INVESTIGATING CHRONIC PAIN IN A WORK SETTING USING ELECTROENCEPHALOGRAPHY AND AN APPROACH-AVOIDANCE TASK

A Thesis

by

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ABSTRACT

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Chronic pain leads to missed work and billions of dollars lost in economic productivity. Pain sufferers have a hard time validating their pain and report bosses can become irritated or ignore when their pain is discussed. The current study was designed to objectively compare pain sufferers and controls hypothetically at work using an approach-avoidance (A-A) task, electroencephalogram (EEG), and a cold pressor task (i.e. noxious stimulus) to investigate differences in decision-making, reaction time (RT), and prefrontal asymmetry (PFA). Nine participants with chronic pain (8 females, *M* age= 19.78 years, *SD*=2.28 years) and 16 controls (7 females, *M* age= 19.17 years, *SD*=2.82 years, 4 exclusions) completed the study. B-Alert EEG files were filtered and cleaned using MatLab's EEGLab Plugin, and CarTool was used to complete Fast Fourier Transforms to obtain frequency data. Prefrontal Asymmetry (PFA) for the alpha frequency (8-12 Hz) was calculated by taking the natural log of the right frontal (F4) mean sensor data and subtracting the left frontal (F3) mean sensor data. PFA scores were calculated for baseline, A-A task, and post-test recordings by subtracting the left frontal lobe scores from the right frontal lobe scores. Independent samples *t*-tests indicated no significant difference in A-A scores ($p = .245$) and RT's ($p = .08$) between the pain and control groups. A Mixed ANOVA for PFA indicated no main effect for time, group, or interaction, $p > .05$. Although PFA was not significantly different by group and across time, there was a significant difference in frontal lobe activity. Chronic pain shows to directly affect the frontal lobe activity compared to controls during baseline, A-A task, and post-test recordings. The acute pain stimulus (i.e. cold pressor task) significantly raised alpha band activity in both groups during the A-A task but increased the activity significantly more within the control group. Alpha band activity in the frontal lobe of pain suffers compared to controls is less and increases when additional acute pain is present. The pain sufferers, compared to controls, confirmed the known physiological differences but showed no significant behavioral differences when approaching extra work for future time off. Future research should implement different workplace settings and age groups to fully understand the influence of chronic pain while at work.

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CHAPTER I

INTRODUCTION

The Problems with Chronic Pain

Chronic pain remains a mystery primarily due to the inability to explain or treat chronic pain conditions with established pain models and theories (Melzack, 2001). Chronic pain causes disruptions that are far greater than acute pain, and the limited understanding leaves treatment options limited for pain sufferers. Pitcher, Korff, Bushnell, and Porter (2018) addressed the complexities of treating various types of chronic pain and identified the need to expand the classification of chronic pain conditions as either "high-impact chronic pain" or "chronic pain without limitations" to improve medical and research approaches. Pitcher et al. (2018) found that chronic pain is experienced at different debilitating levels which could suggest further differences behaviorally and physiologically among the chronic pain population. Although efforts are being made to strengthen chronic pain treatments, 100 million Americans remain in chronic or severe pain which leads to an estimated 261 to 300 billion dollars in health care costs (Nahin, 2015; Gaskin & Richard, 2011). In addition to health care costs, an estimated 297.4 to 335.5 billion dollars are lost in economic productivity (e.g., missed work that resulted in lower wages; Gaskin & Richard, 2011). Faced with a constant state of pain and financial constraints, chronic pain sufferers also report negative social influences when trying to cope with symptoms and side effects (Glenton, 2003).

An example of the social misunderstanding is provided by Glenton (2003) that stated people tend to focus on visible tissue damage rather than expressing concern for the emotional distress a chronic pain sufferer may experience. In the work environment, chronic pain sufferers report that bosses ignore their pain condition or became irritated

when their pain is brought up (Peter D. Hart Research Associates, 2003). Family members and friends of chronic pain sufferers also express similar attitudes towards a sufferer's pain. As a result, some chronic pain sufferers have a hard time receiving support due to the fear of health-care professionals, family members, and friends questioning their pain (Glenton, 2003).

Society's misunderstanding of chronic pain side effects identifies the lack of empathy healthy individuals can have towards pain sufferers (Peter D. Hart Research Associates, 2003; Glenton, 2003). Pain sufferers also report feeling helpless or even depressed due to the inefficiency of finding the right treatment for their pain (Samwel, Evers, Crul, & Kraaimaat, 2006). The social misunderstandings of chronic pain conditions underscore the need for researchers to expand traditional pain approaches to investigate the effects and viable treatments. Melzack (2001) urges the investigation of the neural mechanisms involved with pain by using novel study designs that increase the objective understanding of chronic pain. Further review of the current understanding of pain will illuminate chronic pain sufferers' experience.

Theories of Pain Processing

For years, specificity theory was the accepted explanation of the pain processes (Moayedi & Davis, 2013). Descartes claimed there are specific nerves that transmit pain signals to a pain center in the brain, but specificity theory was eventually challenged for its simplicity (Bedau & Cleland, 2010). Although Descartes identified that nerves were responsible for transmitting noxious stimuli, Melzack and Wall (1965) proposed that pain was complex and involved an intricate communication system.

The Gate Control Theory

The gate control theory, developed by Melzack and Wall (1965), expanded the previous leading pain theories by further defining the role of sensory pathways, cognitive functions, and motivational systems during the processing of pain (Melzack & Casey, 1968). Melzack and Wall (1965) stated the substantia gelatinosa, located in the dorsal horn of the spinal cord, modulates large and small fiber signals that can influence transmission (T) cells. The addition of input to the sensory system can block the projection of signals beyond the T cells. If a pain threshold is surpassed, the dorsal horn T cells are sent to the ventrobasal, thalamus, reticular formation, limbic system, and the somatosensory cortex in the brain (Melzack & Wall, 1965). There is also a descending transmission pathway for pain. Ascending pain signals received by the brain can be influenced by a descending signal that activates an individual's motor mechanism response to the pain that is being experienced (Melzack & Casey, 1968).

The gate control theory explains how ascending pain signals can be interrupted with additional input. Ultimately, the theory revolutionized the approach towards understanding pain processing and the development of pain treatments. Although the theory was revolutionary, researchers were not able to apply the theory to describe all types of pain conditions (i.e. phantom limb pain) (Melzack, 2001). Melzack (1999) addressed this limitation by defining the need to observe brain activity related to chronic pain conditions.

The Pain Neuromatrix

Pain is not solely processed as a sensation, but additionally disrupts the brain's homeostatic state which influences cognitive functions (Melzack, 2001). When individuals are in pain, a widespread neural network is elicited and is genetically unique

and changed by experiences (Melzack, 2001). Reyes-Gibby, Aday, Todd, Cleeland, and Anderson (2007) found genetical differences in pain thresholds with African Americans having a lower pain threshold compared to Caucasian counterparts. Experience with a debilitating chronic pain condition can contribute to negative beliefs towards future pain encounters (Jaminson, 2003). These individual differences in genetics and experiences explain why participants being administered the same noxious stimuli (e.g., a pin prick on the back of the hand) can report experiencing various levels of pain (Nielsen et al., 2008). To accommodate the variance of pain experiences, Melzack (1999) proposed the neuromatrix as a brain activity map that uniquely displays brain activity disruptions that are caused by pain and pain processing.

