

Running Head: THE P3 STUDY

Pandora Internet Radio's Impact on Pain Perception: The P3 Study

By

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Dedication

This thesis is dedicated to all of my family and friends who have supported me during this stage of my education. In particular, I would like to dedicate this to my parents, Connie and Brian Frisch, as well as to my siblings, Brandon Frisch and Sarah Frisch. You have supported me with countless phone calls from home, and believed in my abilities to fulfill my dreams. Furthermore, I would like to thank my close friends: Rachel Lundgren, David Anderson, Stacy Wolhart, Patrick Pelzer, Lise Holte, and Jessica Dieter. At different times of this process, you have each provided me with the encouragement and support I needed to persevere. I am very grateful for the friendships I have with each of you.

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Abstract

Purpose: The current study investigated the impact of Pandora Internet Radio on the perception of pain in an experimentally induced cold pressor task. The current theoretical models of pain stress the importance of both physiological sensations and psychological factors on the pain experience. Distraction of attention, perceived control, and pain catastrophizing are among the psychological mechanisms identified (Mitchell & MacDonald, 2006; Sullivan et al., 2001), for moderating pain. Music therapy has been suggested as a way to target some of these psychological factors to reduce pain. Previous research by Mitchell and MacDonald (2006) has suggested that a personal preference of music is an influential factor when applying effective music therapy for pain relief. Current technological advances, such as Pandora Internet Radio, might enhance music therapy effectiveness as it may help distract people, provide some form of control with music choice (feedback system), and help people to discover new music tailored to their musical preferences (novelty). However, there has been no study of Pandora Internet Radio's impact on pain to date. Therefore, the current study compares the use of preferred music selection, against Pandora Internet Radio, as well as against a third control group of empirically supported relaxation music.

Methods: Participants were 100 undergraduate students at the University of Michigan-Dearborn who were randomly assigned into one of three music groups: relaxation, preferred, and Pandora Internet Radio. Every participant underwent an experimentally induced cold pressor task while listening to music. Demographic information, tolerance times, multiple pain severity ratings, pain catastrophizing, and other variables that may modulate music therapy effectiveness (e.g., the frequency and the importance of music in an individual's life) were measured in each group.

Results: Results from this study showed that none of the music groups were statistically more effective in regard to tolerance time for the cold pressor task, pain rating reactivity, or pain catastrophizing. However, the mean tolerance times for the relaxation, preferred, and Pandora Internet Radio music groups were in the expected direction.

Conclusion: Although study hypotheses were not supported, results may tentatively suggest that Pandora Internet Radio may provide similar effectiveness as preferred music when implementing music therapy. As this is believed to be the first study to include Pandora Internet Radio as a form of music therapy, future research could provide more clarity to its effectiveness, enhancing music therapy interventions for the management of pain.

Chapter I

Introduction

Pain is the most common reason a person will seek medical attention from a healthcare professional (National Center for Complementary and Alternative Medicine, 2012). In 2001, the American Academy of Pain Management reported findings which estimated that 25 million Americans experience acute pain from injury or surgery, as well as another 50 million who suffer from chronic pain (Weiner, 2001). Highlighting the importance of pain, in 2001 the Joint Commission on Accreditation of Healthcare Organization (JCAHO) began to require physicians and other medical staffs to consider pain as the fifth vital sign (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). Additionally, it is estimated by Gaskin and Richard (2012) that the United States national cost of pain is from \$560 to \$635 billion dollars (Gaskin & Richard, 2012), providing support for the need for greater investments in research, training, and education for managing and preventing pain.

Pain can be both an adaptive, protective mechanism: to warn the body of potential dangers; and maladaptive: as in a state of chronic pain similar to a chronic disease (Flor, 2001). Pain can be divided into acute and chronic types. Acute pain is considered pain that is sharp and sudden, a sign of potential injury or disease, or some aversive threat to the body. Often, acute pain has varying levels of discomfort from a mild paper cut to severe pain related to recovery from surgery (Carr & Goudas, 1999). If acute pain persists beyond the normal healing process, it may become chronic (Flor, 2001). Chronic pain has been defined in the literature as pain which minimally endures for at least three to six months (Gatchel et al., 2007).

Pain has been defined by the International Association for the Study of Pain as “An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (IASP, 1979). This definition emphasizes that pain is a complex phenomenon. Additionally, another working definition of pain put forth by McCaffery (1968) defines pain as “whatever the experiencing person says it is, existing whenever s/he says it does” (as cited by MacDonald, McNulty, Erickson, & Weiskopf, 2000, p. 70). This definition supports pain as a subjective experience expressed by the individual.

Given the complexity of operationally defining the pain experiences, there is no objective measure of the experience of pain at present, and both research and clinical care rely heavily on the self-report from the individual as the most reliable indicator of pain severity and negative correlates of the pain experience. In addition, in research settings, other measures utilized in measuring pain include pain threshold (the point of initially interpreting something as painful) and pain tolerance (the point at which the individual cannot tolerate the sensation of pain any longer), both are used often in pain studies (IASP, 1979). This subjectivity with the experience of pain is why it is particularly important that individuals are asked to wholly describe and rate their pain, and that medical staffs pay particular attention, which may allow researchers to better understand individual variations in pain modulating factors in order to better understand and aid in pain relief.

Theoretical Perspectives on Pain

Influential theories of pain begin with Rene Descartes, who believed that pain was a reflex of the mind, and there are direct and unique pain pathways to the body (Vlaeyen, Crombez, & Groubert, 2007). This theory followed a mechanical model, where pain is thought to

be directly related to the severity of the underlying pathology. Descartes “specificity” theory, proposed that an injury will activate special pain receptors and fibers, which would then return pain impulses through a spinal pain pathway directly to the pain center in the brain. The psychological experience of pain was thought to be equal to the peripheral injury; it was viewed as a “straight-through” sensory system (Melzack, 1996). At this time, there was no inclusion of a psychological contribution of pain, because it was believed that the mind and body were separate (Melzack, 1996).

Another theory called the “pattern” theory of pain, by Goldschneider (1894) posits pain differently. It was believed sensations could be felt, but pain is produced when the total summation of sensory output reaches a critical limit, as a result of excessive stimulation. Pain was viewed as a result of the stimulation of certain nerve impulses, which form a pattern and are then combined and aggregated into the spinal cord as a lump sum of the pain; this was called “central summation” (Melzack, 1996). Consequently, sensations like warmth, touch, or heat could be experienced without pain if this critical limit was not reached (Elton, Stanley, & Burrows, 1983).

In 1965, Melzack and Wall developed the “gate control” theory of pain (Melzack, 1996). This model of pain suggests that pain will be felt if the flow of nerve impulses is allowed to pass through the spinal gating mechanism within the dorsal horn of the spinal column. Unique to this theory, Melzack and Wall incorporated psychological processes along with the interpretation of pain. The psychological variables that they emphasized were attention, past experiences, cultural learning, and other cognitive activities. In the current literature, these psychological variables continue to be studied and integrated in the research of pain and a copious amount of research has found support for the modulation of pain through these mechanisms. However, the gate

control theory was not able to explain certain other chronic pain problems, specifically phantom limb pain. In response, Melzack further extended the gate control theory of pain to better explain the phantom limb pain, which he called the “neuromatrix” theory (Melzack, 1996). This theory proposes that pain perception is a reflection of a complex interchange of information from a number of somatosensory, limbic, as well as other cortical areas of the brain. This explains pain as a product of the output from the vastly distributed neural network in the brain, versus the direct sensory input from pathophysiological perceptions. Neuromatrix theory is believed to be genetically determined and then modified by sensory experiences, to be the primary mechanism to generate the neural pattern interpreted as pain (Melzack, 1996).

To summarize, the current theoretical models of pain appear to stress the importance of both the physiological sensations of pain and certain psychological factors that can impact the pain experience. Two specific mechanisms related to moderating pain include: distraction of attention and perceived control (Mitchell & MacDonald, 2006). Another relevant psychological factor found to exacerbate the pain experience is pain catastrophizing (Sullivan, Thorn, Haythornthwaite, Keefe, Martin, Bradley, & Lefebvre, 2001). In the following sections, these components will be further discussed as well as a few more relevant components: distraction of attention, pain catastrophizing, perceived control, as well as the use of music therapy for pain management.

Distraction of Attention

Distraction in the context of pain has been “...defined as directing one’s attention away from the sensations or emotional reactions produced by a noxious stimulus. Thus, any strategy whose purpose is to block awareness of the painful stimulus or its effects will be considered a

distraction strategy” (McCaul & Malott, 1984, p. 517). There are two important theoretical assumptions related to the effectiveness of distraction: cognitive interpretation and attentional capacity. Cognitive interpretations are important because they can directly relate to the degree of distress resulting from the sensation of pain. For example, a negative cognitive interpretation of pain may be “I can’t endure this anymore,” where the degree of distress associated with the pain may be high. On the other hand, a positive cognitive interpretation of pain may be “I’ve dealt with this pain before, I can do it again,” which may therefore reduce or mitigate the degree of distress associated with the pain sensation.

The second theoretical assumption for effective distraction regards the concept of a limited attentional capacity. According to Miller (1956), short-term memory has a limited capacity of seven items, plus or minus two items held in one’s memory, which could be recalled correctly and immediately (Shiffrin & Nosofsky, 1994). A difficult or novel task will most likely consume most of one’s attentional capacity, which helps to successfully *not* attend to an unrelated task (such as persistent pain) (McCaul & Malott, 1984). Pain is thought to involve an element of control in terms of the cognitive processing of these experiences, as opposed to automatic processing of information. Without this control, distraction as a means of pain management would not be as effective. It would be ineffective as it would essentially not draw away any attentional resources, and thus reflect no change in the pain experience. Therefore, since pain is thought to be a more controlled versus an automatic cognitive process, distraction is suggested to be effective as it does involve some control of your attention. A task which involves controlled processing uses short-term memory for the task, which is why it is capacity bound (about seven, plus or minus two items in one’s memory). Based on these concepts, for a distraction task to be effective, it must use a majority of the individual’s attentional resources,

which would leave less attentional resources available to be processing the components of the sensations of pain. Unfortunately, as a painful stimulus reaches greater intensity levels; it will demand greater control over the attentional resources, which will impede the effectiveness of the distracting task (McCaul & Malott, 1994). Often, using focused attention distraction tasks do not completely ignore task-irrelevant stimuli present in one's environment, but it can be more or less effective depending on the demand of the present stimuli. This can explain why quiet settings are predominantly used with focusing one's attention for reading, studying, or listening to music, so as not to interrupt one's attention.

Certain attentional tasks have been used to distract one's attention away from pain, in research aimed at understanding the pain-related attention focus (Sullivan et al., 2001). One task that has been frequently been used in the literature is arithmetic, as it tends to consume the greatest amount of attention (Mitchell & MacDonald, 2006). Another, and perhaps more enjoyable, distraction task that is used in this area to distract people away from the perception of pain is music therapy, which will be discussed in more detail later in this manuscript.

Pain Catastrophizing

Pain catastrophizing is described as an exaggerated negative cognitive style expressed during an actual or anticipated pain experience (Sullivan et al., 2001). Pain catastrophizing during a the experience of pain leads to more intense pain severity and increased emotional distress, as well as an overall heightened pain experience (Sullivan et al., 2001); which may potentially result in the development of chronic pain (Khan, Ahmed, Blakeway, Skapinakis, Nihoyannopoulos, Macleod, Sevdalis, Ashrafian, Platt, Darzi, & Athanasiou, 2011). Pain catastrophizing has also been associated with increased use of health care services, longer

hospital stays, increased use of analgesics, and increased pain behavior (Sullivan et al., 2001). It has been found that high postoperative pain catastrophizing scores often predict heightened postsurgical pain, even independent of anxiety, as well as depression, or the combination (Khan et al., 2011). Research on pain catastrophizing reveals that it accounts for 7-31% of the variance for pain ratings and has been found across various types of pain from low back pain to pain related to burn dressing changes. It is an important psychological predictor of pain, and research is ongoing for discovering potential clinical management (Sullivan et al., 2001) and there is particular utility for further exploration of this construct in acute pain settings such as surgical procedures as this provides a unique environment of a pain experience; because one can predict the exact time of the onset of both injury and pain for an individual *in advance* (Khan et al., 2011).

