THE EFFECT OF ACCEPTANCE AND COMMITMENT THERAPY ON LABORATORY PAIN AND EMOTION: AN ERP STUDY

An Undergraduate Research Scholars Thesis

by

JESSICA CAROLINE LUEDKE

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Approved by Research Advisors: Dr. Mary Meagher
Dr. Annmarie MacNamara

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ABSTRACT

The Effect of Acceptance and Commitment Therapy on Laboratory Pain and Emotion:
An ERP Study

Jessica Caroline Luedke
Department of Psychological and Brain Sciences
Texas A&M University

Research Advisor: Dr. Mary Meagher
Department of Psychological and Brain Sciences
Texas A&M University

Research Advisor: Dr. Annmarie MacNamara
Department of Psychological and Brain Sciences
Texas A&M University

Acceptance training has been used to help individuals cope with negative emotion and pain (Hayes et al., 1999), however little is known about the neural mechanisms mediating these effects. The present study examined whether acceptance training can modify pain and emotion (both subjective and brain responses), whether these changes in emotion are associated with changes in pain, and whether subjective changes are associated with brain changes. Event-related potentials (ERPs) were used as a measure of neural response to laboratory pain and pictorial stimuli. Participants (*N* = 15) came in for one laboratory visit and underwent thermal pain testing and passive picture viewing of negative and neutral stimuli before and after a randomly assigned intervention of either acceptance training or an active control. A mixed-design was used to analyze changes in subjective and neural responses within-subjects (before and after emotion and pain stimuli) and between participants (acceptance training or an active control). Hypotheses were that a) acceptance training would decrease evoked potentials and subjective ratings to both pain and picture stimuli and b) greater training-induced reductions in picture-elicited responses

would be associated with greater reductions in pain-elicited responses. Results of this study may increase our understanding of the neurological mechanisms by which acceptance affects pain and emotion.

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NOMENCLATURE

ACT	Acceptance Commitment Therapy
CHEPS	Contact Heat-Evoked Potential
EEG	Electroencephalography
EP	Evoked Potential
ERP	Event-Related Potential
LPP	Late Positive Potential
SAM	Self-Assessment Manikin
VAS	Visual Analog Scale

CHAPTER I

INTRODUCTION

Pain is not simply determined by the intensity of noxious stimulation, it also depends on psychological factors such as emotion (Gatchel & Turk 1999; Rhudy & Meagher 2001). It is well-established that emotion can have powerful modulatory effects on pain perception (Meagher, Arnau, Rhudy 2001; Rhudy & Meagher 2001; Rhudy & Meagher 2000; Lumley et al 2011; Roy et al., 2009). For example, negative emotions such as anxiety, fear, and depression have been shown to amplify the experience of pain (Rhudy & Meagher 2000; Zelman et al. 1991; Willoughby et al 2002). However, relatively few studies have investigated whether emotion regulation alters the experience of pain and whether training in emotion regulation can diminish pain. Emotion regulation refers to processes people use to influence how they experience emotional events. In addition, Denny and Ochsner (2014) state that while many of us have a certain capacity to regulate our emotions to cope with difficult or trying times, many of us could benefit from enhancing our regulatory skills. Given its efficacy at reducing negative affect (Denny & Ochsner, 2014), emotion regulation may provide a method for modulating and managing pain (Masedo & Esteve, 2007). In this study, acceptance training was used. Acceptance is the ability to more objectively observe and accept, rather than control, your thoughts, feelings, and sensations (Hayes, 2005). The current study investigated the emotion regulatory effects of an acceptance-based therapy on self-report ratings and neural ERPs to laboratory-induced noxious heat and negative pictures.

Psychological acceptance as a therapeutic technique and emotion regulation skill has been shown to be extremely beneficial in treating chronic pain (McCracken & Vowels, 2006). The acceptance technique helps teach patients to dispassionately observe their thoughts, emotions, and bodily sensations from a distance without attempting to avoid or control them (Hayes et al., 1999). In this way, acceptance can reduce an individual's emotional reactivity and suffering in response to pain without exerting effort to control thoughts and feelings (Hayes et al., 1999). When struggling against pain or suffering, the experience of pain tends to be heightened, and our time and energy is consumed by struggling. Acceptance training thus aims to allow participants to accept the notion that although pain remains a part of life, simply acknowledging the pain rather than struggling to suppress or catastrophize it can allow individuals to focus on moving towards goals in other areas of their lives so they may become less consumed by the pain, regardless whether the pain diminishes. Acceptance training has been shown to increase pain tolerance compared to cognitive-control training and attention to pain control conditions (Hayes et al., 1999). There is a growing body of research that has been using acceptance to help people cope with a number of health conditions, including affective disorders (Zettle & Rains, 1989) and anxiety disorders (Hayes et al., 1990).

Although previous research suggests that acceptance training helps individuals cope with pain and negative affect, relatively little is known about the psychological and neural mechanisms mediating these effects. As previous literature has shown the association between emotionality and pain (Lapate et al., 2012, Woo et al., 2015), it is possible that acceptance training may modulate a shared self-regulatory system that works to affect both pain and emotion. If so, acceptance training would be expected to decrease subjective and neural responses to both negative emotional and painful stimuli. Moreover, individuals showing greater training-induced reductions in negative emotion would be expected to show the greatest reductions in pain.

Specifically, we hypothesized that acceptance training would decrease evoked potentials and subjective ratings to both pain and picture stimuli. We also predicted that greater training-induced reductions in picture-elicited responses would be associated with greater reductions in pain-elicited responses. ERPs were used as markers of neural activity. ERPs, or event-related potentials, are the positive and negative voltage changes that occur following a stimulation event. To assess pain, heat pulses with a rapid onset were used to induce contact heat-evoked potentials (CHEPs), or heat ERPs, that occur after the heat stimulus. Previous research by Granovsky, Granot, Nir, and Yarnitsky (2008) found that heat ERP amplitudes were strongly associated with the intensity of the thermal stimulus as well as the participant's subjective pain perception. Heat ERPs are measured by evaluating the N2 (the most negative peak in the waveform for a given amount of time) and P2 (the most positive peak in the waveform for a given amount of time) components. To assess emotional reactivity, negative and neutral pictures were used. Previous literature has shown that ERPs to emotional pictures were strongly associated with their unpleasantness (valence) and arousal (Hajcak, MacNamara, &Olvet, 2010). The ERPs resulting from image stimuli are referred to as late positive potentials, or the LPP response. For more negative images, the LPP measure tends to be more positive than the LPP measure for neutral images (Hajcak, MacNamara, &Olvet, 2010). For this experiment, we used a brief acceptance-based therapy intervention to teach participants to cope with their experience of negative emotion and pain.

Due to pain and emotion infiltrating our daily lives, this experiment was developed to see if an acceptance-based therapy could work to effectively increase emotion regulation skills and allow individuals to cope with their pain and negative affect. This project is the first study to examine whether training in acceptance is able to decrease the amplitude of contact heat-evoked potentials and event-related potentials to negative pictures. If the acceptance training is effective, participants should show increased emotion regulation through decreased pain and negative emotion on self-report measures, and corresponding decreases in contact heat-evoked potentials and event-related potentials to negative pictures. The study presented is a pilot study with preliminary data from 15 participants. The final study will include approximately 40 participants.

CHAPTER II

METHODS AND MATERIALS

All experimental procedures and questionnaires given were approved by the Institutional Review Board at Texas A&M University, and all participants gave their informed consent. Participants received course credit for their participation. Participants were told that they could withdraw from the study at any time and they would be given partial participation credit for the duration of time in the study. Data obtained from the participants were de-identified.

2.1 Participants

Participants were undergraduates at Texas A&M University that were enrolled in a Psychology course, and were between the ages of 18 and 40. Exclusionary criteria included: a) current use of any prescription drugs (with the exception of hormonal contraceptives), b) history of fainting spells, c) any skin condition/numbness on the hands or forearms, d) history of neurological disorders, e) current chronic pain or health condition, and f) use of allergy or pain medication within 24 hours prior to the experiment. Exclusionary criteria were used to make sure participants were healthy and did not take medications that could affect pain sensitivity as well as to ensure that any pre-existing conditions would not have an effect on the data collected through increased variability in the data. Exclusion criteria were assessed by asking participants if they met each criterion during the informed consent part of the study.

The study consisted of 15 participants with a mean age of 19.00 years (*SD* = 1.20). Among the 15 participants, 8 were male (53.33%) and 7 were female (46.67%); 66.67% were white non-Hispanic, 13.33% were Hispanic, and 20.00% were Asian/Pacific Islander.

2.2 Materials

Participants answered questionnaires via Qualtrics Survey Software at the beginning and end of the experiment. Emotional stimuli were standardized pictures, including those developed at the National Institute of Mental Health's Center for the Study of Emotion and Attention. The International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) is a standardized set of pictures that represent a range of content from neutral to pleasant to unpleasant. This experiment utilized 25 neutral pictures (e.g. household objects, neutral faces, buildings, etc.) and 25 negative pictures (e.g. human mutilation, depictions of car crashes, bodily injury, etc.). Pictures and rating scales were presented to participants using Presentation Software (Neurobehavioral Systems, Inc., Albany, CA).

For the experimental pain task, thermal stimuli were administered to the skin using a Medoc PATHWAY Pain & Sensory Evaluation System (Medoc Advanced Medical Systems, Ramat Yishai, Israel). Rating scales were presented to participants using Presentation Software (Neurobehavioral Systems, Inc., Albany, CA).

For both the emotion reactivity and pain reactivity tasks, participants were asked to make subjective ratings using the Self-Assessment Manikin (SAM) pictograms for both valance and arousal (Bradley & Lang, 1994). Both rating scales ranged from one to nine. The valance SAM was used to measure how pleasant or unpleasant the participant felt about a specific stimulus. Higher ratings of valance indicate a more pleasant response to the stimulus, while low ratings of valance indicate a more unpleasant response. Similarly, SAM arousal was used to assess how intense a participant perceived a specific stimulus. High ratings of arousal indicate a more intense response to the stimulus, while low ratings of arousal indicate a calmer, less intense response. Participants were given specific instructions for how to utilize the SAM ratings for the emotion reactivity and pain reactivity tasks and practiced making valance and arousal ratings immediately before each task.

2.3 EEG Recording

During the pain and picture viewing tasks, continuous electroencephalography (EEG) was recorded using a Biosemi system (ActiveTwo, BioSemi, Amsterdam, Netherlands). 32 electrode recording cites were used, and there was one electrode on either mastoid. Four facial electrodes were utilized to record facial movements such as eyeblinks, and consisted of two electrodes, one above and one below the right eye, measuring vertical movements, and two horizontal electrodes places on the outer corner of each eye measuring horizontal eye movements.

2.4 Procedure Outline

Figure 1 shows a graphic of the experimental procedure. Participants arrived at the laboratory and were instructed to remove any jewelry, then told to wash their hands. Participants were informed of the tasks and procedures they would be doing as part of the study and were asked about their personal history to ensure that they met the inclusion criteria for the study. After giving their informed consent, participants were asked to complete an introductory set of questionnaires via Qualtrics Software. After completion of introductory questionnaires, participants completed an individualization task based on the methodology utilized by Atlas (2010), and was used to determine the “high pain” temperature used for testing. After the individualization procedure, participants were fitted with an EEG cap and had EXG electrodes placed on their face. Following the EEG setup, participants completed the emotion reactivity task and the pain reactivity task; the order of these tasks were counterbalanced across participants. Following completion of both tasks, participants were randomly assigned to either an active control intervention or an intervention that contained acceptance commitment therapy components (described in more detail below). Interventions were performed by student counselors at Texas A&M University who were given extensive training prior to conducting the study intervention. After the conclusion of each intervention, participants were asked to complete a short practice using the skills they had learned in the intervention practice. After the intervention practice, participants completed the same two reactivity tasks prior to the intervention again in the same order they were delivered pre-intervention. Once the emotion and pain reactivity tasks were completed post-intervention, experimenters removed the EEG cap and face electrodes. Participants then answered final questionnaires, and were given a debriefing form that explained the nature of the study.

