THESIS

INVESTIGATING THE ISO PRINCIPLE:

THE EFFECT OF MUSICAL TEMPO MANIPULATION ON AROUSAL SHIFT

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ABSTRACT

INVESTIGATING THE ISO PRINCIPLE: THE EFFECT OF MUSICAL TEMPO MANIPULATION ON AROUSAL SHIFT

The *iso principle* is a well-known concept in music therapy practice wherein a clinician meets a client at a current body state with a musical element, then moves them to a new body state by modulating the musical element. However, few scholars agree on what bodily states and musical elements define the iso principle, which limits music therapy clinicians' targeted application of the concept. Further, it appears there have been no studies objectively addressing physiologic change during the iso principle. The purpose of this study was to investigate arousal shift during iso principle-informed tempo change in a musical stimulus. Arousal was measured via physiological responses (galvanic skin response [GSR]) and self-perception (self-assessment manikin [SAM]). Participants' (n = 9) took part in a randomized block design with control in which they completed a mindfulness-based intervention before listening to one of three five-minute auditory stimuli: 1) an iso principle-informed song, 2) a compensation principle-informed song, and 3) a spoken short story. GSR data from participants did not show statistically significant differences between the iso principle and compensation principle, but did show significant differences between musical conditions and speech. While the music was designed to increase arousal using the iso principle, overall there was a reduction in arousal levels over the experimental period. Participants' self-ratings of their arousal shifts (SAM scores of arousal) showed a perceived increase in arousal during all conditions. Limitations, clinical implications, and future directions are discussed.

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CHAPTER 1
INTRODUCTION

A well-known concept in music therapy practice is the iso principle (Davis et al., 2008; Heal & Wigram, 1993; Wigram et al., 2013). The iso principle was first postulated in 1944 by Ira Altschuler in regard to the use of music with psychiatric patients. This concept has been named in many music therapy studies, textbooks, and presentations, and is not often cited in music research outside of music therapy journals. As of this writing, the iso principle was not found in any articles in a general EBSCO search outside of articles written by or in collaboration with credentialed music therapists. Despite the term's use across music therapy literature and educational programs, the term lacks a clear definition. For example, the term *iso principle* is sometimes used synonymously with the terms mood vectoring (Shatin, 1970; Thaut, 2005), the iso-moodic principle (Donald & Pinson, 2012; Heal & Wigram, 1993, Saperston, 1995), the ISO-Vectoring Principle (Richardson et al., 2008), or entrainment music (Donald & Pinson, 2012; Rider, 1985). Across these synonymous terms, the iso principle can be broadly defined as using one or more elements of music to meet a patient's current state, then changing said musical element(s) to lead them to a different state (Altschuler, 1954; Heiderscheit & Madson, 2015; Yinger & Lownds, 2018). The given state being changed can be mood, pain level, arousal, or a number of other states.

Studies describing how to use the iso principle or providing data for its efficacy (alone or compared to other methods) are sparse. While definitions for the iso principle were found in no fewer than 18 sources, only three research articles were found in which the iso principle was studied directly (Heiderscheit & Madson, 2015; Lee, 2005; Shatin, 1970). There appears to be a need for additional empirical research supporting the existence and/or efficacy of the iso principle in general, as well as for specific populations and/or diagnoses (Saperston, 1995). Discovering support for the iso principle can increase effective use of this concept in music therapy interventions, and a lack of support could change how the concept is taught and used in practice.

A lack of a central definition surrounding the iso principle extends into experimental evidence of the concept itself, leaving this well-known concept largely theoretical. Only three studies were found using the iso principle as a specific experimental condition (Heiderscheit & Madson, 2015; Lee, 2005; Shatin, 1970). In the first known study (Shatin, 1970), a group of university students in a concert hall listened to pairs of classical musical excerpts and reported their emotional changes after each music set. Shatin concluded that music can be used to vector the moods of listeners from one state to another. Extending study of the iso principle into clinical populations, Lee (2005) studied the analgesic effects of live music using the iso principle compared to recorded music for patients in palliative care. Lee found that iso principle-informed live music was more effective at reducing pain scores than recorded music. In a more recent case study, Heiderscheit and Madson (2015) reported on the care of an individual client and provided a general protocol for helping individuals create iso principle-informed playlists of preferred music. These studies asked individuals to self-report mood and/or pain level. However, there are many reported options for bodily states that can be modified through the iso principle. The present study will focus on one of these bodily states: level of arousal.

An important aspect of the iso principle is the active perception and manipulation of bodily states, however, arousal shift does not yet appear to be experimentally studied in literature related to the iso principle. Arousal can be considered a fundamental feature of behavior, defined as “the neurophysiological basis underlying all processes in the human organism” and can be considered “the basis of emotions, motivation, information processing, and behavioral reactions” (Groeppel-Klein, 2005, p. 428). Arousal can manifest across several forms (e.g., tonic, phasic) that each relate to specific brain localities and/or behavioral reactions (e.g., alertness, emotional state). Arousal precedes emotional reaction (Groeppel-Klein, 2005; Huron, 2006; Thaut & Hoemberg, 2014), and tempo is an explicitly quantified element of music; as such it is appropriate to begin study on the effect of iso principle-informed musical tempo on arousal. Many other musical and physical metrics may be addressed in further study of the iso principle.

Arousal level is a specific bodily state mentioned in literature on use of the iso principle (Fiore & Masko, 2018; Yinger & Lownds, 2018). The current study measured galvanic skin response (GSR) as a measure of arousal. Studying arousal in real-time is essential to the current study, as simply offering a pre/post design would not show dynamic differences between conditions (Krumhansl, 1997). GSR has been found to be an effective and rapid measurement of arousal change in real-time, devoid of bias from an individual (Groeppel-Klein, 2005; Peretti & Swenson, 1974). The choice to measure arousal via GSR and SAM were made for cost-effective and pragmatic reasons when compared to EEG or fMRI. In addition to arousal measurements, participants also self-reported current states using a simple pictorial assessment called the Self-Assessment Manikin (SAM) (Figures 2-4, Chapter 3) before and after the musical stimulus.

Participants were engaged in three conditions across three days: a) compensation principle b) iso principle c) control condition. At the start of each of the three testing sessions, participants completed basic paperwork and a mindfulness-based intervention to ensure that their arousal levels were set at a baseline level before encountering the auditory stimuli. In each testing session participants began by filling out a demographic questionnaire both for data collection and to make sure each individual met the recruitment requirements. Participants then had the GSR and pulse rate detectors attached, then sat in silence for one minute. They then blew up a balloon until it nearly popped to find the maximum GSR output for that session. If they achieved a higher GSR output elsewhere during the session this output was used instead of the maximum from blowing up the balloon. Participants then engaged in a 7-8-minute mindfulness-based intervention (MBI). The goal of the MBI was to induce a similar initial state of low arousal for all participants. They filled out the first SAM, spent five minutes in the musical (or control) condition, then filled out the second SAM. Finally, they were given the chance to ask questions during debriefing.

After this initial experimental protocol, participants were randomly assigned to one of six orders of treatment for their three sessions. The compensation principle condition had participants listen to a five-minute original composition starting and remaining at 130 beats per minute (BPM) throughout the piece. The iso principle condition had participants listen to a five-minute original composition that followed the same musical patterns as the first original composition. This piece began at 80BPM, increased tempo continuously throughout the piece, finally reaching 130 BPM for the duration of the final minute. The control condition had individuals listen to a five-minute reading of a fictional short story.

The purpose of this study was to investigate arousal shift during iso principle-informed tempo change in a musical stimulus. The procedures included a randomized block design with control on galvanic skin response (GSR), compared with a self-report of difference scores for the self-assessment manikin (SAM). This study examined the following research questions:

- Research question (RQ) 1: What is the difference of arousal level using the iso principle when compared to the compensation principle measured by galvanic skin response and self-report?

- RQ 2: What is the difference of arousal level when using the iso principle when compared to recorded speech measured by galvanic skin response and self-report?

Hypotheses

1. Listening to an iso principle-mediated musical stimulus will affect arousal shift (measured by galvanic skin response) differently than the compensation principle.
2. Listening to an iso principle-mediated musical stimulus will affect arousal shift (measured by galvanic skin response) differently than silence.

CHAPTER 2
LITERATURE REVIEW

The iso principle appears to be a fundamental technique for music therapy practitioners. It is frequently mentioned in music therapy textbooks (Davis et al., 2008; Heal & Wigram, 1993; Knight et al., 2018; Wigram et al., 2013) including being titled "Principle Number One" in one textbook (Donald & Pinson, 2012). The iso principle is stated to be, "[. . .] well known in music therapy literature" in a chapter by Gfeller (1990, p. 59), and, in Bunt (1994) it is stated that "[the iso principle] can still be regarded as the heart of much current music therapy practice" (p. 33).

The iso principle has been used in the treatment of a wide variety of illness and needs, including musical sound identity (Wheeler et al., 1999), behavior modification (Lee, 2005), mood-shifting (Giles et al., 1991; Heiderscheit & Madson, 2015; Lee, 2005, Thaut, 1989), and venting emotion (Giles et al., 1991). Music therapy clinicians have used the iso principle for several purposes including stress reduction (Rider, 1985; Saperston, 1995; Thaut, 1989) and pain management (Rider, 1985, Lee, 2005). Furthermore, the iso principle has been applied to pediatric populations for entraining breathing, singing, instrument play, improvisation, and relaxation (Yinger & Lownds, 2018), and adults via supportive-level music therapy in the medical environment (Gooding, 2018). Continuous music, an intervention technique in hospice care, also uses the iso principle and can be used to decrease pain, distress, or anxiety in patients during procedural support or general care (Fiore & Masko, 2018). The iso principle (along with other techniques) has also been used in hospice and palliative care models for increasing quality of life scores (Hilliard, 2003). Despite the importance of the iso principle, and the many applications described in literature, there appear to be very few investigations into empirically testing the use of the iso principle.

While the iso principle is the main focus of this paper – there is an alternative called the compensation principle (Altschuler, 1944). This is a process in which music is played that explicitly contrasts with the current mood of a client (Wigram et al., 2002). For instance, if a child was displaying hyperactive behavior one could play slow music to try and reduce the arousal level of the child. The compensation principle is different than the iso principle in that instead of meeting a client in their current state musically, one immediately plays the music of the intended destination bodily state.

History of the iso principle

The term and method for the iso principle (short for isometric principle, derived from the Greek word "*isos*" for "equal to") were first named by Dr. Ira Altschuler (1944), a psychiatrist at Eloise state hospital in Michigan in the mid-20th century. Altschuler first described the iso principle as "the principle of using music identical to the mood or mental tempo of the patient" (Altschuler, 1944, p. 793). Altschuler wrote about this principle in papers and chapters (1944, 1948, 1954) and lectured on it throughout his career at conferences around the world (Davis, 2003). While Altschuler was the first to name this principle, other historical figures had alluded to the influence of musical elements on humans' mental and emotional states. For example, Pythagoras had used a similar technique to calm violent youths by altering musical modes in the 5th century BCE (Gouk, 2001; Strunk, 1998) and Samuel Mathews, a medical student at the University of Pennsylvania in the early 19th century, wrote in his dissertation that one should use music that matched the emotional state of the patient (Mathews, 1806, as cited in Davis et al., 2018). There are several other terms that appear synonymous to the iso principle in their definitions. These include mood vectoring (Shatin, 1970; Thaut, 2005), the iso-moodic principle (Donald & Pinson, 2012; Heal & Wigram, 1993, Saperston, 1995), the ISO-Vectoring Principle

(Richardson et al., 2008), and entrainment music (Donald & Pinson, 2012; Rider, 1985). This paper exclusively uses the term "iso principle."

