleagues (2017) used the Trier Social Stress Test, a stressor that requires par-

ticipants to make an interview presentation and complete an arithmetic test in front of a panel of confederates, to measure the physiological stress response through cardiovascular activity and levels of cortisol, a steroid hormone released in response to stress. The results suggested that those with higher extraversion and openness showed smaller cortisol activation and less increase in negative affect (Xin et al., 2017). A similar study also measured personality traits, cardiovascular changes in response to stress, and cortisol changes in response to stress, but the stressors in this study were composed of a speech task where participants were asked to defend themselves from an accusation, a mirror tracing task where a star had to be traced through its mirror image during a timed period, and the emotional Stroop task, which assessed the influence of attention on information processing (Bibbey et al., 2013). Results showed that individuals higher in neuroticism and lower in both agreeableness and openness had significantly smaller cortisol stress reactions and diminished stress reactions of the cardiovascular system. The researchers of this study concluded that those with higher neuroticism had blunted biological stress reactions because of maladaptive psychological states from greater threat perception; over time, this would amount to chronic stress and contribute to blunted physiological reactivity as a result of allostasis, the process by which the body impairs and down-regulates the physiological stress reactions to daily stressors (Bibbey et al., 2013). These findings indicate that different dimensions of personality traits are associated with contrasting aspects of acute physiological stress responses, and these findings can further be used to predict an individual's susceptibility to stress-related disorders.

Although abundant research has been dedicated to linking personality traits and various physical health outcomes, few studies have investigated the relationship between personality and pain threshold or tolerance. Some studies explored the relationships between extraversion and discomfort ratings during pain (e.g., Harkins et al., 1989; LeBlanc et al., 2004; Miró and Raich, 1992). Another study found that lower-order personality traits, which are specific aspects of a broader personality trait, were associated with predicted pain ratings (Lee et al., 2010). One study by Boggero and associates (2014) investigated the connections between blood pressure and pain tolerance during the cold pressor task, an acute pain task where participants immerse their hands into ice water. Researchers concluded that there was a correlation between neuroticism and mean arterial pressure, or the average blood pressure during one cardiac cycle, but no significant relationship between any of the Big Five personality traits and the ability to tolerate pain (Boggero

et al., 2014). Another study based on Eysenck's theory of personality found personality traits to be associated with pain threshold and pain tolerance, and extraversion was correlated with high pain threshold and tolerance (Barnes, 1976). While predicted pain and discomfort ratings have been explored through various studies, there is still a lack of literature that significantly correlates personality traits with pain threshold or pain tolerance.

Much of past research on the Big Five Personality traits has primarily focused on examining personality associated with physical health, but there has been a lack of literature specifically exploring the significance between personality traits and pain threshold or tolerance. In this study, we aimed to further research the dimensions of personality in relation to pain threshold and tolerance by collecting the timed threshold and tolerance during acute pain, as well as the measured pressure during the pressure algometer task. Additionally, this study used both the cold pressor, to apply sudden temperature stress to the left hand, and the pressure algometer, to apply a controlled pressure rate to the first dorsal interosseous muscle of the right hand, for the stressor tasks. Through these two stressors, we explored the pain threshold and pain tolerance correlation with personality traits through both immediate and gradual pain application. To our knowledge, no previous study had used the pressure algometer task to explore the relationship between pain threshold, pain tolerance, and personality. By exploring the impact of specific personality traits on pain tolerance levels across two different tasks, we can gain a clearer representation of the correlation between individual characteristics and endurance to stressful experiences.

Methodology

Participants

Seventy-eight participants (69.2% female, Mage = 20.83 years) were recruited as part of a larger study on facial expressions and pain through the University of California, Irvine, Human Subjects Lab Pool and through fliers on campus. Subject pool participants received course credit, and flier participants were compensated $20 for the two-hour session. The racial/ethnic breakdown of the sample was 52.6% Asian, 17.9% Hispanic/Latino, 10.3% White/Caucasian, 9% Biracial/Multiracial, 5.1% Black/African American, and 5.1% other ethnicities. Use of mood-altering or heart-altering medication, pregnancy, sensitive skin, and caffeine or alcohol intake within 24 hours of the study made the participant ineligible.

Procedure

This study was part of a larger study on the effects of facial expressions on painful experiences. It took approximately two hours for the participant to complete, and the experimental process took place in a controlled, secure laboratory located in the Social & Behavioral Sciences Gateway building on the University of California, Irvine, campus.

After recruitment, an email describing the qualifications to participate in the study was sent to the participant. Upon arrival, the participant was consented and completed a screening questionnaire to check for eligibility. If the participant was ineligible, they were compensated for their time and dismissed. If the participant was eligible, research assistants applied electrocardiogram (ECG) sensors to the participant's front and back torso, and baseline physiological readings were recorded where the participant was asked to sit still and breathe normally for five minutes. The participant then began the first pain task (order of the tasks was counterbalanced).

For the pressure algometer task, pressure was applied to the belly of the first dorsal interosseous muscle of the participant's right hand with a medical pressure algometer with a one-centimeter metal circle tip at a rate of 5 kilopascals (kPa) per second. The participant was instructed to make a vocal sound as soon as they started feeling pain, and this pain threshold time was recorded. The task was immediately terminated when the participant pressed a button when the pain became too much to bear, and this pain tolerance time was recorded. Immediately after termination of the task, a five-minute cardiovascular recovery period began.