Melzack (1999) designed the new model to map pain sufferers' neural activity and relate other sources of influence (e.g., quality of life, social influence, and personal experiences) to further investigate the complex multidimensional experience of pain (Melzack, 2001). The neuromatrix extends the gate control theory by defining neural networks that create a neurosignature for specific types of pain (Melzack, 1999). Therefore, pain experiences are produced by the brain's vast neural network instead of solely sensory input (Keefe, Lefebvre, & Starr, 1996). The neuromatrix of pain is unique to an individual and is genetically predetermined and altered with personal experience (Keefe et al., 1996). There are people that are born with chronic pain conditions (e.g., hemochromatosis) or develop chronic pain from their social environment (e.g., work injuries; Pietrangelo, 2004; Van Uum et al., 2008).

Researchers using the neuromatrix approach are enabled to explore unique constructs of chronic pain processing and help illuminate the differences in treating

chronic pain versus acute pain (Moseley, 2003). Trout (2004) claimed the pharmacological treatment of pain (e.g., opioids) is not always effective in alleviating symptoms, and the first step in treating someone's pain is determining the causes and decreasing the specific influences causing the experience. There are multiple non-pharmacological treatments of chronic pain including but not limited to: (a) hypnosis, (b) acupuncture, (c) transcranial magnetic stimulation, and (d) biofeedback (Jafarizadeh, Lotfi, Ajoudani, Kiani, & Alinejad, 2018; Vickers et al., 2018; Young, Sharma, & Deogaonkar, 2014; Jepson, 2008). However, many treatments are unreliable and may not be significantly more effective than a placebo. Although there are many treatment options, determining which treatment will work remains a trial and error process for most chronic pain sufferers (Samwel et al., 2006).

The neuromatrix has redefined pain experiences as a unique response constrained by genes and altered by experiences that varies from person to person. Researchers are now able to focus on neural mechanisms associated with chronic pain sufferers, but the approach is still relatively new and remains underdeveloped (Melzack, 2001). Research over the social behaviors and neural activity of chronic pain sufferers in the workplace remains scarce, but unique approaches can make the investigation possible.

Decision-making Challenges of Pain Sufferers

Pain is a complicated event that is biologically communicated with a very intricate series of top-down and bottom up processing that influences brain activity (Lorenz et al., 2003). The prefrontal cortex plays a key part in the processing of pain and other sensory input (Lorenz, Minoshima, & Casey, 2003; Seminowicz & Moayedi, 2017). The dorsolateral prefrontal cortex (DLPFC) is acutely altered by chronic pain due the constant pain signals being processed by the pain sufferer (Seminowicz & Moayedi,

2017). The alterations within the DLPFC directly contribute to the decision-making challenges of chronic pain sufferers (Lorenz et al., 2003).

Lorenz et al. (2003) used an acute pain stimulus (topical treatment) and a PET scan to observe the frontal cortex activity for top-down and bottom up pain processing. Participants were given a topical treatment with capsaicin and administered a painful amount of heat. Results indicated that many parts within the midbrain were activated but relied on the amount of activity being produced by the DLPFC to feel pain. When an individual had lower amounts of activity within the midbrain, a higher amount of activity was observed in the left DLPFC. Results from Lorenz et al. (2003) further the understanding of directional processing of pain. Although the nervous system initiates the signal of noxious stimuli, the frontal cortex dictates the response to stimuli.

Pain has been researched with the assumption that organisms choose to avoid or escape pain to gain relief (Goubert, Vervoort, & Crombez, 2009). In contrast, chronic pain sufferers experience pain that lingers or remains constant and must endure their pain to complete other tasks for survival (Borsook & Kalso, 2013). A chronic pain sufferer cannot escape their pain and must attend work to provide for their family even when they are not mentally or physically prepared. This leaves chronic pain sufferers subject to develop emotional disorders, endure decision-making challenges, and experience lower quality of life caused by social and psychological influences (Apkarian et al., 2004; Becker et al., 1997). Since chronic pain sufferers experience more adverse effects compared to acute pain, there are increased efforts to objectively understand the differences between the two (Pitcher et al., 2018). Over time, the psychological distresses of a chronic pain condition can rewire the brain's motivation and reward circuits that

contribute to developing decision making challenges and emotional disorders (Nees & Becker, 2018).

Approach-Avoidance Challenges

Since pain is unpleasant and aversive the "Escape-Avoidance" (E-A) decision making tasks are commonly used to depict the behavioral choices an organism makes when pain is experienced (Fuchs & Mcnabb, 2012). Escape-avoidance paradigms allow the organism to "escape" or "avoid" a noxious stimulus, and researchers have the ability to test other variables that alter an organism's response to pain (Fuchs & Mcnabb, 2012). Seligman and Maier (1967) used the E-A paradigm to explain the behavioral state of organisms subjected to inescapable pain (e.g., chronic pain) by comparing the behaviors of organisms that could escape the pain (Seligman & Maier, 1967).

Seligman and Maier (1967) used a repeated measures design with dogs that could "escape" a shock or not "escape" a shock to evaluate the behavioral responses overtime. The dogs provided with the ability to "escape" an electrical shock in the first trial continued to make behavioral efforts to "escape" in subsequent trials. Conversely, the group of dogs subjected to inescapable shocks in the first trial eventually stopped displaying "escape" behaviors in subsequent trials. Seligman and Maier (1967) explained that the dogs initially receiving the inescapable shocks failed to escape in subsequent trials because the escape response was assimilated as "useless" and independent from the shocks. Seligman and Maier (1967) concluded organisms that have previously experienced the inability to escape pain develop a response of "helplessness" in subsequent pain scenarios.

Although Seligman and Maier (1967) attempt to explain the behavioral state of organisms with inescapable pain, researchers have identified the inadequate

representation of behavioral choices the E-A task offers a chronic pain sufferer in a preclinical model (Harris, 2013; Salcido, Bozer, Mcnabb, & Fuchs, 2018). Since chronic pain sufferers cannot choose to "escape" their pain, the constructs of the E-A task does not accurately investigate the behavioral decisions that are respective to pain sufferers. As a result, the "approach-avoidance" (A-A) decision-making task was implemented into an experimental pain setting with human participants, to more accurately represent a pain sufferer's behavioral options and investigate the underlying neural mechanisms (Brown, Hartman, Bland, & Bozer, 2017).

The A-A task offers an objective cross examination between healthy controls and chronic pain sufferers by using behavioral choices that are available to both groups (Brown et al., 2017). The A-A task allows participants (pain or no pain) to either "avoid" or "approach" various levels of pain stimuli (i.e. low-threat, moderate threat, high-treat) that can be paired with hypothetical rewards (i.e. low-reward, moderate-reward, high-reward). By using the A-A task, a chronic pain sufferer's real-world behavior choice can be assessed and compared to healthy controls. With a more valid behavior assessment, researchers using the A-A task can investigate direct influences and effects of chronic pain whereas E-A pain studies remain limited (Apkarian et al., 2004; Epstein, 1978; Harris, 2013; Moriarty, Mcguire, & Finn, 2011).