Altschuler further considered the role of individual music elements, specifically the importance of tempo and emotional valence. His writings discuss the importance of both the tempo of the music and the "mental tempo" of the patient, finding that sad music was more effective than "gay music" when interacting musically with a depressed patient, and that fast music would be more effective than slow when interacting with patients experiencing mania (Altschuler, 1944, p. 30). While Altschuler's initial discussion focused on how to meet a patient musically in line with their current state, he later expanded his writings about the iso principle to describe leading the patient to a new mental or physical state with musical elements (Altschuler, 1954). Altschuler further said that timbres of various instruments are also part of enacting the iso principle. For example, he clarified that the sounds of string instruments are more effective in sad music and should therefore be used in the initial musical stimulus of depressed patients (1954). This idea that individual musical elements can drive the iso principle is mirrored in modern iterations of music therapy practice that discuss musical elements used in the iso principle. For instance, Heiderscheit and Madson (2015) studied how an individual client rated the musical and meaning-based elements of self-selected music using various emotional descriptors. While Altschuler originally enacted the iso principle through playing programmed classical music (1954) modern iterations of the iso principle focus on live performance of music by a music therapist (Lee, 2005; Thaut, 1989, Yinger & Lownds, 2018) or patient-preferred recordings (Heiderscheit & Madson, 2015).

The literature surrounding the iso principle has also considered the larger contexts within which it is delivered. While Altschuler's definition of the iso principle focuses on being used with individuals, his operational directions for enacting the iso principle were focused on usage in groups. This group protocol was guided by two main metrics: nationalities and mood states of patients on the unit (Altschuler, 1954). The first metric is based on noting the nationalities of the patients on a unit and equally matching the demographics of the patient population to the music being offered. For instance, if the patients on his unit were made up of 50% American and 50% Italian patients, the songs would be half American songs and half Italian songs (1944). The second metric is based on the percentage of patients on a unit that are depressed or hyperactive. For instance, if the group was populated by 25% depressive and 75% hyperactive patients, 25% of the music selections would have a depressive valence and 75% of the music would be hyperactive in nature (Altschuler, 1954). However, it does appear to be different than modern iterations of the iso principle which focus on individualization and/or self-guidance (Heiderscheit & Madson, 2005; Lee, 2005; Thaut, 1989, Yinger & Lownds, 2018).

Definitions of the iso principle 1944-2018

Music therapy researchers do not arrive at a consensus for how to define the iso principle, despite it being a well-cited clinical technique. Since Altschuler's founding of the term in 1944, music therapy researchers have posited no less than eighteen overlapping definitions for the iso principle (Table 1). These definitions generally group around the idea that music can be used to meet a patient's current state then changing one or more elements of the music to lead them to a different state. Despite overlapping ideas amongst these definitions, there is considerable disagreement amongst scholars in 1) what bodily state is/can be modified, and 2) the specific elements of music drive the intended change (Table 1). Definitions vary in what bodily state is being modified; it can be the patient's mood, mental tempo, tempo, rhythm, emotional state, venting emotion, behavior, physiological responses, energy level, or how the patient presents.

The specific element(s) of music being used to modify the patient's state also vary. These include tempo, volume, complexity, accompaniment, key, meter, and the less defined elements of mood of music, musical stimuli, or simply: matched music.

Table 1. Definitions of the iso principle 1944-2018.

Year	Definition	Source	State being modified	Musical element used
1944	"The principle of using music identical to the mood or mental tempo of the patient"	Altschuler, 1944, p. 793	Mood, mental tempo	Mood, tempo
1946	"In order to evoke a quicker response from patients, the tempo, for example, of music should parallel or equal the mental tempo of the patient. Mood and volume must be treated similarly."	Perry, 1946, p.42	Mental tempo, mood	Tempo, volume
1948	"Only after one has worked himself 'musically' into the mood or tempo of the mental patient can a shift to a different mood or tempo be made [...] the mood or tempo of the music in the beginning must be in "iso" relation with the mood or tempo of the mental patient. The 'iso' principle is extended also to volume and rhythm."	Altschuler, 1948, p. 266	Mood, tempo	Mood, tempo, volume, rhythm
1954	"The use of rhythmic, stimulating music to arouse a quiet ward and soft, soothing music to quiet a disturbed ward" [author's note: this appears to be describing the compensation principle, but is stated in regard to "the iso-moodic principle"]	Ruppenthal,1954, p. 55	Arousal	Rhythm, stimulation

1970	"Music is selected to match the actual mood of the subject person, the negative affect that we would alter. For example, if the mood of the subject were depressive, then blue and depressive music might be matched to the depressive mood of the subject. This is the 'Iso' or 'Similar' phase of music stimulation. Then by stages the content and quality of the music is changed towards a happy cheerful feeling-tone, thereby altering the mood of the subject into a happy cheerful direction. This is the step-wise 'vectoring' or directed movement of music to the desired goal: e.g., from sad to cheerful, or restless to tranquil, or bored to stimulated."	Shatin, 1970, p. 75	Mood/affect	Mood of music, content and quality
1989	"[. . .] a clinical technique to influence a patient's mood by first matching music to the existing mood, subsequently channeling the mood in the desirable direction via gradual changes in the music stimuli"	Thaut, 1989, p. 156	Mood	Musical stimuli
1991	"Matching the patient's emotional state (anger, sadness, etc.) to music with a similar mood, thereby allowing the patient to vent emotion through music."	Giles et al., 1991, p. 136	Emotional state, venting emotion	Mood of music
1993	"By matching the music to the client's existing mood, changes in the client's mood can be altered through subsequent changes in the mood of the music"	Heal & Wigram, 1993, p. 159	Mood	Mood of music

1995	"[. . .] matching musical stimuli to an individual's existing mood and then changing the musical stimuli in the direction in which the individual's mood is to be influenced"	Saperston, 1995, p. 58	Mood	Musical stimuli
1996	"a natural and intuitive technique for moving into a new rhythm. With the iso principle, a change in tempo and mood is accomplished by entraining to the present mood and slowly altering the pace in the desired direction"	Brewer, 1996, p. 14-15,	Rhythm, tempo, mood	Mood of music
2001	"Here the therapist attempts to match the 'inner' music of the patient with actual music, and having done so, can begin to shift his or her mood or tempo by changing the music"	Gouk, 2001, p. 67	Mood, tempo	Mood of music, tempo
2002	[Finding music that] "[…] matches the mood of [the] client in the beginning, and then gradually induces the intended mood"	Wigram, Pedersen, and Bonde, 2002, p. 110	Mood	Mood of music
2005	the process "of matching music with an equal behavior or mood of an individual"	Michel & Pinson, 2005, p. 19	Behavior, mood	"Matched" music
2008	"A technique by which music is matched with the mood of a client, then gradually altered to affect the desired mood state. This technique can also be used to affect physiological responses such as heart rate and blood pressure"	Davis et al., 2008, p. 52	Mood, physiological response	"Matched" music
2016	"[A music therapist will] match the music to the mood or energy level of the client and then	Hodges, 2016, p. 184	Mood, energy level	Matched music

	modify the music to effect a change in the desired direction”			
2018	“A process in which music stimuli is matched to the client’s behavior/mood/physiological state and slowly adjusted in complexity, volume, and tempo to produce an emotional change in the client”	Yinger & Lownds, 2018, p. 272	Behavior, mood, physiological state, emotional change	Complexity, volume, tempo
2018	“Matching the **mood or tempo** of the music with the mood of the patient and gradually shifting the musical elements to alter the patient’s mood”	Gooding, 2018, p. 285	mood	Mood, tempo, musical elements
2018	(for use in continuous music technique) “The music therapist provides continuous music [. . .] initially matching the complexity and/or tempo of the music to how the patient presents **(e.g. anxious**). The therapist then chains together multiple songs, altering the elements of the music (e.g. rhythmic complexity of accompaniment, key, tempo, phrasing, meter) over the duration of the intervention to decrease or increase the patient’s arousal state based on the patient’s needs.”	Fiore & Masko, 2018, p. 410	How the patient presents, arousal state	Complexity, tempo, accompaniment, key, phrasing, meter

Studies using the iso principle

Altschuler’s original work with patients was considered scientific evidence for its time (Gouk, 2009). However, empirically measured studies for the existence and efficacy of the iso principle since that time are rare. Many writings attempt to define the iso principle, but only three studies were found that used and studied its effect(s). One, by Shatin (1970) used a single-group posttest only design, another by Lee (2005) used a two-group control group design, and the third by Heiderscheit and Madson (2015) used a case study design. All of these collected data in the form of self-reporting by subjects. In 1995 Saperston called for study of the iso principle measuring specifically physiologic data instead of solely mood-related information. As of this writing, no such studies appear to exist.

The first of these studies (Shatin, 1970) focused on exploring the step-wise alteration of mood using the "vectoring power of music" (p. 81). The study had 74 male college students sit in a lecture-hall listening to a single record player. The students were instructed that they would hear four musical excerpts. Following each excerpt, they would then rate each by how their emotional state started and to where it shifted based on four emotional continua, or the response 'none of these' (Shatin, 1970). The excerpts were all classical, three being instrumental and one being a choral piece, and all were two-minute sections of larger pieces. Each excerpt had an intended result with the four possible continua of emotional starting points and destinations. The four emotional continua presented to the students were "sad and depressed to gay and happy," "restless and agitated to serene and tranquil," "bored and listless to active and alert," and "active and alert to majestic and exalted" or the students could choose "none of these" (p. 82). While these options are described as continua, it appears the students did not rate these on a continuum, but instead chose which option best fit their post hoc interpretation of their emotional response. The statistical results (the first found example of data analysis for an iso principle-based study) showed that each musical excerpt stimulated the correct mood shift with a p value of .001. This led the author to state that musical excerpts can achieve the vectoring effect on the mood of a given listener. Shatin cited Altschuler's 1944 paper and chapter in *Music and Medicine* (1948) mentioning the importance of matching the initial mood of a client. However, despite being inspired by the iso principle, this study seems to be ignoring the first step of most definitions: meeting an individual musically in their current state. This oversight may be due to the study focusing on the vectoring aspect of the iso principle instead of the entire process from start to finish.

The next empirical study to examine the iso principle was conducted by Lee in 2005. In their paper, Lee (2005) compared the analgesic effects of relaxing recorded music compared to iso principle-informed live music for individual patients in a hospital receiving palliative care. The author did not provide an explanation for how the iso principle was implemented in this setting outside of Altschuler's definitions. Lee found that iso principle-informed live music was more effective than recorded music on self-ratings of pain but not pulse rate. Lee discussed how live presentation of music offers additional variables in regard to human connection that may increase the analgesic effect.

Heiderscheit and Madson (2015) followed the care of an individual client experiencing depression, anxiety, and an eating disorder. The interventionist collaborated with the patient to create a playlist of patient preferred-music recordings informed by the iso principle. The interventionist created a rating system offering two scales to measure emotional descriptors (e.g. depression to hopefulness): one in regard to the musical elements of a recording, and another in regard to the message of the piece (e.g. lyrical content). These scores were used to create a data-driven playlist to lead the patient from one emotional state to another.

Heiderscheit and Madson (2015), similar to the aforementioned thesis by Lee (2005), discussed the power of human interaction on the therapeutic process. The paper sought to provide a clinical example of using the iso principle in practice, and stated that "[the] gap in the literature [regarding the iso principle and mood management] makes it unclear as to how the iso principle is being utilized in music therapy" (p. 50). Heiderscheit and Madson (2015) offered the only individualized account of using the iso principle with a given protocol, whereas Lee's thesis, while also for individual patients, did not provide a method, protocol, or tools for usage of the iso principle.

Arousal and music

Many definitions have been presented regarding the iso principle, and these definitions frequently focus on the mood or mental tempo of a patient; terms which are sometimes used interchangeably with arousal. Arousal can be defined as "the neurophysiological basis underlying all processes in the human organism" (Groeppel-Klein, 2005, p. 428). These processes include the autonomic nervous system, neuroendocrine system, and/or central nervous system (Thaut, 2005). The term "mood" tends to be in regard to long-lasting emotions with more pronounced consequences for cognition than for action, whereas arousal tends to be in regard to emotional intensity and/or physiological activation (Husain et al., 2002). These terms also parallel Russell's (1980) circumplex model of emotions, replacing arousal and mood with activation and valence respectively. Arousal can be considered "the basis of emotions, motivation, information processing, and behavioral reactions" (Groeppel-Klein, 2005). One must be careful not to equate arousal with intensity, as these are related but different theoretical constructs (Picard et al., 2016).