The Pain Catastrophizing Scale (PCS) is currently one of the most widely used measures of pain catastrophizing. It has been well validated and also translated into multiple languages (Sullivan, 2009). The development of the Pain Catastrophizing Scale items were drawn from examples of cognitive experiences noted by participants in earlier studies of pain catastrophic thinking as a result of the pain sensations individuals felt (Sullivan et al., 2001). There have been three main facets to pain catastrophizing identified in the literature: magnification, rumination, and helplessness (Sullivan et al., 2001). Specifically, magnification is conceptualized as the individual's intensification of the expectancies for negative outcomes as well as unpleasantness of the pain situation. Rumination relates to the individual's ruminative thoughts, worries, and their perceived inability to avert or control pain related thoughts. Lastly, helplessness involves the individual's perceived inability to deal or cope with the pain situation (Sullivan, Bishop, Pivik, 1995).

In relation to the concepts of focused attention (within the context of distraction) described earlier, it is theorized that individuals who exaggerate the threat perception of pain sensations or pain stimuli, will probably increase their focus on the pain (Sullivan et al., 2001). As such, the rumination subscale of the PCS has been found to be most highly correlated to the individual's pain intensity ratings. By way of explanation, people who endorse the items on the rumination subscale including "I cannot stop thinking about how much it hurts" and "I can't seem to keep it out of my mind" were notably more likely to experience increased levels of pain (Sullivan et al., 2001; Sullivan, 2009). This also gives some evidence that focused attention on pain could be a critical connection between catastrophizing and a pain experience (Sullivan et al., 2001).

Perceived Control

Perceived control is one's belief that they have the ability to respond in some manner, which will influence the aversiveness of an event (Skevington, 1995). The cognitive interpretations of pain affect perceived control, because they lead to an evaluation and eventual initiation of coping resources available for pain management (Haythornthwaite, Menefee, Heinberg, & Clark, 1998). Perceived control over a potential or present pain related stressor may lessen levels of anxiety and decrease the experience of pain (Elton, Stanley, & Burrows, 1983).

Knowledge of the importance of control began in the early 1980's, when a device called the patient-controlled analgesia (PCA) became a major pain management technique used for postoperative patients (Shiloh, Zuckerman, Butin, Deutch, Yardeni, Benyamini, & Beilin, 2003). With the push of a button, this device would deliver an analgesic dose directly into the venous line of the patient. Importantly, it is a patient-controlled machine, which allows the patient (who

is experiencing the pain) to control the timing of the analgesic drug, in order to achieve a maximum drug effectiveness. Studies of PCA's reflect that they mainly affect pain tolerance, whereby the patients are ready and able to tolerate stronger pain levels without being dissatisfied with their pain management, or demanding more medication (Shiloh et al., 2003). Arntz and Schmidt (1989; as cited by Shiloh et al., 2003), proposed that one's perceived control in an acute pain situation (such as after surgery) decreases uncertainty about possible worsening of pain. Therefore, people are not inclined to attend continuously to the internal signals of danger associated with pain (Shiloh et al., 2003), they are instead, able to avert their thoughts away from the pain, focus on other things, and in effect, reduce rumination associated with pain and pain catastrophizing. The anxiety and uncertainty related to obtaining adequate pain relief at the time when it is most needed are instead replaced with the beliefs and certainty of being in control of one's pain (Skevington, 1995). This supposition also links attention and cognitions to perceived control.

In a study of surgery patients, Pellino and Ward (1998) found patients who believed they had control over their pain were more satisfied with their pain management (Pellino & Ward, 1998). The perception of having a perceived sense of control over their pain was strongly associated with the satisfaction of the management of pain relief (Pellino & Ward, 1998). Furthermore, they found that pain was perceived as more "controllable" when it was not as severe. "On the other hand, when pain is severe, using pain interventions that are effective in increasing the perception of control may lead to increasing satisfaction with how the pain has been managed" (Pellino & Ward, 1998, p. 115). As mentioned before, pain catastrophizing during a pain experience is associated with increased pain severity and emotional distress, as well as a heightened pain experience related to the exaggerated negative cognitive style

(Sullivan et al., 2001), by a person perceiving control in relation to their pain experience, their pain experience could be moderated efficaciously. In addition, the opposite of helplessness may be directly related to control – one's ability to change outcomes with voluntary action (Peterson, Maier, & Seligman, 1993). Therefore, a relationship may exist between the helplessness subscale of the PCS, and the perception of control; people who feel more in control of their pain situation may feel less helpless.

In summary, perceived control is an important psychological factor related to the pain experience, as well as other variables that are associated with pain. Having the belief that one can respond in some manner to pain, can moderate the pain experience, consistent with the theoretical perspectives described earlier (e.g., the gate control theory of pain, neuromatrix theory of pain). In the context of a pain condition or acute pain situation, even a miniscule amount of control may be beneficial.

Pain and Music Therapy

Given what is known about pain and pain management, music therapy is one non-pharmacological intervention that has been explored. The goals of music therapy in pain management are to assist the person in experiencing an improved sense of inner well-being and improved comfort, as well as to assist the person in achieving a sense of control and participating in the involvement and management of their pain (Bailey, 1986). Consistent with these goals, the literature has shown that music therapy has been successfully applied as a form of pain management to assist with sleep, decreasing anxiety before surgery, and to compliment the administration of local anesthesia (Tse, Chan, & Benzie, 2005).

Studies of patients who are hospitalized for surgical procedures have shown that music is found to calm patients, improve vital signs, and positively impact a patient's overall level of comfort (Wakim, Smith, & Guinn, 2010). Brown, Chen, and Dworkin (1989) believe "Perceived control, therefore, related to the ability to use music at any time to distract from pain and relieve anxiety, promoting a sense of belief in controllability of pain" (Mitchell and MacDonald, 2006, p. 297). Adverse effects from postoperative pain can impact the physiological and psychological well-being of patients, and can lead to delays in recovery, an increase in analgesic use, and even depression (Tse, Chan, & Benzie, 2005). The work by Tse, Chan, and Benzie (2005), studied the effect of music therapy on postoperative pain. In this study, a control group was compared to a music therapy group, which played music intermittently during the first 24 hours postoperatively after nasal surgery. It was found that the pain intensity of the music therapy group was significantly decreased compared to the patients in the control group. In addition, the music therapy group had lower heart rates, lower systolic blood pressure, and required fewer oral analgesics (Tse, Chan, & Benzie, 2005). Similarly, research done by Vaajoki, Pietila, Kankkunen, and Vehvilainen-Julkunen (2011) on the use of music therapy for patients who had undergone abdominal surgery, found that patients who listened to music postoperatively reported milder pain distress and pain intensity (Vaajoki, Pietila, Kankkunen, & Vehvilainen-Julkunen, 2011). In summary, these studies support the use of music therapy as a non-pharmacological form of pain relief for the first 24 hours postoperatively following surgical procedures, or acute pain circumstances. This helps to encourage the use of music therapy as a complimentary therapy to analgesics.

It is also suggested that "Music may facilitate physical and mental relaxation, and this may modulate pain perception, because it has been reported that an individual can exert control

over the sensory-discriminative component of pain by means of physical and mental relaxation...” (Tse, Chan, & Benzie, 2005, p. 22-23). Music therapy can potentially alleviate the cycles of distress that are found to exacerbate pain, consistent with the gate-control theory of pain (Bailey, 1986). It is also reported that the presence of music helps to release physical and emotional tension, and induce relaxation (Wakim, Smith, & Guinn, 2010). Therefore, music therapy can act to refocus a person’s attention on to the pleasing sensations associated to listening to music and away from the painful stimuli (Bailey, 1986). In this way, music helps to secure a portion of one’s attentional capacity, leaving less available to focus on the pain stimuli.

Adding to the suggestions that part of the effectiveness of music therapy could be resultant from control, a study done by Mitchell and MacDonald (2006) investigated the effects of listening to music regarding pain perception and pain tolerance. This study used data from 54 participants who experienced three cold pressor trials while listening to three different types of music. In this study, three types of music were used: white noise (used as a control), relaxation music, and each participant’s own music (which they were required to bring with them to the study). Results of this study showed that participant’s tolerance times were significantly longer for the preferred music than either the relaxation, or white noise groups. The participants also reported feeling significantly more in control when they were listening to their own preferred music than in the other two groups. Mitchell and MacDonald (2006) suggest that a personal preference is an important factor for the individual when considering the effectiveness of music therapy and pain management (Mitchell & MacDonald, 2006).

Although tremendously informative, the above mentioned study does not however, examine the full cognitive interplay between psychological correlates of pain in the context of music therapy, namely pain catastrophizing. Furthermore, and arguably more importantly, it also

excludes some of the innovative technological advances in music listening options today. Given the positive impact that personal preference on music can have in regard to pain perception and tolerance, perhaps Pandora Internet Radio can help people in a different way? Pandora Internet Radio is an online, personalized, free internet radio (Pandora, 2012). This program takes one song, artist, or genre and creates a personalized “station” for the listener. This is accomplished through a comprehensive analysis of music by what has been called the Music Genome Project, where highly trained musicians have identified and categorized music. This Music Genome Project was started in 2000, and has created what the Pandora company refers to as a “complex musical DNA of songs” (Pandora, 2012). “By utilizing the wealth of musicological information stored in the Music Genome Project, Pandora recognizes and responds to each individual's tastes. The result is a much more personalized radio experience - stations that play music you'll love - and nothing else” (Pandora, 2013). The goal of Pandora Internet Radio is to play only music the listener will enjoy, through the use of a feedback system. A listener is given the option to rate songs by giving a thumbs-up or thumbs-down, which refines their station as well as interweaving a greater variety of song choices. Therefore, Pandora Internet Radio provides an element of control, both with the music selection (e.g., songs, artists, genres), as well as with the use of the feedback system (i.e., positive or negative) which may enhance a perceived sense of control. Likewise, this program aims to provide individuals with music tailored to their tastes, providing a greater expansion of their music preferences. It is constantly exposing the listener to both: music they *already* enjoy listening to, and similar music (which may also be novel) they *may* enjoy. Exposure to new music may provide some level of increased distraction, because it has never been heard by the listener before and the listener must reflect whether they are enjoying the experience, or not. If not, the listener may choose to skip the song playing and move on to

another selection, an active cognitive process. Thus, Pandora Internet Radio provides an element of control and likely absorbs some attentional capacity through active cognitive processes (i.e., identifying novel versus familiar songs, like versus dislike of novel songs). Questions remain, if this is applied to an acute pain situation, could this program provide the benefits of distracting with preferred music, as well as the distracting quality of the novelty of the new, similar music?

As Pandora Internet Radio may offer a novel approach to examining music's ability to impact the pain experience through avenues of both distraction and control, a number of other characteristics of music should be considered. The quality of music is found to capture one's attention and hold it effectively; the patterns of sound, tones, rhythms, melodies, all work together in music to hold attention. Often, there are emotional components which could include the emotional tones expressed in the speech or lyrics of songs and the associations that can be connected to personal memories and meanings (e.g. a wedding song) and increased one's personal level of focus of attention. Notably, how an individual responds emotionally to music influences preference for particular music styles (Sloboda, 2008). Furthermore, people listen to different types of music in reflection of their specific situations; they know which songs can reliably up-lift their mood: "Experiments also show that listeners can acquire a complex and fine-grained appreciation of the link between the choices they make about what to listen to and the resultant psychological outcomes" (Sloboda, 2008, pg. 33). It has been suggested by Juslin and Sloboda (2001), that music is used to administer an emotional therapy, in order to bring about an aspiring emotional change (Juslin & Sloboda, 2001), similar when listening to upbeat, fast, energetic music used to motivate one to work out more intensely.

Another interesting factor, which relates to how effective music is for pain management for to the listener, is music potency (Mitchell & MacDonald, 2006). The idea of music potency

relates to how potent, or strong, the application of music therapy will be for the individual related to their pain management. With this knowledge, a potential confound may exist with the use of music therapy for pain management at present. That is, a person may not benefit from music, if they have not been exposed to very much, other than what is popular on the radio. Pandora Internet Radio may help to solve this potential problem as it does attempt to expose the listener to new, but similar, artists and songs that the listeners have already provided positive feedback on. This may be especially relevant for use with pain patients, who over a longer length of time may have grown tired of listening to songs they once enjoyed. By applying Pandora Internet Radio for use in a pain management technique, it could help distract people from pain, give some control with choice, and help people discover new music, which may in turn increase their music potency.

