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Differential Effects of Two Mindfulness Strategies on Pain and Distress

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Abstract

Prior research has shown that training in mindfulness may lead to outcomes relevant to positive emotional and physiological health. Despite growing evidence for pain and stress modulation, previous research has primarily investigated the effects of generalized mindfulness practices in chronic pain populations. Considering the high prevalence of distress and pain among acute pain sufferers (e.g., surgery, childbirth), there is a need to explore more specific mindfulness techniques in non-clinical populations. The primary goal of this study was to assess the efficacy of the mindfulness strategies of attention and acceptance as approaches to acute pain and distress management. One-hundred and five participants completed the cold pressor task (CPT) after being randomized to one of four intervention conditions: mindfulness-based attention, mindfulness-based acceptance, guided visual imagery (i.e., distraction), or control. The primary outcome variables investigated were tolerance time, measured by length of time in the CPT, and subjective ratings of pain and distress during and after the CPT. Planned comparisons revealed the mindfulness-based interventions as having significantly longer tolerance times than the guided visual imagery intervention. Additionally, significantly longer tolerance times were found for participants in the acceptance condition when compared to the attention condition. No significant differences in subjective pain or distress were found between participants with high and low dispositional mindfulness, or among the four experimental conditions. Results of this study support the idea that different forms of mindfulness training can impact sensory experiences in unique ways. Findings lend support to the acceptance approach (compared to the attention approach) as a promising therapeutic avenue in mindfulness-based pain management.
Differential Effects of Two Mindfulness Strategies on Pain and Distress

Understanding the human mind and reducing suffering are basic goals of Western psychology; however, only recently has attention turned towards exploring the minds of individuals who do not suffer from psychopathologies. In particular, the past two decades have witnessed a steady growth in the sub-discipline of positive psychology and in the cultivation of mental well-being (Compton & Hoffman, 2013). As part of these burgeoning interests, Western scholars are increasingly turning towards the long-standing traditions of Buddhist thought for inspiration (Kok, Waugh & Fredrickson, 2013). In basic terms, Buddhist practice has spent roughly 2,000 years seeking to understand and enhance the human mind, with a central focus being the realization of spiritual liberation and mental enlightenment (Wallace & Shapiro, 2006; Walsh & Shapiro, 2006). Buddhist thought shares with Western psychology a primary interest in reducing human suffering (Wallace & Shapiro, 2006). Sharing such a fundamental goal makes a relationship between these two disciplines seem axiomatic, yet due to a history of ignorance and misunderstanding, they are only now beginning to coalesce (Walsh & Shapiro, 2006). Coming into contact after centuries of separate development has also led to mutual enrichment and to the discovery of further shared interests including the understanding of physical health, psychological capacities, and mental training and development (Wallace & Shapiro, 2006; Walsh & Shapiro, 2006). Although engaged in mutual exploration, a paradigm clash still exists, with some practitioners from each discipline tending to dismiss or pathologize the other. For example, many Buddhist-oriented thinkers view psychology as superficial, and believe that psychological techniques diminish the comprehensive Buddhist perspective by distorting its intended meaning and overlooking its larger context (McWilliams, 2012; Walsh & Shapiro, 2006). However, with greater knowledge has come greater open-mindedness; the importance of maintaining the
integrity of the broader Buddhist perspective has been noted by psychologists and it has been argued that this can be achieved through mutually sensitive engagement (Ekman, Davidson, Ricard, & Wallace, 2005). When differences between disciplines are not recognized, problems arise. Yet, when differences are appreciated, both disciplines are capable of enhancing one another and furthering the understanding of human nature and potentials (Walsh & Shapiro, 2006).

**Mindfulness**

There are many traditions of Buddhist thought that can be used to inspire Western psychology but, to date, the most researched and integrated practice has been that of mindfulness (Wallace & Shapiro, 2006). According to McWilliams (2012), mindfulness is “intentionally focusing on evident, sensory experience, which consists of momentary physical sensations and arising thoughts, combined with a willingness to experience these phenomena as they actually appear, with acceptance and curiosity” (p. 239). This encompassing definition describes a dynamic process that is much more than just being conscious of the present moment. It describes a deliberate focus, an enhanced awareness, and an unconditional acceptance.

There is a richness and depth to the meaning of mindfulness that makes it a concept that is not always easy to define. An understanding of mindfulness may be helped by considering its converse, mindlessness. Humans have all experienced the state of mindlessness. For example, consider a person driving the same route to work every day, arriving, and realizing she has no memory of how she got to her destination. Or consider when a person is asked how he is feeling, and based on failing to acknowledge and attend to thoughts or emotions, his response is, “I’m not sure” (Brown & Ryan, 2003). Functioning on autopilot is widely accepted as normal behavior because it provides a way to enhance functioning as it frees up cognitive resources to focus on
novel tasks. Mindlessness is so commonplace that mindfulness seems as if it should also be a feature of normal functioning. However, based on the definition from McWilliams (2012), as well as others (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Brown & Ryan, 2003; Coffey, Hartman, & Fredrickson, 2010), mindfulness requires intentionality as well as a clarity and vividness of experience that disengages individuals from automatic thoughts and behaviors (Brown & Ryan, 2003; Ekman et al., 2005).

Although the meaning of mindfulness can be considered subtle and elusive, numerous definitions and descriptions are available. A large collaboration of researchers (Bishop et al., 2004) proposed an operational definition of mindfulness that utilizes both an attentional and an acceptance based component. The attentional component is commonly considered a first step in mindfulness and refers to the ability to intentionally regulate attention. The authors explain that although regulating the focus of attention to current experience can prove difficult, it can be honed by repeated and deliberate observation of thoughts, feelings, and sensations of the present moment. The acceptance component commonly follows self-regulated attention and involves an openness and curiosity towards where the mind wanders and towards each moment of experience. The authors explain that maintaining a non-judgmental receptivity, rather than trying to produce or achieve a particular state, is an active process of allowing direct exposure to all experiences. Attention and acceptance are the most commonly cited components in the psychological literature conceptualizing mindfulness.

Some definitions of mindfulness include elements besides attention and acceptance. For example, the Baer et al. (2006) study conceptualizes mindfulness as a multifaceted construct comprised of the components of non-reactivity to inner experience, awareness, describing/labeling, and non-judgment of experience. This particular definition stands apart from
others as it does not incorporate the element of observation. It suggests that individuals low in mindfulness cannot experience both a state of observation and a state of non-judgment simultaneously because they lack the required skill. Brown and Ryan (2003) describe mindfulness as being attentive to and aware of the present moment by registering all incoming stimuli, including activities of the mind, while clearly attending to them as they are and not through any construal. Brown and Ryan’s (2003) definition does not incorporate an acceptance component; they argue that acceptance is not an active process as it can be equated with passive resignation. Moreover, they contend that attentional control can subsume any concept of acceptance. Another definition constructed by Shapiro, Carlson, Astin and Freedman (2006) defined mindfulness as including attention, but added two additional components: intention and attitude. Intention is realizing the purpose behind mindfulness actions, and then using a dynamically evolving understanding to shape mindfulness outcomes. Attitude refers to how a person attends to attention beyond bare awareness. The authors explain that pleasant experiences should not be strived for, just as aversive experiences should not be pushed away. Instead, the attitudes of patience, compassion and non-striving should be brought to the act of awareness to keep from cultivating a cold, judgmental pattern of attention.

All of the aforementioned descriptions capture aspects of mindfulness, with the definitions treating mindfulness as either a dispositional or a trait-like factor possessed by a person over time, or as a state-like skill that can be utilized in the moment (Brown & Ryan, 2003). Mindfulness scholars generally agree that only through repetition can people begin to strengthen their ability to control and sustain attention, and to openly accept experience (Shapiro et al., 2006; Walsh & Shapiro, 2006). The Kentucky Inventory of Mindfulness Skills (KIMS) is an instrument designed to assess a person’s tendency to be mindful in their life while also
measuring mindfulness as a multifaceted construct. The KIMS separates mindfulness into the component processes of observing, describing, acting with awareness, and accepting without judgment (Baer, Smith, & Allen, 2004). A study by Baer, Smith, and Allen (2004) found in a student population without mindfulness experience that mindfulness was a naturally occurring characteristic which demonstrated meaningful variation across the four KIMS factors. After the development of the KIMS, a question that remained to be answered was whether the KIMS could generalize to situational (i.e., state-like) processes. The empirical literature provides numerous examples of support for the efficacy of training in mindfulness but assessments of mindfulness have received far less attention. An accurate mindfulness measurement should occur at both the dispositional and situational level. The gap between the dispositional and situational assessment of the KIMS was examined by Mitchell, Bach, and Cassisi (2013). These authors sought to demonstrate that although the KIMS was designed as a dispositional measure that it would also be able to detect mindfulness skills in various situations. Results of their study showed that higher levels of dispositional mindfulness predicted greater use of situational mindfulness.