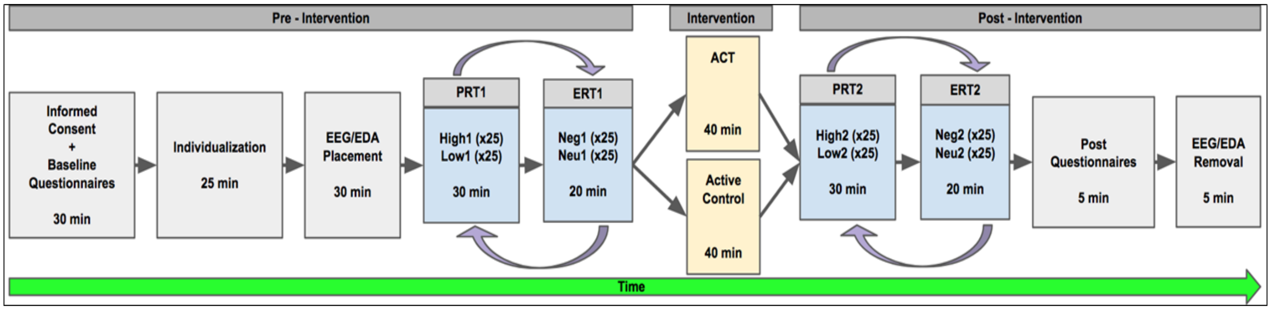


Figure 1: Experiment procedure. The large arrows above and below the pain reactivity and emotion reactivity tasks indicate counterbalancing. PRT1 and PRT2 refer to the “Pain Reactivity Task” while ERT1 and ERT2 refer to the “Emotion Reactivity Task,” and the ACT intervention refers to “Acceptance and Commitment Therapy” as the form of intervention. Within the pain task, participants had high and low heat stimulations, and within the emotion task, participants viewed neutral (Neu) and negative (Neg) images.

2.5 Individualization for Thermal Testing

Due to variation in individual pain sensitivity, individualization testing was conducted to determine the temperature at which a participant rated an “8” on an 11-point scale measuring pain intensity. The temperature at which they reliably reported “8” was used to indicate their individualized “high pain” condition utilized in the pain reactivity task in the experiment. Participants were given a Visual Analog Scale (VAS) that included specific markers to allow for greater accuracy. Utilizing the verbal anchors for the VAS used by Atlas et al. (2010), a zero indicates no pain, a two indicates low pain, a five indicates moderate pain, an eight indicates high pain, and a ten indicates intolerable pain. Participants were asked to describe situations in which they experienced or imagined an experience at low, moderate, and high pain to ensure that participants understood the rating scale. For the first part of individualization, participants received two heat pulses at 42ºC with a 30ºC baseline to the volar surface of their dominant arm on two adjacent sites to reduce potential for startle. To find four sites with equivalent sensitivity, participants then experienced 12 heat pulses on 6 sites on the volar surface of their non-dominant forearm. The total 14 heat pulses each had a duration of two seconds at peak temperature with a ramp of 70ºC/s and a cooling rating of 40ºC/s. Inter-stimulus intervals (ISI) between heat pulses ranged from 25-30 seconds. The participant's volar forearm was separated into a two by three grid resulting in 6 sites used for individualization testing. Participants were presented with heat pulses to each site in a semi-random order, making sure avoid stimulation of adjacent sites. Each site received two sequential heat pulses and pain intensity ratings were recorded for every pulse using the VAS. After pain intensity ratings were recorded, the ratings were input into an Excel sheet to find the average and range of pain intensity ratings for each site. A total average of pain ratings and variance was calculated and used to find the participant's four most similarly sensitive sites. In the case that there were five sites all having similar sensitivity calculations, a square pattern of sites was preserved.

After discovering the participant's four equivalently sensitive sites, individualization testing was conducted to discover each participant's "8" temperature, or the temperature at which they experience "high pain." Following the methodology used in Atlas (2010), participant's experienced three distinct temperatures at 41ºC, 44ºC, and 47ºC and made pain intensity ratings according to the VAS that they learned to utilize during the first part of individualization. These distinct three temperatures were used to elicit low pain, moderate pain, and high pain to create a linear curve with participant's ratings from the three different temperatures (Atlas, 2010). Using the participant's four equivalently sensitivity sites, each site received a pulse at each temperature resulting in 12 total pulses. Each pulse had a duration of five seconds with a ramp of 70ºC and cooling rate of 40ºC with ISI's of 25-30 seconds. Participants made ratings for every pulse and their ratings were used to calculate their "8" temperature using a linear regression following Atlas' methodology (2010). The individualized "8" temperature calculated in this task was used as their "high pain" condition during the pain reactivity task.

2.6 Emotion Reactivity Task

For the emotion reactivity task, participants viewed two blocks of 25 pictures each. One block consisted of negative pictures (e.g., car crashes, sick or injured people) and the other block consisted of neutral pictures (e.g., household objects, buildings). Order of blocks were randomized for each participant, but order remained the same for the emotion reactivity task before and after the participant's intervention. In addition, picture order within blocks was random and all participants saw each picture one time. All pictures were chosen from the IAPS database. First, the picture was presented and lasted for five seconds (5000 ms). Immediately following picture presentation, participants were presented with SAM ratings to make their emotional response ratings for their level of unpleasantness and intensity/arousal relating to the picture stimulus. In between the two SAMs ratings, there was a short-lasting fixation cross (500 ms). After participants made their ratings there was a random/varied inter-stimulus interval timed fixation cross that ranged from 2000-2500 ms that occurred before the presentation of the next image. Participants were told to simply view the pictures and keep their eyes on the screen for the duration of the picture and would then rate each picture. Participants did not have a time constraint in which to make their ratings, but once they did, the next stimuli would follow immediately. Pictures and ratings were presented via Presentation Software (Neurobehavioral Systems, Inc., Albany, CA) and pictures were in color and filled the entire screen. Between the two blocks of pictures, participants were given the opportunity to take a break and could terminate the break whenever they felt comfortable to continue to the next block. The numbers of the IAPS neutral pictures used were (1670, 2026, 2745.1, 5520, 6150, 7000, 7002, 7006, 7009, 7010, 7012, 7025, 7035, 7036, 7037, 7040, 7042, 7050, 7080, 7081, 7150, 7491, 7500, 7547, 7705) and the negative pictures used were (1274, 1300, 2205, 2375.1, 3030, 3120, 3180, 3400, 3550, 6312, 6313, 6560, 6800, 8230, 9041, 9042, 9412, 9413, 9415, 9421, 9423, 9561, 9610, 9910, 9912).

2.7 Pain Reactivity Task

For the pain reactivity task, participants received two blocks of 25 thermal stimuli each. One block consisted of low heat thermal stimuli and the other block consisted of high heat thermal stimuli. Participants were informed before the start of the task that they could stop the experiment at any time if the pain became too much. Low heat stimuli were given at a temperature of 34ºC with a baseline of 32ºC. This temperature was chosen as an acceptable low heat stimulus used based on an article published by Kong et al. (2006) that utilized 34ºC as a non-painful, warm stimulus. For the high heat thermal stimulus, temperatures were chosen according to participant’s individualized “8” temperature given from their data collected in the individualization process detailed above and had a baseline of 32ºC. The order of the temperature blocks was randomized for each participant, but order remained the same for the pain reactivity task before and after the participant’s intervention. Thermal stimuli were delivered via Medoc Pathway using the CHEPs thermode. Heat pulses had a duration of five seconds at peak temperature with a ramp of 70ºC/s and a cooling rate of 40ºC/s. ISI’s between thermal pulses ranged from 25-30 seconds and there was a brief fixation cross (500 ms) between the two SAM ratings. During ISIs, participants would make emotional response ratings for their level of unpleasantness and intensity/arousal relating to the thermal stimulus. Between the two blocks of thermal stimuli, participants were given a two-minute break. Ratings were presented via Presentation Software (Neurobehavioral Systems, Inc., Albany, CA).

2.8 Intervention

The treatment intervention utilized in this experiment emphasized components of acceptance and commitment therapy (Hayes, Strosahl, & Wilson, 2012). The control therapy functioned as an active control, using similar language without the active acceptance components. Much of the material for the treatment therapy derived from Steve Hayes book *Get out of Your Head and into your Life: The new Acceptance and Commitment Therapy* (2005). In addition, many of the specific acceptance-related metaphors used in the acceptance training were developed by Russell Harris, M.D., in his book *ACT Made Simple: An Easy-To-Read Primer on Acceptance and Commitment Therapy* (2009). Scripts for both the treatment intervention (Page 47) and the active control (Page 52) can be found in the appendix.

After participants completed the first set of tasks, they were randomly given either the acceptance based intervention or the active control intervention. Both interventions lasted approximately 40 minutes, varying only slightly due to participants having questions or needing more explanation to utilize the therapeutic skills. Two counselors from the student HelpLine crisis call center located in College Station performed the interventions (active and control). Intervention delivery was counterbalanced. For each experiment, one of the two counselors would deliver the intervention to the participant and each counselor delivered approximately the same number of each type of intervention. Both counselors were trained extensively in crisis counseling and have hundreds of hours of clinical experience in counseling. In addition, the counselors were given training on how to conduct the specific intervention by clinical psychologists Dr. Mary Meagher and Dr. Annmarie MacNamara. Recordings of both interventionists were taken and used to assess similarity and ensure that both individuals were conducting the acceptance based and active control interventions the same way.

Following the intervention, an experimenter came in to give the participant two practice stimuli each for both picture and thermal stimuli, to allow the participant to practice utilizing their newly acquired skills with experimental stimuli. The experimenter was blind to the condition of the participant and was only involved in delivering stimuli. Participants in both conditions were given practice trials following their intervention. Participants were shown two negative pictures in the same experimental format (i.e. stimuli had a duration of five seconds). As in the real task, participants were shown one picture at a time and were asked to make unpleasantness and intensity/arousal ratings for each picture. After making subjective ratings, participants met again with the interventionist, who asked them if they were able to utilize the therapeutic concepts discussed in the intervention previously given, and talked through the emotions of the participants following both negative images. The second part of the intervention practice consisted of two painful heat stimuli given at the participant's individualized "8" temperature. Similar to the pain reactivity task, participants were given five second heat stimuli at peak temperature and had 25-30 second ISIs. Participants were asked to make unpleasantness and intensity/arousal emotional response ratings to each heat stimulus immediately following the stimulus. Following both heat stimuli, after making subjective ratings, the interventionist asked participants if they were able to utilize the therapeutic concepts discussed in the intervention previously given to ensure that the participant had understood the training they had received. Following the intervention practice session, participants were reminded that they could utilize the taught therapeutic techniques to assist them in coping with the painful and emotional stimuli throughout the second half of the experiment and were allowed to ask any questions relating to the intervention training before completing the second emotion and pain reactivity tasks.