The Current Study:

As previously mentioned pain is common and is associated with numerous negative outcomes. Theoretical and empirical evidence suggest that there are certain psychological factors that can impact the pain experience. The three important psychological factors mentioned here are distraction, perceived control, and pain catastrophizing. Distraction regarding pain involves directing one's attention away from the sensations of pain. Pain catastrophizing involves an exaggerated negative cognitive style before or during a pain experience. Lastly, perceived control includes the belief that the individual has some ability to respond to an aversive event. Together these variables appear to influence and moderate the perception of pain. One well-known, non-pharmacological approach to the treatment of pain is music therapy. Integrating literature of psychological variables and music therapy, Mitchell and MacDonald (2006) have reported that a personal preference for music choice, as well as reports of feeling more in control

when listening to their music preference is considered an influential factor with the application of music therapy as an effective form of pain management.

The utilization of Pandora Internet Radio during a music therapy intervention may provide another level of music preference/control and increase the effectiveness of music as a means of distraction. Therefore, this study will look at the effects of preferred music listening on the perception of pain in an experimentally induced cold pressor task, while examining other variables that may modulate music therapy's effectiveness (e.g., the importance of music in an individual's life or pain catastrophizing). The study will examine the use of preferred music listening with the participant's own media player and music selection, against Pandora Internet Radio, as well as against a third relaxation music control group.

Hypotheses:

Hypothesis 1: The participants in the Pandora Internet Radio music group will have significantly greater tolerance times than those in the preferred music group, which will have significantly greater tolerance times than those in the relaxation music group.

Hypothesis 2: The participants in the Pandora Internet Radio music group will express significantly lower pain rating reactivity than the preferred music group, which will be significantly lower than the relaxation music group's pain rating reactivity.

Hypothesis 3: People in the Pandora Internet Radio music group will score significantly lower on the pain catastrophizing scale than people in the preferred music group, which will score significantly lower than people in the relaxation music group.

Statistical findings regarding the three pain catastrophizing sub-scales: magnification, rumination, and helplessness, are of interest to the researchers. However, generating any congruous hypotheses is believed to be beyond the scope of this research, and therefore will not be included in this study.

Hypothesis 4: People who view music as important in their life (reflecting a higher score regarding the importance of music in their life), will indicate a significantly greater tolerance time than both people who view music as somewhat important (reflecting a median score regarding the importance of music in their life), and people who view music as not important in their life (reflecting a lower score regarding the importance of music in their life).

Hypothesis 5: People who view music as important in their life (reflecting a higher score regarding the importance of music in their life), will indicate a significantly lower pain rating reactivity than both people who view music as somewhat important (reflecting a median score regarding the importance of music in their life), and people who view music as not important in their life (reflecting a lower score regarding the importance of music in their life).

Chapter II

Methods

Participants

Based on effect sizes obtained from the current literature an a priori power analysis was conducted (GPower computer program (Faul & Erdfelder, 1992)). It suggested that a sample size of 100 would be sufficient to detect effects in the current study. Participants for this study were 100 undergraduate students at the University of Michigan-Dearborn recruited from the introductory psychology subject pool. This system allows potential participants in the subject pool to view a brief description of the study, along with a detailed list of eligibility requirements, and if the participant is interested and eligible for the study they can sign up for an appointment to participate in the study directly on the SONA website. Participants were eligible for the study under the following inclusion criteria: they were 18 years of age, able to read, and were able to bring with them to the study a personal music listening device (e.g., MP3, iPod, etc.) with their own music present on the device. Every participant was also required to pre-select three songs from one genre of music prior to participating in the experiment. Participants were excluded from the study if they: had not eaten something in the last two hours, had consumed caffeine in the last two hours, had a history of chronic pain (duration of at least three months), had taken any analgesic medications within 24 hours of the study (i.e., prescription, cold-medications, OTC medications, or consumed alcohol), had any history of cardiovascular disorders or diseases, had a history of fainting or seizures, had a history of frost bite on their hands, had an open cut or sore on their non-dominant hand, or were currently pregnant. A total of 137 participants signed up for the study via the SONA website, 27 did not attend the study or cancelled via email, 7 were ineligible to participate as a result of insufficient fulfillment of the inclusion/exclusion criteria

required, and 103 participants completed the protocol. However, 3 of those participants had to be dropped from the study because they did not follow the instructions of the researcher (2) or for the safety of the participant when they appeared to have a strong physical reaction to the cold pressor task (1).

On average, participants were 20.62 (SD = 4.46) years old. They averaged a body mass index of 23.37 (SD = 3.66), where men were 24.08 (SD = 3.87) and women were 22.90 (SD = 3.46), respectively within the normal BMI range (18.5 – 24.9), (CDC, 2014). Of the 100 participants who successfully completed this study, 40% were male (60% female), 93% were right-handed (7% left-handed), and 81% had heard of Pandora Internet Radio (while 19% had not heard of Pandora Internet Radio). A complete summary of demographic information can be found in Table 1.

Measures/Instrumentation

Demographics Questionnaire:

Participants completed a demographics questionnaire which asked them to report their date of birth, school status, sex, handedness, weight, and height. Height and weight was gathered in order to calculate BMI because adipose tissue on the hand may affect the sensations of pain (Tashani, Alabas, & Johnson, 2010), which could affect tolerance times and/or pain rating scores. This questionnaire also asked the participant to rate how important they believed music was in their life, the frequency they listen to music each week, and if they had ever used Pandora Internet Radio (see Appendix D).

Pain Ratings-Visual Analog Scale:

Participants were required to complete a visual analog scale (VAS) pain rating three times during the study. The VAS is a commonly used pain rating scale (Williamson & Hoggart, 2005). This scale uses a 10-cm line with a written description of “no pain” on the left and “worst possible pain” on the right (see Appendix I for VAS used in study). The participant was asked to indicate their level of pain by marking a vertical line on the 10-cm line. To obtain a score for each pain rating the researcher provided the VAS pain rating to the participant on a clip board and asked the participant to place a vertical mark on the line in relation to the amount of pain they were feeling at that time. This VAS pain rating was completed three times during the experiment: prior to starting the cold pressor task, immediately upon removal of their hand from the water, and four minutes after removal of their hand from the water. Each VAS pain rating was completed using an new, unmarked VAS pain rating, and documented at which time the VAS pain rating scale was completed: time 1, time 2, or time 3, in the upper right hand corner of the page (see Appendix I for VAS used in study). When measuring, this scale provides 101 available options of marking on the line to indicate pain, which reflects its sensitivity to detect change (Williamson & Hoggart, 2005). The VAS is found to have high test-retest reliability in acute pain settings (Bijur, Silver, & Gallagher, 2001; Williamson & Hoggart, 2005). The average VAS pain ratings for the current study were: VAS at time 1 of .57 (SD = .81); VAS at time 2 of 69.01 (SD = 19.06); and VAS at time 3 of 6.74 (SD = 7.15).

Pain Catastrophizing- Pain Catastrophizing Scale:

The Pain Catastrophizing Scale (PCS; Sullivan, 2009) was used in the current study to measure pain catastrophizing (see Appendix J for PCS used in study). The PCS has been shown to be a valid and reliable measure of catastrophizing (Sullivan, Bishop, & Pivik, 1995). The scores are considered significant predictors regarding the intensity of physical and emotional

distress expressed by participants during a cold pressor task (Sullivan, Bishop, & Pivik, 1995). The PCS contains three subscales: magnification, rumination, and helplessness. The magnification scale is associated with a magnification of the unpleasant pain sensations, as well as a magnification of potential negative expectations (Sullivan, Bishop, & Pivik, 1995). The rumination scale is most strongly related to pain intensity ratings because it has been theorized that individuals will probably focus on their pain if they exaggerate the threat value of pain sensations or pain stimuli (Sullivan, et al., 2001). The helplessness subscale relates to the individual's perceived inability to deal or cope with the pain situation (Sullivan, Bishop, & Pivik, 1995), and could potentially relate to the amount of control felt by the participant during the experiment.

The internal consistency of the total pain catastrophizing scale has been reported by Sullivan (2009) in his Pain Catastrophizing Scale user manual to be expected at $\alpha = .87$ (Sullivan, 2009). Furthermore, the internal consistencies of each subcategory are expected to be: rumination at $\alpha = .87$, magnification $\alpha = .66$, and helplessness with $\alpha = .78$ (Sullivan, 2009). The internal consistency of the total scale score for this current study was good, $\alpha = .92$, as were the internal consistencies of each subcategory: rumination at $\alpha = .92$, magnification $\alpha = .54$, and helplessness with $\alpha = .89$.

Pain-Induction (through the use of a Cold Pressor Apparatus):

Numerous research studies have utilized noxious stimuli to examine perception and modulation of pain experiences (e.g., Sullivan et al. 2001; Mitchell, MacDonald, & Brodie, 2004; & Mitchell & MacDonald, 2006). A commonly used stimulus is the cold pressor, whereby the participant immerses their hand in a vessel of cold water that produces an acute pain

experience. Rainville and colleagues (1992) suggest that the unpleasant experiences related to cold pressor task pain may best simulate the experience of chronic pain conditions, thus making it ideal for the study of various analgesic mechanisms. The cold pressor used in the current study is a custom designed apparatus, which includes an insulated basin with a self-contained device to consistently circulate the cold water. The apparatus also includes a thermometer to ensure that the temperature of the water is properly regulated at 40 degrees Fahrenheit (consistent with the current literature) (Von Baeyer, Piira, Chambers, Trapanotto, & Zeltzer, 2005). For this study, a manipulation check was completed to examine if the study procedure had the intended effect. The results provided evidence that the cold pressor task did indeed produce pain in the participants (see Results section).

Tolerance Time:

Tolerance times are the point at which the individual cannot tolerate the sensation of pain any longer, and are a measure often used in pain studies (ISAP, 1979). In this study, the tolerance times are the recorded time the participant kept their hand immersed in the cold water. The time was stopped once the participant removed their hand from the water. Participant's tolerance times were recorded by the researcher on a stopwatch during the cold pressor task. The average tolerance time of the participants was 99.80 seconds (SD = 69.06), (see Table 2 for tolerance times between music groups). These are similar average tolerance times to other cold pressor task studies involving 5°C (40°F) water temperatures (Mitchell, MacDonald, & Brodie, 2004).

Music Selection:

All participants were asked to listen to music during the study procedure. Participants were asked to listen to music in one of three music groups: preferred, relaxation, or Pandora Internet Radio. In the preferred music group they were to listen to their pre-selected three songs (from the same genre) on their own portable music device (e.g., iPod, MP3 player, etc.). Relaxation was another music group and participants were provided with empirically supported relaxation music (Tan, Yowler, Super, & Fratianne, 2012). There were three songs available for the participants to choose from (see Appendix H for relaxation song references). The third group was provided with Pandora Internet Radio. For both the relaxation and Pandora Internet Radio music groups, a Kindle Fire HD 7 inch tablet was provided to the participants. This Kindle Fire HD tablet contained the selected relaxation music uploaded to the device and an application for a Pandora One account. Each Pandora Internet Radio station created during the study by a participant was deleted upon completion of the study protocol in order to provide a clear history for the next participant. See Tables 3 and 4 for music genres selected by participants in the preferred and Pandora Internet Radio music groups.

Procedure

Ethical approval for the study was granted by the University of Michigan-Dearborn ethics committee: IRB-Dearborn. The lab used had no windows and was a secondary room inside a lab, which provided a sufficient noise-reducing effect. As mentioned above, the SONA system was used for recruitment. The day prior to the potential participant's appointment, they were sent a reminder email that also outlined the eligibility requirements. Upon arrival to the lab at their scheduled appointment time, participants were greeted and escorted into the lab. They were then reminded of the eligibility requirements described on the SONA system using the script in Appendix A. They were asked if they met these requirements and if the participant reported that

they did not meet the criteria as a whole, they were excused from the appointment and encouraged to reschedule. They were not assigned credit in SONA and were given an “excused” no-show for the study. A document was signed by the researcher to document the participant’s answer (Appendix B), to help keep track of potential participants, rescheduling, and allowing the participants to proceed with the study in a safe manner.