Brown et al. (2017) used the A-A task and reported chronic pain sufferers avoid hypothetical pain less than healthy controls when a hypothetical reward is offered. The results from Brown et al. (2017) expand on the assumption that organisms with inescapable pain develop a "helplessness" response towards additional pain (Seligman & Maier, 1967). The results from the A-A study, rather, explain that chronic pain sufferers

may be more motivated to approach painful stimuli when a reward is present. A chronic pain sufferer may feel helpless towards the constant pain stemming from their pain condition but may not be helpless towards approaching additional pain to complete a goal-oriented task (Samwel et al., 2006; Brown et al., 2017). Since the A-A study shows circumstances when chronic pain sufferers approach pain more than healthy controls, then sufferers are presumably subject to psychological disruptions that influence their "indifferent" response to rewarding pain. Chronic pain sufferers do not necessarily make a rational choice to feel "helpless" when additional pain occurs but seem to be have a unique psychological adaptation when evaluating the costs and benefits of approaching additional pain.

Elliot and Covington (2001) used an A-A task in a "non-pain setting" (i.e. offering an intuitive choice between desirable and undesirable events) discovered that participants demonstrate prefrontal asymmetry (PFA) brain activity that has more left hemispheric activity during approach decisions and more right hemispheric activity during avoid decisions. However, chronic pain sufferers that completed a hypothetical A-A task in a pain setting demonstrated a widespread inhibition in the alpha frequency band in multiple electrodes without any significant PFA (Brown et al., 2017). Chronic pain sufferer's altered decision-making may be due to a widespread decrease in cortical activity that is dependent on the threat level of pain and reward rather than an imbalance of hemispheric activity (Brown et al., 2017).

Fisher, Keogh, and Eccleston (2016) used an A-A task designed with 16 vignettes that described either a "high" or "low" pain intensity situation that participants could "avoid" or "approach". Pain suffers' motivations to approach, when answering the

vignettes, was determined by the importance of a goal but only when the pain was described as intense (Fisher et al, 2016). Therefore, a pain sufferer's decision may be dependent on the current level of pain experienced and directly influence the motivation to achieve an attainable goal (Fisher et al. 2016). Similarly, Brown et al. (2017) found that the neural mechanisms of A-A pain are intensity dependent. Overall, the A-A task better models a pain sufferer's behavioral choices and offers researchers a unique approach to investigate the multidimensional effects of chronic pain (Harris, 2013).

Risk Taking Challenges of Pain Sufferers

Individuals make daily decisions by evaluating the level of risk and the potential reward an action has (Chen & Kwak, 2017). Chronic pain sufferers are challenged when assessing risk due to the disruptions within the orbitofrontal cortex that lead to an increase of risk-taking behaviors (Pais-Vieira, Aguiar, Lima, & Galhardo, 2012). Some pain sufferers take larger risks when their pain becomes a high cost or when negative moods develop towards any debilitation (e.g., needing help with a task that was previously achievable; Hess, Haimovici, Munoz, & Montoya, 2014). As a result, pain sufferers are subject to misevaluating the level of risk associated with a reward.

The Iowa Gambling Task (IGT) is a widely used risk decision-making task that allows researchers to test pain sufferers with healthy controls to explain the risk-taking challenges (Tamburin et al., 2014). The IGT contains four decks of cards (two advantageous and two disadvantageous) with each card having an associated gain or loss value. The "advantageous" decks contain cards with smaller gains or losses while the "disadvantageous" decks have large gains or losses. With the option to switch decks at anytime, the object of the task is to determine which decks are advantageous (Tamburin et al., 2014).

Tamburin et al. (2014) used the IGT to compare participants with chronic pain and healthy controls and found that pain sufferers had an absence of learning processes which resulted in a poorer performance. During the IGT, chronic pain sufferers lacked in development of a strategy to discover which of the decks were advantageous. Instead, the pain sufferers had a random fluctuation of decisions throughout the task that involved switching from advantageous and disadvantageous decks that resulted in less overall gains. Tamburin et al. (2014) concluded that the risk-taking abnormality might also contribute to work impairments that is dependent on the level of chronic pain experienced. Apkarian et al. (2004) discovered participants with chronic pain reported a higher present pain intensity that correlated with a poorer IGT performance.

Lion and Meertens (2001) point out that risk research is too heavily focused on observing risk behaviors related to gambling (i.e. IGT) rather than assessing everyday risks. The Risk Propensity Scale is designed to assess everyday risk taking tendencies rather than specific behaviors related to gambling (Lion & Meertens, 2001).

Purpose and Hypotheses

Chronic pain is a condition that must be researched independently to fully understand the multidimensional aspects of pain. A focused research approach can further enlighten how chronic pain is directly affecting an individual. Chronic pain sufferers avoid pain less than healthy controls and have increased risk behaviors when rewards are present (Brown et al., 2017; Tamburin et al., 2014). The findings of Brown et al. (2017) were very counterintuitive, which creates a need to implement additional components during the A-A task. Additional components include a noxious stimulus, risk-taking assessment, and brain activity recordings to enlighten how these challenges may interact.

Therefore, chronic pain sufferers were compared to controls in a hypothetical work setting along with an acute pain stimulus while completing the A-A task. The A-A task was formed into a descriptive workplace scenario that investigates if pain sufferers are more willing than controls to risk staying late at work to complete physical labor for a chance to get off early another day. The chronic pain group's brain activity was compared to controls to see if there are any significant differences in PFA.

H1: During an acute pain state elicited by the cold pressor task, a chronic pain group will avoid less potentially rewarding laborious tasks than a control group (measured by a mean avoidance scores on the A-A task).

H2: During an acute pain state elicited by the cold pressor task, the control group will complete the A-A task significantly faster than the chronic pain group.

H3: The chronic pain group will show more PFA within the alpha band measured by electroencephalography over time (i.e. baseline resting activity, AA-task, post-test activity) than controls during the cold pressor and A-A tasks.

CHAPTER II

PROCEDURES

Participants and Groups

Twenty-five volunteers, Tarleton State University students, faculty, and staff were recruited to participate in the study (see Table 1). All volunteers for the study were between 18 and 30 years of age and not rewarded any compensation for their time. The specified age range limited the variability in cognitive performance that increases with age (Hultsch, MacDonald, Hunter, Levy-Bencheton, & Strauss, 2000). Epileptic individuals were not used due to the hyperactive synaptic functions the condition causes which influences brain activity output (Scharfman, 2007). Pregnant women were not admitted due to the changes in the brain caused by pregnancy (Barha & Galea, 2017). Individuals with pacemakers were not used due the device's interference with the EEG recording (Clark, Goldberg, Gorman, & Gerwer, 1989). A left-handed individual was excluded due to the unique cortical processes that could be interpreted as an inaccurate effect during the study (Guadalupe et al., 2014). Three participants were excluded for excessive artifacts in the EEG data due to poor impedance/line noise. Excluding participant EEG data with excessive artifacts is common due to the unreliable evaluation of brain activity (Allen, Coan, & Nazarian, 2004).

Table 1

Participant demographics by group

Pain Group (pain for 6≥ months) n=9	Control Group n=12
1 male, 8 females 8 Caucasian, 1 African American	5 males, 7 females 9 Caucasian, 2 African American, 1 Hispanic
*M*age= 19.78 years *SD*= 2.28 years	*M*age= 19.17 years *SD*= 2.82 years

Measure and Equipment

Qualtrics Survey

A Qualtrics Survey (see Appendix A) was administered to participants containing: (a) informed consent, (b) demographic questions that inquire age, gender, ethnicity, and chronic pain status, (c) the Edinburgh Handedness Inventory short-form and (d) the Risk Propensity Scale (RPS) short form.

Edinburgh Handedness Inventory.