**Potential Processes of Mindfulness**

Intentionally focusing on thoughts, feelings, and sensations, is a practice whereby a person is aware of all incoming sensations and experiences and attends to them without construal or change. Elevated moment to moment awareness acknowledges experience as it is, freeing a person from judgment, and from thoughts and emotions that are detrimental to the pursuit of enduring happiness (McWilliams, 2012). The goal of mindfulness is not to completely rid oneself of thoughts and emotions, but instead to regulate experience and action once a thought comes to mind or an emotion is felt (Ekman et al., 2005). As an individual develops abilities to remain aware and accepting of the present moment it is possible that he or she will also come to
regard experience less conditionally and that this increasing unconditional regard will result in more awareness and more acceptance. As a person becomes more aware and accepting, he may be better able to distinguish disruptive thoughts and emotions from useful ones, thereby facilitating behavior choices that are consistent with needs, values, and interests (Brown & Ryan, 2003). Additionally, the refinement of awareness may help with disidentification, or the process of precisely observing incoming stimuli as nothing more than what it is and therefore ceasing to identify with it (Ekman et al., 2005). By taking meaning away from events, a person can shift the way she views and interacts with reality, and thereby remain unaffected by it. These forms of behavioral and emotional inhibitions, as well as non-reactivity, are types of self-regulation, and it is thought that they can help lead to more adaptive responses to incoming aversive stimuli.

Through mindfulness training people can learn to perceive what is presented to the senses, including their own state of mind, as simple representations of a constantly changing world. This is in comparison to viewing a distorted image of the world that is the result of personal projections. Certain Buddhist thoughts hold that personal flourishing arises from true insight into the nature of reality, but that a sound understanding cannot be achieved until a person has reduced imbalances of the mind (Ekman et al., 2005). One model for mental balance proposed by Wallace and Shapiro (2006) includes processes also involved in mindfulness training. The components are fourfold: conative, attentional, cognitive, and affective. Conative balance describes the ability to set goals, and have intentions and volitions. Attentional balance is the ability to sustain voluntary attention. Cognitive balance is described as non-judgmental moment-to-moment engagement, and affective balance is explained as the ability to regulate emotion. Cultivating mental balance through practicing these components increases personal functioning by shifting emotions away from conceptual stimuli and creating an unstructured and
unfiltered awareness of reality. In this way, a person can stop grasping at hedonic pleasures for enduring happiness and begin to identify true sources of genuine well-being.

**Mindfulness and Psychological Health**

The growing interest over the past few decades in the concept of mindfulness has attended primarily to its benefits for clinical populations (McWilliams, 2012; Shapiro et al., 2006). However, training in mindfulness is not only about freeing a person from suffering, it is also about nurturing and strengthening well-being. The relationship between mindfulness and well-being has been shown by Brown and Ryan (2003) in that more mindful individuals show higher self-esteem, optimism, positive affectivity, and life satisfaction, and by Baer et al. (2006) in that mindfulness is positively correlated with greater emotional intelligence and self-compassion. There are also a growing number of studies suggesting that training in mindfulness can result in positive psychological outcomes in non-clinical populations. In a study by Shapiro, Schwartz and Bonner (1998), students in medical school were randomly assigned to a mindfulness intervention or a wait-list control group. The intervention was an 8-week program in which students received training in focused attention, loving-kindness meditation, and active awareness of body sensations, thoughts, and emotions. Participants in both groups were measured before and after the 8-week program on levels of psychological distress, depression, and anxiety. Those in the mindfulness program showed significantly reduced symptoms on all measures, and the effectiveness of the intervention was found to be positively related to compliance and commitment to the mindfulness practices. Another study looked at university students studying for an exam, and assessed psychological wellness through a depression, anxiety, and stress questionnaire (DASS; Myint, Choy, Su, & Lam, 2011). Students were assigned to either a 3-week mindfulness program consisting of focused breathing, open attention,
and non-judgmental acceptance, or a control group consisting of eyes-closed relaxation. In response to the intervention, participants in the mindfulness group showed a significant reduction in their DASS scores. One last example comes from Arch and Craske (2006), who looked at the effects of a mindfulness breathing induction on university students. A focused breathing group was told to direct their attention and awareness to experiencing the present moment and to particularly focus on the experience of breathing. An unfocused attention group was told to let their minds wander freely and to refrain from focusing on anything particular. After the induction, participants in the focused breathing group reported lower negative affect and less emotional volatility than did the unfocused attention group.

The aforementioned studies show positive benefits of mindfulness training for non-clinical populations. Unfortunately, these particular studies also show that the efficacy of mindfulness is often inferred from a variety of interventions which generally fail to relate the mindfulness skill to the perceived benefit (Kingston, Chadwick, Meron, & Skinner, 2007). In other words, the exact mechanism by which mindfulness leads to the noted psychological benefits, or whether mindfulness per se is the active ingredient, remains unexamined. Most studies are not equipped to establish such mechanisms since mindfulness programs are complex and multifaceted, incorporating elements of various mindfulness techniques. Even considering only the most directly related mindfulness components, two different aspects remain: attention and acceptance. In order to investigate the mechanisms of mindfulness, and develop it as a maximally effective intervention, it would be helpful to study mindfulness in a form that separates it into the processes of attention and acceptance as much as possible. In this way, a step towards characterizing what mindfulness strategies benefit subgroups of individuals could be
taken. Further, this should be done not only for mental health measures, but also for physical well-being.

**Mindfulness and Physiological Health**

Historically, approaches to treating physical health problems, such as pain, have focused on physiological means (e.g., drugs). Yet physical well-being can, at times, have little to do with physical sensations but instead be dependent on how a person deals with experiences. Specifically, recent research suggests that cognitive manipulation techniques may offer an approach to physiological ailments such as chronic pain, fibromyalgia, and issues related to cancer (Gard, Holzel, Sack, Hempel, Lazar, Vaitl, & Ott, 2012; Reiner, Tibi, & Lipsitz, 2013). Cognitive manipulations such as anticipation, distraction, modification, and hypnosis have been well researched and they have all been shown to have variable effects on treating physiological health (Gard et al., 2012; Perlman, Salomons, Davidson, & Lutz, 2010). Likewise, research is beginning to suggest that mindfulness may also help treat physical symptoms (e.g., Blacker, Herbert, Forman, & Kounios, 2012; Kok et al., 2013; Masedo & Esteve, 2007). Two of the latest meta-analyses on mindfulness-based interventions (Grossman, Neimann, Schmidt, & Walach, 2004; Reiner et al., 2013) found that mindfulness can help improve both pain tolerance and pain intensity ratings in chronic pain populations. This is thought to be the result of mindfulness uncoupling the physical from the emotional and cognitive sensations and, in doing so, reducing the amount of suffering. A recent neuroimaging study by Davidson and colleagues (2003) measured electrical activity in the brain before and after an 8-week mindfulness training program. Results showed that training in the program resulted in greater left-sided anterior brain activation, an area of the brain associated with positive emotions, immune function, and adaptive responding to aversive stimuli. Specifically, it was shown that individuals with the greatest left-
side anterior activation showed the fastest recovery to negative physical provocation (the influenza vaccine). Although a causal effect cannot be inferred, a relationship between physical health and psychological states suggests that the contribution of mindfulness to one area may positively affect the other.

**Mindfulness and Pain**

When it comes to physiological health, most scientific attention has been devoted to mindfulness for its use in the treatment of chronic pain (Brown & Ryan, 2003; Kabat-Zinn, Lipworth, & Bruney, 1985; Shapiro et al., 2006). In 1985 a study by Kabat-Zinn and colleagues was one of the first to demonstrate that after a 10-week mindfulness training program, treatment-resistant chronic pain patients demonstrated fewer medical symptoms and reported feeling significantly lower amounts of pain. Even after 15 months, during a post study follow-up, the improvements were still evident. More recently, two studies (Grossman, Tiefenthaler, Raysz, & Kesper, 2007; Morone, Greco, & Weiner, 2008) showed that after 8-week mindfulness programs, participants with either chronic lower back pain or fibromyalgia reported improvements in pain as well as in their ability to physically function.

Unlike other cognitive manipulation strategies for pain treatment, mindfulness does not call for distraction, reappraisal, or change. Instead, mindfulness proposes directing non-judgmental attention towards the pain. Although it seems counterintuitive, bringing attention towards the painful stimuli can help to reduce pain catastrophizing, or the tendency to exaggerate the seriousness of the pain (Gard et al., 2012; Perlman et al., 2010). Further, mindfulness does not involve a top-down approach, or a striving to change expectations about the intensity of the pain stimulus, but rather it emphasizes a bottom-up approach of processing the sensory stimuli (Gard et al., 2012). Taken from this perspective, mindfulness emphasizes broad outcomes such
as quality of life and well-being, instead of primarily focusing on pain intensity, which for many humans is a major source of psychological distress (Reiner et al., 2013).