Arousal can be influenced by three main categories of musical stimuli: Psychophysical properties (e.g., tempo, perception of intensity), collative properties (e.g., related to structure of a piece, especially regarding novelty and surprise, along with their opposites), and ecological properties (e.g., personal extramusical associations) (Berlyne, 1971; Thaut, 1990). Music appears to induce arousal shift through perception of patterns (the psychophysical and collative properties) as well as extramusical associations to the specific musical stimulus (Huron, 2006; Thaut, 1990). One's need for levels of arousal are important in one's representation of affect (Thaut, 2002) and evidence exists that many people already use music for arousal modulation (Georgi et al., 2006; Husain et al., 2002). Affective arousal is the main focus of the current study, and emotional response will also be measured.

Arousal precedes emotional reaction (Groeppel-Klein, 2005; Huron, 2006; Thaut & Hoemberg, 2014) as modeled in Huron's *ITPRA* theory of expectation wherein two responses precede an event (*imagination* at any point before a stimulus, and *tension* directly before a stimulus) and three responses after (*prediction, reaction,* and *appraisal*). In this theory, the prediction being correct or incorrect will alter the intensity of the emotional reaction, called contrastive valence (2006). Huron also posited that there are brain-based rewards for predicting correctly due to how this may have affected human survival in previous eons. This is similar to the arousal-mood hypothesis – that "listening to music affects arousal and mood, which then influence performance on various cognitive skills" (Husain et al., 2002, p. 153). However, these physiological responses to music do not simply all increase or decrease with a single stimulus. For example, sad-sounding music has been found to lower heart rate and skin-conductance levels but increases blood pressure (Krumhansl, 1997).

Mood, as well as affect, are commonly stated as states that can be modified by music (Table 1); however, mood/affect appears to be oversimplifications of multiple elements of experience. There appears to be an important connection between arousal, affect, and reward in aesthetic experiences (Berlyne, 1971; Thaut, 1990), and between arousal, cognition, and affect in emotion (von Georgi et al., 2006). Aforementioned studies on the iso principle have focused on self-report of mood-modulation (Heiderscheit & Madson, 2015; Lee, 2005; Shatin, 1970), a generally subjective phenomenon that may suffer from biases (Groeppel-Klein, 2005). While music can induce specific emotions to listeners (Brattico & Pearce, 2013; Carlson et al., 2015; Krumhansl, 1997), self-report regarding emotion and music may be fraught as listeners may not report their personal emotional reaction, but instead report the emotion they believe the passage is supposed to indicate (Krumhansl, 1997; Meyer, 1956).

One option for avoiding this bias is to use a picture-oriented questionnaire that separates various elements of emotion. The three-dimensional pleasure, arousal, and dominance (PAD) model measures emotion more accurately than single spectra (Bynion & Feldner, 2017; Lang et al., 1993) and has been incorporated into a pictorial measure called the Self-Assessment Manikin (SAM) (Bradley & Lang, 1994, Hall et al., 2017). This model consists of three spectral measures: 1) pleasure-displeasure (the valence or level of pleasantness), 2) arousal-nonarousal (energized vs. tranquil), and 3) dominance-submissiveness (controlling vs. controlled)[1] (Larsen & Diener, 1992). The SAM has shown validity cross-culturally (Handayani et al., 2015) and has been used while studying emotional reactions to food (Racine, 2018), odor (Bestgen et al., 2015), and packaging (Liao et al., 2015).

Mindfulness-based stress reduction

One method of reducing arousal is mindfulness training (Lazar et al., 2005; Vago & Silbersweig, 2012). Mindfulness training, originally from a 2500-year old Buddhist tradition and more recently co-opted by Western clinicians (Kabat-Zinn, 1990; Vago & Silbersweig, 2012), has been found as a prominent method for assisting in stress-related biobehavioral conditions (Garland et al., 2010). In the context of historical Buddhist practice of mindfulness, the Sanskrit

[1] For instance, anger and fear would both be rated as unpleasant emotions, both could be rated as having a moderately high-level arousal, however anger would be rated as more dominant and fear would be rated as more submissive.

term *bhävana* can be understood as “causing to become” and its Tibetan equivalent *sgoms* can be understood to mean “development of familiarity” (Vago & Silbersweig, 2012). Buddhist perspectives of mindfulness emphasize continuous and intimate connection between attention and memory (Thera, 1962). Modern clinical usage appears to have been initiated in 1990 by the book *Full Catastrophe Living* (Kabat-Zinn) which described a mindfulness-based stress reduction (MBSR) program developed at the University of Massachusetts Medical Center in the 1970s (McCown et al., 2010).

Mindfulness requires one to practice intentionally sustaining focus on current bodily experiences such as thoughts, mood states, and bodily feelings with an attitude of detachment. This process is sporadically interrupted by spontaneous thought or mind-wandering, wherein individuals strive to shift their attention back to the meditation object (e.g., breath) (Campanella et al., 2014; Hasenkamp et al., 2012; Matiz et al., 2019). Mindfulness can also be described as an enduring trait of an individual’s cognition, emotion, or behavioral tendencies, a meditation practice, or a mindfulness-based intervention (Vago & Silbersweig, 2012).

MBIs have been found to be effective in treatment of a number of clinical disorders, including alcohol dependence, anxiety, depression, and eating disorders (Garland et al., 2010; Hofmann et al., 2010; Kristeller & Hallett, 1999). MBIs have also been adapted for use in treating stress and emotional dysregulation (Vago & Silbersweig, 2012).

Physiological studies have shown decreases in skin conductivity, heart rate, and rate of breathing during meditation (Lazar et al., 2005; Vago & Silbersweig, 2012). GSR has also been used to measure differences in psychological and physiological anxious arousal for individuals receiving mindfulness training (Paz et al., 2017). Experienced transcendental meditators with greater than two years of experience show specific differences in skin conductance when compared to control groups, including showing decreased startle amplitude (Delgado et al., 2010) and low-level bottom-up forms of emotional regulation (van den Hurk et al., 2010).

Theoretical framework

The present study was guided by a theoretical framework combining optimal complexity theory and the iso principle. If the iso principle can indeed shift arousal, then music therapists could possibly guide patients to an optimal level of arousal for rehabilitating or learning a skill.

Optimal arousal

Optimal arousal is a psychological construct that hypothesizes that physical performance and learning ability are maximized at specific levels of arousal (Lupien et al., 2007; Zuckerman, 1979). Several historical sources underlie modern views of optimal arousal including the Yerkes-Dodson law (Yerkes & Dodson, 1908). This law stated that learning easy associations is best facilitated by high levels of stimulation, whereas difficult learning requires an intermediate level of stimulation. Hebb, specifically in relation to cortical arousal, proposed that individuals strive to reach an optimal level of activation (1949, in Mojet et al., 2012; Zuckerman, 1979). Berlyne (1955) applied Hebb's concept to behavioral experiments towards a theory on optimal arousal. Theories of optimal arousal are generally characterized by an inverted-U graph (Figure 1) wherein the X axis is the level of arousal and the Y axis is the strength of performance (whether that performance is physical, memory, or another skill) (Berlyne, 1955). Performance is best achieved while at this optimal level, and success in difficult tasks diminishes as one reaches inappropriately low or high levels of arousal (Zuckerman, 1979). The arousal shift instigated by a given stimulus can be affected by many factors, including the mere exposure effect wherein humans find increased pleasure with increased exposure to a stimulus (Zajonc, 1968), the diurnal cycle wherein one's optimal level of arousal varies throughout the day (Schlosberg, 1954), and pleasantness/unpleasantness of the stimulus (Zuckerman, 1979).

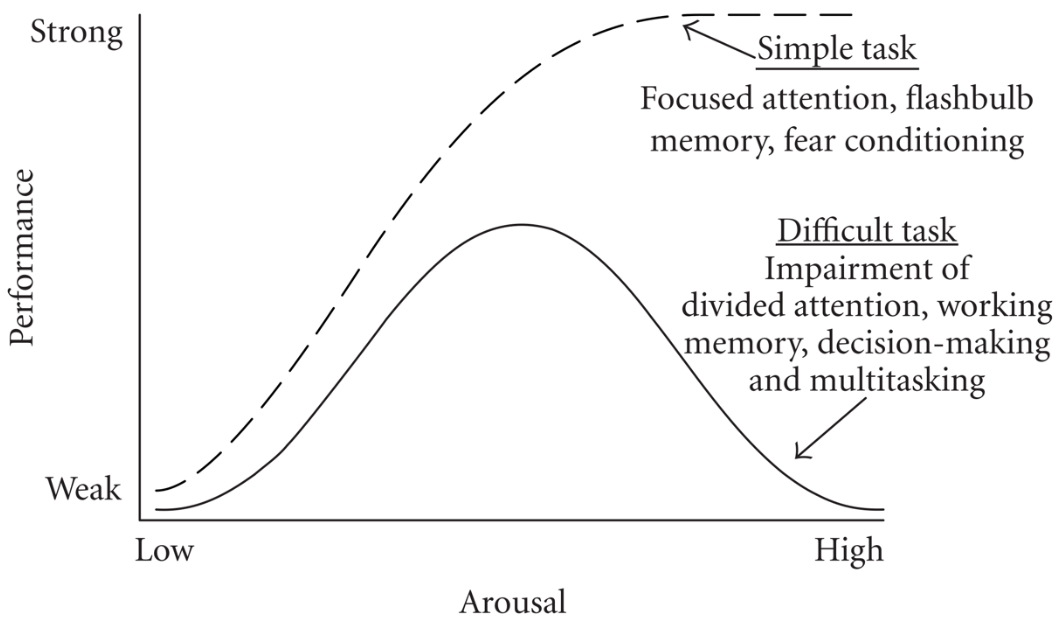

Figure 1. Inverted-U graph of arousal. From Diamond, DM et al. (2007).

Hormonal and neurotransmitter-based theories may also elucidate theories of optimal arousal. Stress-related elevations in glucocorticoids appear to affect memory and long-term potentiation of neurons in the hippocampus, and stress-induced increases in noradrenaline levels affect declarative memory, both in an inverted-U graphic representation (Lupien et al., 2007). In both examples, optimal levels of the given chemical enhance memory function, and lower or higher levels of the chemical impair memory.

These theories of optimal arousal relate to music in the optimal complexity theory – that humans feel the most pleasurable feelings in the musical environment when the music is most appropriately complex and/or familiar to the individual, and that this level of complexity and/or familiarity is dynamic based on the situation (Davis et al., 2008, p. 549). Optimal arousal in music appears to follow a similar paradigm to non-musical stimuli in that arousal shift can be affected by familiarity (the aforementioned *mere exposure effect*) and the perceived pleasantness/unpleasantness of a given stimuli (Hargreaves, 1984; Huron, 2006).

Iso principle

The present study uses the definition of the iso principle by Yinger & Lownds (2018), emphasizing arousal as the bodily shift and tempo as the musical element driving that change. Hence, for the purposes of this paper, the iso principle will be defined as: wherein one uses music to meet an individual's current level of arousal, then changes the tempo of the music to lead them to a different level of arousal. Given the theories of optimal arousal, one could possibly use the iso principle to guide an individual from a given state to the state of optimal arousal for a given task or goal. This application could hypothetically assist individuals in tasks ranging from physical activities, learning and memory, to other skills requiring efficiency.

CHAPTER 3
METHOD

Participants

The researcher recruited fifteen participants over the age 18. Of these, nine completed all three trials. Data collection was halted before the remaining six participants could complete all trials due to the COVID-19 pandemic. Participants were required to 1) be able and willing to complete a mindfulness-based intervention (MBI) no longer than 10 minutes that is meant to decrease affective arousal; 2) not participate in exercise or sports activities for the two hours prior to the experiment (Kuan et al., 2016); 3) have no history of hearing impairments, and 4) not be eating, drinking, or taking any medications on the day of the study that stimulate or depress arousal responses (including but not limited to caffeine, alcohol, CBD, stimulants for ADHD, or sedatives for anxiety disorders) (Balters & Steinert, 2015). Participants were recruited from the general adult population in Minneapolis, MN.