The Edinburgh Handedness Inventory (EHI) has been extensively used to classify handedness (Oldfield, 1971). The EHI short-form has been validated (Veale, 2014). The purpose of including the EHI in this study was to analyze handedness which has implications for prefrontal asymmetry (PFA). Using the EHI insured only right-handed participants were included in the study.

Realistic, Investigative, Artistic, Social, Enterprising, Conventional Test.

Deng, Armstrong, and Rounds, (2007) state the Realistic, Investigative, Artistic, Social, Enterprising, Conventional (RIASEC) test was originally designed to identify a person's career interest. Career interests were acquired to account any job preferences that could influence behavioral decisions (i.e. individuals that prefer manual labor may

approach more during the behavioral task). The RIASEC is comprised of 6 distinct categories that are outlined by general interests while working. The RIASEC model categories are defined as: (a) realistic individuals preferring physical or athletic jobs, (b) investigative individuals enjoy problem solving, (c) artistic individuals have a liking for jobs that rely on creativity, (d) social individuals like to work with other people, (e) enterprising individuals prefer jobs that involve persuading, and (f) conventional individuals enjoy jobs that involve organization and detail (Armstrong & Anthoney, 2009).

Risk Propensity Scale.

The Risk Propensity Scale (RPS) short form has been tested and validated as an accurate measure of risk-taking tendencies (Meertens & Lion, 2008). The A-A task designed for the current study assess risk taking at work. Therefore, RPS scores were used to observe if participant behavior scores are correlated with RPS scores.

Cold Pressor Task

Cold water circulating in a therapeutic cuff was used to induce pain during the A-A task and is referred to as the cold pressor task. Vonbaeyer, Piira, Chambers, Trapanotto, and Zeltzer (2005) completed an extensive review of multiple cold pressor studies ranging from 1937 to 2004 that used a total of 1,700 children. Adverse effects were not reported in any of the studies which indicates the cold pressor task is a safe and valid acute pain stimulus (Vonbaeyer et al., 2005). Furthermore, a standardization of time and temperature of the cold pressor task that is dependent of age was proposed. For adolescents the cold pressor task can be endured for 3-4 minutes with the water temperature of 10±1°C (Vonbaeyer et al., 2005). Koeing et al. (2014) reported pain experiences during a cold pressor task were not affected by room temperature, level of

humidity, or if the temperature of the water was 4°C or 6°C. During the study participants experienced water temperatures ranging from 4.45°C to 7.22°C for >6 minutes.

McGill Pain Questionnaire

The McGill Pain Questionnaire (MPQ) short form is widely used to record a person's current level of pain experienced (Correll, 2007). The Present Pain Intensity Scale (PPI) is a part of the and is based on a likert scale that ranges from 1 representing "no pain" and 10 representing "worst possible pain." Participants were able to drag and drop a dial on a number line to indicate their pain with 1 being the lowest and 10 being the highest and 0 indicting no pain. Participants then provided answers to describe the pain. The PPI operates the same way the Numeric Rating Scale used in emergency rooms and is continually held as one of the most convenient ways to assess pain levels (Cowan, 2013).

Work Environment Based Approach-avoidance task

The A-A task consisted of descriptive vignettes that created a working environment where participants could approach or avoid a task in order to receive a reward. The vignettes were modeled with similar constructs used in Fisher et al. (2016) A-A vignettes. Fisher et al. (2016) surveyed adolescents in chronic pain and the likelihood of completing schoolwork dependent on the hypothetical pain level being described.

The A-A vignettes in the current study were coupled with a pain stimulus (i.e. the cold pressor task) and variations of chance-based rewards (see Appendix B). The 12 A-A stimuli were presented 3 times in a set random order creating a total of 36 stimuli. The stimuli were designed with a descriptive workplace scenario that assess if a participant will risk staying late to complete a laborious task at work for a chance of getting off work

early the next day. In the scenarios, risk is associated with chances of getting off work, and reward is based on the amount of time off.

Electroencephalogram Measures

An electroencephalogram (EEG) is an investigative tool that is used to record brain activity. Since an EEG records neuronal activity from the scalp, the equipment is incapable of recording the fast and very short action potential activity (Kirschstein & Köhling, 2009). Instead the EEG records the postsynaptic activity that lasts substantially longer than the action potential activity. The postsynaptic activity is produced by the chemical exchanges within the synapses (Kirschstein & Kohling, 2009). The excitatory activity is produced by glutamate that binds with AMPA and NMDA receptors in the postsynaptic membrane (Kirschstein & Kohling, 2009).

The AMPA and NMDA receptors allow for the influx of positively charged ions such as sodium which transcend into an excitatory signal (Kirschstein & Kohling, 2009). The inhibitory activity is produced by the GABA that binds with the GABAa and GABAb receptors. The GABAa receptors are responsible for the influx of negatively charged ions while the GABAb receptors are responsible for the release of positively charged potassium ions which transcend into an inhibitory signal (Kirschstein & Kohling, 2009). Therefore, this study used an EEG to measure the amount of excitatory or inhibitory activity within the frontal lobe to observe if the behavioral task is influencing PFA.

A B-Alert x10 wireless electroencephalogram (EEG) module that uses a 9 mono-polar electrode sensor strip recorded participant brain activity. The sensor strip plugged into the back of the EEG module and rested on the participant's scalp. The module was attached to the back of the head by using an adjustable headband. Mastoid leads were

placed behind each ear to establish a ground for the EEG. Synapse cream was placed on each of the electrodes and mastoid leads until the desired impedance level was achieved.

Materials and Procedures

A flow chart of the materials and procedures can be viewed in Appendix C. After completing the Qualtrics survey, a therapeutic cold pressor sleeve was applied to the participants left arm and remained turned off until the A-A task was ready to begin.

After attaching the cuff, iMotions was opened and participants selected their age and gender and were designated an anonymous participant identification number (e.g., P0, P01, P03, P04, etc.). The EEG was then applied to a participant's scalp, and the sensors were adjusted until a reading of 40 Ω's or less was acquired for each of the sensors. A 9-minute benchmark exam, designed by iMotions, was completed to ensure the EEG was recording properly. A 5-minute resting EEG was then recorded as a baseline brain activity measure. After the 5-minute recording was finished, the EEG remained attached and the cold pressor machine was switched on.

A Participant was then presented with the MPQ to acquire the participant's level of pain. After the MPQ was answered, the A-A task began. All participants completed the 36 A-A vignettes with the cold pressor and EEG attached the entire length of the task.

After a participant completed the A-A task, the cold pressor machine was turned off, but remained in place until the 5-minute post EEG recording was completed. After the recording, all devices were removed from the participant and they were required to wait a minimum of 5 minutes after the study to ensure no medical attention was needed. After the brief waiting period, participants were given directions to the bathroom for clean up.

Data Analyses

Behavioral data was stored in iMotions software and set to code "approach" behaviors as a "1" and "avoid" behaviors as a "2", as well as the latency to respond to each stimulus. Behavioral data was extracted and stored in the "Master Data Sheet" and organized by group. A total avoid score was computed for each participant by adding their decisions of "avoiding" during the 36 scenarios. Therefore, if a participant decided to avoid all 36 A-A stimuli then a score of 36 was recoded.