If potential participants reported that they did meet the eligibility criteria, consistent with the study description on SONA, they were then given the consent form that describes the risks/benefits of the study and the participant’s rights as a research participant. Each participant was asked to read over the consent form and a research assistant asked the participant if they had any questions and would subsequently answer questions. On an important note, the researcher carefully watched each participant read the consent form and pointed out the risks/benefits when the participants appeared to simply look over or read the document too quickly, in order to make sure the participant fully understood their consent to participate in the study. Once consented, all participants were asked to fill out an exclusion sheet (see Appendix C) which assessed each of the eligibility criteria separately. If a participant was found to not meet eligibility criteria at this point (which was rare given the confirmation of eligibility at the arrival of the participant), they were excused from the study; however, those who were deemed eligible for the study were randomly assigned to one of three groups using a random number generator: (1) Pandora Internet Radio music group, (2) preferred music group, or a (3) relaxation music group. All participants were then asked to fill out a demographics sheet (see see Appendix D).

Following the completion of the demographics sheet, those in the Pandora Internet Radio music group were read a short script describing the background of Pandora Internet Radio, if

they were unfamiliar with Pandora Internet Radio (if indicated on the demographics sheet the participant was asked to complete) (Pandora Internet Radio, 2012):

“Pandora Internet Radio is a personalized free internet radio. You enter a favorite track, artist, or genre and Pandora Internet Radio creates a personalized station to play that music and music similar to it. The options to rate songs by giving a thumbs-down or thumbs-up feedback system allow you to refine your station and add more listening variety. Pandora Internet Radio will play only music you love and help you to discover new music you have never heard before.”

All three groups were then given a brief general description of the study protocol:

“This is how the experiment will go: First, I will ask you to rate your pain level and have you listen to music for a few mins. Then, you will be asked to begin the cold pressor task by placing your hand in the water, and we ask that you try to keep your hand in for as long as you can. Most people can keep their hand in for the entire time, but you may remove it at any time. After you have removed your hand, I will have you rate your pain, and you will then be allowed to continue listening to the music for a short time until I ask you to stop. After this time, I will have you rate your pain again and ask you to fill out some forms.”

This description also included an explanation of the cold pressor task which was to inform the participant on how the researcher wanted them to immerse their non-dominant hand in the water 2-3 inches above their wrist for as long as they can, but that they were be able to remove their hand at any time. A visual was also provided (Von Baeyer et al., 2005) (see Appendix E).

“When I tell you, you will place your hand with palm open and immerse it into the water 2-3 inches above your wrist, as is shown in this picture (show picture example). After you have placed your hand in the container of water, we would simply like you to keep your hand in the water for as long as you can. We will ask you to rate your pain throughout the experiment. We will let you know when you can remove your hand. Most people can keep their hand in for the entire time, but you may remove your hand at any time.”

Next, a “time sign” was explained, which was created to inform the participant of when to place their hand in the water (see Appendix F). They were also informed that the researcher would verbalize to the participant the words on the sign; at the same time they raise the “time sign” for the participant to place their non-dominant hand in the water:

“As I mentioned, we will first ask you to listen to music for a few mins before we have you start the cold pressor task. This is our ‘time sign’ (show sign). We will raise this sign up when we would like you to place your hand in the water. When you see this sign, we ask that you place your hand into the water 2-3 inches above your wrist, as was shown in the picture before. We will also state out loud for you to place your hand into the water at this time. We are using this sign so we are minimally interrupting your music listening.”

Then, there was an explanation of how to fill out the visual analog scale given:

“This is a pain rating scale (show VAS), which we will be using to gauge your pain level throughout the experiment. When we ask you to indicate your pain, please do this by placing a vertical mark on the line, in relation to the amount of pain you are feeling at that time. We will ask you to do this three times during this experiment.”

Prior to the cold pressor task, the researcher would make sure the participant is in possession of the proper music for their music group. All participants were asked to listen to their music at half volume for their safety. Additionally, working headphones were provided to the participants by the researcher if their headphones were malfunctioning, or if they did not have any headphones brought with their device to the study. For the Pandora Internet Radio music group participants, they were required to pick a genre of music to listen to, whereby a list was provided on the tablet of the most popular genre stations on Pandora Internet Radio (see Appendix G) (Pandora Internet Radio, 2013). The genre that was chosen by the participant was indicated on a document at the end of the experiment and included in the Appendix (see Appendix L for document and Table 3 for music selected by the participants). Participants were then informed on how to use the Pandora Internet Radio website (Pandora Internet Radio, 2013):

“Please enter a genre in the Search box in the top left corner (Researcher point it out on tablet). Please enter ONLY a genre! A list of popular genres has been provided (show Popular Genre Stations List), but you may also enter your own preferred genre of music. Pandora Internet Radio will create a radio station which features that music and music similar to it. Pandora Internet Radio is designed to tailor the music to your specific tastes and preferences. (Researcher point at different icons on tablet) Pandora Internet Radio offers a “thumbs-up” button to inform Pandora Internet Radio that you like that particular song, which helps to identify similar music to play on your station. A “thumbs-down” button is also provided and informs Pandora Internet Radio that you do not like that particular song, and it will be programmed to not play that track and automatically starts a new song. We encourage you to use these buttons when you feel the need to, but you are not required to use them. Notice: A “skip” button is also present. Pandora

Internet Radio only allows 6 skips per hour per station. A skip is: a thumbs-down rating, or hitting the “skip” button. Shortly, you will be asked to start listening to your music.

Please enter the genre station you wish to listen to at this time on the tablet. Do you have any questions?” (Help participant if needed until they are ready, you can have Pandora Internet Radio paused until ready to start).

For the preferred music group, the experimenter was to check that the participant had their three songs chosen, which all fell within the same genre category. The genre and songs selected from the preferred music group were also indicated on a document at the end of the experiment and included in the Appendix (see Appendix K for document and Table 4 for music selected by participants). Relaxation music was provided for participants in the relaxation group (see Appendix H).

The researchers made sure the participants understood the task they were being asked and answered any questions the participants had regarding the instructions. Then, the participants were asked to complete their first visual analog scale (VAS) pain rating (see Appendix I). Prior to completing the cold pressor task, each participant was instructed to listen to music (depending on which group they were randomly assigned to) for a 4 minutes “baseline.” At the four minutes, the experimenter raised a sign and verbally stated to the participant to start the cold pressor task by placing their hand in the water while still continuing to listen to music. This task included the participant placing their non-dominant hand into the water 2-3 inches above their wrist, for as long as they could. They were previously informed multiple times that they could remove their hand at any time. However, the researcher would not allow the participant to keep their hand in the water longer than three minutes for safety reasons and asked the participant to remove their hand if the participant had kept their hand in the water for the full three minutes. Once the

participant removed their hand from the water they were immediately given another VAS to complete, while informed to continue to listen to music. The amount of time the participant kept their hand immersed in the water was recorded by the researcher on a stopwatch, in order to record tolerance times. Four minutes after the participant removed their hand; they were given a final VAS and asked to complete the pain catastrophizing scale (see Appendix J). Those in the Pandora Internet Radio music group were also asked to write down the Pandora Internet Radio genre station and genre they had chosen to listen to on the tablet (see Appendix L). Also, for those participants in the preferred music group, they were asked to write down the genre and three music song titles they had pre-selected to listen to (see Appendix K). Those in the relaxation group were excused from this activity because they all were provided the same choice of three relaxation music songs (see Appendix H). After the participants filled out all of the required forms, they were thanked for their participation. They were then provided a form with contact information, which provided both medical and psychological resources if the participants felt they needed any attention after participating in the study (see Appendix M). Finally, each participant was provided credit for participating via the SONA system after completing the experiment.

Chapter III

Results

Prior to data analysis, data screening for missing data and normalcy was completed. Missing data were found for some of the variables due to incomplete study demographic measures. Specifically, two participants were missing their weight. To correct for these missing data points, means (by their gender) were substituted for these participants. No other missing data were identified. Three participants were excluded from the study. One participant was excluded because their participation was prematurely terminated due to a potential expected negative reaction to the cold pressor task (which was noted in the informed consent form as a possible, but rare risk). This participant reported that they had felt dizzy, so the experimenter intervened and had them engage in some deep breathing exercises for approximately ten minutes to ensure their safety before leaving the laboratory. The other two participants were dropped because they did not completely engage in the cold pressor task. One participant immediately removed their hand from the water upon submergence. The other participant vigorously moved their hand around the water, as well as hovered their hand just under the water surface during the task. This left a sample size of 100.

In addition, outlier analyses (multivariate and univariate) were conducted. Univariate outlier analyses revealed that each of the study variables had at least three univariate outliers (total of 32 univariate outliers identified). Analyses were run separately with and without these outliers. Instead of deleting the outliers, the item means were substituted for the initial univariate outliers to preserve sample size. In the multivariate outlier analyses, there were eight multivariate outliers identified. Analyses were run separately with and without these outliers. The results

revealed that the magnitude and direction of relationships were similar. Therefore, in order to preserve sample size, the outliers were included in the analyses.

Exploratory analyses were also conducted to examine the relationship between demographic variables and dependent variables (see Table 5 for correlations). Any relationships found were controlled for in later analyses. In order to examine if the study procedure had the intended effect, a paired samples *t*-test was conducted as a manipulation check and revealed that VAS 2 ($M = 69.01$, $SD = 19.06$) was significantly greater than VAS 1 ($M = 0.53$, $SD = 0.68$), $t(99) = -35.92$, $p < .001$; $\eta^2 = .93$, suggesting a very large effect of reported pain from the cold pressor task. Analyses were conducted to examine relationships between demographic variables and study dependent variables. Those participants who identified with the senior class status were found to have an increased VAS 1, $F(4, 95) = 3.03$, $p = .02$; $\eta^2 (.11)$. Additionally, there was a trend for men ($M = 22.94$, $SD = 8.93$) to have a lower pain catastrophizing total score than women ($M = 27.11$, $SD = 12.50$; $t(98) = -1.82$, $p = .07$; $\eta^2 (.03)$). Given that the catastrophizing total differences were not statistically significant, only school status was controlled for in analysis that involved VAS scores. Analyses controlling for school status and those that did not include this covariate yielded similar results. Therefore, in an effort to optimize power and present main effects in a streamlined fashion, the primary versions of analyses were presented.

To examine the first hypothesis, which investigated if the three study groups had a differential impact on tolerance times, a one-way analysis was conducted. It was predicted that the participants in the Pandora Internet Radio music group would have greater tolerance times than those in the preferred music group, which would have greater tolerance times than those in the relaxation music group. Contrary to what was expected, a one-way analysis of variance (ANOVA) revealed that tolerance time was not related to music group, $F(2, 97) = .49$, $p = .62$.

Although not statistically significantly different, the Pandora Internet Radio group tolerance times were the highest, closely followed by the preferred group tolerance times, which were followed by the relaxation group tolerance times (see Figure 1). Nonetheless, the value of η^2 (.01) indicates almost no effect of music group on tolerance times (see Table 2 for tolerance times).

A mixed factorial analysis of variance was used to examine the second hypothesis; which was to identify if the three study groups had an impact on pain rating reactivity. It was predicted that the participants in the Pandora Internet Radio music group would demonstrate lower pain rating reactivity than the preferred music group, which would be lower than the relaxation music group's pain rating reactivity. For pain rating reactivity, a change score was calculated as the dependent variable (VAS2 – VAS1), to account for any pain sensations participants may have reported to be experienced prior to the cold pressor task. Pain rating reactivity by group was examined using a one-way analysis of variance (ANOVA). Results of this analysis revealed that music group did not significantly impact the pain rating reactivity, $F(2, 97) = .44, p = .65$. The value of η^2 (.01) indicates almost no effect of music group on the pain rating reactivity (see Table 6 for VAS scores).

To test the third hypothesis, a one-way analysis of variance was conducted for the total pain catastrophizing scale and the three different music groups. It was predicted that the participants in the Pandora Internet Radio music group would score significantly lower on the pain catastrophizing scale than people in the preferred music group, which would score significantly lower than people in the relaxation music group. The results revealed that music group did not significantly impact the pain catastrophizing scale, $F(2, 97) = .25, p = .78$. The

value of value of η^2 (.01) indicates almost no effect of music group on the pain catastrophizing scale (see Table 7 for pain catastrophizing total scores).

