Comparison of the Strength of Harmony, Melodic Line, Rhythmic Variation, and Expressive Elements in Influencing Emotional Judgment in Music

Marilyn M. Moore
Western Michigan University, mmoore@hcaeagles.org

Follow this and additional works at: https://scholarworks.wmich.edu/masters_theses
Part of the Music Therapy Commons

Recommended Citation
https://scholarworks.wmich.edu/masters_theses/443
COMPARISON OF THE STRENGTH OF HARMONY, MELODIC LINE, RHYTHMIC VARIATION, AND EXPRESSIVE ELEMENTS IN INFLUENCING EMOTIONAL JUDGMENT IN MUSIC

by

Marilyn M. Moore

A thesis submitted to the Graduate College in partial fulfillment of the requirements for the degree of Master of Music
School of Music
Western Michigan University
December 2013

Thesis Committee:

Edward Roth, M.M., Chair
Brian Wilson, M.M.
David Code, Ph.D.
COMPARISON OF THE STRENGTH OF HARMONY, MELODIC LINE, RHYTHMIC VARIATION, AND EXPRESSIVE ELEMENTS IN INFLUENCING EMOTIONAL JUDGMENT IN MUSIC

Marilyn M. Moore, M.M.

Western Michigan University, 2013

Studies in the literature have been conducted that seem to establish that humans make consistent and similar emotional judgments when they are asked to describe an emotion that is being expressed musically. The present study targets four musical elements; harmony, melodic line, rhythmic variation, and expressive elements, to investigate which of these musical elements are most effective for influencing a listener to be able to recognize the composer’s intended emotion of the music. There are eight original songs composed by the researcher, each song is assigned a specific intended emotional term. The eight songs are presented in five distinct conditions, a baseline condition and four manipulations of the baseline, wherein one of the targeted musical elements was removed from the music for each manipulation. Volunteer subjects are presented with forty (40) quasi-randomized audio presentations on a website survey, and are asked to select one emotional term that they feel the composer was intending to convey. Results are tested with Cramer’s V chi square to measure the association that each musical element has with the emotional judgment of the listeners.
Copyright by
Marilyn M. Moore
2013
ACKNOWLEDGEMENTS

I would like to thank the members of my thesis committee, Edward Roth, Brian Wilson, and David Code, for taking the time to review my work and give advisement.

Special thanks to Haolai (Lincoln) Jiang for his expert consultation on statistical matters.

I would also like to thank those who participated in my study and were willing to volunteer their time.

Lastly, I would like to thank my children, Camille, Ben, and Micah, for giving me their emotional support throughout this project.

Marilyn. M. Moore
# TABLE OF CONTENTS

ACKNOWLEDGMENTS .......................................................... ii

LIST OF TABLES ............................................................... v

INTRODUCTION ............................................................... 1

Correlations of Music and Emotion Literature Review ............... 1

Physiological Effects of Music ............................................. 2

How Music Affects Emotions .............................................. 3

Music Processing in the Brain ............................................. 6

Specific Musical Elements and Corresponding Emotional Response 16

Emotional Terms and Categories Used for Describing Musical Emotions 26

METHOD ................................................................. 30

Subjects ........................................................................ 30

Procedure ...................................................................... 31

Descriptions of Variables .................................................. 33

Condition 1 (Baseline) ...................................................... 33

Condition 2 (Expressivity removed) ..................................... 33

Condition 3 (Rhythmic Variation removed) ......................... 34

Condition 4 (Harmony removed) ...................................... 34

Condition 5 (Melodic Line removed) ............................... 34

Emotional Terms and Categories ....................................... 34
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESULTS</td>
<td>36</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>38</td>
</tr>
<tr>
<td>Discussion of Research Question 1</td>
<td>38</td>
</tr>
<tr>
<td>Discussion of Research Question 2</td>
<td>40</td>
</tr>
<tr>
<td>Discussion of Research Question 3</td>
<td>41</td>
</tr>
<tr>
<td>Condition Two Removal of Expressivity</td>
<td>43</td>
</tr>
<tr>
<td>Summary of Condition Two</td>
<td>44</td>
</tr>
<tr>
<td>Condition Three Removal of Rhythmic Variation</td>
<td>45</td>
</tr>
<tr>
<td>Summary of Condition Three</td>
<td>48</td>
</tr>
<tr>
<td>Condition Four Removal of Harmony</td>
<td>49</td>
</tr>
<tr>
<td>Summary of Condition Four</td>
<td>51</td>
</tr>
<tr>
<td>Condition Five Removal of Melodic Line</td>
<td>51</td>
</tr>
<tr>
<td>Summary of Condition Five</td>
<td>53</td>
</tr>
<tr>
<td>Conclusions</td>
<td>54</td>
</tr>
<tr>
<td>Limitations/Suggestions for Further Study</td>
<td>55</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>57</td>
</tr>
</tbody>
</table>
# APPENDICES