Although there is growing evidence that mindfulness may be effective in treating chronic pain, little attention has been devoted to the effects of mindfulness on pain in healthy subjects (e.g., childbirth, surgery). In addition, the majority of studies on mindfulness support the use of persistent, long-term mindfulness training (e.g., several months) to modulate the perception of pain. There is less evidence regarding the shorter term delivery of mindfulness approaches to coping with pain. Considering that mindfulness training can have a limited impact because it can be lengthy, it is important to examine not only acute pain interventions, but also the efficacy of short-term acute pain interventions. To our knowledge, only four studies have looked at the effects of short-term mindfulness interventions in healthy participants. Zeidan, Gordon, Merchant, and Goolkasain (2009) showed that mindfulness training consisting of 30 minutes a day for 3 days led to reduced pain intensity ratings from an electrical stimulus. Liu, Wang, Chang, Chen, and Si (2012) also found that a mindfulness intervention could help with pain coping. Specifically, after one, 15-minute mindfulness intervention, participants showed increased pain tolerance and decreased distress in a pain task. Kingston, et al. (2007) found that compared with a control group, participants with six, 1-hour mindfulness training sessions, showed increased pain tolerance in a pain task. These particular studies concluded that mindfulness training, however brief, can help benefit pain control.

The fourth study investigating mindfulness and induced pain looked at the effects of mindfulness in highly trained mindfulness experts compared to mindfulness naïve participants (Grant & Rainville, 2009). It was found that being mindful during a painful stimulus resulted in reduced pain intensity ratings but only in the experienced mindfulness practitioners. Results from
this study suggest that experience with mindfulness may lower a person’s pain sensitivity or that practicing mindfulness during a painful stimulus may increase analgesic effects. Due to these findings, short-term acute pain interventions should be studied using subjects with no prior mindfulness experience.

Although there appears to be a pattern of benefits for mindfulness interventions, mindfulness strategies are highly varied, and it is unclear which mechanism of mindfulness leads to such benefits. Effective psychological treatments for pain and psychological distress will need to characterize the concept of mindfulness by what strategies benefit subgroups of individuals. Considering the definition from Bishop et al. (2004), the two most related strategies of mindfulness are attention and acceptance. In order to investigate the mechanisms by which mindfulness interventions affect pain and distress, these variables should be studied in an experimental paradigm that separates the attention and acceptance processes as much as possible. In addition, mindfulness should be examined in mindfulness naïve participants. To our knowledge, no previous work has attempted to investigate the particular strategies of attention and acceptance in relation to their effects on acute pain and distress. The proposed project will consider the mindfulness strategies of attention and acceptance and examine the differing effects they have on pain and distress management with mindfulness naïve participants in the cold presser pain task. The cold presser pain task was selected as an acute pain induction technique as prior studies have shown it to have good reliability and validity (Edens & Gil, 1995), and it to be a painful stimulus that can be affected by psychological manipulations (Leventhal, Brown, Shacham, & Engquist, 1979).
Preliminary study

A preliminary study was conducted with college students to assess the adequacy of both the acceptance and attention intervention. Participants were 20 college students recruited from the California State University San Marco Psychology Department’s Human Participant Pool. Participants listened to tailored recordings (i.e., the recordings did not mention the cold presser task) and were then asked to complete a quiz and a questionnaire. The questionnaire assessed experience of the interventions by asking participants to rate on a Likert-type scale (1= not at all, 4= moderately, 7= very much so) how immersed, focused, attentive, and engaged they were while listening to the recording. The quiz assessed if participants had listened, understood, and retained information from the recording. Results showed for both the attention and acceptance intervention recordings that all participants rated being at least moderately immersed, focused, attentive, and engaged and that over 80% rated these experiences as more than moderate. The quizzes showed 97% accuracy which was taken to indicate that participants understood the recorded intervention and that they should be able to utilize the intervention technique during the cold presser task.

The Current Study

The primary goal of the current study is to assess the efficacy of the mindfulness strategies of attention and acceptance as approaches to pain management. In order to develop a fuller understanding of the effects of these specific mindfulness strategies on acute pain and distress, we made use of four intervention conditions. Previous research (e.g., Liu et al., 2012; McMullena et al., 2008) has shown that participants in pain tasks spontaneously try to cope with pain and distress by distracting themselves from their current experience. On the basis of these findings, a guided visual imagery condition, which directs attention away from the present
moment but also shares several important features with mindfulness such as physical inactivity and mental alertness, was used. A control condition was also included that did not provide a coping strategy for participants to utilize during the cold presser task. Finally, although the processes of attention and acceptance may overlap to some degree, the two interventions for these strategies were designed to separate the two states as much as possible.

The following hypotheses were tested:

1. Compared to participants with low dispositional mindfulness during the cold presser pain task, those with high dispositional mindfulness will show:
   a) Longer tolerance time
   b) Lower pain ratings
   c) Lower distress ratings

2. Compared to the control group during the cold presser pain task, attention, acceptance, and guided visual imagery groups will show:
   a) Longer tolerance time
   b) Lower pain ratings
   c) Lower distress ratings

3. Compared to the guided visual imagery group during the cold presser pain task, attention and acceptance groups will show:
   a) Longer tolerance time
   b) Lower pain ratings
   c) Lower distress ratings

In addition, one research question was investigated:
1. Do participants using the mindfulness strategy of acceptance during the cold presser pain task differ from participants using the mindfulness strategy of attention in:
   a) Tolerance time?
   b) Pain ratings?
   c) Distress ratings?

Methods

Participants

A power analysis was conducted in order to establish appropriate sample sizes. To obtain an estimated effect size of mindfulness, pain ratings and pain tolerance, and mindfulness, distress ratings and distress tolerance, Cohen’s d was calculated from previously published studies. Once effect sizes were obtained, all analyses were done at a power of .80 and alpha set at .05 (Cohen, 1992). From this, in an effort to detect a medium effect, 105 participants were recruited and divided into the four intervention groups. Based on prior research showing gender to moderate experimentally induced pain (Keogh, Bond, Hanmer, & Tilston, 2005; Keogh, Hatton, & Ellery, 2000), each intervention group was constructed to have an equal number of males and females. Of the 105 participants, 53 were female and 52 were male (the extra female was due to oversampling). Almost all participants (97%) were between the ages of 18 and 30, with three participants between the ages of 33 and 43. In terms of ethnicity, 43.8% identified as White/Caucasian, 43.8% as Hispanic or Latino, 15.2% as Asian or Pacific Islander, 6% as other, and 5.7% as Black or African American. Dispositional mindfulness scores of the 105 participants ranged from 100 to 171 with a median score of 128 (the highest score possible on the KIMS is 195).
Cold Presser Apparatus

The cold presser machine (JeioTech Inc) is a water pump that continually circulates water at a freezing temperature of 0°C Celsius. A lid covers an opening at the top of the machine holding the water. When the lid was removed participants submerged their hand in the water for as long as tolerable. To be careful about recording reliable results, the cold presser machine was calibrated using an external thermometer after every five participants to ensure that the temperatures were accurate.

Measures

Medical History and Demographics. A questionnaire was used to exclude participants with pre-existing health conditions or prior mindfulness experience. The list of medical conditions used in previous cold presser task research, and what was included for medical ineligibility in the present study, included: arthritis, circulatory problems, peripheral neuropathy, thyroid problems, diabetes, systemic lupus erthematosis, scleroderma, other connective tissue disorder, cardiovascular disorder or high blood pressure, fainting or seizures, frostbite, and any trauma to the non-dominant hand. Along with medical history, demographic information was assessed, including age, gender, and ethnicity.

Mindfulness. Participants completed the Kentucky Inventory of Mindfulness Skills (KIMS), a 39-item questionnaire that has shown to measure mindfulness at both the dispositional and situational level (Baer et al., 2004; Mitchell et al., 2013). The KIMS has shown good internal consistency between $\alpha = .77-.91$, and it assesses mindfulness with four factors: observing, describing, acting with awareness, and accepting without judgment. The subscales can be scored individually or the scales can also be combined to form a composite score of dispositional mindfulness. Questions are scored on a 5-point scale (1 = never true, 5 = always true) and include
questions such as, “I pay attention to how my emotions affect my thoughts and behaviors” and “I get completely absorbed in what I am doing, so that all my attention is focused”.

**Outcome Measures.**

*Tolerance time.* The tolerance time is the length of time that the subject’s non-dominant hand was kept in the cold water. The seconds of immersion were recorded using a digital stopwatch.

*Pain immersion ratings.* Subjective pain was assessed by a Likert-type rating scale (displayed in front of the subject during the cold presser task) with the endpoints (0) indicating ‘no pain’ and (10) indicating ‘the worst pain’. Participants were asked ‘how much pain do you feel at the moment?’ Based on prior research (Kingston et al., 2007; Masedo & Esteve, 2006) pain intensity was measured at 30 second intervals. The scores for each participant was summed and divided by the number of ratings collected for each participant. This ratio helped control for individual participants’ different tolerance times (i.e., shorter tolerance times may result in the lowest pain and distress ratings).