Measures

There are two outcome measures of this study: Galvanic skin response (GSR) and the self-assessment manikin (SAM). These outcome measures focus on the physiologic measurement of participants' arousal states for quantitative observation of the iso principle. Demographic data were also collected from each participant, although these data were not analyzed.

Galvanic Skin Response

Galvanic skin response (GSR), also known as electrodermal activity (EDA), was measured using a GSR device. GSR is recognized as fluctuations in skin conductance at the epidermis (Hutcherson, 2013). Eccrine sweat glands secrete fluid and electrolytes when stimulated through the sympathetic nervous system, which increases the conductance of the skin.

Increased conductance signifies increased arousal. This can be caused by physical exertion and/or emotional arousal. This conductance is measured by two electrodes on the device, usually placed on the middle and forefingers (Balters & Steinert, 2017; Groeppel-Klein, 2005; Poh et al., 2010).

GSR has been used to measure multiple physiologic concepts including cognitive load (Shi et al., 2007), motivation (Groeppel-Klein, 2005), autonomic nerve response (Perala & Sterling, 2007), emotional identification (Westerink et al., 2008), emotional arousal (Bradley & Lang, 1994; Critchley et al., 2000; Groeppel-Klein, 2005), emotional processing (Buchel et al., 1998), and stress (Perala & Sterling, 2007). GSR devices have also been used to measure differences in psychological and physiological anxious arousal for individuals receiving mindfulness training (Paz et al., 2017). Emotional arousal in particular is associated with encoding of memories (Cahill, 1997). GSR responses have been correlated with results of fMRI (Critchley et al., 2000), participant perceptions (Perala & Sterling, 2007), and salivary amylase (Perala & Sterling, 2007). Important to this study, GSR devices have been used to dynamically measure GSR related to arousal in studies of music and physiology (Krumhansl, 1997; Peretti & Swenson, 1974; Salimpoor et al., 2009; Thayer & Levinson, 1983).

While GSR levels can be analyzed as they increase and decrease, frequency of GSR peaks can also be analyzed. Peaks are defined as points of data greater than the previous and following data points (Boucsein, 2012). Frequency of GSR peaks can be correlated with emotional intensity, such as during situations deemed stressful (Bakker et al., 2011). However, while intensity of emotion is correlated with GSR peaks, the valence is not inferred through these data.

The GSR device was the NeuLog NUL-217 Galvanic Skin Response Sensor, and the heartrate monitor was the NeuLog NUL-208 Pulse Logger Sensor. These were connected to an HP laptop computer through the USB port. The GSR device output was at a rate of 10 Hz from 0.01-10.0 microSiemens (μS) where a higher output indicates a higher level of arousal. The pulse logger output was in beats per minute (BPM).

Self-Assessment Manikin

The Self-Assessment Manikin (SAM) was used to measure emotional information parallel to arousal (Bradley & Lang, 1994) The SAM "is a non-verbal pictorial assessment technique that measures the pleasure (Figure 2), arousal (Figure 3), and dominance (Figure 4) associated with a person's affective reaction to stimuli" (Bradley & Lang, 1994, p. 49).The three pictorial spectra feature nine small circles for participants to mark which were then tabulated by the researcher on a separate spreadsheet. These scores are rated between 1 – 9, each small circle represents one point. A lower valence score is considered *more* pleasant, and a higher score is *less* pleasant. For the arousal spectrum a lower score is *more* aroused and a higher score is *less* aroused. In the dominance spectrum a lower score is *less* dominant and a higher score is *more* dominant.

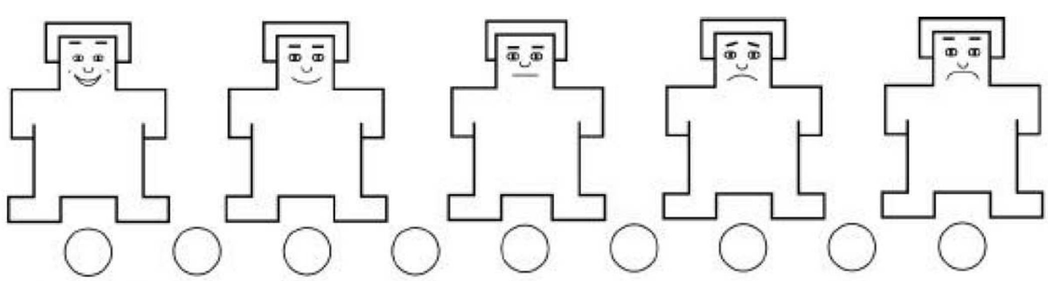

Figure 2. SAM scale for pleasure.

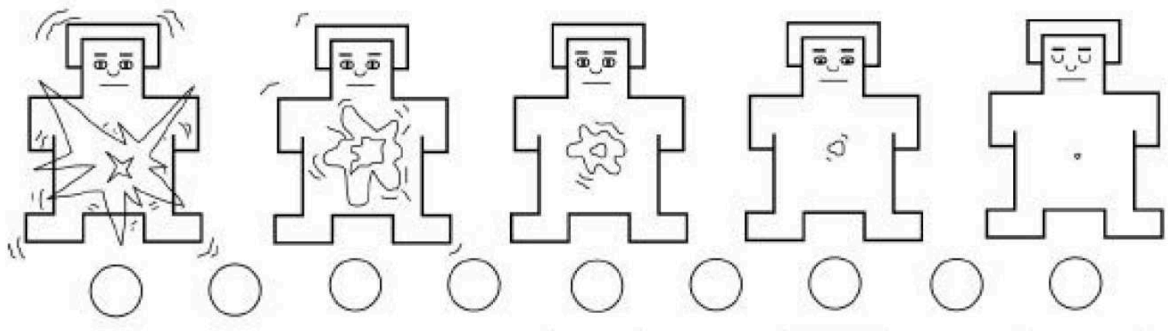

Figure 3. SAM scale for arousal.

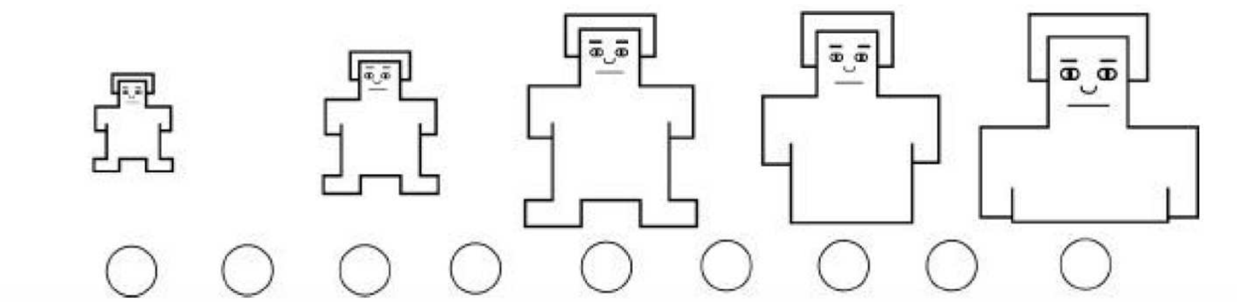

Figure 4. SAM scale for dominance.

The SAM has been utilized while studying emotional reactions to food (Racine, 2018), odor (Bestgen et al., 2015), and packaging (Liao et al., 2015). The SAM was completed directly before and after all conditions. The SAM was printed on 8 ½” x 11” paper and was presented to the participants prior to and directly following the experimental condition.

Procedure and data collection

Design

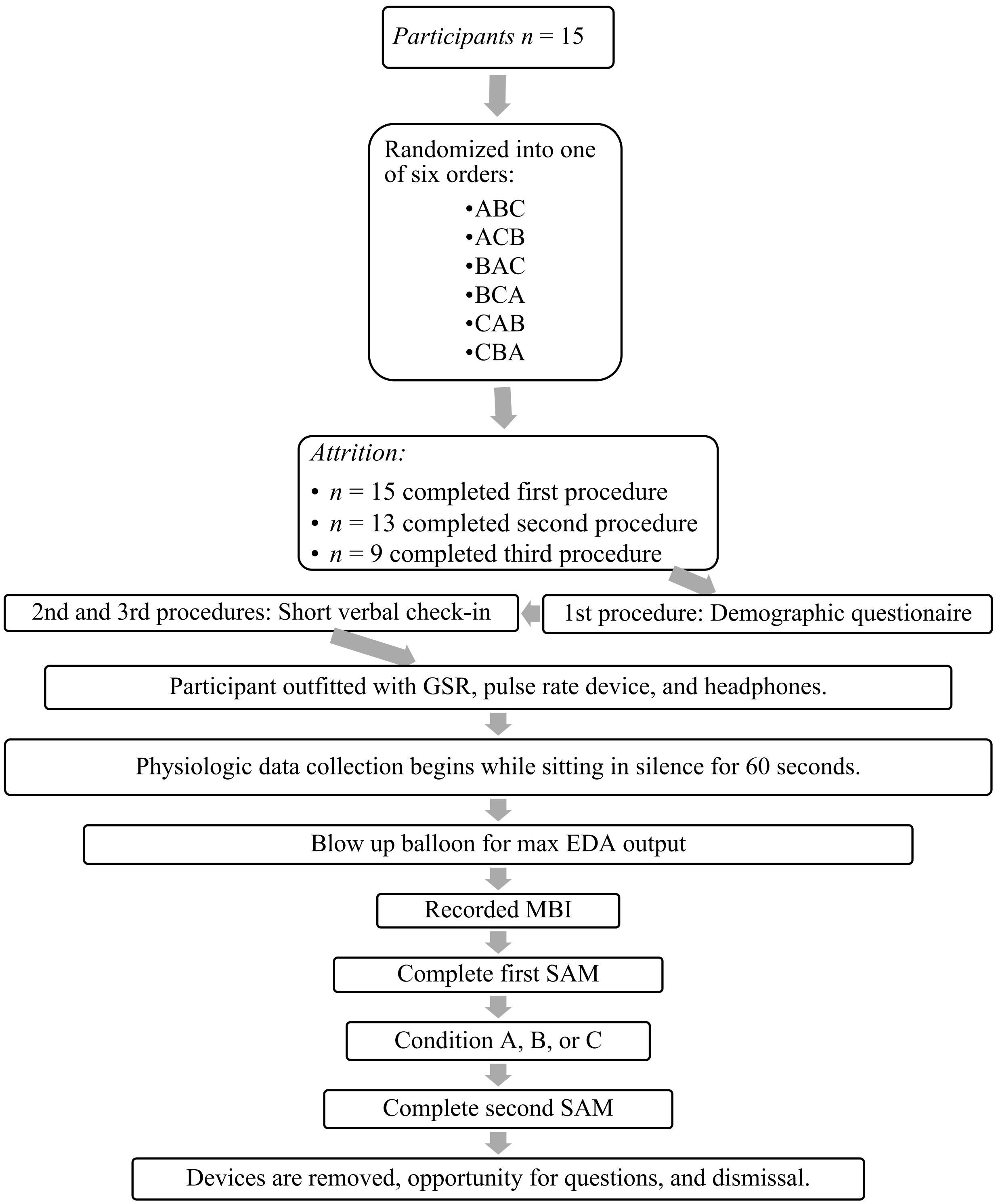

Figure 5. Study design.

This study used a within-subjects design with counterbalancing. Participants who completed all three procedures (*n* = 9) took part in three 15-minute procedures: two experimental conditions (conditions A & B) and one control condition (condition C) on three different days. Participants were randomly placed in one of six possible orders of conditions (ABC, ACB, BAC, BCA, CAB, CBA) decided by rolling a dice (Table 2).