Brain activity recorded with the Advanced Brain Monitoring 9 electrode EEG was extracted from the iMotions software. The EEG Lab plugin from Matlab software was used to clean and filter the data, while Cartool software performed Fast Fourier Transform for frequency analyses. Once brain activity was processed, the alpha band data were stored into the Master Data Sheet Excel file. Frontal lobe activity was calculated for each participant by taking the natural log of the mean F4 sensor activity to acquire right frontal activity, while the natural log of the mean F3 senor activity acquires left frontal lobe activity. PFA scores are calculated by subtracting the natural log of F3 sensor activity from the natural log of F4 sensor activity for each participant. Right frontal lobe scores, left frontal lobe scores, and PFA scores were computed for the baseline, A-A task, and post-test alpha band activity. Dennis and Solomon (2010) conducted an EEG study that used these same methods.

CHAPTER III

RESULTS

Behavioral Outcomes

An independent samples *t*-test was computed in SPSS to test for any significant differences of avoidance scores between groups to test if chronic pain suffers would "avoid" less than controls during the A-A task. The control group (M = 12.17, SD = 10.29) avoided more than the pain group (M = 10.44, SD = 10.62) during the A-A task, but not at a significant rate $t(19) = -.38$, $p = .71$. The hypothesis stating controls will complete the task significantly faster than the pain group, was evaluated with an independent samples t-test that compared latency of A-A responses by group. There was not a significant difference in RT between the pain group (M = 190424.22 ms, SD = 51913.28 ms) and the control group (M = 233766.92 ms, SD =54215.89 ms) during the A-A task $t(19) = -1.85$, $p = .08$. The results show that the pain group had a quicker mean response time than the control group.

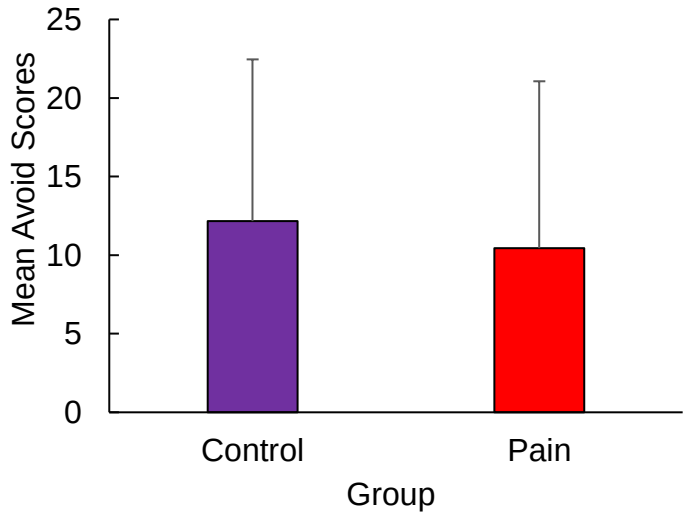

Figure 1. Average number of avoids displayed by group.

A *t*-test, comparing RPS scores of the pain group and control group, resulted with less risk propensity among pain sufferers (M = 3.67, SD = 1.66) compared to the control group (M = 3.96, SD = 1.31) but not significantly lower $t(19) = -.46$, $p = .67$. A correlation was computed using the chronic pain group's and control group's data to observe if risk tendencies related to avoid scores during the A-A task. There was not a correlation between RPS and avoidance scores $r = -.02$, $p = .47$. Additional correlations were computed for RPS scores by group. The chronic pain group's RPS scores did not correlate with avoidance scores $r = -.01$, $p = .99$. The control groups avoidance scores also did not correlate with RPS scores $r = .41$, $p = .19$.

When scoring the RIASEC career inventory, some participants resulted with the same high score in different career interest (e.g., artistic and investigative interests having the highest score of 5). A one-way ANOVA was computed with the 6 career interest scores and the A-A task's approach scores as the dependent variable. The analysis was used to test if a specific career interest significantly influenced decisions to approach during the A-A task. There was not a significant effect of career interest when considering decisions to approach $F(5, 95) = 1.26$, $p = .29$. A mixed ANOVA was computed to test for any differences in career interests by group. Results indicated that career interests had no main effect of group $F(1, 19) = 3.18$, $p = .09$, no main effect of career interests $F(6, 14) = 3.43$, $p = .11$, and no interaction effect $F(6, 14) = 2.75$, $p = .06$.

The level of pain experienced by the cold pressor task was assessed using the MPQ short-form. The MPQ short-form scores were calculated based on the numerical number of pain and the descriptive choices participants chose. A *t*-test indicated no significant differences of overall MPQ scores between the pain group (M = 6.78, SD =

2.77) and the control group (M = 7.4, SD = 4.46) $t(19)$ = -.38, p= .35. Additional t-test were completed to test for specific differences of the PPI, sensory, and effective components of the MPQ short-form. Results from the PPI t-test assessment indicated no significant differences between the control group (M = 1.75, SD = .62) and the pain group (M = 1.78, SD = .44) $t(19)$ = .114, p= .91. The sensory t-test assessment indicated no significant differences between the pain group (M = 4.89, SD = 2.32) and the control group (M = 4.67, SD = 2.8) $t(19)$ = .193, p= .85. The control group's affective scores (M = 1, SD = 1.71) did not significantly differ from the pain group's scores (M = .11, SD = .33) $t(19)$ = -1.53, p= .14.

Electroencephalogram Outcomes

A mixed ANOVA was computed to test for significant differences of PFA between the chronic pain and control group over time (baseline, AA-task, post-test). The mixed ANOVA yielded no main effect for time $F(2, 18)$ = .13, p = .88. There was no main effect of group $F(1, 19)$ = .07, p = .84. There was not an interaction of group and time $F(2, 18)$ = .13, p = .37. All means and standard error for group across time are listed in Table 2, while Figure 2 is a bar graph representing the same.

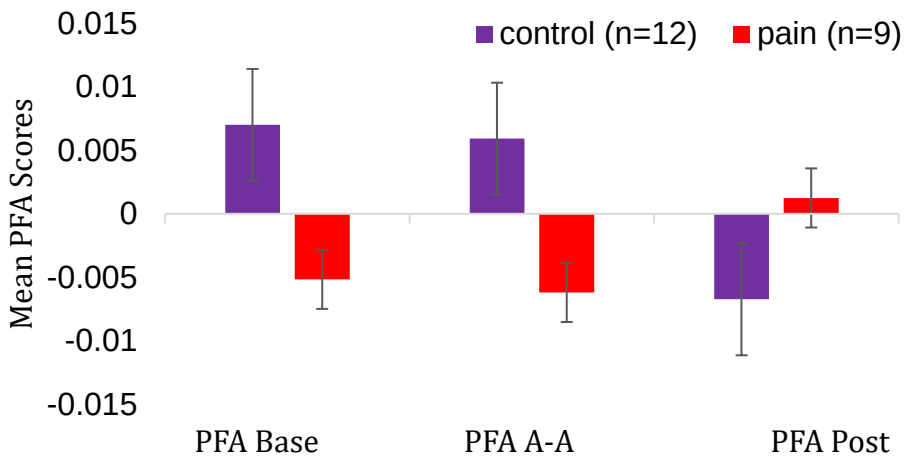

Figure 2. Bar graph displaying the mean prefrontal asymmetry scores for the pain group (displayed in red) and the control group (displayed in purple) across time. Positive scores indicate more left frontal lobe activity while negative scores indicate more right frontal lobe activity.