The fourth hypothesis involved the relationship between music importance and tolerance times and used a one-way analysis of variance, while the fifth hypothesis involved the relationship between music importance and pain rating reactivity and used a one-way analysis of covariance (holding for VAS 1). Notably, the fourth and fifth hypotheses involved a tertiary split of music importance. A tertiary split was conducted on the participant's perceived level of music importance in their life. This was due to the distribution, whereby the participants overall reported a high importance of music in their lives. The music importance cut point groups are as follows: music is important = score of 9 and greater ($n = 36$); music is somewhat important = score of 8 ($n = 36$); and music is not as important = score of less than 8 ($n = 28$).

The fourth hypothesis was to examine if people who view music as important in their life, will indicate a greater tolerance time than both people who view music as somewhat important, and people who view music as not important in their life. A one-way analysis of variance (ANOVA) revealed that tolerance time was not related to how important music was viewed in one's life, $F(2, 97) = .96, p = .39$; partial $\eta^2 = .02$.

The fifth hypothesis examined if people who view music as important in their life, will indicate lower pain rating reactivity than both people who view music as somewhat important, and people who view music as not important in their life. Some people did indicate experiencing some pain sensations prior to completing the cold pressor task. This is indicated in the first VAS. Therefore, the VAS pain rating 1 was used as a covariate. The one-way analysis of covariance

(ANCOVA) revealed that pain rating reactivity was not significant, $F(2, 97) = .26, p = .77$; partial $\eta^2 = .00$.

Chapter IV

Discussion

It has been recognized that acute and chronic pain are common (Gatchel et al., 2007). Not only are these conditions the most common reasons a person will seek health care (Gatchel et al., 2007), but they are also costly; pain is estimated to cost the United States a conservative \$560-635 billion dollars (Gaskin & Richard, 2012). Current theoretical models of pain appear to stress the importance of both physiological sensations of pain and also psychological factors that can impact the pain experience, such as distraction of attention and perceived control (Mitchell & MacDonald, 2006). Another psychological factor that has been shown to moderate the pain experience is pain catastrophizing, which involves an exaggerated negative cognitive style which is found to lead to a heightened pain experience (Sullivan et al., 2001).

Based on literature that supports the role psychological factors play in the pain experience, a number of non-pharmacological interventions have been identified. One such treatment approach that has been shown to be effective in pain management is music therapy (e.g., Bailey, 1986; Nickel, Hillecke, Argstatter, & Bolay, 2005; Mitchell, MacDonald, Knussen, & Serpell, 2007). It is suggested that music therapy is effective through, in part, distraction and a perceived sense of control. Literature involving music preference use is not vast, but the results from a study conducted by Mitchell and MacDonald (2006) were impressive. This study provided support that there was likely a significant difference between relaxation and preferred music effectiveness for pain management. Current technology provides an enhancement of the perceived level of control that one can have in the implication of music therapy through the use of Pandora Internet Radio. In addition to a listener's ability to choose preferred music, Pandora Internet Radio also capitalizes on the theoretically supported use of novel stimuli to distract or

engage attentional capacities. It was this element of novelty intertwined with the control of preferred music that led to the hypothesis that Pandora Internet Radio may be more effective than preferred music to reduce pain. This study is believed to be one of the first to use Pandora Internet Radio as an experimental form of music therapy.

In the first study hypothesis, it was expected that participants in the Pandora Internet Radio music group would demonstrate greater tolerance times than those in the preferred music group, which would have greater tolerance times than those in the relaxation music group. Although this hypothesis was not supported by this study, a number of reasons why the data did not show this pattern may exist. Notably, studies often use relaxation music (identified as simple rhythms, sustained melodic lines, slow tempo, non-percussive, and lots of repetition) for music therapy (Tan et al., 2012) and several studies have provided support for relaxation music therapy for effective pain management (e.g., Michel & Chesky, 1995; Mitchell et al., 2007). The chosen relaxation music for this study was empirically supported and based on Tan et al.'s (2012) recommendations from a panel of experts in music therapy. As this music was chosen among the most effective songs for inducing relaxation, the relaxation music selected for this study may be considered potentially more effective than the general genre of relaxation music. Thus, this study's pre-selected relaxation music may have impacted the relaxation music group in a more effective way than was expected, lessening the chance for discovering statistically significant differences between the music groups. Second, due to allotted participant size of 100 the randomization of participants into the relaxation music group resulted in only 26 participants in this group. This may have left statistical analysis comparing groups underpowered resulting in non-statistically significant differences. Indeed, examination of mean tolerance times for the other music groups and the relaxation music group shows the magnitude of tolerance times is in

the expected direction. Even so, it is important to note, during analysis there was no violation of equality between groups for any of the statistical tests. Additionally, the effect sizes were quite small for all analyses. Third, a large amount of variance in tolerance times, reflected by the large standard deviations, may have impacted results. Although the standard deviations were large, they were similar to those found in the Mitchell & MacDonald's (2006) study. Although the majority of individual difference factors should have been eliminated through randomization, specific individual factors may have impacted results. Specifically, experience with tolerating cold temperatures, such as participating in winter sports or activities (often pursued by people in the Midwest region) could contribute to these individual differences, but were not addressed in this study (Launay & Savourey, 2009).

The second study hypothesis was that the participants in the Pandora Internet Radio music group would demonstrate lower pain rating reactivity than the preferred music group, which would demonstrate lower pain rating reactivity than the relaxation music group. This was not supported by the study. One factor might be differences in participant's "anchors" for the VAS when the participant compares the cold pressor task pain experience to their "worst possible pain" on the VAS (Kane, Bershadsky, Rockwood, Saleh, & Islam, 2005; Dionne, Bartoshuk, Mogil, Witter, 2005; Frampton & Hughes-Webb, 2011). In conjunction with previous pain experiences, the cultural and ethnic differences surrounding pain could also impact how participants may report pain (Edwards, Fillingim, & Keefe, 2001). Alternatively, participants may have indicated lower pain (or higher pain) than they would have normally indicated based on social desirability effects (Lee & Kieckhefer, 1989). These effects could be related to gender, such that it is more socially acceptable for women to express pain and for men to not express pain (Levine & De Simone, 1991; Mayer, Labus, & Berkely, 2007). Lastly, anxiety of the

participant immediately following the cold pressor task could have been misidentified as pain sensations and indicated the VAS 2 or VAS 3. It may be that the participant experienced concern regarding the potential duration of recovery from, or the long-term effects of, the cold pressor and misattributed this as painful sensations. Bement and colleagues (2010) found a significant relationship between stress and anxiety associated with a cold pressor task and sensitivity to pain (Bement, Weyer, Keller, Harkins, & Hunter, 2010). As the introduction of the cold pressor task was consistent across groups, this may have resulted in artificially higher pain reactivity for all groups, thus negating group differences.

The third hypothesis was that the participants in the Pandora Internet Radio music group would score significantly lower on the pain catastrophizing scale than those in the preferred, which would score significantly lower than those in the relaxation music group. This hypothesis was also not supported by the study. However, there was a trend for men to have lower pain catastrophizing scale totals compared to women which is consistent with the literature (Sullivan et al., 2001). A participant's prior experience of being exposed to pain themselves or witnessing other people having catastrophic reactions to pain (Helsen, Goubert, Peters, & Vlaeyen, 2011), can impact the participant's ability to manage their psychological/cognitive reaction to painful stimuli (Sullivan, Bishop, & Pivik, 1995). Alternatively, the participants may have misunderstood the pain catastrophizing scale. Anecdotal evidence from participants suggests that there may have been confusion as to the time frame or situation that they were to answer the questions about. Further, as mentioned above, some distress may have been experienced when the participants realized the study would involve experiencing pain. This distress may have resulted in anxiety and appraisal of threat, which has been found to directly influence the

likelihood to catastrophize, even when the pain reports are found to be no different than others (Jackson, Pope, Nagasaka, Fritch, Iezzi, & Chen, 2005).

The fourth and fifth hypotheses focused on the participant's perceived level of music importance in their life. It was expected that those participants who reported greater importance would experience a stronger pain reduction effect from the music. This hypothesis, however, was not supported. One possible reason for the lack of support may be driven by data distribution for this variable. The overwhelming majority of participants reported music to be important to them. This may be, in part, due to the fact that music is considered a socially attractive activity (North, D. Hargreaves, & J. Hargreaves, 2004) and participants may be subject to the social desirability bias (Miller, 2012), where it may be favorable to distort self-reports in order to be viewed positively, like holding the view that music is an important aspect in life and music listening frequently should be high. Nonetheless, a tertiary spit was utilized, but using this approach likely caused a decrease in power which reduced the likelihood that true associations would be identified. Alternatively, participants may not have understood the question regarding music importance. This question was aimed at capturing the personal impact that music has on the participant, in order to explore how effective listening to music may be to them as form of pain management. As participants may have had a variety of experiences with music (e.g., playing a musical instrument, taking a music appreciation class, or participation in a band), when participants were asked how important they thought music was in their life they may have interpreted this in many different ways (e.g., emotional, enjoyment, social, cultural, religious, etc.) and not only on how it is used to cope with stressors. Indeed, it has been suggested that experience or involvement with music might be useful in "matching" music therapy for patients (Bailey, 1986), and thus may be a confound that was not measured in the current study. The

context or situation that a participant listens to music is also important to highlight (North, D. Hargreaves, & J. Hargreaves, 2004), because listening to music for enjoyment versus listening to accompany a daily task, would impact how actively people are concentrating on the music, likely tapping into their attentional capacities and levels of engagement towards music. This may have been a factor in the current study as “mindless” listening may dilute the effectiveness of music as a therapeutic intervention. By coupling music with another task, instead of listening as a main task, the listening situation is no longer the central focus of the activity.

In summary of the results, it would appear that none of the music groups were statistically more effective for tolerance times, pain rating reactivity, or pain catastrophizing. However, what could be carefully and cautiously inferred is that the preferred music group and the Pandora Internet Radio group may be equally effective music therapy interventions. However, when reviewing the data, the direction of outcome variables (i.e., pain tolerance, severity and pain catastrophizing) tentatively suggests Pandora Internet Radio may be more effective as a music therapy than this study reveals. Additionally, the relaxation group music selection for this study, although previously supported in the literature, may actually have provided a stronger influence for that music group than would typically be found in a relaxation genre for use in effective pain management. Lastly, even though music importance was rated very high by the participants in the study, there may be an effect for this variable when a more comprehensive assessment of experience with music is conducted (Mitchell et al., 2007).

Although the study utilized an innovative methodological approach, the findings were unexpected and there are a number of possible limitations which may have contributed to the study. First, the use of a true control group (no music or white noise) was not used and may have limited this study. Music therapy is found to be effective, but the use of a true control group

would anchor the results to provide a measurement of how effective the music groups are in the study. Thus, a true control group can provide greater evidence of effectiveness for all music groups, particularly the Pandora Internet Radio group. A second limitation related to the study design was the use of a between subjects group design compared to a within subjects group design. The within subjects group design was used in Mitchell and MacDonald's (2006) study and did provide statistically significant results between the relaxation and preferred music groups. However, in the current study, a between subjects group design was preferred because multiple inductions of the cold pressor task under the three different music groups had the potential to cause excessive pain to the participants. A third limitation involves the sample size in general. With a larger sample it may be that the between subjects differences could be more easily identified, and effect sizes may therefore increase to a more clinically relevant level. A fourth limitation is the use of a convenience sample of undergraduate students for pain research. This non-pain student sample may not be generalizable to actual pain populations. A final limitation could be related to the perceived music frequency and music importance for this student population. Often students listen to music when they travel to school or work, and this could influence how strong the distractibility of music would be, because they may be used to doing multiple things at once (e.g., driving, listening, possibly singing the lyrics, walking with headphones in, etc.). Therefore, this population may be better at dividing their attention and less distracted by listening to music. Likewise, this population uses advanced technology on a daily basis.