Table 2. Order of conditions

Number on dice	Order of conditions
1	ABC
2	ACB
3	BAC
4	BCA
5	CAB
6	CBA

Intervention

GSR response is implicated in the anticipation of events (Critchley, 2002). As anticipation is an important component of music perception (Huron, 2006; Margulis, 2014), the compositions for this project were written specifically to minimize the extension or thwarting of musical expectations (Meyer, 1956). The compositions consisted of rhythmic chords, a consistent percussive beat, and a metronome click, but no definitive melody line. No melody line was included as to further avoid changes in arousal related to musical expectation. The score is found in Appendix E.

Reducing Arousal

A Mindfulness-based intervention (MBI) was used to lower the arousal of all participants prior to each experimental or control condition. Mindfulness requires one to practice intentionally sustaining focus on current bodily experiences such as thoughts, mood states, and bodily feelings with an attitude of detachment. Physiological studies have shown decreases in skin conductivity, heart rate, and rate of breathing during meditation (Lazar et al., 2005; Vago & Silbersweig, 2012).

Procedure

Upon first entry to the study space, participants completed a questionnaire outlining demographic information and ensuring they meet required criteria. In the second and third sessions (completed on separate days) the participant answered a shorter verbal questionnaire to ensure they had not ingested stimulants or depressants that were still in effect (all questionnaires are included in Appendix B). Participants meeting the inclusion criteria were seated in front of a table and outfitted with the GSR, pulse rate device, and headphones. The music was played through Bose SoundTrue II over-ear wired headphones. The sensors for the GSR device were attached to the index and middle fingers of the non-dominant hand, and the heart rate sensor was attached to the fifth finger. They were asked to keep their non-dominant hand (with attached sensors) rested on an outline of a hand on the table (Appendix C) in order to avoid disconnecting from or altering the data from the GSR and pulse devices (Boucsein, 2012).

The participant sat in silence for 60 seconds to allow time for moisture to build between the skin and sensors, then data collection of GSR was initiated. The participant then blew up a balloon until it nearly popped to find their maximum GSR output (Fowles, 2007). Participants in all conditions then participated in a MBI pre-recorded by the researcher (script: McCown et al., 2010, pp. 196-201, Appendix D). The same script was used for all three sessions, and has not been used in other studies. Following MBI, participants completed the first SAM to show their perceived current state of affective arousal (Bradley & Lang, 1994), then the five-minute musical or control stimulus began. Following this stimulus, participants completed a second SAM. Markers were placed in the Neulog data collection showing when the MBI began, ended, when the stimulus began, and the data collection was stopped when the music completed. The times of these marks were also recorded in an excel spreadsheet for accuracy.

There were three conditions: the control condition was a pre-recorded short story (Keret, 2003) read by the researcher, the first experimental condition ("compensation principle condition") played music set at a fixed moderately-fast tempo (120 beats per minute (BPM)) and the second experimental condition ("iso principle condition") employed music starting at a slow tempo (60 BPM) ascending to the same moderately-fast tempo as the first experimental condition (120 BPM).

The musical examples may be found here:

Experimental condition one (compensation principle condition)

Experimental condition two (iso principle condition)

In the control condition, participants stayed seated for five minutes wearing the headphones listening to narration of the short story "The bus driver who wanted to be God" (Keret, 2003). In the two experimental conditions participants listened to one of two musical stimuli. In the compensation principle condition, they heard an original composition ("Autumn") featuring a piano playing predictable chord progressions lasting five minutes at a moderately-fast tempo (120 BPM) produced in Logic Pro software by the researcher. While the compensation principle is less studied, playing an unchanging fast tempo should theoretically increase arousal of the participant. In the iso principle condition they heard a very similar composition ("Springtime") using the same musical information (notes, instruments, and so on), but with the aforementioned gradual changes in tempo. Springtime began at a slow tempo (60 BPM) increased in tempo gradually to 75BPM at marker 1:00, 90 BPM at marker 2:00, 105 BPM at marker 3:00, and halting acceleration at 120BPM at marker 4:00. Theoretically, this usage of the iso principle is intended to gradually increase the arousal level of participants. The compositions' similarities utilized gross repetition – while "Springtime" included fewer repetitions, it contained no additional musical material than "Autumn." Data was recorded with the GSR device at 10 hertz (10 bits of data per second). Following the five-minute stimulus participants remained seated and completed the second SAM. The GSR device was removed, and they were given the opportunity to ask questions while being debriefed.

Data analysis

Measuring GSR. GSR output (µS, microSiemens) of each participant was analyzed to find levels of arousal and peaks during the intervention period (Hutcherson, 2013). The quantity of peaks was recorded for each participant. GSR levels vary by person, emotional state, and many other factors. Min-max scalar normalization was used to normalize the data for each session with the equation: $X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$ (Zhang et al., 1997). The normalized output of GSR were all between 0.001 and 1.0. A level of 0.001 indicates the lowest level of arousal a participant experienced during their session (i.e. 0.1% of range). A level of 1.0 indicates the maximum level achieved by the participant during that session (i.e. 100% of range). The maximum and minimum levels achieved during the entire procedure were used for this normalization. For instance, if a participant's minimum GSR level was .95 during the MBI and their maximum was 2.4 while blowing up the balloon, a GSR level of 1.89 during the experimental period would be normalized to 0.65, or 65% of the difference between .95 and 2.4.

A block design univariate analysis of variance was used to find if there was a significant difference in arousal levels and arousal peaks between conditions. The normalized mean GSR and peaks were found for each participant and for each condition in intervals of one second and one minute. A *p*-value less than 0.05 was considered to be significant (95% confidence interval) and effect sizes were calculated to show any degree of association. Visual inspection of the graphs was also utilized for data analysis (Groeppel-Klein, 2005; Hutcherson, 2013).

Measuring SAM. Scores were tabulated for each of the three elements in the SAM pre- and post- musical/control stimulus for six data-points per participant. The participant marked in the small circle below the pictures for each scale (1-9) and this was marked in a spreadsheet. The pre-test score for each element was subtracted from the post-test score to find the change in self-report for each condition. These data were analyzed with a univariate analysis of variance. A *p*-value less than 0.05 was considered to be significant (95% confidence interval).

GSR data for the experimental period were normalized based on the minimum and maximum arousal levels during the condition being analyzed. Normalization was employed in order to account for possible differences in baseline state across different days that an individual attended to undergo one of the three trials. These normalized data read as a percentage between the minimum and maximum value for each participant each session. For instance, a value of 0.68 would signify 68% of the difference between the minimum and the maximum value for that session.

CHAPTER 4
RESULTS

Fifteen individuals participated in this study. Participants were met on a rolling basis as available; nine individuals completed three conditions, four participants completed two sessions, and two participants completed just one condition. The study was not completed for some individuals due to contact precautions during a global pandemic. Galvanic skin response (GSR) and Self-Assessment Manikin (SAM) data were only analyzed from participants who completed trials in all three conditions (n = 9 participants, 27 conditions completed).

Demographics

Demographic information can be found in Table 3.

Table 3. Demographic information for all participants and participants who completed all three conditions.

	All participants n = 15	Participants who completed all three conditions n = 9
Mean age	38.5	46.1
Median age	30	48
Age range	23-67	26-67
# White	13	9
# SE Asian and white	1	0
# Hispanic	1	0
% born in USA	100	100
Listening to music each week:		
Mean hours	7.9	6.1
Median hours	7	4.5
Range hours	0-16	0-16
Musical training:		
Mean years	5.8	1.6
Median years	2	1
Range years	0-23	0-10
Concerts per year:		

Mean concerts	2.9	2.3
Median concerts	2	1
Range concerts	0-10	0-7

Analysis of GSR data

GSR During MBI

During the mindfulness-based intervention (MBI) GSR levels fell evenly across all conditions from approximately 0.78 down to 0.46 (Figure 6). The average GSR levels (and standard deviations) for the compensation, iso, and control conditions at the end of the MBI were 0.43 (0.15), 0.45 (0.16), and 0.49 (0.25) respectively. At the beginning of the experimental period the average GSR levels increased to 0.67 (0.27), 0.53 (0.29), and 0.58 (0.24) respectively (Table 4).

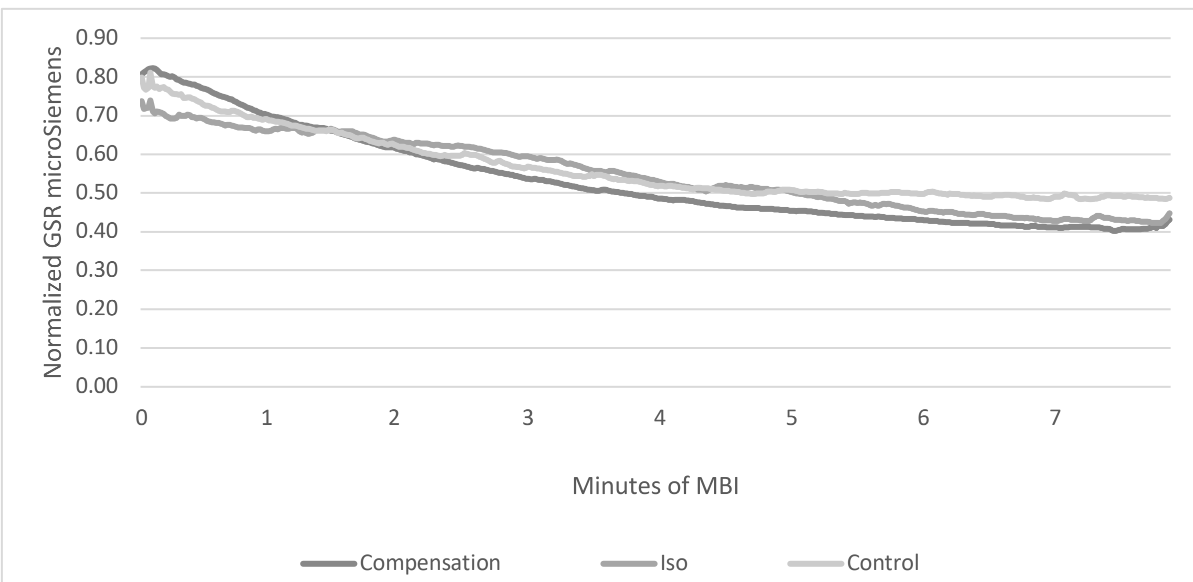

Figure 6. Normalized averaged of GSR scores for MBI period.

Table 4. GSR levels at the beginning of MBI, end of MBI, and beginning of each condition.

	Beginning of MBI	End of MBI	Beginning of condition
Compensation	0.81 (0.09)	0.43 (0.15)	0.67 (0.25)
Iso	0.71 (0.17)	0.45 (0.16)	0.53 (0.21)
Control	0.77 (0.17)	0.49 (0.25)	0.58 (0.20)

GSR During Experimental Conditions

Visual inspection of normalized GSR scores during the experimental period (Figure 7) averaged across participants who completed all three trials shows the compensation condition starting at approximately 0.67 (0.25), the control condition starting at approximately 0.58 (0.21), and the iso condition beginning at approximately 0.54 (0.20). GSR levels went down in all conditions. Over the five-minute experimental period the compensation condition falls by 0.2, the iso condition by approximately 0.06, and the control by 0.26. The differences between the two musical conditions can be better observed in Figure 8, where the scores from the control are subtracted from the musical conditions. This shows how the two musical conditions compare when using the control as a baseline.