Table 2

Prefrontal asymmetry scores (natural log of F3 minus natural log of F4) by group and time

Group	PFA Base	Base SE	PFA A-A	A-A SE	PFA Post	Post SE
Chronic Pain	-.005	.01	-.006	.03	.001	.02
Control	.007	.02	.006	.01	-.007	.02

Mixed ANOVAs were computed to compare frontal lobe activity (F3 and F4 sensor activity) within the alpha band and a main effect of time and group was found for both sensors (see Figure 3 for bar graph comparisons by group and time).

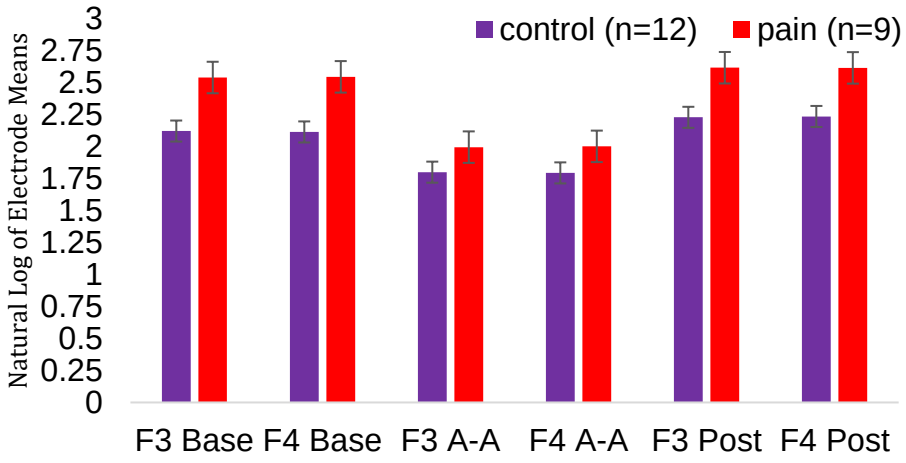

Figure 3. Bar graph displaying the mean F3 and F4 sensor activity for the pain group (displayed in red) and the control group (displayed in purple) across time.

The results indicated a main effect of group within the alpha band right frontal lobe activity (i.e. F4 sensor activity). Right frontal lobe activity for the pain group and the control group were significantly different $F(1, 19) = 9.56$, $p = .01$. (see Table 3 for means and standard error by group). The effect of time on right frontal alpha activity was significantly different during the baseline recording compared to the A-A task recording, as well as the post recording, and significantly different during the A-A task and the post recording $F(2, 38) = 44.53$, $p = .01$ (see Table 4 for means and standard error across time). There was not an interaction effect of group and time for the F4 sensor activity $F(2, 38) = 1.93$, $p = .16$.

Table 3

Alpha band mean by group (natural log of averaged F3 and F4 electrode activity)

Group and Sensor	F3 Mean	F3 SE	F4 Mean	F4 SE
Chronic Pain	2.39	.08	2.39	.08
Control	2.05	.07	2.05	.07

The left frontal lobe activity (i.e. F3 sensor activity) of the chronic pain group and the control group was significantly different $F(1, 19) = 10.18$, $p = .01$ (see Table 3 for means and standard error by group). The effects of time for left frontal lobe activity was significantly different during the baseline recording compared to the A-A task recording, as compared to the post recording, and significantly different during the A-A task and the post recording $F(2, 38) = 48.31$, $p = .01$ (see Table 4 for means and standard error across time). There was not an interaction effect of group and time for the F3 sensor $F(2, 38) = 2.25$, $p = .12$.

Table 4

Alpha band mean by time (natural log of averaged F3 and F4 electrode activity)

Recording	F3 Mean	F3 SE	F4 Mean	F4 SE
Baseline	2.33	.06	2.31	.07
A-A Task	1.9	.05	1.9	.05
Post	2.4	.08	2.43	.08

CHAPTER IV

CONCLUSIONS

Validation of Measures

Pain researchers have stated the essential need to study chronic pain independently (not just as a symptom), as well as implementing behavioral tasks that accurately assess chronic pain sufferers against non-pain sufferers (Harris, 2013; Brown et al., 2017; Pitcher et al., 2018). Previous chronic pain studies show how social misunderstandings and brain alterations caused by a pain condition can lead a sufferer to develop emotional disorders and behavioral challenges (Glenton, 2003; Apkarian et al., 2004). Therefore, researchers comparing chronic pain sufferers and non-pain sufferers should utilize constructs to account for the natural differences caused by chronic pain.

In the current study investigating pain sufferers in the workplace, additional questionnaires and assessments were administered to account for the known effects of chronic pain that could have influenced the results. The Risk Propensity Scale (RPS; Meertens & Lion, 2008) accounted for the increased risk-taking pain sufferers are subjected to. Results from the RPS showed no relation between RPS scores and the number of approaches during the approach-avoidance (A-A) task for either group. Therefore, risk propensity did not influence the pain sufferers to avoid more than the control group.

Since the A-A task was designed with a hypothetical work office setting, the RIASEC career inventory was implemented to test if participants' career interest influenced their decisions to approach or avoid. Someone that resulted with a higher score for labor jobs on the RIASEC could have been more inclined to approach the hypothetical labor task offered during the A-A task. Results concluded no significant

differences were found between the pain group's and control group's career interest scores. Therefore, career interest did not skew the behavioral outcomes acquired from either group.

Knowing that pain is subjective means that the same pain stimulus (i.e. a pin prick) can cause variations of the intensity of pain experienced from person to person (Correll, 2007). To account for the subjectivity of pain associated with the cold pressor task, the MPQ short-form was completed to test if the pain experienced was different between the groups. Although the water temperature varied slightly from each participant, no significant differences were found between the pain group's and control group's MPQ scores. Therefore, the therapeutic sleeve and the range of water temperature used for the cold pressor task, provided a consistent level of pain for participants.

Behavior Discussed

Previous studies that used the A-A task in a pain setting were not designed for a workplace setting (Fisher et al., 2016; Apkarian et al, 2004; Brown et al. 2017). In order to address the latter, a novel A-A task was created using vignettes that depicted a hypothetical work environment and labor task. Results from the A-A task indicated chronic pain sufferers did approach the labor tasks more than controls, but were not at a significant level. Pain sufferers overall did take longer than controls to complete the A-A task, but not significantly slower. The results from the work environment based A-A task align with results from Brown et al. (2017) that found pain sufferers do not avoid pain more than controls during an A-A task. With the outcome of pain sufferers and controls not significantly differing in reaction time and approaches, some of the social beliefs

towards pain sufferers at work are contradicted (Glenton, 2003; Peter D. Hart Research Associates, 2003).

Chronic pain is classified as an invisible disease because many pain sufferers do not show the physical characteristics of pain (e.g., a cast or walking cane; Kemper, 2017) which creates misunderstandings of chronic pain in the workplace. Chronic pain sufferers experience hardships validating their pain at work due to the pain being "irritating" for bosses and questioned by society (e.g., co-workers) because the pain may not cause physically seen tissue damage (Peter D. Hart Research Associates, 2003; Glenton, 2003). Aside from validating their pain, sufferers report fear that society will presume an ulterior motive to report their pain (e.g., to get out of work or to obtain opioids; Glenton, 2003). With a person being in pain and society not validating what they feel, pain sufferers are left in an undesirable dilemma.

Chronic pain sufferers can either choose to report their pain at work and risk judgements or potential wage loss (e.g., scheduled less hours or passed on a promotion) or not report their pain and risk further injury (Gaskin & Richard, 2011). Pain sufferers without healthcare have a harder time validating their pain at work due to the inability to acquire an official diagnosis (Glenton, 2003). The social hardships pain sufferers can experience directly influence feelings of worthlessness and risks of developing an emotional disorder such as depression (International Association for the Study of Pain, 2004).