After the recovery period, the participant began the cold pressor task. During this task, the participant placed their left hand up to the wrist in 7.6 mL of water ranging from 3.8 to 4.0 degrees Celsius. The participant was instructed to make a vocal sound as soon as he or she started feeling pain, and this pain threshold time was recorded. The participant was also instructed to immediately remove their hand from the water to terminate the task when the pain became too much to bear, and this pain tolerance time was recorded. Immediately after termination of the task, a second five-minute cardiovascular recovery period was started.

Upon completion of the two pain tasks, the participant was asked to complete the remaining questionnaires, including the Big Five Inventory (BFI; John & Srivastava, 1999). All of the measuring apparatuses were then removed and the participant was thanked, debriefed, compensated, and dismissed.

Table 1.

Correlation Matrix for the Big Five Personality Traits and Pain

	Conscientiousness	Extraversion	Openness	Agreeableness	Neuroticism
CP threshold time [sec]	-.104	.167	.084	.000	.067
CP tolerance time [sec]	.100	.099	.054	.101	.018
PA threshold time [sec]	.021	-.118	-.096	.014	-.131
PA threshold [kPa]	.028	-.098	-.146	.029	-.168
PA tolerance time [sec]	.045	.005	-.064	.023	-.192
PA tolerance [kPa]	-.093	-.071	.013	-.080	.035

Note: CP = cold pressor; PA = pressure algometer
* p < .05, ** p < .01

Measures

Following the completion of both pain tasks and before debriefing, the participant completed questionnaires regarding the Big Five Inventory (John & Srivastava, 1999).

Data Analysis

Data analysis included correlational measures between the Big Five personality traits (agreeableness, conscientiousness, extraversion, openness, and neuroticism) and the tolerance and threshold times of the two pain tasks.

Results

Personality and Pain during the Cold Pressor Task
None of the five personality traits were significantly associated with pain threshold or tolerance during the cold pressor task (ps > .05). Correlation coefficients for these relationships are shown in Table 1.

Personality and Pain during the Pressure Algometer Task
None of the five personality traits were significantly associated with pain threshold or tolerance during the pressure algometer task (ps > .05). Correlation coefficients for these relationships are shown in Table 1.

Discussion

The goal of this study was to determine if there is a relationship between the Big Five personality traits and pain threshold and tolerance during two different acute pain tasks. Previous studies have only investigated these relationships using the cold pressor task, but our study used both the cold pressor task and the pressure algometer task to measure pain threshold and pain tolerance. Most past studies have not found relationships between these variables, and the results of this study align with this past literature. The Big Five personality traits were not significantly related to pain threshold or pain tolerance during either of the pain tasks. These findings imply that personality traits do not affect endurance and decisions made during painful experiences, such as terminating the stressful experience, at least within a college student sample.

The findings of this study are important because the results may be useful in developing future studies that use different methods to measure personality traits and assess pain so that individual susceptibility to chronic stress-related diseases can be better understood. The results do not completely rule out the possibility that personality traits may influence pain perception. This study measured personality traits using the Big Five model, but using alternative models to measure personality may provide a more comprehensive analysis of personality variables that are not encompassed in the Big Five model. A study by Feher and Vernon (2020) demonstrated that alternative models such as HEXACO and the psychobiological model contain novel personality dimensions that are not included in the Big Five model. For example, HEXACO includes honesty-humility and emotionality, and the psychobiological model includes operativeness, self-directedness, self-transcendence, and underlying biological differences (Feher and Vernon, 2020). It may be the case that personality traits such as these are more important during the pain experience. Additionally, this study used the cold pressor and pressure algometer as pain tasks to measure pain threshold and tolerance. Several studies have proposed alternative pain stimulation methods, such as heat immersion, cutaneous electrical stimulation, spring-clamp, and cuff algometry, that investigate different types of acute pain (e.g., O'Neill et al., 2014; Petersen et al., 2017; Werner et al., 2010). Thus, an important future direction for research in this area is to use different experimental pain and personality assessment methods to develop personalized interventions for those with elevated risk for stress- related disorders.

This study has some limitations. First, the participants were primarily undergraduate students at UC Irvine, so the results are not generalizable to other populations. Including only undergraduate students may have produced results that do not apply to other age groups. Past studies have demonstrated that the experience and perception of pain can vary due to age differences (e.g., Gagliese and Melzack, 1977; Gibson and Farrell, 2004; Wong and Baker, 1988). Similarly, other studies have shown that personality traits can change in adulthood (e.g., Lodi-Smith et al., 2009; Roberts and Mroczek, 2008; Srivastava et al., 2003). Because these differences between age groups may also result in differences in the relationship between personality and pain tolerance/threshold, a study that includes a broader sample age range may result in more generalizable data for all age groups. Second, the personality traits of participants were measured with self-reported data that were not independently verified, so this may have been a potential source of bias. The answers that participants chose in the questionnaires regarding the Big Five Inventory may have inaccurately reflected their behaviors in real life situations. Past studies investigated methods in measuring personality traits, and they found that combining self-reported data with directly measured data, such as behavioral observations, resulted in more accurate and reliable estimates of personality (e.g., Cattell, 1946; Nave et al., 2018; Speer et al., 2015). A study that assesses the Big Five personality traits using a combination of self-reported data and directly measured data instead of only self-reported data may result in more accurate and reliable measurements of the Big Five personality traits.

In conclusion, this study shows that different dimensions of the Big Five personality traits may not be connected to pain threshold and pain tolerance during either the cold pressor task or the pressure algometer task. The results suggest that individuals with different personality traits do not have differences in their pain endurance and experiences. Further research into the influence of personality traits on pain threshold and tolerance can be useful in understanding individualized responses to painful experiences, which can provide insight into exploring the development of personalized interventions for those with higher risk for stress-related disorders.

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