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Recruitment Flyer</td>
<td>66</td>
</tr>
<tr>
<td>B</td>
<td>Informed Consent Document</td>
<td>68</td>
</tr>
<tr>
<td>C</td>
<td>Subject Questionaire</td>
<td>72</td>
</tr>
<tr>
<td>D</td>
<td>Website Instruction Script</td>
<td>74</td>
</tr>
<tr>
<td>E</td>
<td>Original Songs</td>
<td>76</td>
</tr>
<tr>
<td>F</td>
<td>Research Protocol</td>
<td>98</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

1. Hevner’s Adjectives of Musical Moods ........................................ 26
2. Geneva Emotional Music Scale .................................................. 29
3. Description of Musical Excerpts ................................................ 32
4. Emotional Terms and Categories ............................................... 35
5. Cramer’s V Association Results .................................................. 37
6. Comparison of Emotional Terms and Basic Categories .............. 39
7. Valid Percentages of Correct Responses per Condition .............. 42
8. Most Effective Element per Intended Emotion ......................... 55
INTRODUCTION

Correlations of Music and Emotion Literature Review

Music is universally appealing in part because of its ability to provide an emotional reward to the listener. Recent research suggests that the brain regions that are activated by emotion-eliciting music are the same regions that are activated by rewards such as sex, food, and drugs of abuse (Blood & Zatorre, 2001; Menon & Levitin, 2005). Humans use music for enjoyment, to comfort themselves or relieve stress, and to express or even change emotions (Behne, as cited in Zentner, 2008; Sloboda & O’Neil, 2001). A current neurobiological theory of human emotion is that emotion is either a pleasant or unpleasant state that is processed and organized in the limbic system (Kringelbach, O’Doherty, Rolls, & Andrews, 2003). Emotions are thought to be responses to external stimuli which in turn correlate to brain activity that directs our attention and helps decide the significance of what we are experiencing (Drake & Meyers, 2006). While emotions are generally thought to be short-term in duration, moods are usually classified as lasting longer than a simple emotion, anywhere from an hour to a few days or longer. Leonard Meyer (Meyer, 1956) distinguished between emotions, which he termed temporary, and mood, which he defined as relatively permanent and stable.

Current evidence suggests that music has the potential to elicit both short-term emotional response, and to affect a longer-term mood change on the listener. Music has shown to be helpful in increasing positive affect in the elderly (Laukka, 2007), to relieve anxiety and depression, (Hanser, 1996; Robb, Nichols, Rutan, Bishop, & Parker, 1995), and for improving general mood (Rigg, 1964). Recent studies show that listeners
commonly use music to change their mood, or to distract from an unpleasant task or situation (Laukka, 2007; Sloboda & O’Neil, 2001). In a related study, 145 subjects self-reported that in their experience, music often communicated and expressed emotions (Juslin & Laukka, 2004). Music has been used as a means of emotional manipulation in order to influence consumer buying patterns (Alpert & Alpert, 1990, Bruner, 1990). Music listening has been reported to outrank watching television or reading as a means of relaxation (Rentfrow & Gosling, 2003). Infants as young as four months have been shown to display emotional reactions to music (Zentner & Kagan, 1996), which indicates that basic emotional response to music may be inborn rather than learned, attesting to the importance of music in human development and experience.

Physiological Effects of Music

Studies show evidence that music affects humans in measurable physiological ways, indicating emotional arousal. In previous studies, emotions have been found to produce certain physiological reactions. For example, sadness has been shown to lower the pulse, raise blood pressure, and decrease body temperature. Fear results in increased pulse rates. Happiness has been observed to cause increased speed of respiration (Steen, 2000). In an attempt to show that music not only expresses emotion, but actually elicits emotion, Krumhansl (1997) studied the physiological changes in blood circulation, respiration, body temperature, and skin conductivity of volunteer music listeners. When subjects were presented music with a rapid tempo in a major key, increase in respiration occurred, which is a known physiological indication of happiness. Slow tempo and minor key induced signs of sadness (lower pulse rate, increased blood pressure, decreased
body temperature), while rapid tempo combined with dissonance resulted in increased pulse rate, which is associated with the emotion of fear. Krumhansl found that the sad excerpts produced the largest changes in heart rate, blood pressure, skin conductance, and temperature. Fearful musical excerpts produced the largest changes in blood transit time. Happy excerpts were most effective in changing the rate of respiration.