*Distress immersion ratings.* Subjective distress was assessed by a Likert-type scale (displayed in front of the subject during the cold-pressor task) with the endpoints (0) indicating ‘no distress’ and (10) indicating ‘the worst distress’. Participants were asked ‘how distressed are you at the moment by the pain in your hand?’ Based on prior research (Masedo & Esteve, 2006), distress was measured at 30 second intervals and all the ratings were summed and divided by the number of ratings collected. Distress immersion ratings were assessed either directly before or directly after the pain immersion ratings. To account for the possibility of ordering effects, the two questions were reversed at every 30 second time interval.
**Pain recovery ratings.** Pain recovery ratings were assessed by the same Likert-type scale as the pain immersion ratings with the endpoints (0) indicating ‘no pain’ and (10) indicating ‘the worst pain’. Participants were asked ‘how much pain do you feel at the moment?’ Pain recovery was taken in two periods of 30-seconds after the participant removed their hand from the ice water: Period 1, 30 seconds after participants took their hand out of the water; and period 2, 60 seconds after participants took their hand out of the water (Masedo & Esteve, 2006).

**Distress recovery ratings.** Distress recovery ratings were assessed by the same Likert-type scale as the distress immersion ratings with the endpoints (0) indicating ‘no distress and (10) indicating ‘the worst distress’. Participants were asked ‘how much distress do you feel at the moment?’ Distress recovery was taken in two periods of 30-seconds after the participant removed their hand from the ice water: Period 1, 30 seconds after participants took their hand out of the water; and period 2, 60 seconds after participants took their hand out of the water (Masedo & Esteve, 2006). To account for the possibility of ordering effects, the two recovery questions were reversed at the second time period.

**Procedure**

**Recruitment and Screening.** Students were recruited through the Psychology Department Human Participant Pool (HPP) at California State University San Marcos. The recruitment page on the HPP website included the medical criteria for eligibility in the study. Upon arriving for the study, participants were again screened for medical eligibility as well as for inclusion criteria through a verbally administered questionnaire. Inclusion criteria consisted of being 18 years of age or older and having no prior mindfulness experience. Prior mindfulness experience was considered as having had exposure to at least one formal version of mindfulness training (e.g., a class, a practice, a self-help model). Medical eligibility was classified as not
possessing any criteria on the screening questionnaire. Once the participants were deemed eligible, they were allowed to participate in the study.

**Conditions.** Participants were randomly assigned to one of two mindfulness strategies (attention or acceptance), or one of two distraction conditions (guided visual imagery or control). All conditions were played by recording on a non-internet accessible computer, which was administered by an experimenter blind to condition. The interventions for each of the groups lasted approximately 15-minutes. At the beginning of the interventions, participants were told the rationale for the study and that it was important they treat the recording and the cold presser task seriously. The attention, acceptance, and guided visual imagery conditions were also told that the strategies they learned should be used during the cold presser task (see Appendix).

**Acceptance.** This group was asked to accept, and not control sensations, emotions and thoughts. The training was based on the acceptance framework of Acceptance and Commitment Therapy (Blacker et al., 2012; Hayes, Bissett, Korn, Zettle, Rosenfarb, Cooper, & Grundt, 1999; Hayes, Strosahl, & Wilson, 1999). The first part of the training focused on introducing the idea of acceptance. After the introduction, an acceptance rationale was provided with examples and metaphors. The rationale attempted to disconnect automatic thoughts and feelings. Following the rationale there was guided practice and exercises.

**Attention.** This group was asked to notice sensations, emotions and thoughts. The training was based on exercises from Acceptance and Commitment Therapy (Hayes et al., 1999a; Hayes et al., 1999b) as well as breathing exercises from Arch and Craske (2006). The first part of the training focused on introducing the idea of attention. After the introduction, an attention rationale was provided with examples and metaphors. The rationale attempted to
connect participants in an in-depth way to the present moment. Following the rationale there was guided practice and exercises.

**Guided Visual Imagery.** This group was trained in guided visual imagery (GVI), a relaxation strategy that directs attention away from the present moment (Smith, 1999), but shares several common features with the concept of mindfulness (e.g., restful alertness, mental activity). The training focused on introducing GVI, and then practicing. It encouraged participants to evoke mental images of scenes (e.g., walking through the woods) described by the recording.

**Control.** This group was instructed to rest and look through provided neutral magazines for 15 minutes. They were not told to utilize any techniques during the cold presser task.

**Post-experimental manipulation check.** To evaluate the integrity of the interventions, participants were asked to complete a post-intervention questionnaire. Rating on a scale of 1 to 7, the questionnaire assessed how useful each strategy was (i.e., with 7 corresponding to very useful) and how much the participant applied the given strategy during the cold presser task (i.e., with 7 corresponding to applied fully).

**Day of the study.** Upon arriving for their scheduled intervention, a screening questionnaire was verbally presented to participants to exclude those who possessed pre-existing health conditions which might be exacerbated by the cold presser task. In addition to being deemed medically eligible, participants also had to meet the inclusion criteria of being 18 years old and having no formal mindfulness training. Participants that passed the screening were given a consent form to sign indicating their understanding of the study. Participants were told that the purpose of the study was to gain information that may benefit people suffering from pain. Upon consent, participants were told about the cold presser task. Following this, participants were instructed to complete the demographic questions and the KIMS questionnaire and to then listen
to and, if applicable, follow along with, one of the four intervention recordings. When this was completed, participants were again instructed on the cold presser task (CPT). Instructions were to keep their non-dominant hand in the water up to the wrist for as long as possible, and to remove their hand when the sensation became intolerable. No subject was allowed to exceed 5 minutes due to safety concerns, but no one was informed of this limit prior to the procedure. While engaging in the CPT participants answered questions about their subjective pain and distress. Once they removed their hand from the water, they were again asked about their pain and distress levels. After participants completed the post-experimental manipulation check questionnaire, they were debriefed and given information about Student Health and Counseling Services.

**Results**

Prior to analysis, the data set was examined for accuracy of data entry. Visual inspection of histograms and calculated confidence intervals for skewness were used to assess normality for each of the dependent variables. Pain tolerance and subjective pain ratings greater than 2.5 SD away from the mean were winzorized to help improve normality.

**Hypothesis 1: High versus low dispositional mindfulness**

An independent samples $t$-test was conducted to determine whether participants with low dispositional mindfulness and high dispositional mindfulness differed in tolerance times. Results showed no significant difference in the amount of time that participants with low and high dispositional mindfulness were able to keep their hand submerged in the cold water, $t(52.12) = 0.67, p = .51, d = 0.18$ (see Table 1 for means and standard deviations). Pain immersion ratings for participants with low and high dispositional mindfulness were also investigated. Results showed no significant group differences, $t(52.96) = 1.24, p = .22, d = 0.33$. Finally, an
independent samples $t$-test for distress immersion ratings showed no significant differences between participants with low and high dispositional mindfulness, $t(52.86) = 0.16, p = .88, d = 0.04.$

Table 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>Low</th>
<th>SD</th>
<th>High</th>
<th>SD</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Immersion</td>
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<td>1.97</td>
<td>6.81</td>
<td>1.94</td>
<td>.22</td>
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<td>4.76</td>
<td>2.42</td>
<td>.88</td>
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<tr>
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<td>98.91</td>
<td>88.95</td>
<td>.51</td>
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<tr>
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<td>2.16</td>
<td>4.41</td>
<td>2.37</td>
<td>.93</td>
</tr>
<tr>
<td>Pain Recovery 2</td>
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<td>2.00</td>
<td>2.18</td>
<td>2.13</td>
<td>.33</td>
</tr>
<tr>
<td>Distress Recovery 1</td>
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<td>1.83</td>
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<td>2.24</td>
<td>.35</td>
</tr>
<tr>
<td>Distress Recovery 2</td>
<td>.82</td>
<td>1.22</td>
<td>1.37</td>
<td>1.59</td>
<td>.16</td>
</tr>
</tbody>
</table>

Hypotheses 2 and 3 and research question 1: Experimental condition comparisons

Three series of planned orthogonal contrasts were used to test the effects of experimental condition (attention, acceptance, guided visual imagery, or control) on tolerance time, pain immersion ratings, and distress ratings. See Table 2 for means and standard deviations.

Table 2

<table>
<thead>
<tr>
<th>Measure</th>
<th>Attention</th>
<th>SD</th>
<th>Acceptance</th>
<th>SD</th>
<th>GVI</th>
<th>SD</th>
<th>Control</th>
<th>SD</th>
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</thead>
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<td>6.88</td>
<td>1.28</td>
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<td>1.78</td>
<td>6.84</td>
<td>2.16</td>
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<tr>
<td>Distress Immers.</td>
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<td>5.06</td>
<td>2.25</td>
<td>4.42</td>
<td>2.29</td>
<td>4.30</td>
<td>2.88</td>
</tr>
<tr>
<td>Tolerance</td>
<td>83.15$^{a1,b1}$</td>
<td>75.06</td>
<td>135.91$^{a1,b2}$</td>
<td>100.55</td>
<td>75.69$^{a2}$</td>
<td>61.40</td>
<td>133.67</td>
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<tr>
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<td>4.35</td>
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<td>2.74</td>
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<tr>
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<td>1.97</td>
<td>2.50</td>
<td>2.06</td>
<td>2.20</td>
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<tr>
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<td>1.83</td>
<td>1.03</td>
<td>1.51</td>
<td>1.16</td>
<td>1.79</td>
<td>0.48</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Note. Means that do not share a superscript within rows are significantly different at $p \leq .05$. $^a$Planned contrast comparing the two mindfulness conditions to the distraction condition. $^b$Planned contrast comparing the attention condition to the acceptance condition.