There are some strengths of this study that should be mentioned. First, the data collection was completed during the fall season, which meant it was after the warmer months, but before the colder months. This was important because the research was conducted during the ideal

weather, so that the participants were not acclimated to either extreme hot or cold temperatures experienced in the natural climate of Michigan. This general, hot or cold temperature acclimation could impact participant's tolerance to the cold water temperature involved in the cold pressor task. Launay and Savourey (2009) report that general (whole body) cold adaptations result in alterations of metabolic heat production, amount of body heat lost, as well as core body temperature changes, after repeated exposures to cold temperatures (e.g., resultant during the winter months). In addition, this also relates to repeated local cold exposures (such as exposed hands), which can lessen the rate of skin temperature decreases, lessen pain, and provide greater manual dexterity (Launay & Savourey, 2009). Second, conservative inclusion/exclusion criteria were utilized to ensure participant safety. Third, the data collection was conducted by one researcher, which enhanced reliability and reduced possible experimenter effects. Fourth, the use of the tablet is considered a strength, based on the ease of touch screen and size of the tablet. The integration of this new technology in research provides support for an alternative way to administer music therapy, whether this is through Pandora Internet Radio or purchased music online. This can also be considered appropriate for this student population because they are part of the generation that understands and uses advanced technologies on a daily bases. One final strength to mention relates to the participants in the Pandora Internet Radio group who had not previously heard of Pandora Internet Radio. For this "subgroup" the researcher would often ask participants how they liked it at the conclusion of the study. Anecdotally, these participants responded positively to it, even when their first exposure to Pandora Internet Radio was coupled with a cold pressor task. Three of these participants provided the following anonymous quotes with their approval.

One participant responded highlighting the applications use:

“I like it. I would defiantly use it.”

Another participant informed the researcher that they loved Jazz music, but that it only played on the radio during certain times of the day and they could only enjoy it at those times. This feedback highlights the accessibility to particular artists and genres of music:

“I really enjoyed it; to be able to access ‘real’ music.”

Yet, another participant further inquired as to where they could attain Pandora Internet Radio, and if it would work on their particular Smartphone device. Their feedback highlights their desire to explore new genres of music:

“I would like to listen to hard rock. I don’t know where to get the music from because I’ve always listened to Arabic music my entire life.”

There are positive implications and practical uses regarding the information relating to the current study. Based on the data, it seems as though listening to any music could potentially be a practical intervention for pain management, or at least it will do no harm (Mitchell et al., 2007). Music is dynamic, meaning that it can be changed with individual preference: and in addition, music may also be shared in the presence of others (North, D. Hargreaves, & J. Hargreaves, 2004), who could provide social support. Overall, listening to music may positively impact the quality of life in pain populations, especially chronic pain sufferers (Mitchell et al., 2007). In terms of Pandora Internet Radio specifically, in reflection of the feedback from the study participants, it can be cautiously concluded that the use of Pandora Internet Radio as a means of music therapy intervention within pain populations may be accepted positively. Coupled with this acceptance, patients may find the use of Pandora Internet Radio enjoyable, and they may be more likely to consistently use this form of treatment. Furthermore, Pandora Internet

Radio is widely available through the internet which is available in most hospitals for patients use and the general population usually has access to the internet at home, or can locate free Wi-Fi (e.g., local coffee shops, libraries, and stores). More than that, Pandora Internet Radio provides a free application online and also an app for the use of the same account linked to one's Smartphone or tablet (Pandora, 2014), and even in some vehicles (e.g., Chrysler) (U.S. Newswire, 2013).

The findings of this study point out that more research needs to be done involving the use of Pandora Internet Radio within the area of music therapy in order to further understand the potential benefits and to be better able to apply it in the health fields. If future research reveals similar results or greater support for the use of Pandora Internet Radio as a form of music therapy, considering hospitals in the United States typically have internet, this application could be easily transitioned across the nation for acute pain situations. As for chronic pain, the introduction of this potential treatment may be delayed by slower dissemination practices, but ultimately could still be achievable. It should be noted that an alternative potential therapy, which would be in contrast to the theoretically underpinning of distraction that Pandora Internet Radio would utilize, is the use of mindfulness (a non-judgmental state of awareness to one's present moment) which intentionally uses attention and awareness. Indeed, research has supported the use of mindfulness based interventions to effectively treat chronic pain patients (Kang, Gruber, & Gray, 2013).

In conclusion, even though Pandora Internet Radio didn't seem to have as strong of an impact on pain perception and catastrophizing as expected, it did reveal that all of the music groups seem to be effective. As greater advances in technology have provided accessible, inexpensive, and an inexhaustible supplies of music, the application of potential music therapies

in research and clinical practice becomes important for aiding pain populations. However, more research is required to support this particular application and potentially target those individuals that may best benefit from this type of intervention. It is believed that this is currently the only study to use Pandora Internet Radio as a potential form of music therapy for pain relief, thus future research should be conducted in order to further understand the implications of its use, especially long term application. In addition, age, personal importance of music to the participant, music frequency, and other intra-individual variables should be incorporated into future research, as these variables may impact the potential efficacy of Pandora Internet Radio as a form of music therapy.

References

- Bailey, L. M. (1986). Music therapy in pain management. *Journal of Pain and Symptom Management, 1*(1), 25-28.
- Bement, M. H., Weyer, A., Keller, M. Harkins, A. L., & Hunter, S. K. (2010). Anxiety and stress can predict pain perception following a cognitive stress. *Physiology & Behavior, 101*, 87-92.
- Berkley, K. J. (1997). Sex differences in pain. *Behavioral and Brain Sciences, 20*, 371-380.
- Bijur, P. E., Silver, W., & Gallagher, J. E. (2001). Reliability of the visual analog scale for measurement of acute pain. *Academic Emergency Medicine 8*(12), 1153-1157.
- Centers for Disease Control and Prevention (CDC). (2014). In *About BMI for adults*. Retrieved from http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html
- Carr, D. B., & Goudas, L. C. (1999). Acute pain. *The Lancet, 353*, 2051-2058.
- Dionne, R. A., Bartoshuk, L., Mogil, J., & Witter, J. (2005). Individual responder analyses for pain: Does one pain scale fit all? *Trends in Pharmacological Sciences, 26*(3), 125-130.
- Edwards, C. L., Fillingim, R. B., & Keefe, F. (2001). Race, ethnicity, and pain. *Pain, 94*, 133-137.
- Elton, D., Stanley, G., & Burrows, G. (1983). *Psychological control of pain*. New York, NY: Grune & Stratton, Inc.
- Faul, F., & Erdfelder, E. (1992). *GPOWER: A priori-, post hoc-, and compromise power analyses for MS-DOS* [Computer program]. Bonn, Germany: Bonn University.
- Fillingim, R. B., & Ness, T. J. (2000). Sex-related hormonal influences on pain and analgesic responses. *Neuroscience and Biobehavioral Reviews, 24*, 485-501.
- Flor, H. (2001). The Health Psychology of Pain. In the *International Encyclopedia of the Social & Behavioral Sciences*, 10990-10995. Retrieved from <http://umdearborn.summon.serialssolutions.com/search?s.q=The+Health+Psychology+of+Pain>
- Frampton, C. L., & Hughes-Webb, P. (2011). The measurement of pain. *Clinical Oncology, 23*, 381-386.
- France. J. (2008, July 17). Top 5 online music stores: A roundup of the top five online stores that sell digital music. *Crave – CNET*. Retrieved from http://news.cnet.com/8301-17938_105-9992592-1.html#!

- Franco, L. L. (2004). Winds of peace. On *New morning* [CD]. Studio City, CA: Lavender Sky Music (2008).
- Gaskin, D. J., & Richard, P. (2012). The economic costs of pain in the United States. *The Journal of Pain*, 13(8), 715-724.
- Gatchel, R. J., Peng, Y. B., Peters, M. L., Fuchs, P. N., & Turk, D. C. (2007). The biopsychosocial approach to chronic pain: Scientific advances and future directions. *Psychological Bulletin*, 133(4), 581-624.
- Haythornthwaite, J. A., Menefee, L. A., Heinberg, L. J., & Clark, M. R. (1998). Pain coping strategies predict perceived control over pain. *Pain*, 77(1), 33-39.
- Haahr, M. (accessed 2013). RANDOM.ORG. Retrieved from <http://www.random.org/>
- Helsen, K., Gouber, L., Peters, M. L., & Vlaeyen, J. W. S. (2011). Observational learning and pain-related fear: An experimental study with colored cold pressor tasks. *The Journal of Pain*, 12(12), 1230-1239.
- International Association for the Study of Pain Subcommittee on Taxonomy & Merskey, H. (Eds). (1979). Definition of pain terms. *Pain* (Supple.3), S1-S226. Retrieved from <http://www.iasp-pain.org/Content/NavigationMenu/GeneralResourceLinks/PainDefinitions/default.htm#Pain>
- Jackson, T., Pope, L., Nagasaka, T., Fritch, A., Iezzi, T., & Chen, H. (2005). The impact of threatening information about pain on coping and pain tolerance. *British Journal of Health Psychology*, 10, 441-451.
- Juslin, P. N., & Sloboda, J. A. (2001). *Music and emotion: Theory and research*. Oxford, NY: Oxford University Press.
- Kane, R. L., Bershadsky, B., Rockwood, T., Saleh, K., & Islam, N. C. (2005). Visual analog scale pain reporting was standardized. *Journal of Clinical Epidemiology*, 58, 618-623.
- Kang, Y., Gruber, J., & Gray, J. R. (2013). Mindfulness and de-automatization. *Emotion Review*, 5(2), 192-201.
- Khan, R. S., Ahmed, K., Blakeway, E., Skapinakis, P., Nihoyannopoulos, L., MacLeod, K., Sevdalis, N., Ashrafian, H., Platt, M., Darzi, A., & Athanasiou, T. (2011). Catastrophizing: A predictive factor for postoperative pain. *The Journal of Surgery*, 201, 122-131.
- Kobialka, D. (2008). Trois Gymnopedies. On *Fragrances of a dream* [CD]. DKM Label.
- Launay, J. C. & Savourey, G. (2009). Cold adaptations. *Industrial Health*, 47, 221-227.

- Lee, K. A., & Kieckhefer, G. M. (1989). Measuring human responses using visual analogue scales. *Western Journal of Nursing Research, 11*(1), 128-132.
- Levine, F. M., & De Simone, L. L. (1991). The effects of experimenter gender on pain report in male and female subjects. *Pain, 44*, 69-72.
- Mayer, E. A. Labus, J. S. & Berkley, K. J. (2007). Sex differences in pain. [ebruary Reader]. doi: [10.1093/acprof:oso/9780195311587.003.0019](https://doi.org/10.1093/acprof:oso/9780195311587.003.0019)
- McDonald, D. D., McNulty, J., Erickson, K., & Weiskopf, C. (2000). Communicating pain and pain management needs after surgery. *Applied Nursing Research, 13*(2), 70-75.
- Melzack, R. (1996). Gate control theory: On the evolution of pain concepts. *Pain Forum 5*(1), 128-138.
- Michel, D. E. & Chesky, K. S. (1995). A survey of music therapists using music for pain relief. *The Arts in Psychotherapy, 22*(1), 49-51.
- Miller, A. G. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *The Psychological Review, 63*(2), 81-97.
- Miller, A. L. (2012). Investigating social desirability bias in student self-report surveys. *Educational Research Quarterly, 36*(1), 30-47.
- Mitchell, L. A., & MacDonald, R. A. R. (2006). An experimental investigation of the effects of preferred and relaxing music listening on pain perception. *Journal of Music Therapy, 43*(4), 295-316.
- Mitchell, L. A., MacDonald, R. A. R., & Brodie, E. E. (2004). Temperature and the cold pressor test. *The Journal of Pain, 5*(4), 233-238.
- Mitchell, L. A., MacDonald, R. A. R., Knussen, C., & Serpell, M. G. (2007). A survey investigation of the effects of music listening on chronic pain. *Psychology of Music, 35*(1), 37-57.
- McCaul, K. D., & Malott, J. M. (1984). Distraction and coping with pain. *Psychological Bulletin, 95*(3), 516-533.
- National Center for Complementary and Alternative Medicine (NCCAM). (2012). Pain [data file]. Retrieved from: <http://nccam.nih.gov/health/pain?nav=gsa>
- Nickel, A. K., Hillecke, T., Argstatter, H., & Bolay, H. V. (2005). Outcome research in music therapy: A step on the long road to an evidence-based treatment. *Annals of the New York Academy of Sciences, 1060*(1), 283-293.
- Pandora Internet Radio (accessed Jan, 2013). In *How to use Pandora*. Retrieved from