The use of music as effective therapy for various emotional disorders is further confirmation of the correlation between music and emotion. The effects of Music Assisted Relaxation (MAR) on preoperative anxiety with pediatric patients was investigated by researchers at the Shriners Burns Institute (Robb, et al., 1995). Results showed that those who received MAR before surgery experienced a significant decrease in anxiety, as measured by the State Trait Anxiety Inventory for Children (STAIC). Cevasco, Kennedy, and Generally conducted a study of the effectiveness of music therapy interventions on stress, anxiety, anger, and depression of females in a substance abuse program (Cevasco, Kennedy, & Generally, 2005) with clients self-reporting positive mood changes after music interventions.

How Music Affects Emotions

From the above-cited studies, it seems clear that music has both an emotional and a physiological effect on humans. In addition to empirical studies regarding the various effects of music on listeners, writers have long postulated philosophical theories as to how or why music affects human beings. In his philosophical work on the musical experience, Kivy (1990) identified two primary views on the relationship between music and emotions. “Emotivists” hold that music itself can elicit affective responses in the
listener, while “Cognitivists” maintain that music only expresses emotions that the
listeners perceive and identify. Although philosophies regarding music and emotions
have existed since at least the time of Aristotle, empirical research on the potential for
music to induce emotions or change mood is relatively recent (Juslin & Sloboda, 2001;
Juslin & Vastfjall, 2009; Krumhansl, 1997; Vastfjall, 2002). An important theory of
musical emotion was proposed by Suzanne Langer (1957) in her book on philosophy and
music. She states that “the forms of human feeling are much more congruent with
musical forms than with the forms of language…” Langer did not agree with the
prevalent theory of the day, which suggested that music affects humans emotionally only
because it seems to imitate human vocal expressions. Langer argued that music imitates
the form of emotion, but not the content, which is to say that music may be very
emotional, but in a vague, unspecific way. Mandler (1984) and Meyer (1956) proposed a
more compromising philosophy of emotion in music, wherein music affects humans
emotionally both from the elements of the music itself and from extra-musical stimuli,
such as culture and emotional state of the listener.

Several studies have been conducted that seem to establish that humans make
consistent and similar emotional judgments when they are asked to describe an emotion
that is being expressed musically (Behrens & Green, 1993; Dolgin & Adelson, 1990;
Gabrielsson & Juslin, 1996; Gerardi & Gerken, 1995, Kratus, 1993; Thompson &
Robitaille, 1992). A study by Blood, Zatorre, Bermudez and Evans (as cited in Blood
Zatorre, 2001) suggests that emotional and non-emotional judgments are the products of
distinct neurological pathways, particularly the subcortical emotional circuits. There is
further support for this distinction in a study by Zatorre and Samson (as cited in Blood &
Zatorre, 2001), wherein the researchers found that areas of the brain thought to be associated with perception and cognition differed from areas that are associated with musical dissonance. Although consistent emotional judgments have been established, researchers disagree on whether these judgments are determined by cultural norms alone (Feld & Keil, 1994), or by universal musical influences inherent in the music itself (Dowling & Harwood, 1986). To attempt to clarify this question, one must look at studies of the emotional perception of unfamiliar music.

Perceptual studies suggest that listeners who are unfamiliar with a particular musical style are able to adapt in their ability to interpret the intended emotion in unfamiliar music. Castellano, Bharucha and Krumhansl (1984) found that listeners who were unfamiliar with the style of North Indian music gave attention to the statistical distribution of the pitches as a way of describing the emotional meaning of the music. Similar results were found for listeners unfamiliar with Balinese music (Kessler, Hansen, & Shepard, as cited in Oram & Cuddy, 1995) and with music that had artificial tonalities.