**Tolerance time.** The first orthogonal contrast compared the control condition to the other three conditions (Hypothesis 2). The hypothesis that the intervention conditions would show
significantly longer tolerance times compared to the control condition was not supported, 
\( t(34.68) = 1.47, p = .16, \hat{d} = 1.16 \). This comes as no surprise as participants in the acceptance condition demonstrated only marginally longer tolerance times than those in the control condition. The second contrast (Hypothesis 3) compared the distraction condition (guided visual imagery) to the two mindfulness conditions (attention and acceptance). Results showed that participants in the mindfulness conditions had notably different tolerance times than participants in the distraction condition, \( t(62.99) = 1.95, p = .05, \hat{d} = 0.37 \). Tolerance times were significantly longer in the attention (\( M = 83.15, SD = 75.06 \)) and acceptance (\( M = 135.91, SD = 100.55 \)) conditions than in the guided visual imagery condition (\( M = 75.69, SD = 61.40 \)). The third orthogonal contrast tested the research question by comparing the two mindfulness conditions to each other. Results showed that participants in the acceptance condition differed significantly from those in the attention condition, \( t(46.22) = 2.16, p = .036, \hat{d} = 0.28 \). Tolerance times were significantly longer in the acceptance group (\( M = 135.91, SD = 100.55 \)) than they were in the attention group (\( M = 83.15, SD = 75.05 \)).

**Pain immersion ratings.** Results from the planned comparison contrasting the control condition to the other three conditions for Hypothesis 2, demonstrated no significant differences in pain immersion ratings, \( t(34.91) = .816, p = .42, \hat{d} = 0.65 \). Similarly for Hypothesis 3, no significant differences were found between the distraction and mindfulness conditions, \( t(36.53) = 1.09, p = .28, \hat{d} = 0.26 \). The research question, which contrasted the acceptance condition with the attention condition for pain immersion ratings, showed no significant differences, \( t(50.99) = .998, p = .32, \hat{d} = 0.10 \).

**Distress immersion ratings.** Testing distress immersion ratings, no significant differences were found to support Hypothesis 2, \( t(37.92) = .747, p = .46, \hat{d} = 0.56 \), or Hypothesis
3, \( t(46.98) = .916, p = .36, \hat{d} = 0.21 \). Additionally, no evidence was found to support the research question regarding distress immersion ratings, \( t(50.99) = .408, p = .68, \hat{d} = 0.05 \).

**Secondary analyses: pain and distress recovery ratings**

**Hypothesis 1:** High versus low dispositional mindfulness. Distress recovery ratings were taken 30 seconds after participants removed their hand from the cold water (Time 1), and again 60 seconds after they withdrew their hand from the water (Time 2). Distress recovery ratings demonstrated no significant differences between participants with low and high mindfulness dispositions at either Time 1, \( t(50.26) = 0.94, p = .35, d = 0.39 \), or Time 2, \( t(48.64) = 1.43, p = .16, d = 0.26 \). In addition to distress recovery ratings, pain recovery ratings were also taken. No significant group differences were found in pain recovery ratings between participants with low and high dispositional mindfulness at either Time 1, \( t(52.13) = 0.08, p = .93, d = 0.02 \), or Time 2, \( t(52.47) = 0.33, p = .74, d = 0.08 \).

**Hypotheses 2 and 3 and research question 1:** Experimental condition comparisons. Distress recovery ratings taken after participants removed their hand from the cold water showed no significant differences between the intervention conditions and the control condition at either Time 1, \( t(68.39) = 2.66, p = .08, \hat{d} = 0.58 \), or Time 2, \( t(88.53) = 2.64, p = .08, \hat{d} = 0.33 \). The hypothesis that the intervention conditions would show a quicker recovery in subjective pain compared to the control condition was also not supported at Time 1, \( t(47.24) = 0.91, p = .36, \hat{d} = 0.59 \), or Time 2, \( t(57.97) = 0.87, p = .38, \hat{d} = 0.51 \). Comparing the distraction condition to the two mindfulness conditions showed no significant differences in recovery ratings at Time 1 for distress, \( t(38.51) = 0.05, p = .96, \hat{d} = 0.01 \), or pain, \( t(40.27) = 1.08, p = .29, \hat{d} = 0.28 \), or at Time 2 for distress, \( t(44.17) = -0.03, p = .98, \hat{d} = 0.01 \), or pain, \( t(49.69) = 1.27, p = .21, \hat{d} = 0.32 \). Lastly, comparing the two mindfulness conditions to each other, results demonstrated no
significant differences in distress recovery ratings at Time 1, $t(50.64) = -0.97, p = .34, \hat{d} = 0.13$, or Time 2, $t(49.83) = 0.48, p = .63, \hat{d} = 0.07$ or in pain recovery ratings at Time 1, $t(50.80) = .69, p = .49, \hat{d} = 0.09$, or Time 2, $t(50.90) = 0.56, p = .57, \hat{d} = 0.08$.

**Discussion**

The present study explored the effects of short-term training in different techniques as approaches to dealing with acute pain. Participants were instructed in one of three strategies: a mindfulness-based attention technique, a mindfulness-based acceptance technique, or a distraction technique. In addition, a control condition was used where participants were given no instruction, and had to cope with induced pain spontaneously. After being instructed in a technique, management of pain was investigated by exposing participants to a painful stimulus in the form of the cold pressor task (CPT).

Consistent with what was hypothesized, those receiving the mindfulness-based interventions showed significantly longer tolerance times than did those in the guided visual imagery (distraction) intervention. This finding supports previous research from Hayes et al. (1999a) which found that participants trained in mindfulness demonstrated greater tolerance times when keeping their hand in cold water compared with participants in a distraction group. The present research further found significantly longer tolerance times for participants in the acceptance condition compared to the attention condition. This finding adds support to the interpretation that diverse forms of mindfulness-based training can produce specific effects and have different benefits.

Of particular interest to this study was the question of how different pain management techniques affected not only tolerance time but also subjective pain and distress ratings. Contrary to what was predicted, no differences were found in pain or distress ratings between the
experimental conditions. This is consistent with findings from previous studies using similar methodology (e.g., Liu et al., 2012, McMullen et al., 2007). Based on the framework of mindfulness, however, it was expected that participants in the mindfulness-based conditions would experience a reduction in pain and distress due to a stance of detached observation and a subsequent lack of cognitive and affective elaboration of sensory input (Reiner et al., 2013). Although differences between the groups in subjective measures of pain and distress were not found, it is possible that the mindfulness-based interventions still aided participants in uncoupling their experience from their behavior. Considering the participants in the mindfulness-based interventions showed increased tolerance times compared to the distraction intervention, it would be understandable to expect that they would also show higher pain and distress ratings due to increased exposure to the CPT. The fact that higher pain and distress levels did not accompany longer tolerance times suggests the possibility that the mindfulness-based interventions may have broken the synchrony between private reactions and overt behavior (Hayes et al., 1999a; Pulvers, Schroeder, Limas & Zhu, 2013).

**Dispositional mindfulness**

To paraphrase some of the definitions that exist in mindfulness research, mindfulness means experiencing the present moment as it actually is by paying attention to internal and external stimuli without judgment or construal, but with openness and curiosity. Mindfulness based interventions teach participants this mental position and then encourage participants to continue with practice in everyday life. However, mindfulness is not only a state that can be experienced; mindfulness can also be thought of as a personality trait that varies among and within individuals. Specifically, prior research has found that a person’s dispositional level of mindfulness does not have a set-point, but instead, has the ability to be cultivated with practice.
(Baer et al., 2008; Brown, Ryan & Creswell, 2007). It has also been demonstrated that higher levels of mindfulness are associated with lower levels of pain intensity ratings and increased levels of endurance in response to painful stimuli (Gard et al., 2012; Grant & Rainville, 2009; Perlman et al., 2010). Nevertheless, the present study failed to demonstrate a significant difference in pain ratings or in tolerance times between the groups classified as having low and high dispositional mindfulness. One explanation for these results may be that there was not a large enough distinction between the participants with low and high dispositional mindfulness to be able to detect differences. The lowest quartile of composite mindfulness scores from the KIMS ranged from 100-121 ($M = 112$, $SD = 6.61$, $n = 28$), whereas the highest quartile contained scores ranging from 136-171 ($M = 146$, $SD = 9.34$, $n = 27$). The highest possible score on the KIMS is 195, and with the high dispositional mindfulness group demonstrating an average score of 146, the participants may have been on the lower end of the dispositional mindfulness spectrum. Given that one of the requirements for participating in the current study was having no prior mindfulness training of any kind, we may have inadvertently excluded participants with higher dispositional mindfulness. This possibility arises as people with higher levels of dispositional mindfulness may actively seek out training in mindfulness since it aligns with one of their personality traits.