2.9 EEG Data Analysis Parameters

2.9.1 Parameters Used for Analyzing Emotion Reactivity Task

Emotion processing during the emotion reactivity/picture viewing task was measured using the LPP. The EEG data was collected continuously using ActiView software (BioSemi, Amsterdam, the Netherlands) at a sampling rate of 1024 Hz. Brain Vision Analyzer software (Brain Products, Gilching, Germany) was utilized to clean the data. The average of the two mastoids was utilized as the data reference and data filtering occurred with low pass filter of .01 Hz and a high pass filter of 30 Hz. Data was segmented for each trial starting from 200 ms before the stimulus was presented and lasted for the entirety of the stimulus (5000 ms). The baseline for each trial was defined as 200 ms before the picture stimulus onset. After automatic ocular correction, a semi-automatic artifact rejection procedure was used, which included visual inspection of the data. To quantify the LPP, mean amplitudes were measured at a pooling of Pz, CP1 and CP2. LPP averages were computed separately for participants in each group and both conditions (negative, neutral). Two windows of time were utilized for analyzing the EEG data: 400-2500 ms and 2500-5000 ms. Due to technology malfunction, one pre-intervention and two post-intervention

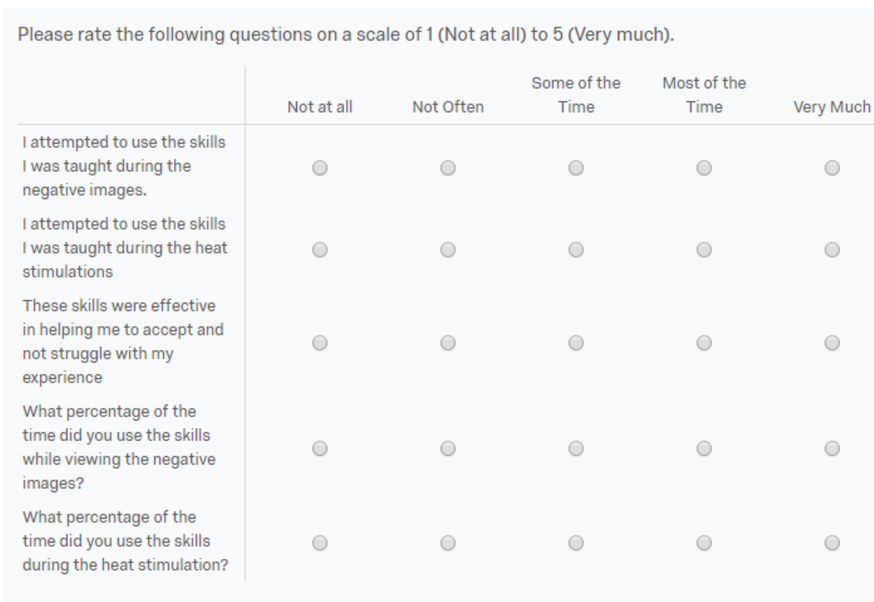
EEG files were corrupted and could not be cleaned properly and were thus excluded from data analysis.

2.9.2 Parameters Used for Analyzing Pain Reactivity Task

To analyze pain reactivity, CHEPs were measured during the pain reactivity task that consisted of feeling low and high heat thermal stimulations. The EEG data was collected continuously using ActiView software (BioSemi, Amsterdam, the Netherlands) at a sampling rate of 1024 Hz. Brain Vision Analyzer software (Brain Products, Gilching, Germany) was utilized to clean the data. The average of the two mastoids was utilized as the data reference and data filtering occurred with low pass filter of .01 Hz and a high pass filter of 30 Hz. Data was segmented for each trial starting from 200 ms before the stimulus was presented and lasted 500 ms after heat stimulation onset. The baseline for each trial was defined as 200 ms before the heat stimulus onset. After automatic ocular correction, a semi-automatic artifact rejection procedure was used, which included visual inspection of the data. N2 and P2 components were quantified at electrode Cz. The N2 component was quantified using peak-detection within the 200-400 ms window, and the P2 component was quantified using peak-detection within a 300-500 ms window post-stimulus onset. Both the N2 and P2 were analyzed by calculating the mean amplitude within +/-25 ms around the peak. N2 and P2 components were identified for both groups and both conditions within each group. Due to human error, one pre-intervention low heat condition was not recorded and could thus not be used for analysis.

2.10 Manipulation Checks

Several manipulation checks were put in place to ensure the utilization of skills taught during the intervention. Both the active control group and the acceptance group were given a post-experiment questionnaire to assess how well they were able to utilize the skills they learned about in the intervention. The manipulation check consisted of five questions, and used a scale that ranged from 1 (Not at all) to 5 (Very much). A copy of the questions as presented to the participants is shown below (Figure 2).


Please rate the following questions on a scale of 1 (Not at all) to 5 (Very much).

	Not at all	Not Often	Some of the Time	Most of the Time	Very Much
I attempted to use the skills I was taught during the negative images.	○	○	○	○	○
I attempted to use the skills I was taught during the heat stimulations	○	○	○	○	○
These skills were effective in helping me to accept and not struggle with my experience	○	○	○	○	○
What percentage of the time did you use the skills while viewing the negative images?	○	○	○	○	○
What percentage of the time did you use the skills during the heat stimulation?	○	○	○	○	○

Figure 2: Copy of the manipulation check given to both groups at the end of the experiment.

Although all participants completed post-questionnaires, participants that were given acceptance training had an additional questionnaire that measured how well those individuals utilized the skills they were taught during the intervention to ensure they were using acceptance skills in the latter half of the experiment. Figure 3 depicts the questionnaire given. There were five questions that were each scored from one to five. One indicated they did not feel they were able to utilize the relevant concept well, and five indicated they did feel they were able to utilize the relevant concept well. The lowest score possible was a five, and the highest score possible was a 25.

Please rate the following questions on a scale of 1 (Not at all) to 5 (Very much).

	Not at all	Not Often	Some of the Time	Most of the time	Very Much
I attempted to apply the acceptance and willingness skills during the pictures and thermal stimuli.	○	○	○	○	○
I was able to observe my sensations, emotions, and thoughts from a dispassionate distance.	○	○	○	○	○
I found myself getting entangled with my thoughts, feelings, and sensations.	○	○	○	○	○
I was able to let go of my struggle with challenging thoughts, feelings and sensations.	○	○	○	○	○
I was willing to experience challenging thoughts, feelings, and sensations.	○	○	○	○	○

Figure 3: Copy of the acceptance specific manipulation check given post-intervention.

2.11 Questionnaires

Baseline questionnaires were used to determine whether groups initially differed in variables related to pain sensitivity and emotional wellbeing. All questionnaires listed were given before the intervention except for the PANAS-state which was only given post-intervention to assess differences following testing procedures between groups, and the Chronic Pain Acceptance Questionnaire (Acute Pain Variant) which was given both pre- and post-intervention to assess baseline differences and whether acceptance training affects participant's acceptance of acute pain.

2.12 Statistical Analyses

One-way ANOVAs were used to assess baseline questionnaire differences between conditions. A mixed between-within ANOVA was used to analyze the subjective valence and arousal scores for the emotion reactivity and pain reactivity tasks. Similarly, a mixed between-within ANOVA was used to analyze the EEG data for the LPP from the emotion reactivity task for an early and late window, and the CHEPs N2 and P2 components from the pain reactivity task. For both sets of analyses a 2 (group: active control, acceptance) X 2 (time: pre- and post- intervention) X 2 (condition: neutral and negative/ low and high heat) ANOVA was used. To look at baseline differences between groups for the pre-intervention data for both the subjective and EEG data, univariate ANOVAs were performed. For the manipulation check used for both groups, one-way ANOVAs were utilized to look for differences between groups. For the acceptance specific manipulation check, the mean, standard deviation, and range were analyzed. For all graphs depicted, * indicates a significance level less than .05, ** indicates a significance level less than .01, and *** indicated a significance level less than .001.

CHAPTER III

RESULTS

The results that will be presented in this section are preliminary and reflect only a portion of the participants that will be utilized in the complete study.

3.1 Psychological Characteristics

Analyses of baseline self-report measures indicated that the groups did not differ at baseline on key demographic and psychological factors related to depression, anxiety, and emotion regulation (ASI, ERQU, IUS, PSS, PCS, CES-D, AAQ, DERS, STAI, CPAQ, ETISR-S, data not shown). Therefore, any differences between groups on our emotion and pain measures cannot be attributed to pre-existing differences on these dimensions.

3.2 Affective Responses to Pictures

3.2.1 Valence Scores

Figure 4 depicts valence scores for the emotion reactivity task by treatment group, condition, and time. There was a significant main effect of time $F_{(1, 13)} = 12.36$, $p = .004$, indicating that collapsed across condition and group, valence scores were higher post-intervention ($M = 4.70$, $SD = 1.54$) compared to pre-intervention ($M = 4.19$, $SD = 1.67$). Additionally, as expected, there was a main effect of condition (picture type), $F_{(1, 13)} = 59.587$, $p < .001$, partial $\eta^2 = .82$, indicating that when collapsed across intervention group and time, valence scores for neutral images were significantly higher ($M = 5.62$, $SD = 1.23$) than valence scores for negative images

(M = 3.27, SD = .96). This shows expected methodology as participants felt more unpleasant viewing negative images than neutral pictures.

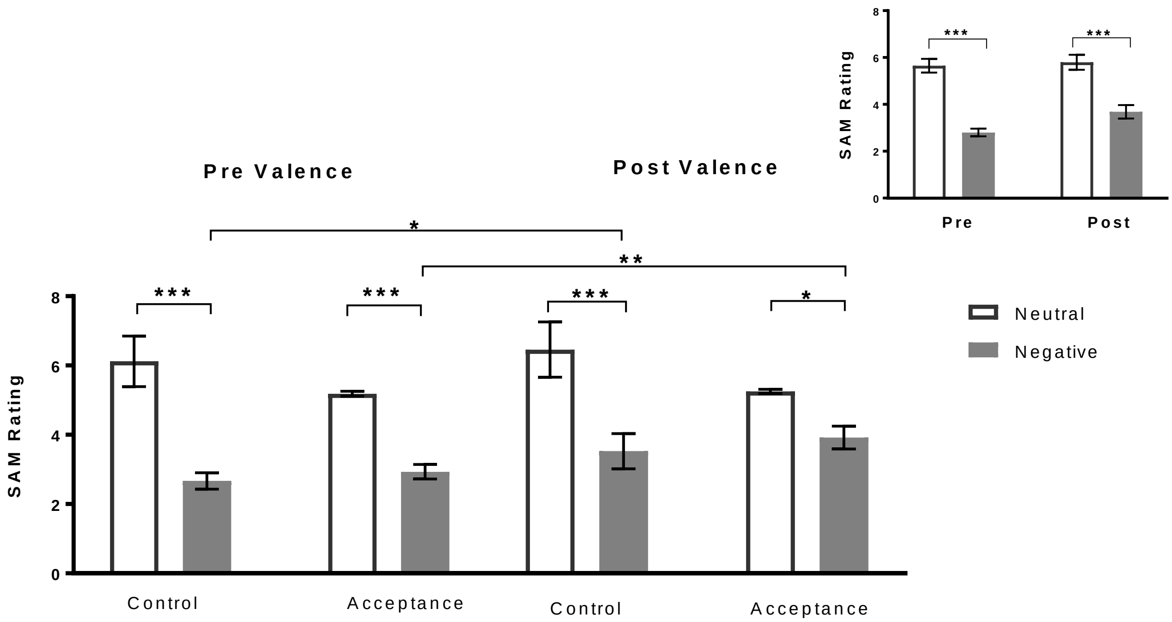


Figure 4: Valence scores for the emotion reactivity task by treatment group, condition, and time. Error bars signify standard error of the mean.

* $p < .05$, ** $p < .01$, *** $p <$ 001.

There was also a statistically significant two-way interaction of time and condition, $F_{(1, 13)}$ = 14.70, p = .002, partial η^2 = .53 (inset graph in Figure 4), indicating that the difference between neutral and negative valence scores decreased following the intervention compared to before the intervention. This was driven by decreased unpleasantness to the negative images post-intervention collapsed across group. Pre-intervention valence scores were significantly higher for the neutral condition than the negative condition $F_{(1, 13)}$ = 71.09, $p < .001$, partial η^2 = .84, an expected result as pre-intervention, both groups should be showing higher unpleasantness ratings to negative pictures. Post-intervention, valence scores were significantly higher for the neutral condition than the negative condition $F_{(1, 13)} = 23.36$, $p < .001$, partial $\eta^2 = .63$.