The misunderstandings of chronic pain sufferers in the workplace becomes apparent when comparing the social stigmas and the results of the current study. The current study showed pain sufferers operate at the same behavioral levels as controls

when completing extra work for a potential reward. This could indicate that a chronic pain sufferer would be just as willing as a non-pain sufferer to stay late at work to possibly get off early the next day.

Alpha Band Activity Discussed

Electroencephalogram (EEG) and brain imaging studies assess participants' alpha band prefrontal asymmetry (PFA) in order to relate localized hemispheric functions to specific behaviors (Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Tomarken, Davidson, Wheeler, & Doss, 1992). The PFA results of an A-A task in a non-pain context showed participants having more left hemispheric activity when approaching and more right hemispheric activity when avoiding (Elliot & Covington, 2001). Since the current study was implemented with an A-A task, PFA was expected be present in participants as well. There was an additional presumption that the pain group would show more PFA than the control group due to the noxious stimulus. It is important to note that alpha band cortical activity is inversely related to the EEG output (Dennis & Solomon, 2010), meaning a higher calculated score of alpha band activity indicates less activity present (Davidson & Tomarken, 1989).

Results indicated differences in averaged alpha band PFA between groups and time but not at significant levels. The pain group had left frontal lobe activity present during the baseline and A-A task recordings, while the control group displayed right frontal lobe activity. The pain group had right frontal lobe activity during the post-test recording while the control group had left frontal lobe activity present.

The results of Benedittis and Gonda (1985) show no significant difference of PFA among pain sufferers and controls during resting state recordings. Instead, increased left frontal lobe alpha activity among somatogenic (i.e. physiologically derived) pain

sufferers completing a task were reported (Benedittis & Gonda, 1985). A pain study using the A-A task also lacked finding significant differences of alpha band PFA between chronic pain sufferers and controls (Brown et al., 2017).

A plausible reason for not finding a significant difference in PFA could have been due to the use of a noxious stimulus and the area of investigation. Kucyi, Moayedi, Weissman-Fogel, Hodaie, and Davis (2012) analyzed the temporoparietal junction of non-pain sufferers and found more right hemispheric activity present when processing acute pain. Brown et al. (2017) theorized that PFA may not be the driving force behind A-A decision making in a pain context. Instead, further analysis of the alpha band indicated a widespread cortical activity difference between the controls and pain sufferers (Brown et al., 2017).

Additional analyses were computed for the current study to test if overall frontal lobe alpha activity between the pain and control group was significantly different. Both groups had significantly more left and right frontal lobe alpha activity during the A-A task recording compared to the baseline and post-test recordings. Left and right frontal lobe alpha activity was also significantly less during the post-test recording versus the baseline recording. Results indicated pain sufferers had significantly less right and left frontal lobe alpha band activity compared to controls during the baseline, A-A task, and post-test recordings.

The overall decrease of alpha activity among the pain sufferers align with Jensen et al. (2012) that reported participants with chronic pain have an overall decrease of alpha activity. Additionally, alpha activity is increased within the frontal lobe when more pain is experienced (Jensen et al., 2012). The current study found that the acute pain during

the A-A task raised alpha band activity within the pain group and the control group. Findings suggest that chronic pain sufferers are influenced similarly as controls when acute pain is experienced. These findings are in agreeance with previous research that details how chronic pain affects the DLPFC which plays a crucial role in decision-making (Seminowicz & Moayedi, 2017). Although the pain sufferers did not significantly differ in decision-making, they approached more on average which could indicate DLPFC alterations that contribute to decision-making challenges that are similarly found in Lorenz et al. (2003).

Study Limitations and Future Directions

Hypothetical behavioral data acquired from an A-A task is limited in external validity (Brown et., 2017). The use of vignettes embedded in an A-A task was previously completed (Fisher et. al., 2016) but not as a work setting. Fisher et al., (2016) used hypothetical vignettes that collected presumed and intended behaviors. Inferences made from presumed or intended behaviors (e.g., using hypothetical scenarios) explain a possibility of real world behaviors, but become more objective if real behaviors can be compared (Fisher et al., 2016). Like Fisher et al., (2016) there was not existing data of pain sufferers' real behaviors that was depicted in the hypothetical work scenarios.

The assessment of risk-taking while embedded in the A-A task has not been validated or completed before. A validation measure comparing participant RPS scores to the A-A behavioral decisions did not correlate. This could indicate that the A-A task was did not implement a valid risk assessment. To better understand the constructs that influence a pain sufferers decision making while at work, future studies should implement more groups that test with and without a noxious stimulus present. In doing

so, the differences in activity during the A-A task can be better cross examined with controls to understand what is directly affecting frontal lobe activity.

Participants were college students and may not find the described job or work relatable which may indicate a limitation in the sample used. Some participants may not have found the desk-job scenario relatable and may work a physically demanding job that may influence their decisions. In group limitations were present due to the imbalance of males and females and ethnicities. Future investigations should test gender specific groups as well as specific ethnicities to better understand the chronic pain population. Future use of the work setting vignettes should recruit individuals that have work experience and currently work in the job described. The age range should also be increased to ensure participants have valid working experience.

Concluding Thoughts

The use of novel research designs within an approach-avoidance (A-A) context, allow for an enhanced explanation and investigation of the challenges associated with chronic pain conditions. Chronic pain research is heavily focused on understanding the challenges caused by pain, but there remains a need to investigate how the challenges interact with one another in a sufferer's specific environment. By designing the A-A task as a work setting and incorporating variables to test the known challenges caused by chronic pain; a valid assessment comparing pain sufferers and controls were achieved.

Although study outcomes were not as predicted, the results from the hypothetical A-A task help understand how pain sufferers are not significantly different than controls. On average, chronic pain sufferers approached more potentially rewarding labor tasks than controls. There is a need to address the injustices pain sufferers experience at the workplace (Peter D. Hart Research Associates, 2003). Results from this study could be

implemented in work scheduling by offering chronic pain sufferers a more flexible schedule (e.g., staying late on a day where pain is not bad and being able leave early a different day). Prejudice views of chronic pain sufferers become apparent based on the results as well. Having superiors believing pain is brought up to leave work, is inherently toxic for chronic pain employees. In conclusion, chronic pain is socially misunderstood which leaves sufferers not receiving the treatment an invisible disease deserves.

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APPENDIX A

Appendix A
Qualtrics Survey

Informed consent

Q1

Thank you for your interest to participate in the study, “Investigating Chronic Pain Sufferers in a Work Setting Using an Electroencephalogram and an Approach-Avoidance Task” by Tarleton State University's graduate student Mr. Tracy W. Brown You are being invited to participate in a research investigation of neural activity and decision making of chronic pain sufferers in a work setting. The purpose of the study is to investigate any differences in brain activity and behavioral decisions of chronic pain sufferers compared to healthy controls. During the study, you will complete a series of questionnaires that inquire your demographics (i.e. age, gender, ethnicity), chronic pain experiences, risk-taking tendencies, present pain levels, and behavioral decisions. I will attach a therapeutic cuff that contains frigid water to induce a dull pain during the decision-making task. The pain produced by the cuff will only be endured for approximately 7-10 minutes. Please be assured that you can stop the study at anytime by letting me know. I will also be attaching an electroencephalogram (EEG) to your scalp to record your brain activity. The study should take 45 minutes to 1 hour to complete. The potential risks associated with this study include a temporary lingering pain, and reporting personal information. To keep your information confidential, your name will not be recorded or associated with any of the data collected. The benefits of the study will help researchers utilize a decision-making task that can access pain deficits and how behavior is affected. Although the study may be submitted for publication no one will have access to your information.