Moreover, no significant differences in pain-related distress, or in the recovery ratings for pain and distress, were found between the two different mindfulness dispositions. It is possible that, even if notably distinct mindfulness dispositions were used in the investigation of pain and distress management, a mindfulness-based intervention is somehow impacting a person’s dispositional tendency toward entering a mindful state. When measuring dispositional mindfulness, the results of the evaluation do not fully account for how an individual utilizes
mindfulness in relevant situations. Given this, a post-treatment assessment of mindfulness could have helped identify any mindfulness related change that took place after our interventions. A related concern here is the accuracy of truly assessing a person’s mindfulness disposition. The KIMS is a self-report questionnaire, and although any assessment method is subject to error, self-report mindfulness questionnaires ask respondents questions about their own tendency to be mindful. Even if respondents report honestly, they may be unable to accurately answer the questions as they are not familiar with noticing these parts of their own functioning.

**Experimental conditions**

Contrary to what was hypothesized, no differences were found in any of the pain and distress variables between the groups provided with a strategy for use in the cold pressor task and the group that was not. The lack of difference may be the result of instruction in the various techniques being “therapist-free,” that is, not being led by a trained professional. In theory, interventions that are therapist-free could benefit a great number of people who cannot afford, or who may have limited access to experienced guides. In actuality, however, contact with a trained professional may be necessary to help people effectively learn the relevant strategies. The current study used pre-recorded instructions to teach participants the different techniques, and although this method helps control for inadvertent experimenter cuing, it cannot adapt to participant characteristics. In contrast, a therapist, or researcher would have direct social interaction with participants and have the ability to make any necessary adjustments while assessing how the intervention and participant are progressing.

On the other hand, the lack of difference in pain and distress variables between the strategy and control conditions may be due to the short-term training. With mindfulness-based practices, if participants attend to and accept pain, they could gradually learn that pain is in fact
not threatening and uncontrollable. However, when first learning mindfulness, and without any substantial opportunities for practice, participants may experience mental fatigue, especially during times of stress. During the cold pressor task, participants in the intervention conditions may have exerted more effort and less coping while they tried to control pain in a way that did not come naturally to them. Conversely, the lack of instructions in the control condition let participants rely on their own resources and strategies, which may have increased their ability to cope during the task. This would be consistent with the finding that tolerance time was longer in the control group than in the attention and guided visual imagery groups.

Despite the lack of differences found between the strategy groups and the control group, it was identified that the mindfulness-based interventions had a significantly greater impact on tolerance times than did the distraction intervention. Participants in the attention technique and the acceptance technique were able to keep their hand submerged in the cold water longer than participants in the guided visual imagery technique. This result supports the theoretical structure of mindfulness in that paying attention and processing incoming sensory stimuli, without construal or elaboration, can reduce pain catastrophizing (Perlman et al., 2010). By not enhancing the aversive nature of the cold pressor task, participants in the mindfulness-based interventions may have regulated their experience better and thus improved their ability to tolerate the freezing water. In addition to increased tolerance times, reduced intensity ratings were also expected to be found for the mindfulness-based interventions, but this hypothesis was not supported. No differences were found between the mindfulness-based groups and the distraction group in ratings of pain or distress. The lack of difference between the interventions in subjective pain and distress ratings supports the idea that being mindful does not necessarily
change the intensity of the pain, but rather that mindfulness targets the perception of pain and helps improve how people deal with their experience.

Prior research studies (Grossman et al., 2004; Reiner et al., 2013) have demonstrated the beneficial effects of mindfulness-based interventions on pain ratings in participants who have chronic pain. However, this study found no differences between the mindfulness-based and the distraction interventions in terms of pain and distress ratings. One explanation for this is that the mindfulness-based strategies and the distraction strategy have different effects for chronic and acute pain. According to research by Suls and Fletcher (1985), distraction can be effective and useful in short-term contexts of pain, but mindfulness is more beneficial for longer periods of time. It is feasible that distraction is only producing short bursts of behavioral perseverance in people, whereas mindfulness may be leading a person towards long-term positive adaptation (Cioffi & Holloway, 1993). Research by Gutiérrez and colleagues (2004) purports that, not only is mindfulness beneficial for longer lasting pain, but mindfulness is also effective for managing more intense pain. They suggest that distraction is more beneficial for a low or mild pain stimulus. As it stands, teasing apart the different effects of when and why distraction works as a pain management technique is still an important area.

This study separated the framework of mindfulness into the basics of attention and acceptance and found that the two strategies differed in terms of tolerance time. The mindfulness-based acceptance group was able to tolerate the cold pressor pain task significantly longer ($M = 135.91$ seconds) than was the mindfulness-based attention group ($M = 83.15$ seconds). Several prior research studies have demonstrated an advantage for acceptance based pain management over other types of interventions, such as instructing participants to try and modify or change their experienced pain (Blacker et al., 2012; Hayes et al., 1999a; McMullen et
al., 2008). In the current study, the research question, ‘Do the mindfulness strategies of attention and acceptance differ?’ was investigated in an effort to tease apart specific mindfulness training techniques and any accompanying effects. To our knowledge, no study in the extant literature had yet investigated the differences between these two mindfulness components. The study results support the idea that different forms of mindfulness training can impact sensory experiences in unique ways.

According to Kabat-Zinn (1982), the attentional aspect of mindfulness is the deliberate application of attention to a primary object of observation. On the other hand, acceptance has been defined as a non-reactive open monitoring of the present moment that distinguishes between observing incoming stimuli and any thoughts or interpretations of that stimulus (Perlman et al., 2010). Based on the results, it appears that acceptance may be more important to pain tolerance in the form of a regulatory process than is attention. This might be due to the fact that this study used novice mindfulness practitioners to investigate the differences between attention and acceptance. Understandably, when asking novice mindfulness practitioners to increase their attention towards a painful stimulus, it is likely that this also increases their awareness of the pain, which may then increase the impact of that pain. Whereas, in addition to the processing the physical sensation of pain, an acceptance approach might also interact with the affective experience of pain, giving it a stronger influence in mindfulness-based pain management (Grant & Rainville, 2009). Moreover, no differences were noted in pain and distress ratings between the attention and acceptance interventions. Taken together, these results are consistent with the underlying process of each technique. The acceptance intervention was designed to disconnect thoughts from actions, so even when participants in the acceptance group
perceived the same amount of pain as those in the attention group, they were able to tolerate the cold water longer.

**Strengths and limitations**

The current study provides additional information to the widespread interest in various forms of mental training. In terms of mindfulness-based interventions, this study was one of the first to examine the effects of two specific regulatory strategies and compare their effects on induced pain and distress. Findings lend support to the acceptance approach (compared to the attention approach) as a promising therapeutic avenue in mindfulness-based pain management. The clinical utility of these results suggest that tailoring mindfulness interventions may help to maximize their effectiveness and target the characteristics of specific psychological or physical conditions.

One notable limitation in this study was the lack of a baseline, or use of a pre-intervention measure. The decision not to use a cold pressor task before the interventions was driven by the interest in comparing differences between the techniques and not comparing the effects within the techniques. Given this, a post-experimental manipulation check was included as a means of evaluating the impact of the interventions. On average, participants within the strategy conditions reported higher than moderate ratings when asked how useful they found their instructions and how much their intervention influenced their behavior on the task. Yet, without use of a pre-intervention cold pressor task, we are unable to determine the influence or the exact amount of change that resulted from the various interventions.

Several other limitations of this study should also be noted. First, a 5 minute maximum was used in the cold pressor task, which likely prevented some participants from reaching their tolerance limit. Considering this, it is possible that group differences may have varied even more
than what was noted. Second, the ability to generalize the results is limited as this study was conducted within the confines of a laboratory and only with undergraduate students. Consequently, this provides generally limited information about more clinically relevant situations. Further, the interventions relied on pre-recorded instructions. Although participants seemed able to use the instructions they were given, it is possible that they did not understand or utilize the strategies as much as was reported. To account for this, a talk-aloud procedure or a writing assessment during the cold pressor task has been suggested (Hayes et al., 1999a), as has a semi-structured interview or quiz following the task to check for compliance and understanding of the instructions (Blacker et al., 2012; Keogh et al., 2004).

**Future research**

Given that mindfulness may benefit a large audience, and in order to create functionally effective interventions, there is still a need for continuing work in this area. Future research should continue to tease apart mindfulness, as well as investigate how the resulting effects generalize across diverse populations and empirical domains, such as psychopathology.

Pain is a multidimensional experience impacting a person mentally, emotionally, and physically (Reiner et al., 2013). In order to properly investigate the relationship between mindfulness and pain management, future research should make use of physiological measures, such as brain scans, cortisol levels, or heart rate monitors. Additionally, future studies should investigate how the effects of personal characteristics, such as anxiety, fear of pain, and emotion regulation, effect pain management. It would also be beneficial to measure pain perception before the intervention to help determine what extent a treatment impacts a person’s natural coping style.
Finally, future research is needed to help gauge when change in the experience of pain takes place during mindfulness training. Mindfulness requires a high amount of self-regulation, and for novice practitioners this demand may lead to self-regulatory fatigue and poorer pain management. On the other hand, if that self-regulation becomes more automatic with practice, there would be a decrease in effort, and mindfulness may yield more benefits (Evans, Eisenlohr-Moul, Button, Baer, & Segerstrom, 2014). Future studies should use a range of mindfulness practitioners (e.g., novice to expert) to allow for a closer examination of potential differences and changes in pain sensitivity and pain management.