There was also a significant two-way interaction between group and condition, $F_{(1, 13)} = 4.56$, $p = .049$, partial $\eta^2 = .27$. Although there was no significant three-way interaction, $F_{(1, 13)} = .98$, $p = .34$, looking at Figure 4 indicates that the valence scores are trending in the expected direction as the acceptance group is showing decreased unpleasantness to the negative images post-intervention compared to pre-intervention.

3.2.2 Arousal Scores

Figure 5 depicts arousal scores for the emotion reactivity task by treatment group, condition, and time. There was a main effect of time, $F_{(1, 13)} = 20.95$, $p < .001$, partial $\eta^2 = .62$, indicating that collapsed across condition and group, arousal scores were lower post-intervention compared to pre-intervention. There was also a main effect of condition (picture type) $F_{(1, 13)} = 51.87$, $p < .001$, partial $\eta^2 = .80$, indicating that negative images were more arousing than neutral images, an expected result as negative pictures should induce a more intense response than neutral pictures. Although there was no significant three-way interaction, $F_{(1, 13)} = 0.00$, $p = .99$, partial $\eta^2 = .00$, Figure 5 conveys decreased arousal scores to negative images for the acceptance group compared to the control group post-intervention, and decreased arousal scores for negative images for the acceptance group post-intervention compared to pre-intervention, trends occurring in the hypothesized direction.

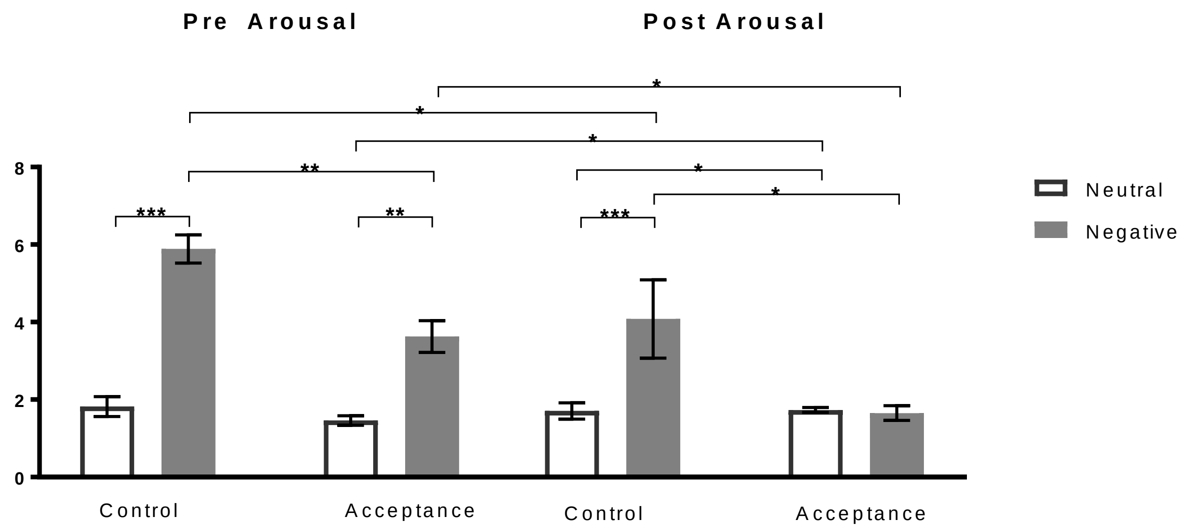


Figure 5: Arousal scores for the emotion reactivity task by treatment group, condition, and time. Error bars signify standard error of the mean.

* $p < .05$, ** $p < .01$, *** p < 001.

Figure 6 depicts arousal scores for the emotion reactivity task for groups collapsed across time. Arousal scores for the negative condition were significantly lower for the acceptance group than the control group. There was a statistically significant two-way interaction of group and condition, $F_{(1, 13)} = 9.05$, $p = .01$, partial $\eta^2 = .41$, indicating that the difference between neutral and negative arousal scores decreased for the acceptance group compared to the control group, indicating that the acceptance group ($M = 2.64$, $SD = .81$) had more attenuated arousal for the negative condition than the control group ($M = 4.98$, $SD = 1.37$), $t_{(13)} = 4.18$, $p = .001$. In addition, arousal scores for the neutral condition were lower for the acceptance group ($M = 1.32$, $SD = .24$) than the control group ($M = 1.76$, $SD = .56$), $t_{(13)} = 2.16$, $p = .050$. This effect indicates an expected trend towards the acceptance group having less intense ratings towards the negative images compared to the control group, although in the future we would want to see this attenuation change occur from pre- to post-intervention.

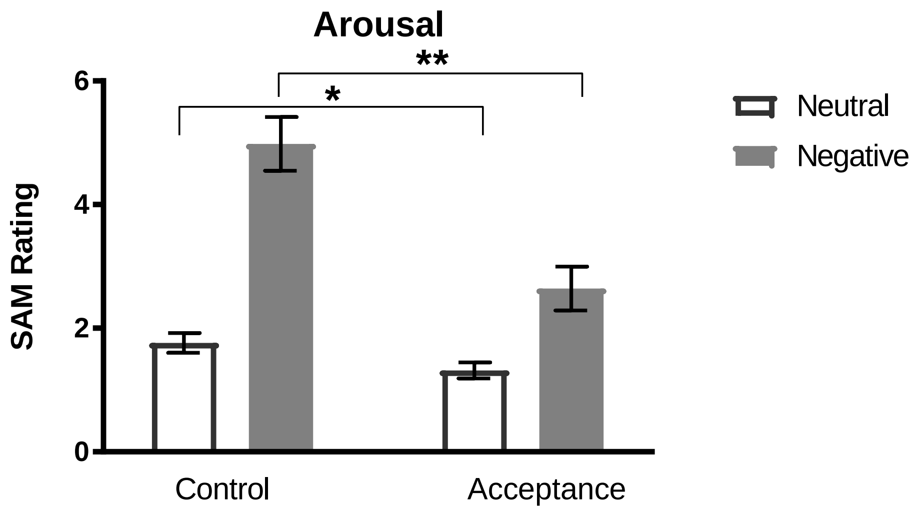


Figure 6: Arousal scores for the emotion reactivity task for both conditions collapsed across time. Error bars signify standard error of the mean.

* $p < .05$, ** $p < .01$, *** $p <$ 001.

Figure 7 depicts arousal scores for the emotion reactivity task comparing pre- and post-intervention scores collapsed across groups. There was a statistically significant two-way interaction of time and condition, $F_{(1, 13)} = 12.57$, $p = .004$, partial $\eta^2 = .49$, indicating that there was a decrease in arousal scores while neutral arousal scores remained consistent. Arousal scores were significantly higher for the negative condition compared to the neutral condition pre-intervention $F_{(1, 13)} = 50.45$, $p < .001$, partial $\eta^2 = .78$, and post-intervention $F_{(1, 13)} = 6.59$, $p = .022$, partial $\eta^2 = .32$.

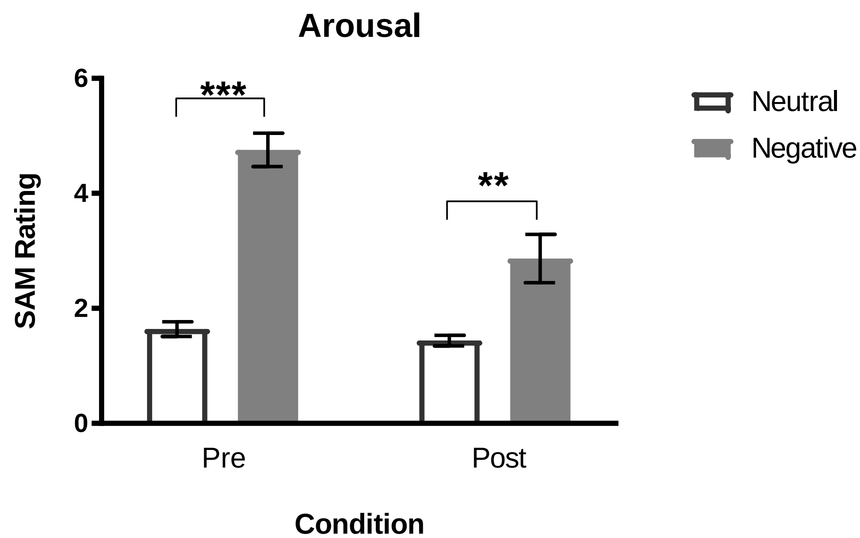


Figure 7: Arousal scores for the emotion reactivity task for both times collapsed across groups.

Error bars signify standard error of the mean.

* p < .05, ** p < .01, *** p < 001.

3.3 Affective Responses to Pain

3.3.1 Valence Scores

Figure 8 depicts valence scores for the pain reactivity task by treatment group, condition, and time. There was a main effect of time, $F_{(1, 13)} = 2.82$, $p < .05$, partial $\eta^2 = .27$, indicating that collapsed across condition and group, valence scores were higher post-intervention (M = 5.16, SD = 2.03) compared to pre-intervention (M = 4.67, SD = 2.40). There was also a main effect of condition (low or high heat) $F_{(1, 13)} = 129.27$, $p < .001$, partial $\eta^2 = .91$, indicating that high heat was more unpleasant (M = 3.23, SD = 1.08) than low heat (M = 6.60, SD = 1.71), an expected result as high heat should induce a more unpleasant response than low heat.

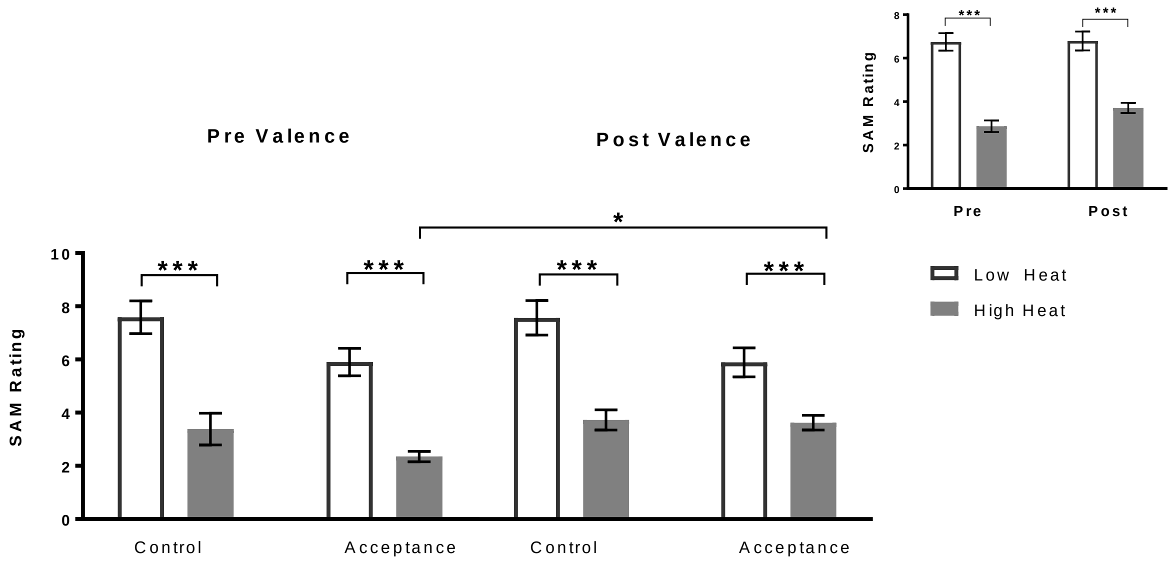


Figure 8: Valence scores for the pain reactivity task by treatment group, condition, and time.

Error bars signify standard error of the mean.

* p < .05, ** p < .01, *** p < 001.