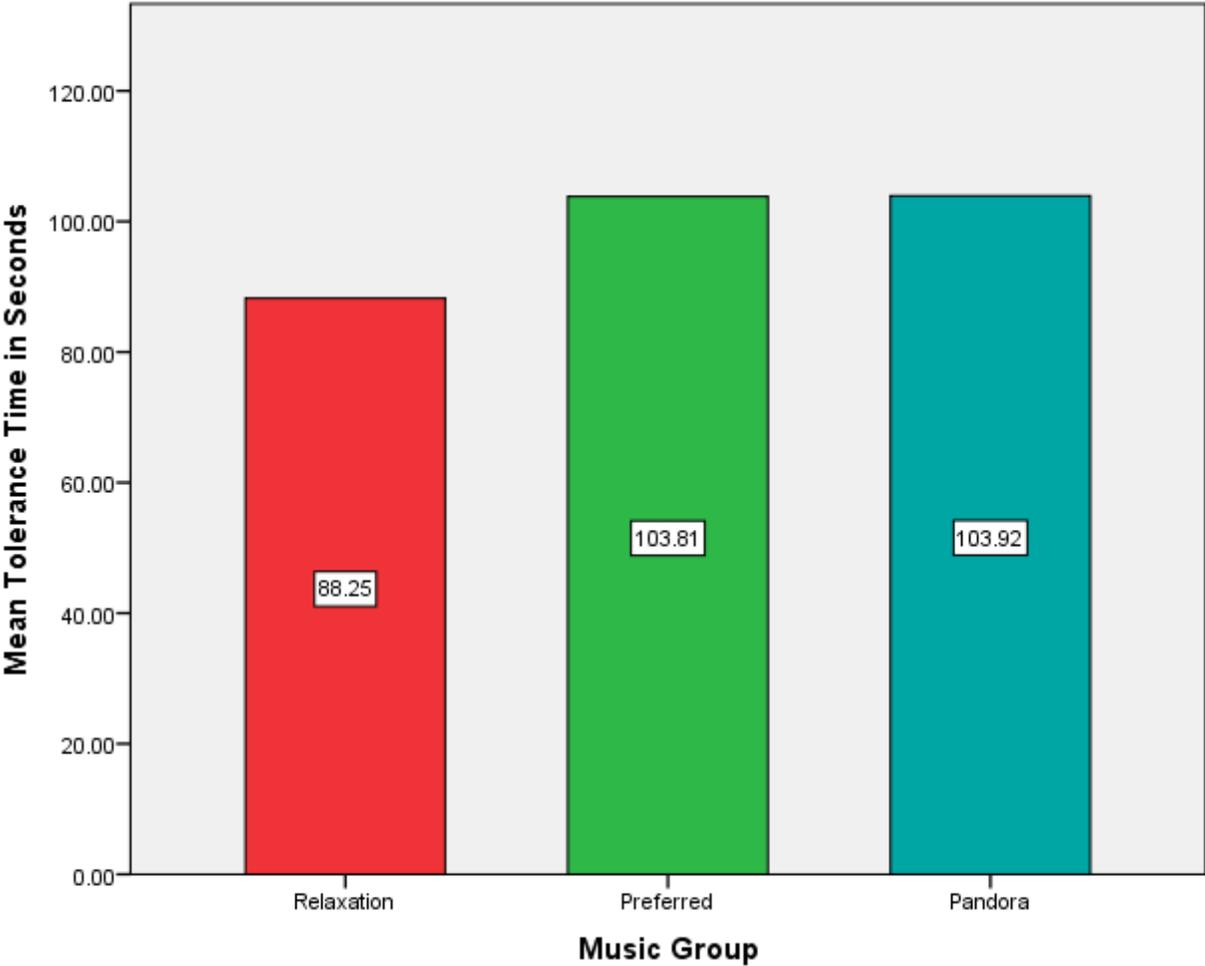
<http://help.pandora.com/customer/portal/topics/38652-how-to-use-pandora/articles>

- Pandora Internet Radio (accessed Dec, 2012). In *About The Music Genome Company*®. Retrieved from <http://www.pandora.com/about/mgp>
- Pandora Internet Radio (accessed Jan, 2014). In Love Pandora®? Try Pandora One™. Retrieved from <http://www.pandora.com/one>
- Pellino, T. A., & Ward, S. E. (1998). Perceived control mediates the relationship between pain severity and patient satisfaction. *Journal of Pain and Symptom Management*, 15(2), 110-115.
- Peterson, C., Maier, S. F., & Seligman, M. E. P. (1993). *Learned helplessness: A theory for the age of personal control*. New York, NY: Oxford University Press.
- Rainville, P., Feine, J. S., Bushnell, C. M., & Duncan, G. H. (1992). A psychophysical comparison of sensory and affective responses to four modalities of experimental pain. *Somatosensory & Motor Research*, 9(4), 265-277.
- Satellite, internet and AM/FM radios - niche or trend? (2013, Jan 15). *U.S. Newswire*. Retrieved from <http://0-search.proquest.com.wizard.umd.umich.edu/docview/1269456501?accountid=14578>
- Shiffrin, R. M., & Nosofsky, R. M. (1994). Seven plus or minus two: A commentary on capacity limitations. *Psychology Review*, 101(2), 357-361.
- Shiloh, S., Zuckerman, G., Butin, B., Deutch, A., Yardeni, I., Benyamini, Y., & Beilin, B. (2003). Postoperative patient-controlled analgesia (PCA): How much control and how much analgesia? *Psychology and Health*, 18(6), 753-770.
- Skevington, S. M. (1996). *Psychology of pain*. New York, NY: John Wiley & Sons, Inc.
- Sloboda, J. (2008). The ear of the beholder. *Nature*, 454(3), 32-33.
- Sullivan, M. J. L. (2009). The pain catastrophizing scale: User manual. Retrieved from http://sullivan-painresearch.mcgill.ca/pdf/pcs/PCSManual_English.pdf
- Sullivan, M. J. L., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: Development and validation. *Psychological Assessment*, 7(4), 524-532.
- Sullivan, M. J. L., Thorn, B., Haythornthwaite, J. A., Keefe, F., Martin, M., Bradley, L. A., & Lefebvre, J. C. (2001). Theoretical perspectives on the relation between catastrophizing and pain. *The Clinical Journal of Pain*, 17, 52-64.
- Tan, X., Yowler, C. J., Super, D. M., & Fratianna, R. B. (2012). The interplay of preference, familiarity and psychophysical properties in defining relaxation music. *Journal of Music*

Therapy, 49(2), 150-179.

- Tashani, O. A., Alabas, O. A. M., & Johnson, M. I. (2010). Cold pressor pain response in healthy Libyans: Effects of sex/gender, anxiety, and body size. *Gender Medicine*, 7(4), 309-319.
- Tse, M. M. Y., Chan, M. F., & Benzie, I. F. F. (2005). The effect of music therapy on postoperative pain, heart rate, systolic blood pressure and analgesic use following nasal surgery. *Journal of Pain and Palliative Care Pharmacotherapy*, 19(3), 21-29.
- Vaajoki, A., Pietila, A., Kankkunen, P., & Vehvilainen-Julkunen, K. (2010). Effects of listening to music on pain intensity and pain distress after surgery: An intervention. *Journal of Clinical Nursing*, 21, 708-717.
- Vlaeyen, J. W. S., Crombez, G., & Groubert, L. (2007). The psychology of chronic pain and its management. *Physical Therapy Reviews*, 12, 179-188.
- Von Baeyer, C. L., Piira, T., Chambers, C. T., Trapanotto, M., & Zeltzer, L. K. (2005). Guidelines for the cold pressor task as an experimental pain stimulus for use with children. *The Journal of Pain*, 6(4), 218-227.
- Wakim, J. H., Smith, S., & Guinn, C. (2010). The efficacy of music therapy. *American Society of PeriAnesthesia Nurses*, 25(4), 226-232.
- Weiner, K. (2001). Pain issues: Pain is an epidemic – A message from the director. *American Academy of Pain Management*, 1-3. Retrieved from http://0-ac.els-cdn.com/wizard.umd.umich.edu/S0897189700800038/1-s2.0-S0897189700800038-main.pdf?_tid=d97f736a-642b-11e2-bcd3-00000aab0f27&acdnat=1358815207_15eeeab65a57971bea5bf8628c416756
- Wild, C. (2004). Into the silence of my being. On *Liquid mind VII: Reflection* [CD]. Sausalito, CA: Real Music/ Chuck Wild Records.
- Williamson, A. & Hoggart, B. (2005). Pain: A review of three commonly used pain rating scales. *Journal of Clinical Nursing*, 14(7), 798-804.

Figure 1. Tolerance Times as a Function of Music Group.



Note: The standard deviations are as follows: Relaxation (74.4), Preferred (69.9), and Pandora Internet Radio (65.2).

Table 1: Means and Standard Deviations of Demographics

Variable	n	%	Mean (SD)	Range
Age	100		20.62 (4.46)	18-48
School Status	100			
Freshman	37	37%		
Sophomore	33	33%		
Junior	24	24%		
Senior	4	4%		
Other	2	2%		
BMI	100		23.37 (3.66)	
Male	40	40%	24.08 (3.87)	
Female	60	60%	22.90 (3.46)	
Handedness	100			
Right	93	93%		
Left	7	7%		
Music Frequency (Weekly)	100			
Always	63	63%		
Often	32	32%		
Sometimes	4	4%		
Once in a while	1	1%		
Rarely	0	0%		
Music Importance*	100			1-10
Low (less than 8)	28	28%		
Some (8)	36	36%		
High (9-10)	36	36%		
Pandora Internet Radio Used Prior				
Yes	81	81%		
No	19	19%		

Note: Age = Participant's age based on date of birth, School Status = Participant's reported school status at the University of Michigan – Dearborn based on credit status, BMI = Body Mass Index calculated from the participant's reported height and weight, Handedness = Participant's dominant hand, Music Frequency (Weekly) = How often the participant listens to music for enjoyment weekly, *Music Importance = Participant's view of the importance of music in their life from a 1-10 Likert scale (Tertiary split conducted: Low (less than 8), Somewhat (8), and High (9-10)), and Pandora Internet Radio Used Prior = Participant's had used the Pandora Internet Radio prior to participating in the present study.

Table 2: Tolerance Times between Music Groups

Music Group	n	Minimum	Maximum	Mean (SD)
Relaxation	26	14.87	180.00	88.25 (74.40)
Preferred	37	15.42	180.00	103.81 (69.89)
Pandora	37	28.30	180.00	103.92 (65.23)

Note: Tolerance times are recorded in seconds.

Table 3: Music Genres in Pandora Internet Radio Group

Genre	Frequency	% Within Group	% of Total Sample
Pop	6	6%	16.2%
Alternative	4	4%	10.8%
Country	3	3%	8.1%
Hip Hop	7	7%	18.9%
Rap	1	1%	2.7%
Classical	1	1%	2.7%
Metal	1	1%	2.7%
R&B/Hip Hop	4	4%	10.8%
Workout Music	1	1%	2.7%
Bachata	1	1%	2.7%
Dance	1	1%	2.7%
Songwriters/Folk	1	1%	2.7%
Jazz	1	1%	2.7%
Indie	1	1%	2.7%
R&B	2	2%	5.4%
Electronic	1	1%	2.7%
Hard Rock	1	1%	2.7%
Total	37	37%	100%

Note: Participants self-reported their music genre selection based off of the Pandora Internet Radio Stations they had listened to.

Table 4: Music Genres in Preferred Music Group

Genre	Frequency	% Within Group	% of Total Sample
Pop	5	5%	13.5%
Alternative	5	5%	13.5%
Country	3	3%	8.1%
Hip Hop	1	1%	2.7%
Rap	5	5%	13.5%
Rock	4	4%	10.8%
Dubstep	1	1%	2.7%
House	1	1%	2.7%
Indian Pop	1	1%	2.7%
Alternative Rock	1	1%	2.7%
Death Metal	1	1%	2.7%
Indie Rock	1	1%	2.7%
Indie Folk	1	1%	2.7%
R&B	2	2%	5.4%
World (Arabic)	1	1%	2.7%
Uplifting and Inspiring	1	1%	2.7%
Alternative Pop	1	1%	2.7%
Machinma	1	1%	2.7%
Techno	1	1%	2.7%
Total	37	37%	100%

Note: Participants self-reported their music genre selection from the music they were required to bring to the study.