Balkwill and Thompson (1999) designed a study to clarify whether or not listeners could identify the intended emotion in music from an unfamiliar tonal system (that is, one from a different culture). They sought to separate cultural cues from psychophysical cues. Psychophysical cues were defined as “any property of sound that can be perceived independent of musical experience, knowledge, or enculturation” (p. 44). These psychophysical cues included tempo, timbre, pitch range, and complexity of the melody and rhythm. Balkwill and Thompson suggest that when music is culturally unfamiliar, the listener is forced to attend to the psychophysical cues inherent in the music. They argue that if the judgments and associations made from psychophysical cues
are not culturally determined, the listeners should then theoretically be able to recognize intended emotions in music from an unfamiliar tonal system. Balkwill and Thompson chose the Hindustani classical tonal system for their study, in large part because Hindustani classical theory outlines specific relationships between ragas and rasas. In classical Hindustani music, the raga is a melodic mode of five or more notes that are used as a framework for composition. These ragas are each associated with a time of day or a season, and a corresponding mood. Since the intended emotion of the raga is very clear, the researchers chose this type of unfamiliar music for their study. Balkwill and Thompson chose four target emotions for their study; joy, sadness, anger, and peacefulness, as these four emotions are well-documented in the literature (Haack, 1980; Behrens & Green, 1993; Terwogt & van Grinsven, 1991). Results of the study supported the researchers' model of perception of emotion in music. Listeners who were culturally unfamiliar with the Hindustani tonal system were sensitive to the intended emotions in the ragas, and the listeners' ratings of the psychophysical elements showed significant correlation with their judgments of the emotions in the ragas. The authors suggest that listeners' sensitivity to emotion in music is perhaps a sensitivity to the psychophysical elements of the auditory environment.

Music Processing in the Brain

In order to identify the neural correlates of affective responses to musical stimuli, one must examine present studies regarding the brain functions and mechanisms that have been identified as being active in music processing.
In a study that compared an individual with brain damage to a normal control group, results showed that emotional judgments in music were highly consistent across subjects, were resistant to brain damage, and that these judgments were immediate (Peretz, Gagnon, & Bouchard, 1998). In this study, Peretz et al. used 32 musical excerpts of Western classical music that were intended to convey either a happy or sad emotion. Excerpts included works by Beethoven, Handel, Mozart, Ravel, Verdi, Brahms, Chopin, Debussy, and Saint-Saens. Computer-generated versions of short selections (7-10 seconds) were made for this study. Subjects were asked to evaluate whether the piece was happy or sad based on a 10 point scale. The researchers based their evaluation of sad/happy music on mode and tempo, maintaining that based on previous studies by Hevner (1935, 1936, 1937) fast tempi tend to evoke happy emotions, and slow tempi generally elicit sad emotions. Likewise, Hevner found that music in the major mode is associated with happy emotions, while music in the minor mode is associated with sad emotions.

Although music can be called a language of sorts, it is different from speech in that music has a distinct processing mechanism in the brain. Some of the first evidence that different areas of the brain are specialized to do different tasks was discovered by Paul Broca in 1861, who documented that when a particular part of the brain was damaged, speech was impaired. In 1874, Carl Wernicke of Germany located another area of the brain used in language processing. Both areas of the brain now bear the name of the respective scientists (Steen, 2000). However, people who experience damage to Broca’s area and Wernicke’s area do not necessarily lose musical abilities, even though language is affected. This would indicate that music is processed by other areas in the
brain (Chritchley & Henson, 1977). Kimura (as cited in Evers, Dannert, Rodding, Rotter, & Ringlestein, 1999) showed a left hemisphere dominance for language perception and a right hemisphere dominance for melody perception. Right hemispheric dominance has also been confirmed for discrimination of musical chords and tonal sequence (Gordon, as cited in Evers et al., 1999; Zatorre, 1979).

Musical sounds and all other sounds have the same processing stages in the auditory neuraxis (Peretz & Zatorre, 2005). In other words, they all start out being received in the cochlea and processed through the brain stem, midbrain, and cortex. Once the brain receives the sound stimulus and auditory signals, the processing of information begins in the various respective areas of the brain.

Although there is some controversy regarding whether melody and rhythm are processed together or independently, the literature seems to show more evidence for an independent processing of melodic and temporal structures. Brain damage can affect pitch discrimination but not rhythmic discrimination. Conversely, brain damage in other areas can affect rhythmic discrimination but not pitch perception. This therefore leads researchers to believe that the two dimensions of musical processing are independent (Ayotte, Peretz, Rousseau, Bard, & Bojanowski, 2000; Peretz 1990; Peretz & Kolinsky, 1993; DiPietro Laganaro, Leeman & Schnider, 2004).

The right temporal neocortex has been shown in several studies to be important in pitch processing (Liegeois-Chauvel Peretz, Babai, Laguitton, Chaubel, 1998; Zatorre 1985, Zatorre, 1988), in particular, the right anterolateral part of Heschl’s gyrus (Peretz & Zatorre, 2005). Patients with damage to this area have difficulty perceiving missing pitches (particularly the fundamental), and have difficulty in determining the direction of
pitch change (Johnsrude et al., 2000). In the study by Liegeois-Chauvel and Peretz (1998), people with damage to the right-temporal lobe had difficulty processing both the contour and the key of a presented melody, while those with damage to the left-temporal lobe had difficulty only with processing the key. In a second set of experiments, Liegeois-Chauvel and Peretz presented melodies in two different time signatures to the same patients. As the patients had no difficulty perceiving the rhythm, it is indicated that rhythm is not analyzed in the temporal lobe.