Conclusion

The results of this study support the idea that training in different forms of mindfulness strategies can have specific effects on sensory and affective experiences. Although this study failed to demonstrate an effect on subjective pain or distress by intervention type, pain tolerance differences between the mindfulness groups and the distraction group were found, as well as between the attention-based and acceptance-based group. There is increasing interest in various forms of mental training, and taking into consideration the likelihood of some overlap in the attentional processes between the attention-based and acceptance-based mindfulness techniques in this study, our results contribute to the knowledge base about contrasting effects of different directions and degrees of attention. Future research utilizing a pretest-posttest design, a more diverse sample, and additional subject variables might be better able to address the question: to what extent, and by what mechanisms, can changes be implemented intentionally through forms of mindfulness training?
References


Pain attenuation through mindfulness is associated with decreased cognitive control and increased sensory processing in the brain. *Cerebral Cortex, 22*(11), 2692-2702. doi:10.1093/cercor/bhr352


Appendix

Attention

The aim of this study is to help people who suffer from discomfort and distress, so it is important that you take the following exercises seriously. During the following recording, I am going to discuss and explain a specific strategy with you for you to use when you complete the cold presser task. The idea behind learning this strategy is that it will help you better cope with any sensations you feel during the task.

1. Assume a comfortable sitting position. Try to find a position where you are sitting straight and your shoulders are relaxed
2. Either close your eyes or arrange yourself so that you are looking at something non-distracting, like a blank wall
3. Bring yourself to this room you are in, to this space and time. Take time to center yourself.

I am going to give instructions now. There is no way anyone can fail at following these instructions; we’re just going to be looking at whatever you are feeling or thinking, so whatever comes up is just right. If you find your mind wandering, just gently come back to the sound of my voice. You have been you your whole life. Everywhere you’ve been, you’ve been there to notice. From that perspective or point of view, I want you to look at some areas of living. There are 3 main points that I am going to discuss with you.

Let’s start with your body. Notice how your body is constantly changing. Sometimes it is sick, and sometimes it is well. It may be rested or tired. It may be strong or weak. Your bodily sensations come and go. Even as we have spoken, they have changed. Watch your body for a few moments and see what it does. See if you notice any bodily sensations arising.

Now let’s go to another area: emotions. Notice how your emotions are constantly changing. Sometimes you feel love and sometimes hatred, sometimes you feel calm and then tense, or joyful—sorrowful, happy—and sometimes sad. Even now you may be experiencing emotions such as interest, boredom, or relaxation. Although a wave of emotion comes, it will eventually change into something else. So take a few moments and just notice your emotions.

Now let’s turn to your thoughts. Notice how your thoughts are constantly changing. Sometimes you think about things one way and sometimes another. Sometimes your thoughts make little sense. Sometimes they seemingly come up automatically, from out of nowhere. They are constantly changing. Look at your thoughts since you came in today and notice how many different thoughts you have had. Notice your thoughts. And notice that your stream of thoughts will continue. And you may get caught up in them. When this happens, notice that a part of you is standing back, watching it all. So now just watch your thoughts for a few moments.

Now, bring your attention to your breathing and do nothing but observe what comes up. Practice awareness. This technique also applies when you have your hand in the cold presser. Instead of distracting yourself from having your hand in the cold presser, focus your attention on the
discomfort or distress and the sensations accompanying those. For now, as you breathe, observe
any sensations as they emerge in your body. As feelings emerge in your awareness, notice them.
As thoughts come into your awareness, observe them. Watch them come and watch them go. If
your mind wanders, just notice that you have wandered off and bring yourself back in touch. If
you have judgments about how well or poorly you are doing, just notice these too. Your job is
simply to practice awareness, and to gently escort your attention back to the sensation of the
breath coming in and out. Allow yourself to experience this moment. Be deeply present with
yourself. As often as the mind wanders from the breath, the task remains the same: simply bring
your mind back to the breath each time, no matter what has preoccupied it.

[pause for 45 seconds]

Keep paying attention to your experiences, and if your eyes are closed, keep them closed
In this next exercise we are going to learn some breathing practices that can be used as a tool to
bring attention to the mind and body when we deliberately choose to become aware of it. It can
create a kind of experiential exercise, as if one can actually use the breath to direct awareness to
different aspect of our lives. It can also be used during the cold presser task. After a breathing
practice has been presented, a few moments will be provided for you to experience the
descriptions.

First, bring your awareness to the changing patterns of physical sensations in the lower abdomen
as the breath moves in and out of your body. Focus your awareness on the sensations of slight
stretching as the abdominal wall rises with each inbreath, and of gentle deflation as it falls with
each outbreath. As best you can, follow with your awareness the changing physical sensations in
the lower abdomen all the way through as the breath enters your body on the inbreath and all the
way through as the breath leaves your body on the outbreath, perhaps noticing the slight pauses
between one inbreath and the following outbreath, and between one outbreath and the following
inbreath

[pause for 45 seconds]

Be fully aware of each inbreath for its full duration, and each outbreath for its full duration.
However often you notice that the mind has wandered, and this will quite likely happen over and
over again, as best you can, congratulate yourself each time on reconnecting with your
experience in the moment, gently escorting the attention back to the breath, and simply resume
following in awareness the changing pattern of physical sensations that come with each inbreath
and each outbreath

[pause for 45 seconds]

Expand the field of your awareness around your breathing, so that it includes a sense of the body
as a whole, your posture, and facial expression. The breathing space provides a way to step out
of automatic pilot mode and reconnect with the present moment. Allow your attention to expand
to any sense of discomfort, tension, or resistance. If these sensations are there, then take your
awareness there by “breathing into them” on the inbreath. Then, breathe out from those
sensations, softening and opening with the outbreath. Take time and try to picture what it would
mean to take an approach of breathing and paying attention towards any discomfort or distress you feel during the cold presser task.

[pause for 45 seconds]

Keep breathing, but slowly bring yourself back to this room you are in, to this space and time. Make a few small movements with your body. Wiggle your fingers and toes. If you had your eyes closed, I want you to open them.

Now I am going to teach you a Memory Aid for the strategy you just learned that may help you during the cold pressor task: The Acronym B.E.T.

B = Notice your body and any bodily sensations as they arise
E = Notice your emotions and how they are constantly changing
T = Notice your constant stream of thoughts and how easily you may get caught up in them. Also, notice how easily you can step back and see them from a distance.
Acceptance

The aim of this study is to help people who suffer from discomfort and distress, so it is important that you take the following exercises seriously. During the following recording, I am going to discuss and explain a specific strategy with you for you to use when you complete the cold presser task. The idea behind learning this strategy is that it will help you better cope with any sensations you feel during the task.

1. Assume a comfortable sitting position. Try to find a position where you are sitting straight and your shoulders are relaxed
2. Either close your eyes or arrange yourself so that you are looking at something non-distracting, like a blank wall
3. Bring yourself to this room you are in, to this space and time. Take time to center yourself.

I am going to give instructions now. There is no way anyone can fail at following these instructions. There are 4 main points that I am going to discuss with you. If you find your mind wandering, just gently come back to the sound of my voice.

1- Control is the Problem. We are taught from a young age that we can control our mind. However, psychologists have begun realizing that attempts to control our thoughts are most likely not going to be successful and may even make things worse, especially in stressful situations. Can you think of an example where an attempt to control a thought or feeling made it even worse? I think I can give you an example right here. Try this: for the next few seconds do not let your mind think about or imagine chocolate cake. Don’t think about what it looks like, tastes, smells, or feels like to eat. You can think of anything, but DON’T THINK OF CHOCOLATE CAKE! Suppose I offered a 1 million dollar reward to anyone who could do this, and I wired you up to a mind-reading machine to verify if you could or not. What do you think would happen? So this example shows that we cannot control our thoughts even when we have the most intense motivation to do so. It works the same for cravings: In the same way that we generally can’t control what we think about we can’t control how we feel or our thoughts. For example, trying to control your thoughts about the discomfort or distress of the cold presser may not help or be effective and you will still think about the discomfort or distress despite your efforts. The following strategy I am about to teach you will give you another way to deal with the cold presser without struggling with your thoughts and feelings.

2- Defusion/Distancing. A very important way to decrease any distress you have is to psychologically distance yourself from it. When we distance ourselves we step back from ourselves or our discomfort and see ourselves experience it from a psychological distance. When we are distanced we can experience discomfort (or any thought or feeling) as just a feeling our mind is having at that moment. Maybe we can even realize this sensation is nothing more than chemical and electrical activity in our brain. When we have this kind of distance from our thoughts and feelings we can choose not to do what those thoughts and feelings are ‘telling’ us to do. In other words, we can say: I can see myself experiencing discomfort or distress right now. I may not like it. But I’m going to accept that feeling and choose not to pull away from it.
Conjure up the image of looking down at a train from a bridge. In your mind’s eye can you get perspective so that you can see each thought or feeling or uncomfortable sensation you have *from a distance*? Now can you imagine being *inside* a particular car where the only thing in your field of vision is a huge sign that says ‘I don’t like this’. That difference between being inside the train car and seeing the train car from a distance is what we mean by distancing.