Table 5: Correlations between Demographics and Dependent Variables

	Age	BMI	Hand	Pandora	TT	VAS1	VAS2	VAS3	PCS- Total
Age	--								
BMI	.05	--							
Hand	.09	-.05	--						
Pandora	.05	-.03	.07	--					
TT	.00	.01	.10	-.07	--				
VAS1	.09	.03	.13	.10	.09	--			
VAS2	.12	-.26*	.04	.01	-.36**	.01	--		
VAS3	-.20*	-.13	-.02	.00	.25*	.20*	.13	--	
PCS- Total	-.03	-.10	.05	.01	-.41**	.11	.53**	.05	--

Note: Correlations among study variables (N = 100). Age = Participant's age based on date of birth, BMI = Body Mass Index calculated from the participant's reported height and weight, Hand = Participant's dominant hand, TT = Tolerance times in seconds, VAS1 = Visual Analogue Scale at time one (prior to cold pressor task), VAS2 = Visual Analogue Scale at time two (immediately upon removal of hand from the cold pressor task), VAS3 = Visual Analogue Scale at time three (four minutes after removal of hand from the cold pressor task), and PCS-Total = Pain Catastrophizing Scale Total score.

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

Table 6: Visual Analog Scale between Music Groups

Music Group	n	Minimum	Maximum	Means (SD)
Relaxation				
VAS 1	26	.00	3.00	.57 (.81)
VAS 2	26	34.00	96.00	70.61 (17.14)
VAS 3	26	.00	25.00	5.80 (6.86)
Preferred				
VAS 1	37	.00	3.00	.56 (.73)
VAS 2	37	33.00	99.00	70.26 (16.77)
VAS 3	37	.00	29.00	7.86 (8.41)
Pandora Internet Radio				
VAS 1	37	.00	2.00	.47 (.55)
VAS 2	37	25.00	100.00	66.62 (22.46)
VAS 3	37	.00	25.00	6.26 (5.92)

Note: Data recorded in millimeters along Visual Analog Scale (VAS).

Table 7: Pain Catastrophizing Scale Total between Music Groups

Music Group	n	Minimum	Maximum	Mean (SD)
Relaxation	26	4.00	46.00	25.87 (11.78)
Preferred	37	3.00	46.00	24.41 (11.77)
Pandora	37	8.00	44.00	26.17 (10.85)

Appendix A

Confirmation Interview Script

To the participant:

You have signed up on the SONA System website as a research participant for The P3 Study. As was listed on the SONA system, the exclusion criteria follows: you have eaten something in the last two hours, you have not consumed caffeine in the last two hours, you do not have a history of chronic pain (duration of at least three months), you have not taken any analgesic medication within 24 hours of the study (i.e., prescription, cold-medications, OTC medications, or consumed alcohol), you do not have any history of cardiovascular disorders/diseases, you do not have a history of fainting or seizures, you do not have a history of frost bite on your hands, you do not have an open cut or sore on your non-dominant hand, and you are not pregnant. Additionally, in order to fit the inclusion criteria listed on the SONA system website, you must be 18 years of age, able to read, and have brought a personal music listening device to the study with three songs from one genre already chosen to listen to?

Please answer with a yes or no. Do you meet these criterion listed on the SONA system website, which were just read to you?

Appendix B

Participant ID #: _____

Date: __/__/____

- Verbally asked and confirmed meeting the criteria
- Did not meet criteria

Signed by: _____

The P3 Study

Appendix C

Participant ID #: _____

Date: __/__/____

Please fill out the following information:

1. Have you eaten something today in the last two hours? Yes No
2. Have you consumed caffeine in the last two hours? Yes No
3. Do you have a history of chronic pain, duration of at least three months? Examples might include:
arthritis, migraines, or low back pain? Yes No
4. Have you taken any pain medication within 24 hours of the study? Over the counter medications
(e.g. Tylenol or Ibuprofen), cold medications (e.g. Sudafed), prescription pain medications, non-
prescription medications, or consumed alcohol in the lasts 24 hours?
 Yes No
5. Do you have a history of any cardiovascular disorders/diseases? Examples include: arrhythmias,
heart murmurs, or hypertension? Yes No
6. Do you have a history of fainting or seizures? Yes No
7. Do you have a history of frost bite on your hands? Yes No
8. Do you have an open cut or sore on your non-dominant hand? Yes No
9. Did you bring your preferred music to the study? Yes No
10. Are you pregnant? Yes No

Appendix D

Participant ID #: _____

Date: __/__/____

Please fill out the following information:

Date of Birth: __/__/____

Status in School: Freshman Sophomore Junior Senior OtherSex: Male Female

Weight: ___lbs. Height: ___ft ___in

How often do you listen to music for enjoyment weekly?

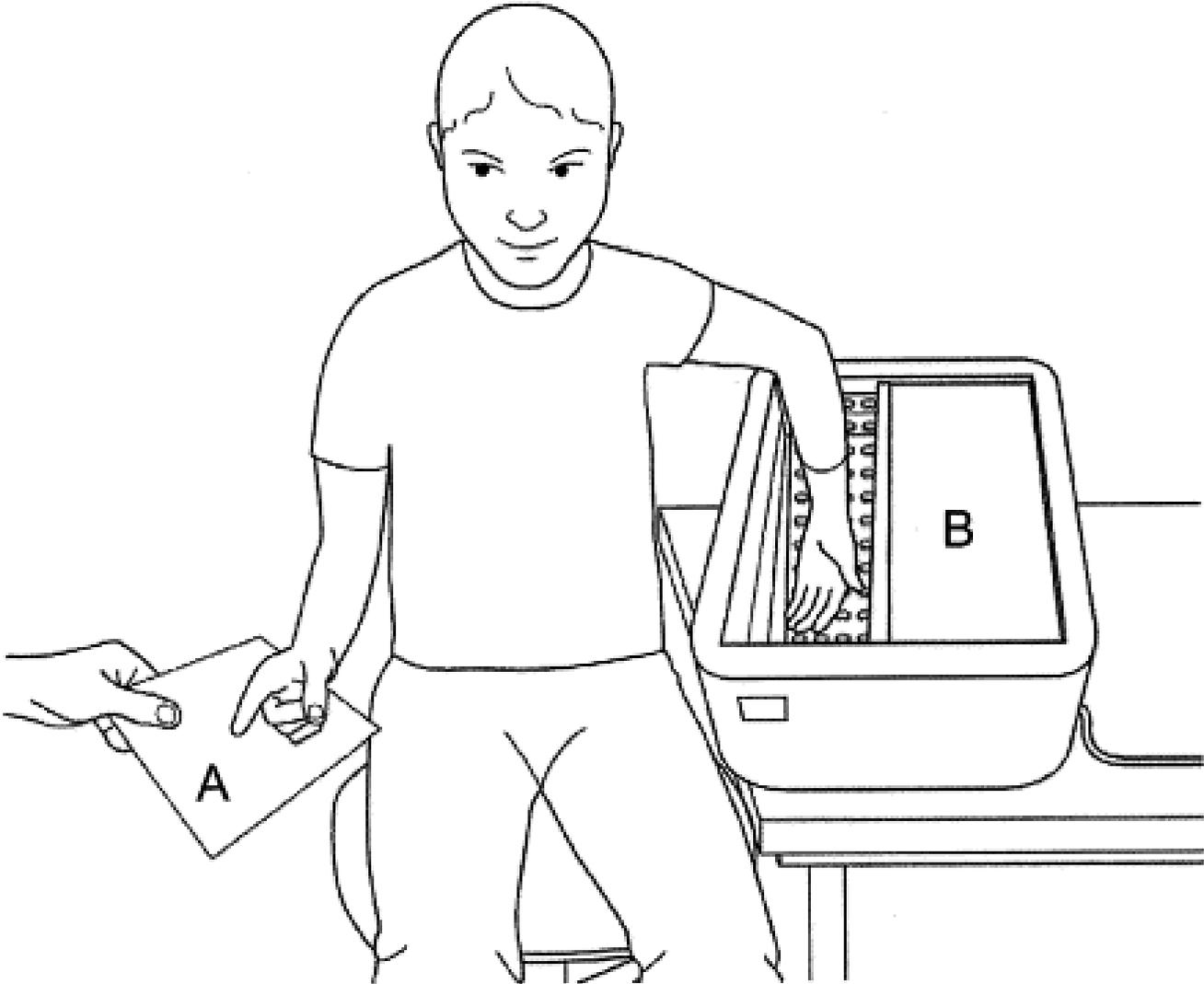
 Always Often Sometimes Once in a while Rarely

Circle the number which reflects the importance of music in your life (1 = no importance, 10 = very important):

1 2 3 4 5 6 7 8 9 10

Have you ever used Pandora Internet Radio? Yes NoAre you right handed or left handed? Right Left

Appendix E



Appendix F

Please place hand
in water

Appendix G

**Pandora Internet Radio's Popular Genre Stations in
Alphabetical Order:**

Alternative

Blues

Christian & Gospel

Classical

Country

Dance/Club

Easy Listening

Electronic

Heavy Metal

Hip Hop

Holiday

Indie

Jazz

Love Songs

New Age

Oldies

Pop

R&B

Rap

Reggae

Rock

Songwriters/Folk

Soundtrack

Soul

Workout

World

Appendix H

Relaxation Music Recording References

Franco, L. L. (2004). Winds of peace. On *New morning* [CD]. Studio City, CA: Lavender Sky

Music (2008).

Kobialka, D. (2008). Trois Gymnopedies. On *Fragrances of a dream* [CD]. DKM Label.

Wild, C. (2004). Into the silence of my being. On *Liquid mind VII: Reflection* [CD]. Sausalito,

CA: Real Music/ Chuck Wild Records.

Appendix I

_____ Participant #

_____ Rating #

Visual Analog Scale

Rectangular Snip



Appendix J

PAIN COGNITIONS

We are interested in looking at the relationship between thoughts and pain. Please indicate the degree to which you experienced each of the following thoughts or feelings when experiencing pain from the cold pressor task used in today's study by circling a number under each statement.

When I felt pain...

1. I worried all the time about whether the pain will end.

0	1	2	3	4
Not at all				All the time

2. I felt I couldn't go on.

0	1	2	3	4
Not at all				All the time

3. It was terrible and I thought it was never going to get any better.

0	1	2	3	4
Not at all				All the time

4. It was awful and I felt that it overwhelmed me.

0	1	2	3	4
Not at all				All the time

5. I felt I couldn't stand it anymore.

0	1	2	3	4
Not at all				All the time

6. I became afraid that the pain may get worse.

0	1	2	3	4
Not at all				All the time

7. I thought of other painful experiences.

0	1	2	3	4
Not at all				All the time

CONTINUED ON NEXT PAGE

Appendix K

Participant ID #: _____

Music Group: _____

Please fill out your music selection:

Indicate Genre: _____.

1.

Artist:

_____.

Song title:

_____.

2.

Artist:

_____.

Song title:

_____.

3.

Artist:

_____.

Song title:

_____.

Appendix L

Participant ID#: _____

Music Group: _____

Please fill out your music selection:

Indicate Genre: _____.

Indicate Pandora Station Title: _____.

Appendix M

Study ID: HUM00071440 IRB: Dearborn Date Approved: 5/17/2013

Thank You!

Thank you for your participation in the Pandora's impact on pain perception study (P3). We hope that by exploring how Pandora Internet Radio compares to preferred music choice, we can better inform health care professionals about how to improve therapeutic music application for pain management, and ultimately provide more comprehensive care for a variety of health problems. Without the input of individuals like yourself, advances in health care cannot be made.

This sheet is provided as a reminder that should your participation in this study lead to a desire to seek any additional services, you have the following contact information and may contact the agencies listed below.

Psychological Services (please call for information on fees for the services.)

University of Michigan – Dearborn Counseling Services* 313-593-5430

Mark Barton, Ph.D 313-577-2841

Jeff Kuentzel, Ph.D 313-600-9840

*provides free counseling to current students of the University of Michigan – Dearborn

Medical Services

Henry Ford Medical Center – Fairlane 313-883-2100

Please feel free to contact any of these agencies should you feel you need additional care following your participation. Once again thank you for your participations. It is greatly appreciated!

Brianna Frisch and P3 team.