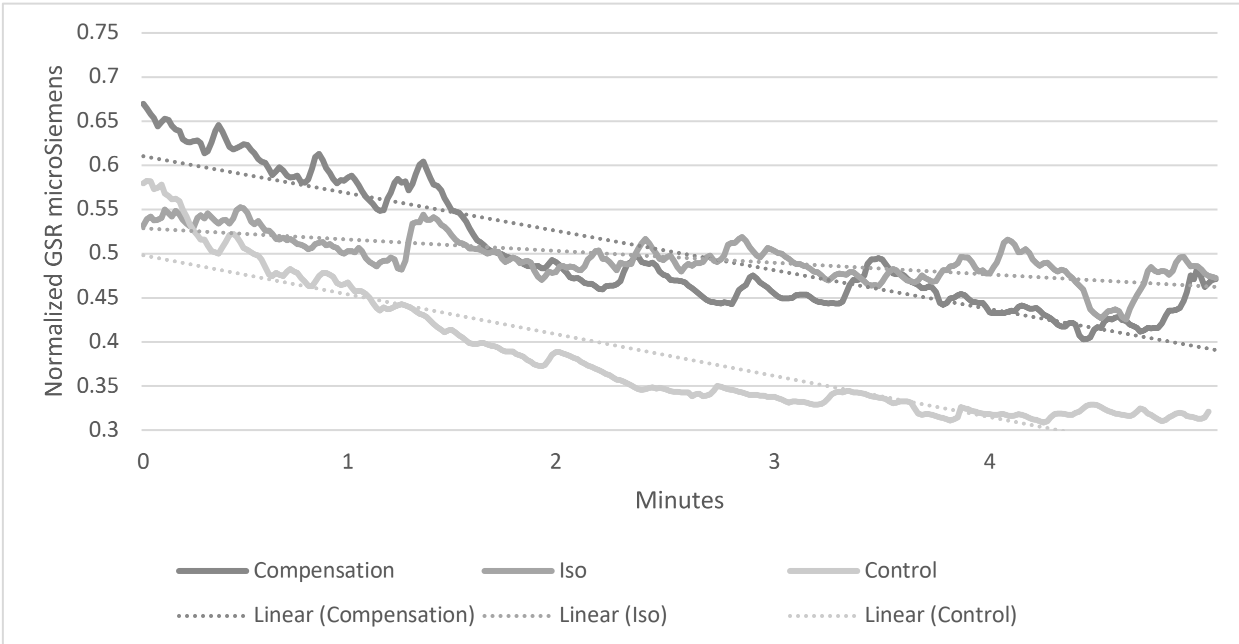

Figure 7. Normalized averaged of GSR scores for experimental period.

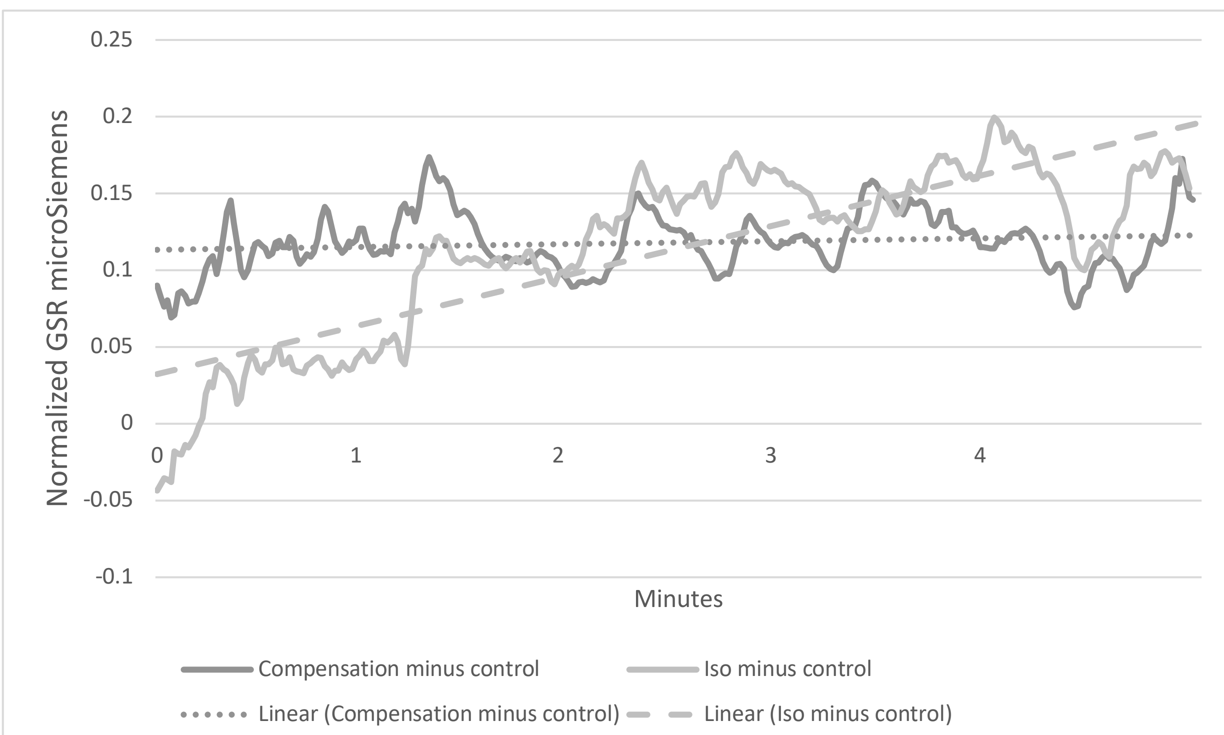

Figure 8. Difference between musical conditions and control condition.

A Q-Q plot of average indicated the data were normally distributed. Means for one-second blocks of GSR data, totaling 300 blocks per condition, were then analyzed using a randomized block design univariate analysis of variance (ANOVA; $F_{(2, 299)} = 309.71$, $p = .00$). Mean scores between the compensation and iso conditions were not significant (Compensation (0.50) = Iso (0.50) $p = .342$). The mean scores between the musical conditions compared to the control were significant: Compensation (0.50) > Control (0.38), $p = .00$, $d = 1.71$, Iso (0.50) > Control (0.38), $p = .00$, $d = 2.23$.

Table 5. Mean scores and standard deviations of one-second GSR data

Condition	M(SD)
Compensation Principle (A)	0.50 (0.07)
Iso Principle (B)	0.50 (0.03)
Control (C)	0.38 (0.07)

Means for one-minute blocks of GSR data (five blocks per condition) were then analyzed using a randomized block design univariate analysis of variance (ANOVA; $F_{(2, 4)} = 5.10$, $p = .01$). There was a significant difference between the compensation (0.50) > and control (0.38) conditions ($p = .023$, $d = 1.60$) and between the iso (.50) > and the control (.38) conditions ($p = .014$, $d = 2.06$), but not between the iso (.50) = and compensation (.50) conditions ($p = .98$).

Table 6. Mean scores and standard deviations of one-minute GSR data

Condition	M(SD)
Compensation Principle (A)	0.50 (0.07)
Iso Principle (B)	0.50 (0.02)
Control (C)	0.38 (0.08)

Analysis of Peaks

Peaks were found for GSR data during the five-minute experimental period. Peaks were defined as points of data greater than the previous and following data points. Sums were found for one-second blocks of peaks data, which were then analyzed using a randomized block design univariate analysis of variance (ANOVA; $F_{(2, 299)}=10.40$). There were statistically significant differences between the peak scores of the compensation (1.20) < and iso (1.31) conditions ($p < .01$, $d = .37$), and between the iso (1.31) and control (1.23) conditions ($p < .01$, $d = .29$). A significant difference was not found between the compensation (1.20) and control (1.23) conditions ($p = .552$). No significant difference was found between conditions when peaks were collected by minute.

Table 7. Mean scores and standard deviations of one-second peaks data

Condition	M(SD)
Compensation Principle (A)	1.20 (0.34)
Iso Principle (B)	1.32 (0.30)
Control (C)	1.23 (0.32)

Analysis of Self-Assessment Manikin (SAM) Data

Self-reported SAM data was analyzed from participants who completed all three conditions. Changes in scores pre- to post- test were found by subtracting the posttest score by the pretest score. In the SAM a lower valence score is *more* pleasant, and a higher score is *less* pleasant. In arousal scores a lower score is *more* aroused and a higher score is *less* aroused. In dominance scores a lower score is *less* dominant and a higher score is *more* dominant.

Each element of SAM score differences (valence, arousal, and dominance) were analyzed using a randomized block design univariate analysis of variance. In regard to the research questions, on average participants rated themselves as having a higher level of arousal by 2.44 points after both the compensation and iso principle conditions, and by 1.67 points after the control condition (Table 8). None of these were found to be statistically significant. There was also no significant difference among conditions of change scores for valence. A significant difference was found for change in dominance scores between the iso and control conditions ($F_{(2, 8)} = 4.16$, $p = .04$, $d = .90$).

Table 8. Average change in SAM scores

	Valence	Arousal	Dominance
Compensation Principle (A)	0.11	-2.44	1.00
Iso Principle (B)	-0.11	-2.44	1.44*
Control (C)	1.78	-1.67	-0.56*

**B>C*

CHAPTER 5
DISCUSSION

The purpose of this study was to investigate arousal shift during iso principle-informed tempo change in a musical stimulus. The procedures included a randomized block design with control on galvanic skin response (GSR), compared with a self-report of difference scores for the Self-Assessment Manikin (SAM). This study examined the following research questions:

- Research question (RQ) 1: What is the difference of arousal level using the iso principle when compared to the compensation principle?
- RQ 2: What is the difference of arousal level when using the iso principle when compared to a non-musical stimulus?

Hypotheses

1. Listening to an iso principle-mediated musical stimulus will affect arousal shift (measured by galvanic skin response) differently than the compensation principle.
2. Listening to an iso principle-mediated musical stimulus will affect arousal shift (measured by galvanic skin response) differently than recorded speech (control).

Data related to Mindfulness-Based Intervention (MBI)

During the mindfulness-based intervention (MBI) GSR levels fell evenly across all conditions from approximately 0.78 down to 0.46 (Figure 6). The average GSR levels (and standard deviations) for the compensation, iso, and control conditions at the end of the MBI were 0.43 (0.15), 0.45 (0.16), and 0.49 (0.25) respectively. This provides evidence that the MBI reduced arousal levels. However, at the beginning of the experimental period the average GSR levels increased to 0.67 (0.27), 0.53 (0.29), and 0.58 (0.24) respectively (Table 4).

Data related to RQ1

What is the difference of arousal level using the iso principle when compared to the compensation principle?

Galvanic skin response

The GSR measures did not indicate statistically significant differences between the iso and compensation principle conditions. GSR data show a general reduction of arousal over five minutes within all three auditory conditions (i.e., both music stimuli and the spoken stimulus). This was in opposition to the expectation that arousal would increase during musical conditions.

There did not appear to be a significant difference for the GSR values between the iso and compensation conditions when analyzed at one-second or one-minute intervals. The compensation principle condition had a greater reduction in arousal over the experimental period than the iso principle condition (a reduction by .2 and .06 respectively). However, this is likely due to the compensation condition data collection beginning .16 higher than the iso condition. These GSR scores appear to regress to the mean over the course of the experimental period.

Peaks

There was a significant difference and small effects size in frequency of peaks between the iso and compensation conditions by second. However, there was no significant difference when comparing peak scores by minute. Frequency of GSR peaks can be correlated with emotional intensity, such as during situations deemed stressful (Bakker et al., 2011). However, while intensity of emotion is correlated with GSR peaks, the valence is not inferred through these data. For instance, individuals speaking at an event will show increased frequency of GSR peaks whether they report enjoying or fearing public speaking (Tomaka et al., 1993).

Arousal can be affected by many different elements of music including lyrics, tempo, dynamics, or timbre (Brattico & Pearce, 2013). The musical examples were deeply repetitive, there were no lyrics to provide explicit emotional content, and it is unlikely that there were memory connections to the music since they were original compositions. This level of homogeneity makes it notable that there was a significant difference between the two musical conditions with the only difference being how their tempi were informed.

Data related to RQ2

What is the difference of arousal level when using the iso principle when compared to a non-musical stimulus?

Galvanic skin response

Significant differences and large effect sizes existed between the iso and control conditions when analyzed both at one-second and one-minute intervals. When experiencing the iso condition, GSR of participants fell by .06 of over five minutes, whereas GSR of these participants in the control condition fell by .26 of maximum output (the opening GSR levels for the iso and control conditions were .53 and .58 respectively). These findings appear to confirm the hypothesis that a difference in arousal shift exists between iso and spoken word stimuli. While the musical conditions did not increase arousal, the GSR levels remained higher throughout the experimental period than they did during the control condition. As such, for these participants, the iso principle-informed music retained arousal, even with a repetitive stimulus, far more than a short fictional story.