The inset graph in Figure 8 depicts valence scores for the pain reactivity task for time and condition, collapsed across group. There was a statistically significant two-way interaction of time and condition, $F_{(1, 13)} = 5.32$, $p = .038$, partial $\eta^2 = .29$, indicating that while valence increased to high heat after the intervention relative to before the intervention, no difference was seen in the low heat condition. Valence scores were significantly higher for the low heat condition than the high heat condition pre-intervention $F_{(1, 13)} = 114.50$, $p < .001$, partial $\eta^2 = .89$, and post-intervention $F_{(1, 13)} = 59.66$, $p < .001$, partial $\eta^2 = .81$. Although there was no significant three-way interaction, $F_{(1, 13)} = 1.85$, $p = .197$, partial $\eta^2 = .12$, looking at Figure 8 indicates that the valence scores are trending in the expected direction as the acceptance group is showing decreased unpleasantness (increased valence) to the high pain post-intervention compared to pre-intervention.

3.3.2 Arousal Scores

Figure 9 depicts arousal scores for the pain reactivity task by treatment group, condition, and time. There was a statistically significant three-way interaction between group, condition, and time, $F_{(1, 14)} = 4.82$, $p = .047$, partial $\eta^2 = .27$. Before the intervention, the control group reported higher arousal for the high heat ($M = 6.30$, $SD = .91$), compared to the low heat ($M = 1.93$, $SD = 1.00$), $t_{(14)} = 10.625$, $p < .001$, and the acceptance group reported higher arousal to the high heat ($M = 5.76$, $SD = 1.50$), compared to the low heat ($M = 1.49$, $SD = .57$), $t_{(14)} = 7.08$, $p < .001$. Following the intervention, the acceptance group showed an attenuated response to the high heat $t_{(14)} = 5.54$, $p = .001$, ($M_{pre} = 5.76$, $SD = 1.50$; $M_{post} = 2.87$, $SD = 1.78$) while the control group did not show this attenuation $t_{(14)} = 1.18$, $p = .291$, ($M_{pre} = 6.30$, $SD = .91$; $M_{post} = 5.14$, $SD = 1.59$).

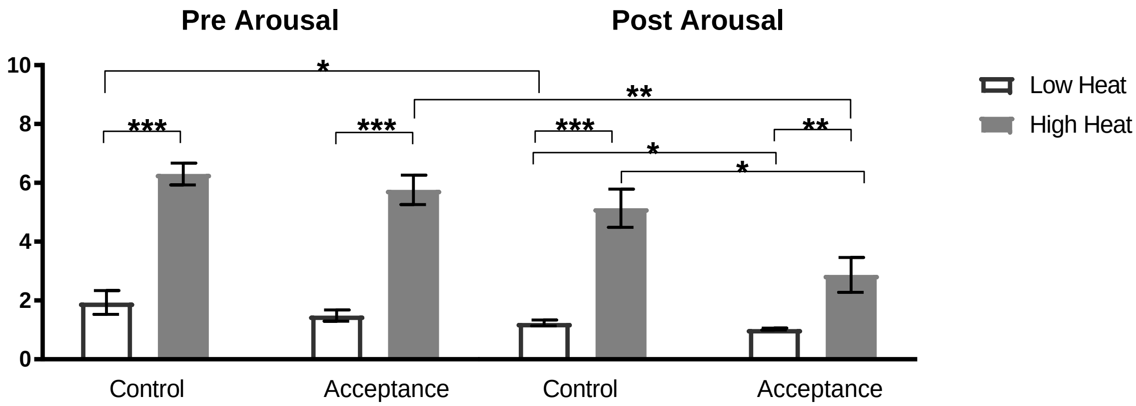


Figure 9: Arousal scores for the pain reactivity task by treatment group, condition, and time.

Error bars signify standard error of the mean.

* $p < .05$, ** $p < .01$, *** $p <$ 001.

3.4 ERPs to Pictures

Figure 10 depicts LPP measures for the emotion reactivity task by treatment group, condition, and time. The inset in Figure 10 depicts the amplitude differences in microvolts between the negative and neutral LPP for the early window of time (400-2500 ms). There was a main effect of condition $F_{(1, 10)} = 6.89$, $p = .025$, partial $\eta^2 = .41$, indicating that the negative condition was significantly more positive than the neutral condition.

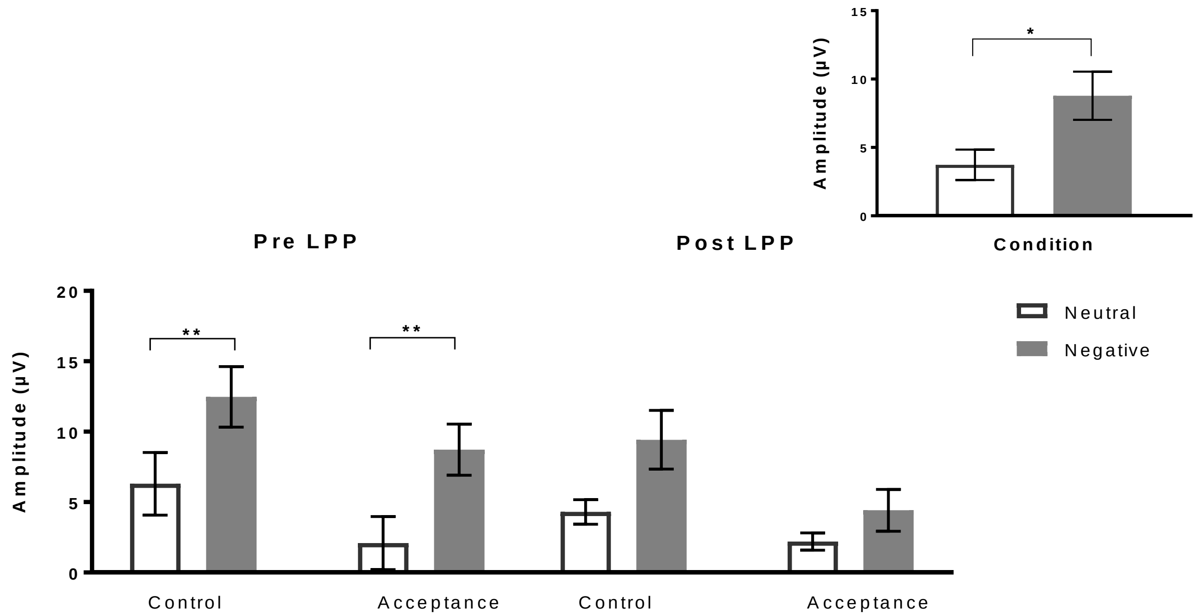


Figure 10: Amplitude measures (µV) for the emotion reactivity task by treatment group, condition, and time. Error bars signify standard error of the mean.

* p < .05, ** p < .01, *** p < 001.

There were no statistically significant three-way interactions for the early window (400-2500 ms), $F_{(1, 10)} = .27$, $p = .613$, partial $\eta^2 = .03$, or the late window (400-2500 ms), $F_{(1, 10)} = .001$, $p = .98$, partial $\eta^2 = .00$, but looking at LPP measures for the early window plotted for both groups comparing their neutral and negative condition amplitudes pre- and post-intervention (Figure 11), there is a trend towards the acceptance group becoming less positive than the condition group.

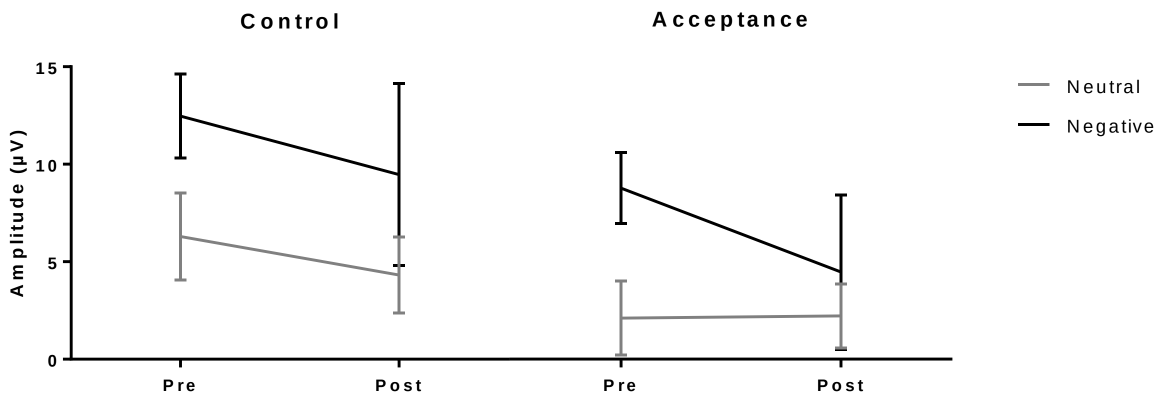


Figure 11: LPP measures pre- and post-intervention broken down by intervention group for the early window.

Lastly, for the waveforms, Figure 12 depicts the pre-intervention LPP for both conditions broken down by group. Similarly, Figure 13 depicts the post-intervention LPP measures for both conditions broken down by group. Figures 12 and 13 depict an average waveform of brain activity at specific electrodes Pz, CP1, and CP2 across the duration of the picture stimuli. This means that the brain response from each picture was averaged to create one measure for both the negative and neutral picture conditions. It can be seen that there is more positivity for the negative group in both conditions compared to the neutral condition, an expected effect. With more participants, it is hypothesized that the acceptance group will show less positivity to the negative images compared to the control group post-intervention, and that positivity for the acceptance group will decrease from pre- to post-intervention.

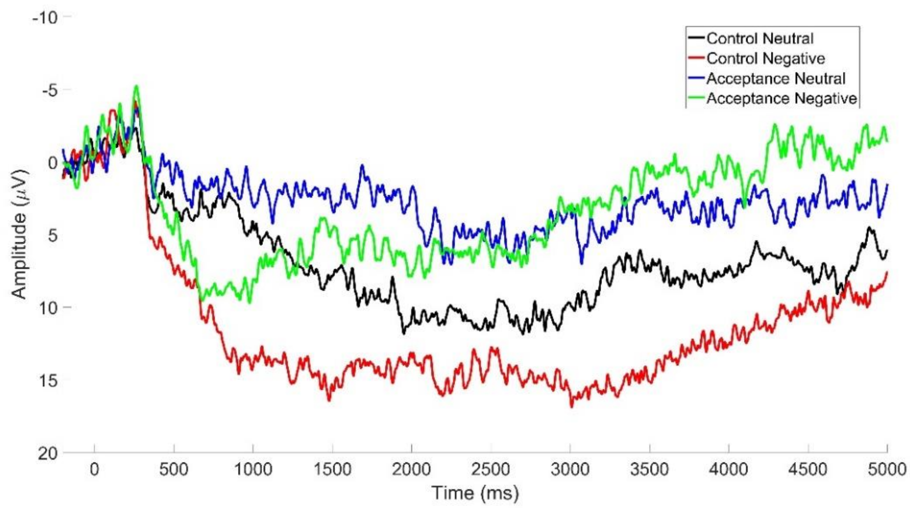


Figure 12: Grand average waveforms of LPP at a pooling of Pz, CP1, and CP2 pre-intervention, broken down by group and condition.