To uphold your confidentiality we will assign you a participant number that can be traced back to your responses during the study, but no connection to your name will be made. Any question(s) during the study may be skipped without any explanation.

If you experience an injury that is directly related from participating in this study please notify me immediately, and contact the Chairman of the Institutional Review Board by calling (254) 968-9463. Participation in this study is completely voluntary and you may end the study at anytime. Keep in mind that there are not any repercussions or penalties for ending the study. If you would like a copy of your informed consent or would like information about the study please email me at tracy.brown@go.tarleton.edu If any questions about the research or about your rights as a subject persist please feel free to ask or contact me directly. If you wish to have a copy of this consent form please email me and I will send a copy Before consenting, please confirm the following:

I am not left-handed.

I understand the information listed above and consent to voluntary participation in this research.

I am at least 18 years of age and no older than 30 years of age.
To begin the study select "Yes" which will confirm your acceptance to participate in the research voluntarily
If you do not wish to participate in the study select "No" and you will be excused from participating.
Yes
No

Q2 Edinburgh Handedness Test
Please Indicate your preferences in the use of hands in the following activities or objects:
Always Right Usually Right Equally Both Usually Left Always Left
Writing Throwing Toothbrush Spoon

Q3
Do you currently experience (or have previously experienced) a specific pain that persisted for 6 months or longer?
Yes
No

Q4
Please select and identify with one of the groups below that best match your pain condition.
a current chronic pain condition diagnosed by a physician
a current chronic pain condition NOT diagnosed by a physician
a previous chronic pain condition diagnosed by a physician
a previous chronic pain condition NOT diagnosed by a physician

Q5
If you know the name of your pain condition please provide an answer below:

Condition: Yes Is Selected. Skip To: Please select and identify with ....
Condition: No Is Selected. Skip To: Do you currently have or experience a....

Q6
Do you have or experience any of the following conditions: currently pregnant, been diagnosed with epilepsy, or have a pacemaker?
Yes
No

Q7
Please input your age below:

Q8
Please select your ethnicity from the choices below:
Caucasian
Native American
African American
Other

Q9 (if other is selected)
Please type in your ethnicity below

Q10
Please select your gender from the following choices:
Male
Female
Transgender
Other

Q11 The Risk Propensity Scale
For the following statements, you will indicate the extent to which you agree or disagree with the statement. The last question you will indicate how you view your self as a risk taker or avoider. Answers will be provided using a number scale where "9" is the highest level of agreement while "1" is the lowest level of agreement. Therefore, if you totally agree with a statement, you will select the "9" while if you totally disagree with a statement then you will select the "1". Answers may also be between 1 and 9. Please do not think too long before answering; usually your first inclination is also the best one. Proceed to the statements by selecting the purple arrow

Q12
Safety first.
Click to write Choice 1
totally disagree totally agree
1 2 3 3 4 5 6 7 7 8 9

Q13
I do not take risks with my health.
Click to write Choice 1
totally disagree totally agree

1 2 3 3 4 5 6 7 7 8 9
Page Break
Page Break
Page Break

Q14
I prefer to avoid risks.
Click to write Choice 1
totally disagree totally agree
1 2 3 3 4 5 6 7 7 8 9

Q15
I take risks regularly.
Click to write Choice 1
totally disagree totally agree
1 2 3 3 4 5 6 7 7 8 9
Q16
I really dislike not knowing what is going to happen
Click to write Choice 1
totally disagree totally agree
1 2 3 3 4 5 6 7 7 8 9

Q17
I usually view risks as a challenge
Click to write Choice 1
totally disagree totally agree
1 2 3 3 4 5 6 7 7 8 9

Q18
I view myself as a . . .
Click to write Choice 1
Risk Avoider Risk Taker
1 2 3 3 4 5 6 7 7 8 9

Q19 RIASEC Career Inventory
For the following statements, you will indicate whether you agree or disagree with them. I like to work on cars- I like to do puzzles- I am good at working independently- I like to work in teams- I am an ambitious person- I set goals for myself- I like to organize things, (files, desks/offices)- I like to build things- I like to read about art and music- I like to have clear instructions to follow- I like to try to influence or persuade people- I like to do

experiments- I like to teach or train people- I like trying to help people solve their problems- I like to take care of animals- I wouldn't mind working 8 hours per day in an office- I like selling things- I enjoy creative writing- I enjoy science- I am quick to take on new responsibilities- I am interested in healing people- I enjoy trying to figure out how things work- I like putting things together or assembling things- I am a creative person- I pay attention to details- I like to do filing or typing- I like to analyze things (problems/situations)- I like to play instruments or sing- I enjoy learning about other cultures- I would like to start my own business- I like to cook- I like acting in plays - I am a practical person- I like working with numbers or charts- I like to get into discussions about issues- I am good at keeping records of my work- I like to lead- I like working outdoors- I would like to work in an office- I'm good at math- I like helping people- I like to draw- I like to give speeches

Q20
Thank you for completing this portion of the study! Please notify the researcher to proceed to the next part of the study.

APPENDIX B

Appendix B

Approach-Avoidance Scenarios

In the following scenarios, risk is associated with chances of getting off work, and reward is based on the amount of time off.

No-Risk/Low-Reward

1.) "You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like stay late to stack filing boxes (that requires heavy lifting) and have a **100 % chance** of getting off **2 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal."

What would you do?

Stack Boxes

Resume work as normal

No-Risk/Moderate-Reward

2.) "You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack filing boxes (that requires heavy lifting) and have a **100 % chance** of getting off **4 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal."

What would you do?

Stack Boxes

Resume work as normal

No-Risk/High-Reward

3.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack filing boxes (that requires heavy lifting) and have a **100 % chance** of being off **completely** tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

Low-Risk/Low-Reward

4.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) and have a **75 % chance** of getting off **2 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

Low-Risk/Moderate-Reward

5.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) and have a **75 % chance** of getting off **4 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

Low-Risk/High-Reward

6.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) and have a **75 % chance** of being off **completely** tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

Moderate-Risk/Low-Reward

7.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) and have a **50 % chance** of getting off **2 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

Moderate-Risk/Moderate-Reward

8.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) and have a **50 % chance** of getting off **4 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

Moderate-Risk/High-Reward

9.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) and have a **50 % chance** of being off **completely** tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

High-Risk/Low-Reward

10.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) and have a **25 % chance** of getting off **2 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal.”

What would you do?

Stack Boxes

Resume work as normal

High-Risk/Moderate-Reward

11.) “You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy

lifting) and have a **25 % chance** of getting off **4 hours** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal."

What would you do?

Stack Boxes

Resume work as normal

High-Risk/High-Reward

12.) "You currently work a desk job and you are required to fill out and file reports. Your boss just asked if you would like to stay late to stack file boxes (that requires heavy lifting) to have a **25 % chance** of being off **completely** early tomorrow. If you refuse to do so, no one will cast judgements and you will resume work as normal."

What would you do?

Stack Boxes

Resume work as normal

APPENDIX C

Appendix C

Study Design Flowchart