Peaks

When comparing GSR peaks across all three conditions, the findings indicate that all three auditory conditions changed arousal differently. Peak scores were significantly different with a small effect size between the iso and control conditions when analyzed at one-second intervals. The iso condition had slightly more peaks on average (1.32) than during the control condition (1.23). The short story includes explicitly stated emotional content and still had a statistically significant lower level of peaks (i.e. a signifier of lower emotional intensity) than the iso principle-informed music. Additionally, the compensation principle condition had an even lower average for peaks per second (1.20) which was not found to be statistically significant when compared to the control condition. These differences in scores between the control/compensation conditions and the iso condition suggest that there may be slightly increased emotional intensity during iso-informed music than during a fictional story and that music with a static tempo functions more similarly to a short story than to the iso principle-informed music.

Self-assessment manikin (SAM) data related to both RQ1 and RQ2

Participants' ratings on the SAM showed a perceived increase in arousal by 2.44 points in the musical conditions and 1.67 points in the control condition. These differences were not found to be statistically significant. While these scores show a perceived difference in arousal in the assumed direction, the musical conditions produced equal perceptions of arousal shift and were not significantly different than the control condition. Therefore, for these participants, the iso principle did not appear to increase arousal differently than the compensation principle.

The SAM uses the pleasure, arousal, dominance (PAD) model of emotion (pleasure is replaced by valence in the SAM). These three components likely impact one another (Hall, Elliott & Meng, 2017). Dominance was the only PAD measure that was found to have a statistically significant difference and moderate to strong effect size between control and musical conditions. Dominance has been found to increase pleasure (valence) of energetic arousal but can decrease pleasure of tense arousal (Chang et al., 2014). Energetic arousal can be thought of as a feeling of being invigorated or energetic, whereas tense arousal could be thought of as feeling anxious or nervous (Chang et al., 2014). As such, the emotional content of the story could have affected self-report of pleasure.

The short story used for the control told a story that included negative experiences of the protagonist. However, participants reported feeling a significantly *decreased* level of emotional dominance after this story (mean change score -0.56) when compared to the increased level of emotional dominance perceived after the compensation condition (1.44) and the iso condition (1.00). This could be related to empathy for the protagonist. Further study may consider using a story with less emotional content for the control.

Limitations

This study's sample size introduced considerable limitations. The sample size for this study was fifteen participants, and only nine were able to complete all three trials. Additional participants completing all three trials would allow for more accurate mean values, would provide a smaller margin of error, and would better identify outliers that could skew data. Further study should include additional participants.

While a mindfulness-based intervention (MBI) was used to invoke a similar state in all participants, it is possible that this practice had lasting effects on GSR during the experimental period (Vago & Silbersweig, 2012). While most participants experienced a significant decrease in arousal during the MBI, some participants' GSR output remained mostly unchanged. This is demonstrated in Figure 9 where participants' GSR levels over the MBI can be observed. Future study may consider excluding data from participants who do not meet a threshold for reduction in arousal during the MBI.

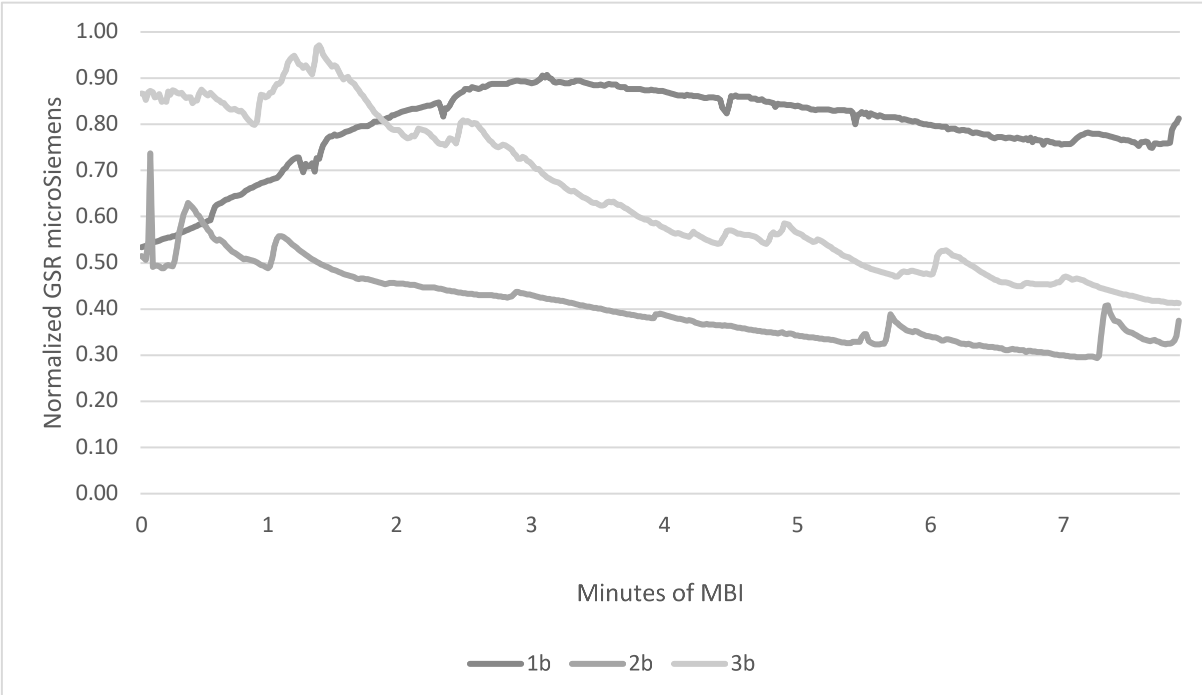

Figure 9. Three participants' GSR scores over MBI demonstrating difference in response.

The arousal levels found at the end of the MBI were far lower than at the beginning of the experimental period. This shows that, while the MBI appeared to reduce arousal, these reduced arousal levels were mostly negated between MBI and the condition. The SAM following the MBI (prior to the experimental condition) showed increased arousal for most participants. For some participants, this score was greater than their maximum score while blowing up the balloon. While the pre-test SAM was important for finding self-report of PAD data, it may have altered arousal prior to experimental stimuli. It may also be that the shift out of MBI (regardless of the SAM) increased arousal more than expected. Replication of this study may consider removing SAM tests, instead creating mindfulness tracks that go directly into experimental conditions. It may also be beneficial for researchers to practice the method with participants to reduce surprise and/or stress from shifting from MBI to other stimuli.

The short story used as a control featured characters and plot that could increase arousal and emotional intensity (peaks). While this was appropriate for the current study, future study may choose to use less emotional content (for instance, an uncontroversial local newspaper story) as the control stimulus.

The equipment used to measure GSR data also limited the degree to which arousal could be measured. The GSR equipment and software were procured with available funds, however higher quality equipment could find more detailed results and analysis. While the researcher made sure to acquire GSR equipment that could measure at 10 hertz (the recommended rate for published research), the accompanying software did not have robust denoising or analysis capabilities (Boucsein et al., 2012). As such, analysis of data lacked advanced denoising procedures. This was addressed through the straightforward denoising/downsampling procedure of finding the mean of each one second period (ten bits of data) and comparing these across conditions in a block design. Future study would likely benefit from the procurement of higher quality equipment and analysis software.

The iso principle has been described in many ways across the literature. It can be a static choice of music to bring to a session (Altschuler, 1944), a dynamic choice across a session for pain management (Lee, 2005), a proactive process for self-soothing of a single patient (Heiderscheit & Madson, 2015), and others. This study had a static approach to the iso principle, over a set period of five minutes, devoid of dynamic personalization to the individual, and this does not conform with clinical usage. Still, within music therapy practice, these variables may interact with the iso principle's effectiveness. Replication of this study could include variations to any of these elements: the musical element (dynamics, tempo, instrumentation, timbre, etc.), the length of stimulus (perhaps related to how long clinicians tend to use the iso principle with a specific population), specific populations of participations, and/or the physiologic element being observed.

Relationship to Literature

This study provides initial data that iso-principle informed use of tempo does not shift arousal differently when compared to music that does not modulate tempo over time possibly in opposition to findings by Shatin (1970). The iso principle did not increase arousal as expected (both GSR and self-report) and the arousal shift was not significantly different than the compensation principle-informed music on participants. These finding do not appear to have been addressed in previous research. This study addressed previous calls for a more empirical investigation into the iso principle (Gouk, 2009; Saperston, 1995).

The design of this study purposefully lacked an important aspect of iso principle usage in music therapy: human engagement. Human engagement is of stated importance in the therapeutic relationship when using the iso principle (Heiderscheit & Madson, 2015; Lee, 2005). Lee (2005) discussed how live presentation of music offers additional variables in regard to human connection that may increase the analgesic effect. Additionally, patient-preferred music and the process of musical choice are discussed by Heiderscheit and Madson (2015) as important aspects of clinical usage of the iso principle. Being that music appears to induce arousal shift through perceptions of patterns and extramusical associations (Huron, 2006; Thaut, 1990) it is likely that the intended effect of iso principle-informed music on arousal can be amplified by lyrical content, personal preference, and a myriad of other elements. For instance, Salimpoor et al. (2009) found that, when participants were given the opportunity to choose music they deemed pleasurable, higher GSR scores were correlated with increased pleasure from music. Patient-preferred music could be related in future research to Lee's (2015) finding that iso principle-informed live music was more effective than recorded music for self-ratings of pain.

Clinical implications

This study's findings do not appear to support iso principle-informed tempo change to increase arousal as being different than compensation principle-informed music. This study only measured arousal shift starting at low levels of arousal during music with fast or accelerating tempi. Researchers should address the reverse for possible use in de-escalation of a client with high arousal level.

There were not statistically significant differences between self-report of arousal levels across all conditions. Participants did, however, rate themselves at a higher level of arousal after the music compared to after the MBI. This higher perceived level of arousal juxtaposed with the decreased GSR levels over all conditions show the importance of using both physiologic and self-report data in further study of the iso principle and other music therapy concepts. Prior to this study all research on the iso principle used solely self-report measures in studying the iso principle (Heiderscheit & Madson, 2015; Lee, 2005; Shatin, 1970).

It is possible that the effects of iso-principle informed music could be better modulated with preferred music. In previous study of GSR and music listening, higher arousal in the musical environment was correlated with increased reports of pleasure (Salimpoor et al., 2009). People are already using preferred music for arousal modulation (Georgi et al., 2006; Husain et al., 2002). All of these concepts could possibly be developed into technology for self-directed music therapy intervention based on GSR level.

Suggestions for future research

Our use and understanding of the iso principle have shifted over time. Future research could help to solidify the term's meaning in order to increase the iso principle's meaningful application in clinical settings. More specifically, research studies could continue to deepen the music therapy community's understanding of the musical and clinical circumstances under which the iso principle is most effective. While early use of the iso principle by Altschuler focused on groups (1944) modern iterations of the iso principle tend to focus on individualization and/or self-guidance (Heiderscheit & Madson, 2005; Lee, 2005; Thaut, 1989, Yinger & Lownds, 2018). All of these definitions have a similar format: Use music to meet a patient's current state then change one or more elements of the music to lead them to a different state.

This study provides a framework to study arousal shift (a specific measure of "patient state") while the musical elements could be changed in future replications of this study. Tempo is an easily quantified element of music and has been an appropriate starting place for this line of study. It appears that there have not been other quantitative and/or physiologic studies related to the iso principle – and this study provided initial quantitative and physiologic evidence that suggests there may be no difference between the iso principle and the compensation principle, and showed a difference between the iso principle and a short story. As such, further study is warranted on tempo and other musical elements to facilitate arousal shift. Additionally, the field of music therapy would benefit from research on the iso principle when performed live compared to prerecorded music.