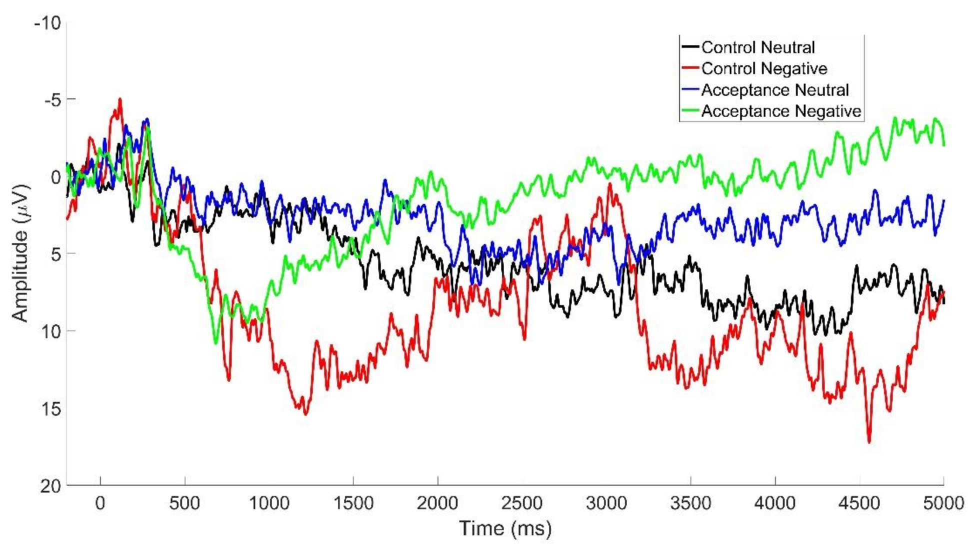


Figure 13: Grand average waveforms of LPP at a pooling of Pz, CP1, and CP2 post-intervention, broken down by group and condition.

3.5 ERPs to Pain

Figure 14 depicts the N2 component of the CHEPs waveform resulting from the pain reactivity task by treatment group, condition, and time. The inset graph within Figure 14 depicts a main effect of condition for the N2 component of the CHEPs waveform resulting from the pain reactivity task for both low heat and high heat conditions described in microvolts. There was a statistically significant main effect of condition $F_{(1, 12)} = 10.52$, $p = .007$, partial $\eta^2 = .47$, indicating that the high heat condition resulted in a more negative N2 component than the low heat condition.

There was no main effect of time $F_{(1, 12)} = .48$, $p = .503$, partial $\eta^2 = .04$, indicating that across group and condition, there were no significant changes in the N2 amplitude from pre-intervention to post-intervention. Additionally, there was no significant three-way interaction, $F_{(1, 12)} = 1.149$, $p = .305$, partial $\eta^2 = .09$.

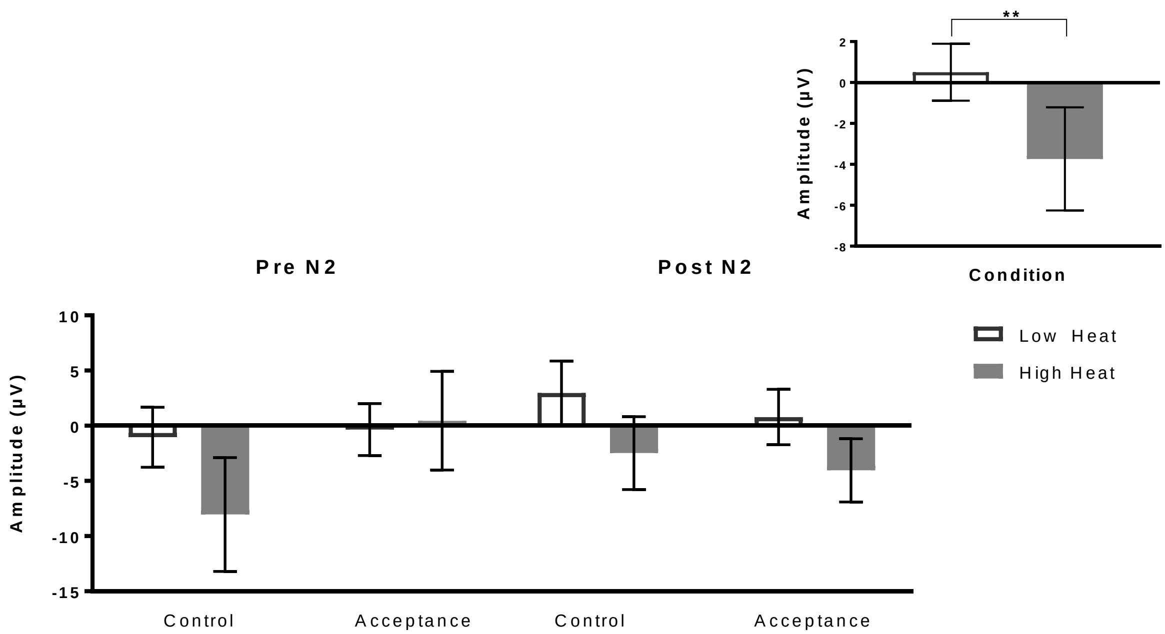


Figure 14: CHEPs waveform amplitude (µV) for the N2 component for the pain reactivity task by treatment group, condition, and time. Error bars signify standard error of the mean. * $p < .05$, ** $p < .01$, *** $p < 001$.

For the P2 component, there was no three-way interaction $F_{(1, 12)} = 1.66$, $p = .222$, partial $\eta^2 = .12$, main effect of time, $F_{(1, 12)} = .59$, $p = .457$, partial $\eta^2 = .05$, or main effect of condition, $F_{(1, 12)} = .14$, $p = .714$, partial $\eta^2 = .01$. Although we predicted a significant main effect of condition that indicated the amplitude of the P2 component was more positive for high heat than low heat, with so few people in the pilot study, a null finding was not unexpected.

Lastly, for the waveforms, Figure 15 depicts the pre-intervention CHEPs measures for both conditions broken down by group. Similarly, Figure 16 depicts the post-intervention CHEPs measures for both conditions broken down by group. Figures 15 and 16 depict an average waveform of brain activity at the Cz electrode across part of the duration of the heat stimulus. This means that the brain response from each heat stimulus was averaged to create one measure for both the high and low heat conditions. With more participants, it is hypothesized that the most negative and positive peak amplitudes for the acceptance group will both be less pronounced for the acceptance group post-intervention compared to the control group, and that the most negative and positive peak amplitudes for the acceptance group will be less pronounced post-intervention compared to pre-intervention.

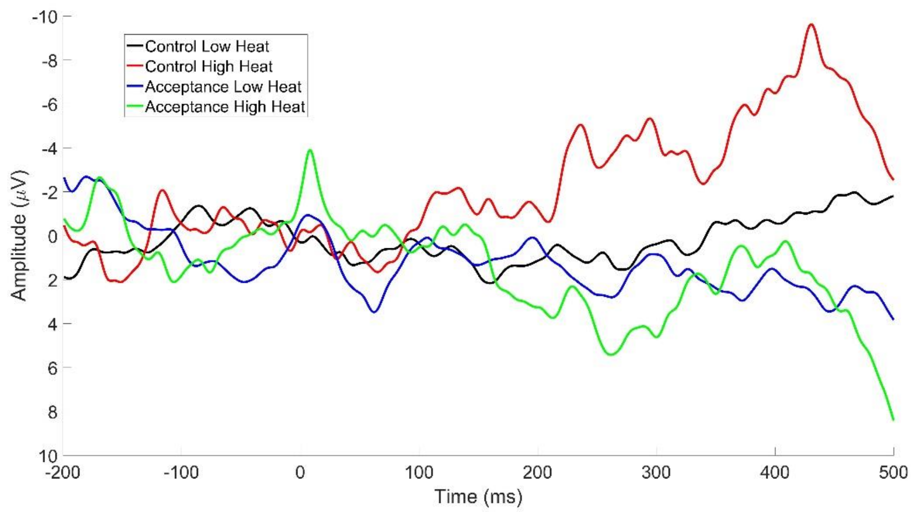


Figure 15: Grand average waveforms of CHEPs at Cz pre-intervention, broken down by group and condition.

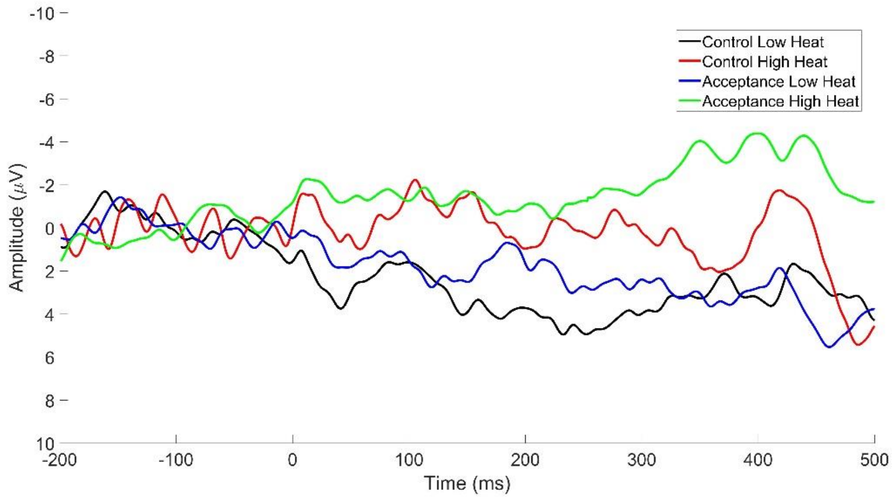


Figure 16: Grand average waveforms of CHEPs at Cz post-intervention, broken down by group and condition.

3.6 Post-Intervention Manipulation Checks

Results were analyzed using a one-way ANOVA for the manipulation check given to both groups. There were no significant differences between groups $F_{(1, 13)} = 2.22$, $p = .16$, partial $\eta^2 = .15$, indicating that groups did not differ in how useful they believed the intervention was. For the acceptance group specific manipulation check, the mean score was 21.34 (*SD* = 1.85) and the range of scores was 6. The lowest score was 18 and the highest score was 24.

CHAPTER IV

DISCUSSION

This experiment was conducted as a pilot study to test initial methodology and many of the initial trends we hypothesized are emerging. Starting with the subjective data, we found the emotion reactivity and pain tasks were effective manipulations. For the emotion reactivity task, valence scores were reported as higher for the neutral condition than the negative condition, indicating that the negative condition was significantly more unpleasant. In addition, arousal scores were higher for negative pictures. Looking at the emotion reactivity arousal scores across time, the acceptance group had significantly lower arousal scores than the control group.

Looking at the pain reactivity task subjective scores, valence scores were lower for the high heat condition than the low heat condition indicating the high heat condition elicited more negative affect. Looking at the arousal scores for the pain reactivity task presents the most interesting finding of this pilot study. Finding a three-way interaction here indicates that group, condition, and time all played a role (see Figure 8). Most importantly, we saw a significant main effect of time for high heat arousal scores for the acceptance group, indicating that the arousal scores for high heat were significantly lower post-intervention compared to pre-intervention for the acceptance group. Taken together, there is a hint at the efficacy of acceptance training to thus lower arousal scores to high heat pain with just a brief, 40-minute intervention. In addition, the acceptance group had significantly lower arousal scores than the control group for high heat post-intervention. Not only did we find a decrease in arousal scores for high heat over time, but we also saw a decrease in arousal scores for high heat between groups post-intervention. This indicates that the acceptance training intervention appeared to be more effective at lowering arousal/intensity ratings to high heat pain more so than the control group given an active control intervention. It is important to note that the active control intervention did have a therapeutic component to it, and that they were taught ways to actively control their pain from a student counselor. Therefore, it appears the acceptance component contributed to a significantly more efficacious intervention in lowering the perceived intensity of high pain.

Looking at the ERP data, although there are no interactions, we did see that the current methodology was effective. Looking at the emotion reactivity task, the LPP showed a main effect of condition indicating that the negative images elicited more positive amplitudes than the neutral images for the early window. Similarly, for the pain reactivity task, there was a main effect of condition and the resulting CHEPs had an N2 component that is more negative for the high heat than the low heat. Both of these findings indicate methodology working as expected. Given this, these components can be modulated with more participants and thus more power.