3- Acceptance. If we don’t try to control or suppress discomfort, what can we do? Perhaps it could help to accept that we are going to have this discomfort no matter what and we can’t do anything to stop our mind from wanting to get rid of it by pulling away. But the key point is that although you may not be able to control the thoughts your mind throws out or the feelings of discomfort, you CAN control your behavior. The more you just notice and accept the thoughts and discomfort the easier it will be to deal with. For example, think of any emotion you may have when you are in discomfort or distress. Is there anything truly dangerous, harmful, hostile, or bad that requires you to get rid of it, or considering it only as an emotion or thought, is this something you can experience? Take a few moments and try and experience this.

In this next exercise we are going to learn some metaphors because metaphors can present an illustration of how things work. They can create a kind of experiential exercise, as if one can actually experience the described event or story. After a metaphor has been presented a few moments will be provided for you to visualize and experience the descriptions.

**Crossing the swamp:** Imagine the cold presser task is comparable to crossing a muddy, gross, creepy swamp. And the best way to get across it is to notice any unpleasant thoughts and feelings and carry them with you, as you continue to the other side of the swamp, because you can have those thoughts and act differently than what you think or feel. The key to this metaphor is that it shows that you can have thoughts like, ‘I don’t like this,’ and still keep your hand in the water.

**Tug-of-war with a monster:** Imagine that you are playing tug-of-war with a huge monster and the monster is trying to pull you into a huge pit in the middle. The more you pull and struggle, the harder the monster pulls and you are getting closer and closer to being drug into the pit. But, rather than struggling to pull against the monster on the other side of the rope, perhaps the best way to stop yourself from being dragged into the pit is simply to let go of the rope and stop fighting against the monster. This can be compared to the cold presser task, if you view the cold water and the discomfort as the monster. Therefore, perhaps accepting the discomfort instead of fighting against it is the easiest way to deal with it.

Now I am going to teach you a Memory Aid for the strategy you just learned: The Acronym C.A.D.

- **C** = *Control is the problem* because attempts at control are most likely not going to be successful and may even make things worse.
- **A** = *Accept* whatever thoughts or feelings your mind creates without struggling with them.
- **D** = Step back from your thoughts and feelings and sensations of discomfort. See them from a *distance*.
Guided Visual Imagery

The aim of this study is to help people who suffer from discomfort or distress, so it is important that you take the following exercises seriously. During the following recording, I am going to discuss and explain a specific management strategy with you for you to use when you complete the cold presser task. The idea behind learning this strategy is that it will help you better cope with any sensations you feel during the task.

1. Assume a comfortable sitting position. Try to find a position where you are sitting straight and your shoulders are relaxed.
2. Either close your eyes or arrange yourself so that you are looking at something non-distracting, like a blank wall.
3. Bring yourself to this room you are in, to this space and time. Take time to center yourself.

I am going to give instructions now. There is no way anyone can fail at following these instructions; we’re just going to be looking at whatever you are feeling or thinking, so whatever comes up is just right. If you find your mind wandering, just gently come back to the sound of my voice. For a moment now, turn your attention to yourself in this room. Picture the room. Picture yourself in this room exactly where you are. Now begin to go inside your skin and get in touch with your body. Notice how you are sitting in the chair. See whether you can notice exactly the shape that is made by the parts of your skin that touch the chair. Notice any bodily sensations that are there.

Now notice any emotions you are having.

Now get in touch with your thoughts and just quietly watch them for a few moments.

Now I want you to notice that as you noticed these things, a part of you noticed them. You noticed those sensations….those emotions….those thoughts.

I want you to imagine that you are walking along the edge of a field towards a small patch of woods just ahead of you. The sun is out and the air is bright and fresh. You walk into the woods along a narrow path between the trees. The woods are composed of many kinds of trees. The trees extend their leafy branches down to the earth. The branches of the trees wave towards you. Brightly colored birds call from the woods, their voices rising and fading. Thousands of shades of green moss carpet the ground beneath the trees. Sunlight plays with the leaves and casts shadows on the path. Take a moment to look around and notice what you experience.

[pause for 15 seconds]

You can smell the damp earth and can see a haze of blue in the distance. You feel the twigs breaking under your feet. Look up to see bits of the blue, blue sky through the tops of the trees. Catch glimpses of birds as they fly from one tree to the next. In front of you a winding path leads uphill through the trees. Feel the path beneath your feet as you travel through the wood. The trees become denser and the air becomes cooler. It becomes darker as the trees grow closer together.
You can see blue sky through the trees. All around you are bluebells, bobbing their heads in the breeze. The scent of the bluebells wafts around you. Take a moment to look around and notice what you feel.

[pause for 15 seconds]

Ahead of you is a large log that has fallen and settled in the middle of the woods. You sit on the log and look around you at the woods. Run your hand along the branch, feeling the contours of the rough, old bark. The woodland creatures are going about their daily business, unaware of your presence. A robin comes close and you can see the red of his chest. Further away you see beetles and ants scurrying along. The branches of the trees make strange shapes against the sky. There are sounds of bird songs and the breeze in the tree branches. You can hear a stream running past somewhere nearby. The sounds of the woods are all around you. Take a moment to look around and to notice what you think.

[pause for 15 seconds]

Within the woods go anywhere you like and do anything you wish. Allow the imagery to take you wherever it wants. What sensations emerge? What feelings emerge? What thoughts emerge? This technique also applies when you have your hand in the cold presser. If your attention wanders from the woods, just notice that it has wandered off and bring yourself back to your experiences in the woods.

[pause for 25 seconds]

If your eyes are closed, continue to keep them closed. In this next exercise we are going to learn some imagery that can be used like a tool to focus attention where you deliberately choose to. The images can create a kind of experiential exercise, as if one can actually experience the described event or story. It can also be used during the cold presser task. After an image has been presented, a few minutes will be provided for you to visualize and experience the descriptions. Images are also easily remembered and they can be used as a technique in the next cold presser task.

Imagine that you are by the seashore. It doesn’t have to be a place you know. Take a good look around and get the sense that you are looking through your own eyes. Don’t see yourself there, be there.

What can you see? What is the weather like? What does the sea look like? Is it still and calm? Or is it stormy? Take a look along the shore to the left…. And to the right…… what is the weather like? What is the temperature of the air? Feel the air on any exposed skin. Take a deeper breath and take in the smell of the sea. You may be able to taste the sea air on your lips. Are you sitting, standing or lying down? What sort of surface are you on? How do you feel about being in this place at this time?

[pause for 45 seconds]
Now let these images go and allow the scene to change. Imagine that you are seated in a room that contains nothing but a desk and a chair. You are seated at the desk and there are two blank sheets of paper in front of you. Now, in your mind, begin writing your name over and over again, until you have filled the two sheets of paper.

[pause for 45 seconds]

Now let these images go and allow the scene to change. Now you are an animal in a zoo. Take the first image of an animal that comes. What kind of animal are you? What is your cage or enclosure like? Don’t see yourself in the imagery. Actually be there, looking through your own eyes. How do you feel about being in this cage or enclosure? Do you have a keeper and if you do, how do you feel about your keeper? How do you feel about the people who come to see you in the zoo? In imagination, see if you can find a way of leaving the cage or enclosure. What happens and how do you feel about leaving? How do any visitors react to you getting out? How does your keeper react? In imagination, just go anywhere you like and do anything you wish. Allow the imagery to take you wherever it wants.

[pause for 45 seconds]

Now let these images fade and change the scene again. You are back by the seashore. Once again, be aware of the scenery, of what you can hear, the temperature, the smell and taste of the sea air. Now build up the expectation that, in a short time, someone important to you will come along the shore. Notice this person in the distance and as they approach engage them in conversation. Notice that the conversation turns to important questions in your life right now and that they make helpful comments.

[pause for 45 seconds]

Now in imagination end the conversation and say goodbye. As you do this, take time and try to picture what it would mean to take an approach of using visual imagery when you are experiencing any discomfort or distress during the cold presser task. When it is right for you, breathe a little more deeply, let the images fade and begin to come back to the room. But don’t rush from the feeling of relaxation.
Control

The aim of this study is to help people who suffer from discomfort and distress. Thank you for being a participant today. At the bottom of the computer screen in the taskbar there is a program entitled SnapTimer. Please click this program to bring the SnapTimer to the front of your screen. Alternatively, you can minimize the Window’s Media Player window that this recording is playing through, and view the SnapTimer on the desktop. Please do this now. Once you have the timer open in front of you, please hit the play button to begin the timer countdown. There are magazines next to the computer that you are welcome to read while you relax and wait for the timer to reach 0. You can keep the headphones on while you wait, but if you choose to take the headphones off, please unplug the headphones so you can hear the timer alert you when the time is up. Once time is up, please exit the room and alert the researcher that you are done.