The demographics of the participants and researcher also limit the generalizability of this study's findings. The participants of this study were vastly white and from the United States. The music was all written by the researcher, who was trained in the Western-Classical musical tradition. Further considerations could consider the existence of a difference in arousal shift and/or emotional intensity for individuals listening to musics that are not from their musical tradition. This could lead to study beyond simply preferred music – but on how one's musical culture can affect responding to music therapy interventions from a dominant monoculture.

Choosing specific periods for data collection during musical examples could be modified in future study. It may be beneficial to begin GSR data collection approximately ten seconds into a musical example and to stop the data collection five to ten seconds before the end of the musical example. Figure 1 and Figure 2 show a GSR response to the onset of the musical stimulus and to the anticipation of a cadence at the end (Huron, 2006). This would allow a researcher to more directly study the physiologic reaction to the continued music, instead of the novelty of the opening or closing.

Variations of GSR levels introduce a challenge to using GSR to predict an optimal level of arousal. Arousal levels were quite different across participants, and sometimes quite different between sessions of individual participants. For instance, one participant's GSR scores ranged from 1.45-5.45 microSiemens (μS) throughout their trials, whereas another participant ranged from .15-.85 μS throughout their trials. As such, it is difficult to define an optimal level of arousal that can be generalized to patients from solely objective data collection. This method of study, however, could be continued with GSR and music while participating in other tasks to better address optimal arousal and musical intervention. Further, GSR could possibly be used to study optimal complexity theory in listeners.

Conclusion

The iso principle, while a well-known concept within music therapy, lacks robust scientific support and requires further study. The results of this study provide initial data indicating that iso principle-informed music may not have a different impact on arousal shift when compared to the compensation principle. Music does appear to have a different impact on arousal shift when compared to speech. Future research should address additional musical elements, differences by population, and other bodily states.

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APPENDIX A

IRB APPROVAL

From: Claire.Chance@colostate.edu
Sent Date: Monday, June 01, 2020 10:02:38 AM
To: Andrew.Knight@colostate.edu, D.Goldschmidt@colostate.edu, Heather.Bellotti@colostate.edu
Cc:
Bcc:
Subject: The following Protocol has been Approved: 19-8653H
Message:

Please note, your Research Continuity Application must be approved prior to starting in-person work. For more details, see the CSU return to work website (https://safety.colostate.edu/return-to-work-on-a-campus/).

The IRB has approved your protocol referenced below:

Protocol ID: 19-8653H
Principal Investigator: Knight, Andrew

Protocol Title: The Iso Principle: Studying arousal shift through musical tempo manipulation
Review Type: EXPEDITED
Approval Date: June 01, 2020

If this study is sponsored and receiving funds through Office of Sponsored Programs, submit your formal Approval Letter to your OSP team. This email is not sufficient documentation of your approval.

This is not an official letter of approval. Your approval letter is available to you in the "Event History" section of your approved protocol in eProtocol. Note that specific information regarding the approval and any conditions of approval are available below the signature line in the footer of the approval letter.

Further instructions can be found here: https://www.research.colostate.edu/ricro/

IMPORTANT REMINDER: If you will consent your participants with a signed consent document, it is your responsibility to use the consent form that has been finalized and uploaded into the consent section of eProtocol by the IRB coordinators. Failure to use the finalized consent form available to you in eProtocol is a reportable protocol violation.

If you have any questions regarding this approval, please contact:

CSU IRB: RICRO_IRB@mail.colostate.edu; 970-491-1553

APPENDIX B

QUESTIONNAIRES

QUESTIONNAIRE

Participant code _______

Gender (circle): Female Male Other (please specify)_______________ **Age** _____

What is your race/ethnicity?

- ☐ White
- ☐ Black or African-American
- ☐ Hispanic, Latino, or Spanish Origin
- ☐ American Indian or Alaskan Native
- ☐ Southeast Asian
- ☐ South Asian
- ☐ Native Hawaiian or other Pacific islander
- ☐ From multiple races (please specify) _____________________
- ☐ Other: (please specify) _____________________

What is your country of birth?

- ☐ United States
- ☐ Outside of the United States

If you are not originally from the US, how many years have you lived in the US? _____

What styles of music do you listen to most frequently? (choose up to three)

- ☐ Country
- ☐ Rap/Hip-hop
- ☐ Classical
- ☐ Rock
- ☐ Folk
- ☐ Heavy Metal
- ☐ Reggae
- ☐ Gospel
- ☐ Electronic
- ☐ R&B
- ☐ Pop
- ☐ Jazz
- ☐ Latin music (Salsa, Bachata)
- ☐ Alternative
- ☐ Soul
- ☐ Other: ________________

On average, how many hours of music do you listen to each week? ___________________

How many years of formal musical training have you received? _____________________
(This is private lessons with a teacher for an instrument or voice)

How experienced are you with mindfulness meditation (choose one)?

- ☐ I've never done it before
- ☐ I've done it a few times
- ☐ I have done it many times, but not more than once per week
- ☐ I practice mindfulness meditation consistently (two or more times per week)

Have you worked out or done another extended physical activity in the past two hours? Y/N

Have you had any stimulants today? (Caffeine, medications including: Adderall, methylphenidate, Concerta, etc.?) Y/N

Are you currently on any depressant medications? (Xanax, sleeping medication, etc.) Y/N

QUESTIONNAIRE

Participant code ______

(After music)

Please rate how much you agree with this statement:
(1= greatly disagree, 4= neutral, 7= greatly agree)

I enjoyed the music: 1 2 3 4 5 6 7

QUESTIONNAIRE: (circle) Session 2 or Session 3

Participant code ______

Have you worked out or done another extended physical activity in the past two hours? Y/N

Have you had any stimulants today? (Caffeine, medications including: Adderall, methylphenidate, Concerta, etc.?) Y/N

Are you currently on any depressant medications? (Xanax, sleeping medication, etc.) Y/N

APPENDIX C

OUTLINE FOR HAND PLACEMENT DURING GSR

APPENDIX D

MINDFULNESS BASED STRESS REDUCTION SCRIPT

MBSR: Body Scan

Body Scan Practice

Sitting in a chair, with your arms and hands at your sides and legs outstretched … or with the knees bent and the soles of the feet on the floor, if that is more comfortable …or sitting in a chair in a relaxed posture… making a choice to allow yourself to be exactly as you are in this moment…

Coming gently to notice the breath… it's such a constant feature of life that it's easy to ignore… so taking time with it now… actually feeling the sensations as the breath enters the body and leaves the body of its own accord… allowing it to move through its cycle of in-breath and out-breath without controlling… if it feels right to you, attending to the belly, the lower abdomen, noticing that it may be rising and falling with the cycle of the breath… if you care to, placing your hands on your belly… feeling the movement of the breath, the rhythm, the waves of the breath… simply riding the waves of your breath from moment to moment.

As you listen to this body scan, if at any time sensations in the body become too uncomfortable, or emotions arise that are too difficult, knowing that it is always possible to return to the breath as a safe place, a haven, a retreat for you to rest in, until you are ready to venture again into the body scan… wherever this recording is in its progress.

If you've placed your hands on your belly, taking them off now, and moving your attention to the top of your head… noticing that sensations may arise when you bring attention to a particular part…maybe tingling, maybe pressure, maybe a feeling of the breath or the pulse affecting this area… or perhaps there's no sensation — that's OK, that's simply your experience of this moment.

And when you're ready, moving your attention to your face… observing any sensations…perhaps furrows of tension, or tingling, or a sense of relaxation… allowing yourself to feel whatever you feel.

Now moving your attention from the face to the eyes and eyelids… noticing how you're holding them… how much or how little pressure does it take to keep them closed? Experiencing the eyes from the inside, from behind the eyelids… are the eyeballs moving or still? Is there darkness? light? color? How does the breath affect this area?

Moving the attention to the jaw… being aware of tightness or softness… allowing the lower jaw to drop down slightly, and noticing any changes in sensations in the muscles of the face and neck, or in other parts of the body which that small movement may create… and expanding your focus of attention to include the mouth and lips… inside the mouth, the tongue against the teeth, against the roof of the mouth… if you care to, breathing in through the nose and out through the lips… allowing the air to play on its way out… observing the sensations of dampness, dryness, warmth, or coolness…

Shifting the attention to your neck… noticing how it is right now in the big muscles in the back of the neck, from the base of the skull to the shoulders… the throat… aware perhaps of the play of air or touch of clothing… being present in this experience…

Moving now to the shoulders, checking into their condition in this moment, any tightness or softness, recognizing that this is the condition *now*… accepting it, knowing that it does not need to be some other way… and knowing also that conditions change… noticing if there is a sense of the breath in the shoulders… how much of the body does breathing affect?

Allowing the attention to travel to the upper and mid back… sensing the muscles, tight or loose… aware perhaps of sensations of the weight of the body here… pressure against the floor or chair back, feelings of the texture of clothing…noting how the breath moves in this area…

Bringing attention to the lower back, to the sense of contact or lack of contact with the floor or chair, the sense of yielding to gravity or resisting, any tightness or softness… noticing any tendency to move away from or towards any sensations or thoughts, feelings, judgments that may arise… remembering that this is simply how it is in the lower back at this moment…

Shifting to the arms… to the upper arms and forearms… aware of the pull of gravity, the weight of the arms… feeling the muscles and joints, the touch and texture of clothing… and expanding the attention to include the wrists and hands… sensations of warmth, or coolness, tingling, moisture, or dryness… how does the breath affect the arms and hands? Is it possible to feel the pulse here? Just being with what's here now…

And moving, as you're ready, to the chest… aware of the lungs and heart in this space… maybe sensing inside, as the lungs fill and empty… perhaps noticing the heartbeat, the rhythm of the heart and the breath together… being present to these sensations of life… and feeling the surface, the touch of clothing, any sense of movement…

Now extending attention into the abdomen, the belly, feeling inside first… this place where we have our gut feelings — there really are nerves here that sense and know — feeling into the motion of the diaphragm, the sense of the breath in the belly…

When it seems right, moving attention to the pelvic region, from hip to hip… aware of the effects of gravity, the weight of the lower body … the buttocks pressed into the floor or chair, sensation in the hip joints… the groin, the genitals… the lower abdomen… tuning in to the sense of the breath, of the pulse here.. how far do they reach? And noticing thoughts and feelings that may arise… aware of judgments, and, as it's possible for you, letting them go…

Shifting the focus into the upper legs — the thighs… aware of gravity's work, the pressing against the floor or chair, the feel of clothing against the skin, and moving in… the quality of the muscles, tight or loose…is it possible to feel the bone running through?
… and extending the attention now to the lower legs, the calves and shins… noticing points of contact or lack of contact with the floor or chair, aware of gravity, aware as well that the legs are alive — how does the breath affect them? How about the pulse — is there a sense of the blood flowing?

When you're ready, exploring onward… to the feet… feeling where they are, the floor, perhaps a sense of temperature… warmth or coolness… a sense of the breath and heartbeat perhaps?

Now expanding the attention to include the entire body from the soles of the feet to the top of the head… being present to the totality of the experience of sitting or lying here in this moment… perhaps feeling the breath — how it has been a constant companion, how it brings the whole body together…as does the pulse, the heart beat…. feeling the sense of gravity, the sense of being held gently, closely, without fail… dwelling in what the body feels… in what it *knows*…

In the last moments of this body scan, congratulating yourself for spending the time and energy to nourish yourself this way… for continuing to make choices to live a more healthy, satisfying life… and knowing that you can carry this awareness of your body's deep wisdom beyond this practice session and into each moment of the day, wherever you may find yourself.

Adapted from: McCown, D., Reibel, D., & Micozzi, M. S. (2010). Getting Grounded (In Our Own Instability). In *Teaching Mindfulness: A Practical Guide for Clinicians and Educators* (pp. 3–30). New York, NY: Springer New York. https://doi.org/10.1007/978-0-387-09484-7_1

APPENDIX E

SCORE FOR MUSIC TREATMENTS

Score

Autumn/Springtime

Daniel Goldschmidt (2018)