Already, the LPP modulation data shows some interesting results. As discussed in the introduction, LPP is utilized as a measure of emotion processing and shows more positivity for participants when looking at negative images than neutral images. In Figure 11, data for the LPP measure show the positivity resulting from negative pictures appeared to be decreasing more rapidly from pre-intervention to post-intervention than the control group. This might indicate the LPP measure for the acceptance is decreasing in positivity more than the control group, showing increased emotion regulation. Due to the lack of participants for this pilot study, it is possible that with more participants, the acceptance group will show a decrease in positivity as a result of viewing negative images significantly more than the control group. Due to the appearance of a trend so early on, it appears that a LPP modulation for the early window from acceptance training may be strengthened with more participants.

Looking at the acceptance manipulation check, presented in Figure 3, the lowest scores so far being 18, participants are utilizing the skills very well. So far, this indicates that the acceptance group has been able to comprehend and apply the skills given to them within the acceptance based training.

There are some limitations to this pilot study. Although there are currently few people in each group, this will change with the addition of more participants being added into the study. In addition, as the demographic information suggests, our study is based on a younger population in early adulthood, thus the population may not be representative of an older adult population. We are utilizing a brief, 40-minute one-time intervention in the hopes that the acceptance training is potent enough to be effective in a short amount of time. Although Hayes et al. (1999) showed the effectiveness of a brief acceptance intervention, it is possible that with the length of the study and the utilization of multiple tasks, that a longer intervention may be necessary for individuals to feel the effects of the training.

Overall, this pilot study has already shown promising results and with a larger sample, we predict seeing decreases in perceived unpleasantness and arousal/intensity of response for both the pain reactivity and emotion reactivity tasks. The subjective data already showed a significant difference for arousal scores for the pain reactivity task between groups, and the data is moving in the correct direction to see significant differences between groups for the other subjective variables. Physiologically, the study design is effective and clearer modulation of the brain waveforms for both tasks is anticipated with a larger sample size. Lastly, if we are able to find training induced decreases in the positivity of the LPP and in the N2 and P2 components with more participants, we will run a correlation to evaluate if these reductions are associated with each other. So far, our results suggest that a brief, 40-minute acceptance intervention leads to decreased/improved responses to negative emotional stimuli and pain. The addition of more participants can potentially reveal decreases in LPP and CHEPs, neurological markers of emotion and pain reactivity that may underlie the changes in subjective responses.

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APPENDIX

Acceptance Training Script:

Overview. During the next phase of this study you will learn skills that will help you to reduce unnecessary suffering with negative emotions and pain. This will involve some new concepts, so feel free to ask me questions and let me know when something isn't clear.

At times, negative emotions and pain provide important information. For example, if you see a snake on the trail ahead, it may trigger the negative emotion of fear –helping to motivate you to flee from danger. In this way, fear can be a good thing. Similarly, there are times when physical pain can be a good thing. When you break your leg, your body generates pain signals to let you know that something is wrong and something needs to be done to remedy the situation. In this way, pain is actually a good thing.

But, at other times, negative emotions like fear and pain can occur when there is no danger. Under these conditions, even though you are safe, you may have the thought that you need to do something to stop or avoid your negative emotional experience. However, your struggle to stop or avoid the fear and pain can actually increase your suffering. This is similar to the commonly known fact about quicksand: the more you struggle, the faster you sink. During this training you will learn how to let go of the struggle with negative emotions and pain, and instead learn how to accept them, in order to reduce unnecessary suffering in your life.

Struggling with Pain Increases Suffering. Everyone experiences physical and emotional pain. For example, many college students know what it's like to feel homesick, to feel regret over not having studied more for an exam, feel down and dejected when rejected from an organization, or to feel miserable when they get the flu or have a headache. We can't avoid painful experiences but we can decide how we are going to respond when they happen. During the first part of this study you were exposed to pictures and heat stimulation that you may have experienced as threatening or painful, but there was actually no threat or risk of tissue damage. Even though you were safe, you may have experienced emotions such as fear or anxiety and thoughts that you need to do something to escape, suppress or ignore the pain. One way of thinking about this is that we've got a "struggle switch" at the back of our mind, and as soon as an uncomfortable emotion or painful feelings shows up, the struggle switch turns on.

Did you have any negative thoughts or feelings in response to the images or heat? What were they? Did you find yourself struggling to control these thoughts or feelings? *[If no response, then try "Do you remember feeling that you wanted to push the sensations away? Or perhaps you felt entangled or overwhelmed by the pain?]*

Have you ever experienced this type of struggle with pain or negative emotion in some other domain of your life? [*If no response, then try "Maybe you've struggled with frustration or guilt over a low exam grade or you've experienced a bad headache and struggled with this pain?*"]

<u>Acceptance</u>. Rather than struggle with the experience of pain, we will focus on acceptance – turning off your struggle switch. Acceptance is the ability to more objectively observe and accept, rather than control, your thoughts, feelings, and sensations. For example, if you were feeling regret for not having studied enough for an exam, you might ordinarily focus on this and keep thinking over and over, "Why did I do that?! If only I had made myself sit down and focus!" Or, on the other hand, you might try to push all thoughts of the exam out of your head. But, it is usually impossible to get rid of negative thoughts, emotions, and sensations by directly trying to control them. Telling yourself, "Do not think about the fear" or "Do not think about the pain" usually increases your attention to the negative feelings and increases your struggle with them. Struggling to control your negative internal experiences *is* the problem and it only *amplifies* your distress and suffering. But, with acceptance, you will be able to stabilize your mind – to free it of its normal preoccupations so that you can observe things you experience in a clear, unhurried, less reactive way. Note that this is different from thinking about your pain constantly AND it is different from trying to never think of pain or negative feelings. With the struggle switch turned off, when a painful feeling shows up, you don't have to like it, want it, or approve of it, you just decide - "I'm not going to struggle with it". Instead you can watch uncomfortable thoughts and feelings move into awareness and float away ---like leaves floating down a stream. [*Do you have any questions?*]

To illustrate this, imagine it is a hot August day. You are sitting outside waiting for a friend. You could spend the whole time fretting about how hot and uncomfortable you are, how you're getting sweaty, and how you're frustrated with your friend for being late. Or you could decide that you are willing to accept that it's hot outside and that your friend is late without letting these thoughts and feelings consume you. You can accept and allow them to be, and without struggle they will pass through your awareness. In this way, your awareness will pass on to other things, such as the birds singing in the trees or the thought of what you'll be eating for dinner. You are now no longer being held captive by the feeling of being uncomfortable and frustrated. You are free. *[Is this making sense?]*

<u>Turning Up Your Acceptance Dial</u>. Another way to think of this is that there are two radio dials in the back of your head. One is labeled the "Mental Pain" dial and this is controlled by negative emotional or physical events such as the stress you feel after a fight with your friend or a back ache. The other dial is also in the back of your head and you didn't know it was there. It is labeled "Acceptance". Its settings control your willingness to accept whatever experiences come your way, including emotional and physical pain. Most people think that the path towards less pain involves turning down the Mental Pain dial.

But if you try to turn down your mental pain dial through thought suppression, avoidance, rumination or distraction, it won't budge. For example, if you try to suppress the feeling of being sad, you only end up thinking about this feeling even more. So, you really can't "dial down" the level of mental pain you experience.

But you can determine what you do with pain when it shows up through your acceptance dial. You decide whether to set your acceptance dial to a high, medium or low setting. When you experience moderate levels of mental pain and your willingness to accept it is zero, this leads to greater suffering. This has been shown in patients with clinical pain. Even with medication and surgery, clinical pain can remain, and patients suffer more if their acceptance dial is set to zero. When people experiencing depression and anxiety have their acceptance dial set too low, their suffering is magnified as well.

In contrast, what would happen if they turned up their acceptance dial? Studies show that when patients with physical pain increase their acceptance of their pain even a little, their distress is reduced. It can even reduce their perception of pain.

Likewise, when you experience mental pain and your willingness to accept it is increased, this will reduce your distress and suffering. Whether you are dealing with emotional or physical pain – if you increase your willingness to experience it, you can begin to live your life without struggling and reduce your suffering.

Self-Observing Perspective. An important part of the process of acceptance is realizing that thoughts, feelings and sensations are not the same as 'who we are'. Depending on how things are going in our life, like whether or not we got enough sleep last night, how our weekend was, or any other number of factors, we can have very different thoughts, feelings and sensations. In other words, these aspects of our existence change on a minute-to-minute or day-by-day basis. Despite this, there is consistency in our perspective and our existence - in who we are - across time. Therefore, we can observe our moment-by-moment thoughts and feelings objectively and distinguish them from our sense of self. We can also view these thoughts and feelings with kindness and compassion.

Rather than holding on to the idea of your thoughts and feelings as who you are, it is helpful to watch these thoughts and feelings from a dispassionate distance -- from your *observing self*. This observing self is the part of you that notices whatever your body or mind is doing. It allows you to experience a larger, more expansive sense of self, which can give you a sense of perspective and calm when facing challenges.

Imagine that your eyes represent your observing self, and you're holding your thoughts, feelings and sensations in your hands. When we have physical or emotional pain, sometimes we begin to entangle ourselves with the pain, and then we associate that pain with who we are. But through a self-observing perspective we are able to hold the thoughts, feelings and sensations at a distance and observe them with acceptance and compassion. In this way, we are not associating the feelings with who we are or becoming entangled with them. *Is this making sense?*

Now, let's practice this. I want you to think of something you have struggled with recently. Maybe this is a fight with a friend or an issue with your family. (*Give them time to think of something.)* Have you thought of something? What is it? Ok, thank you for sharing that with me. Now, I want you to think of this situation while you close your eyes and attempt to remain in your observing self without struggling with your emotions and thoughts. It helps to imagine that you are watching a movie on TV. Notice whether certain thoughts and feelings make you want to change the channel, or whether they pull you into the movie and out of your observing perspective? *[“I'll let you reflect on that for a few seconds."]*

How did that go? What were some emotions or thoughts you experienced while thinking about ______? ((Say whatever they had told you beforehand that they were thinking of)) Did you feel yourself struggling with ______? ((Say whatever emotion or thought they replied to in the last question)) [*If no response or lack of clarity, “Did you find yourself moving away from or becoming entangled with your emotions or thoughts?”]*

Remember that these thoughts and feelings are not the same as who you are. Rather than getting entangled with them, try to experience them from your observing self (demonstrate this with the same hand motions as above). From here, you aren’t running away from them or getting carried away with them, but rather you are experiencing them straight forwardly, warmly accepting them and observing them.

This altered perspective can be the beginning of a fundamental and enduring new relationship with your thoughts and feelings. You can, if all goes well, cease to be a slave to negative thoughts, feelings, and sensations.

Transition to Practice Phase.
In the first phase of this study, you may have struggled with your thoughts and feelings about the pictures and heat stimulation. During the last phase of this study you will experience the same negative images and thermal stimuli. With the stirring of thoughts and emotions inside you, you may begin to feel the pull to struggle with your negative emotions and pain. Rather than give into that pull, you can decide to move your willingness dial and objectively observe your experience with kindness and self-compassion, but without struggle. Keep in mind that it takes some people longer to learn how to do this, so you might not fully grasp this today.

After noticing the sensation of the heat stimulation during the next phase of the study, instead of struggling you might say “yes the heat sensation is there, the sensation that I typically label as unpleasant and intense, but that sensation is down there in my arm and that is not where I am. I am up here in my head. I don’t have to identify with the unpleasant sensations and feelings, I can view them objectively.”

In this way, the negative images and heat sensations don’t have a hold on you. In this way they can cease to be unpleasant without really going away.

Practice Phase. Now we are going to practice using the skills we've learned while viewing a few negative images and then with a few thermal stimulations.

Your job will be to willingly look at your thoughts, feelings and sensations from your observing-self perspective with acceptance and without struggle. If you discover that you have gotten stuck in a feeling, struggling with its content, just notice this and gently return to your observing-self – watching your inner experience from a dispassionate distance with kindness towards yourself.

Image 1: What was your experience like? What were some emotions that popped up for you when viewing this image? Were you able to maintain the observing-self perspective when feeling ____? Did any feelings hook you and pull you away from your self-observing perspective? Were you able to return to your observing perspective? Let's try this again.

Image 2: How was it this time? What were some emotions that popped up for you when viewing this image? Were you able to observe your thoughts and feelings without getting entangled with them or struggling to push them away? Did the feeling of ____ pull you away from your observing perspective? Were you able to return?

Now, let's try practicing with the thermal stimuli. Again, your job will be to look at your thoughts, feelings and sensations from your observing-self perspective with kindness and without struggle. If you discover that you have gotten stuck in a thought, feeling or impulse just notice this and gently return to your observing-self–watching your inner experience from a dispassionate distance with kindness towards yourself.

Thermal stimulus 1: How was that? Were you able to maintain the observing-self perspective? Did any feelings hook you? Were you able to gently return to your observing perspective after feeling ____? Let's try this again.

Thermal stimulus 2: How was it this time? Were you able to observe your thoughts and feelings without getting entangled with them or struggling to push them away? Did any sensations or feelings hook you? Were you able to return to your observing perspective after feeling ____?

Transition to Test Phase: Now that you have learned this new way of accepting your internal experiences, you will get to use them during the final phase of the study where we will present the same pictures and thermal stimuli as we did during the first phase.

Active Control Script:

Overview. During the next phase of this study you will learn skills that will help you to reduce unnecessary suffering with negative emotions and pain. You will also learn types and components of emotional and physical pain, as well as some strategies for coping with pain. Emotional and physical pain come in a number of varieties. One of the main distinctions between different types of pain is whether the pain is acute or chronic. Here are some differences between acute and chronic pain:

Types of pain. Acute pain is short-lived. For emotional pain, this might be somewhere on the order of a few minutes to hours every day, for a total of less than about 2 weeks. For physical pain, acute pain usually refers to pain that lasts less than 3 months. Acute pain can be thought of as a symptom of something else. For example, when we don't study enough and then do badly on an exam or when we stub our toe, we may feel down or in pain. The pain is the result of something else – it's a symptom. The cause of acute pain can often be identified. If the cause is dealt with (e.g., we start to study more or we treat and take care of our stubbed toe), the pain should diminish.

Chronic pain is longer-lasting and can be thought of as a condition. It may develop after an incident such as an upsetting break-up or a physical injury. Or, chronic pain (be it emotional or physical) may have an unknown cause. Chronic pain persists beyond the expected healing time and in spite of treatment. In other words, we continue to feel pain and emotional distress from a breakup longer than would be expected and despite trying to feel better. Or, we continue to feel pain related to a physical injury despite having allowed enough time for our body to heal the injury, and having sought the medical treatment necessary.

Emotional and physical pain come in many varieties. Emotional pain can involve loss or sadness, fear or anger. Physical pain can affect any part of the body. Physical pain is typically classified as "nociceptive" pain, which means pain that is caused by damage to body tissue or "neuropathic" pain, which means pain that occurs when there is nerve damage.

Did you experience acute emotional and physical pain during the first part of the study? Do you remember feeling as if you didn't want these thoughts and feelings, and maybe you struggled with them or wanted to stop these experiences? What sorts of thoughts and feelings did you have? (Give examples of struggling if they don't give you any). Since these were short-term events, they are examples of acute emotional and physical pain.

Have you experienced prolonged emotional or physical pain in some other domain of your life? Maybe you've experienced frustration or guilt over a low exam grade, heartache over a rejection or bad breakup, or maybe you've experienced a bad headache or back pain and struggled with this pain sensation? Do you remember feeling as if you didn't want these thoughts and feelings, and maybe you struggled with them or wanted to stop these experiences? What did that look like? Were your struggles successful?

Now that we've talked about some types of pain and you're clear on their distinctions, we're going to talk about the history of pain (emotional and physical).

<u>Pain – a historical overview.</u> Efforts to understand and treat pain have persisted over time. In the 17th century, René Descartes (Run A Day Cart) suggested that the mind was incapable of influencing the body directly. His ideas solidified a general adoption of unidimensional, reductionist views of medicine that persisted through the 19th century. While this biomedical approach significantly aided the advancement of science, it conceptualized pain in an overly simplistic manner. In 1894, von Frey proposed the Specificity Theory of Pain, which suggested that sensory receptors were directly responsible for specific types of pain, formalizing the ideas of Descartes (Day Cart). The appeal of the Specificity Theory was the straightforwardness in asserting that physical pathology and pain experience have a one-to-one relationship, and this conceptualization captures how many people believe that pain operates even today. However, subsequent advances in recognizing the interaction between physiological and psychological processes in pain perception led to the development of more complex theories.

Perhaps most groundbreaking was Melzack and Wall's **Gate Control Theory** in 1965. This model proposed that pain signals ascend to the brain from the pain location in the periphery (e.g., arm or leg) and can be modulated. A "gate" in the brain can be opened or closed, and therefore the pain experience can be decreased or increased by paying attention to particular stimuli. This gate control theory highlighted the role of psychological and social factors in pain perception such as attention and emotions. This model suggests that pain is a subjective experience influenced by many factors, including thoughts, feelings, and behaviors.

In 1999, Melzack incorporated the **Gate Control Theory** with models of stress (Selye, 1950; Selye, 1976) to form the **Neuromatrix Model of Pain**. This theory proclaims that pain is a multidimensional experience related to an initial pattern of nerve impulses, or neuromatrix, that is then impacted by factors such as sensory experiences and learning. This Neuromatrix theory emphasizes the important relationship between pain and stress, as well as the need to decrease tension with tools such as relaxation to combat pain intensity and disrupt the pain-stress cycle. According to this theory, an individual's neuromatrix determines their experience of pain. The concept of neuroplasticity, the ability of the nervous system to change its structure and function due to psychological or social factors, may similarly apply to pain. Indeed, these neuroplastic changes that occur in the brain may increase or decrease an individual's pain, which may help explain the ongoing experience of pain that people feel after the stimuli has objectively resolved.

While other theories and models evolved to incorporate both the physical and psychological aspects of chronic pain, the Biopsychosocial Model is currently accepted as the most useful way to conceptualize, understand, and treat pain (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). The biopsychosocial model views pain and other chronic conditions through a multidimensional framework that integrates the relationship among physical, psychological, and social factors that may impact the development and maintenance of one's clinical presentation. When trying to manage our own pain or for clinicians attempting to treat pain, the interaction between history, emotional factors, family status, and numerous other variables must be considered in order to determine what is truly affecting one's pain experience.

We have now finished the history and theories of pain, and will begin to move on to way to control pain. Do you have any questions?

<u>Techniques to help modify and regulate pain.</u> There are various techniques that can be used to help modify and regulate pain. Many people find that controlling their thoughts and feelings can be helpful.

<u>Turning Up Your Control Dial</u>. Let's practice controlling pain. One way to think of this is that there are two radio dials in the back of your head. One is labeled Mental Pain, this dial is controlled by negative emotional or physical events such as the stress you feel after a fight with your friend or a back ache. The other dial is also in the back of your head and you didn't know it was there. It is labeled Control. Its settings indicate how much your try to control your mental pain and how much effort you are willing to expend to control it. The path towards less pain involves turning <u>up</u> the control dial – in other words, putting more effort into controlling your pain.

The mental pain dial is determined by the nature of the stimulus (for example, how bad your fight with your friend was or how painful your backache is) and it won't budge. Can you just directly "dial down" the level of emotional or physical pain you experience to a level you would prefer? Can you directly alter the sensory experience of the pain? Can you change the disturbing picture?

If your answer is no, perhaps you are not responsible for that dial. But now ask yourself this: Who sets the control dial in your head? Who determines how much effort you expend to control your pain when it shows up? **You** can set your control dial to a high, medium or low setting. When you experience moderate levels of mental pain and your control dial is zero, this leads to greater suffering.

In contrast, what would happen to your mental pain if we moved your control dial from zero to the fifth notch? What difference would this make to your experience of pain? It is thought that when individuals with physical pain increase their effort to control their pain even a little, their distress is reduced. It can even reduce their perception of pain. Likewise, when you experience distress of any kind - even if that is emotional distress- and you increase your effort to control your experience, you can begin to live your life with a sense of control and reduce your suffering.

How you try to control the pain is up to you. In fact, choosing the strategy yourself is part of the experience of control. You can use strategies you have experience with that have worked for you in the past. What strategies have you used in the past? If you make use of this strategy later, you may feel less pain. Also, feel free to use other control strategies you feel will help.

<u>Identification Perspective</u>. An important part of the process of control is realizing that our thoughts, feelings and sensations **are the same** as 'who we are'. Depending on how things are going in our life, like whether or not we got enough sleep last night, how our weekend was, or any other number of factors, we can have very different thoughts, feelings and sensations. In

other words, our sense of self can change on a minute-to-minute or day-by-day basis. So, if we want to have control over “who we are”, we need to learn how to influence our thoughts and feelings. By striving to control our inner experience, we can develop a sense of coherence to our sense of self over time– because our thoughts and feelings are “who we are”. ./

Cognitive behavioral approaches to pain focus on trying to control the conditions that amplify and prolong it. Self-monitoring is the first step in this process. This includes monitoring your inner experiences and striving to influence them.

Inner experiences that precede a painful event are called antecedents. For example, before experiencing a painful event we can have internal thoughts and feelings going on inside our heads, such as “I am afraid and unable to cope with pain”. Or another person might experience urges to flee the situation. These would be examples of antecedents, inner experiences, or in this case thoughts, that happen before the painful experience.

Inner experiences can also occur after a painful event has ended, and they are known as the consequences of the pain. For example, after experiencing a painful emotional event, such as romantic rejection, one may experience deep feelings of sadness and even feelings of hopelessness as we question whether we are loveable.

So, it is not just the painful event itself, but the thoughts and feelings we experience before and after the event that determine our level of pain. However, how you try to control the internal antecedents and consequence of pain is up to you. In fact, choosing the strategy yourself is part of the experience of control.

Now, let's practice this. I want you to think of something painful you have experienced recently. Maybe this is a fight with a friend or an issue with your family. (give a pause) Describe how your antecedent thoughts or feelings contributed to your pain. (give a pause) Now, describe the thoughts and feelings you had after the painful event, the consequences. (give a pause) Remember that you can learn how to alter your anticipatory thoughts and feelings. Likewise, you can learn how to influence your thoughts and feelings in the aftermath of an event too. These feelings might not change overnight, but overtime you can learn ways to identify and control them.

Transition to Practice Phase.
In the first phase of this study, you viewed some pictures and experienced heat stimulation. During the last phase of this study you will experience the same negative images and thermal stimuli. In this next phase, try your best to monitor your thoughts and feelings that arise and notice whether you can influence them. Keep in mind that it does take some people longer to learn how to monitor their thoughts and feelings and even longer to control them, so you might not fully grasp this today. You may choose whatever strategy you’d like to help you notice and influence your experience of pain that may come from viewing the pictures or the heat

stimulation. However we do need to you keep your eyes on the picture at all times (in other words, don't look away from the picture to reduce any emotional pain you might feel).

<u>Practice Phase.</u> Now we are going to practice while viewing a few negative images and then with a few thermal stimulations.

Image 1: What was your experience like? Did any thoughts or feelings before or after the image make it challenging for you? Let's try this again.

Image 2: How was it this time? Did any thoughts or feelings occur before or linger?

Now, let's try practicing with the thermal stimuli.

Thermal stimulus 1: How was that? Let's try this again. Did any thoughts or feelings before or after the stimulus make it challenging for you?

Thermal stimulus 2: How was it this time? Did you notice any thoughts or feelings before or after the stimulus?

Transition to Test Phase: Now that you have learned a bit about emotional and physical pain and have heard about some different ways that thoughts and feelings may influence your pain, you will get to use these techniques (or others) during the final phase of the study where we will present the same pictures and thermal stimuli as we did during the first phase.