In investigating how music effects blood flow, scientists from the University of Munster and the University of Dortmund used transcranial Doppler sonography to measure how music effects blood flow in the brain. Functional transcranial Doppler sonography is a technique that measures the speed of blood flow in an artery or vein, in order to study the response of blood flow to a stimulus. They studied both musicians and non-musicians. Results showed a bias toward the right hemisphere for music processing for those with no musical training, as blood flow to the right brain hemisphere increased with exposure to music with many harmonic intervals (Evers et al., 1999). The reverse was true among musicians, however, showing an increased blood flow to their left hemispheres. This suggests that musical training may affect harmonic perception. When the participants were exposed to strongly rhythmical music, an equal increase of blood flow was observed in both hemispheres. This seems to confirm that pitch and rhythm are processed independently.

Positron-emission tomography (PET) is another technological tool used for brain research. In studies conducted by scientists from the University of Caen in France, subjects were played familiar music two times, while being inside a PET scanner. One
interesting result from this study was that when change was made in the pitch of one or more notes of a melody, brain activity was observed not only in the temporal lobes, but also in the visual cortex (Brodmann’s area 18 and 19) (Platel et al., 1997). This is the area where images are seen or imagined by the mind’s eye. The researchers discussed that this could indicate that the brain uses a symbolic image to aid in deciphering pitch.

In addition to pitch and rhythm, music processing is also dependent on memory, as music happens over time. Therefore, working memory mechanisms in the brain are activated when listening to music (Peretz & Zatorre, 2005). Lesion and neuroimaging studies suggest that working memory for pitches happens with interactions of the frontal cortical and posterior temporal areas (Griffiths et al., 1999; Zatorre et al., 1994; Gaab et al., 2003). Studies of subjects who received hemispheric anesthesia revealed a neurally specific role of the right temporal lobe in activating memory for music (Loring, as cited in Evers, et al., 1999). The right temporal lobe was also indicated for singing the correct pitch (Bogen & Gorden, 1971; Gorden & Bogen, 1974). Implicit memory may strongly affect music experiences. While some melodies are explicitly remembered, a more general kind of melodic memory may occur implicitly (Crowder, 1993). One study reports findings that patients with amnesia retain implicit memory for melodic sequences, even when explicit memory is impaired (Johnson, Kim, & Risse, 1985). Exposure to music has been shown to have implicit memory effects for emotional judgments in music (Crowder, Serafine & Repp, 1990, Serafine, Crowder & Repp, as cited in Crowder et al, 1990).

Musical expression is a strong factor relating to the emotional appeal of music (Juslin & Sloboda, 2001). Processing of emotional expression in music appears to be
neurally distinct from other music processing, as people with brain damage can often still recognize the emotional tone of the music, even if they can no longer identify the name of the piece (Peretz & Gagnon, 1999). In a related study, Peretz, Gagnon, and Bouchard (1998) observed emotional responses to music in an individual with brain damage. The subject, I.R., sustained damage to both of her temporal lobes as a result of surgery intended to repair damaged blood vessels in her brain. Interestingly, though her speech and intellectual functioning were not affected, her musical ability was. She could no longer sing or recognize music that was formerly familiar to her. Even though I.R. could not recognize any of the presented melodies or detect pitch changes, she could still perceive and feel the emotion in the music (Peretz et al, 1998). She also reported that she still enjoyed music, even though she could not recognize specific pieces regardless of how many times they were presented. This indicates that the emotional and the conscious effects of music are completely separate.

To examine the emotional effects of music on the mid-brain, Blood and Zatorre (2001) have observed the results of PET scanning while subjects were presented melodies with consonant and dissonant patterns. When dissonance was heard, the areas of the limbic system that are associated with unpleasant emotion (right amygdale, left hippocampus/amygdale) were activated. Contrastingly, the parts of the limbic system associated with pleasure (left ventral striatum and dorsomedial midbrain) were activated when the subjects were presented with consonant melodies. The researchers observed and measured “chills” experienced by the subjects, which is a physiological indication of an intensely pleasurable response to music. These musical chills were accompanied by observable cerebral blood flow changes in several areas of the brain which are associated
with rewarding stimuli, such as food, existence altering drugs, and sexual pleasure. These areas include the dorsal midbrain, ventral striatum, insula, and orbitofrontal cortex (Blood & Zatorre, 2001, Small, 2001, Breiter et al., 1977).

In his landmark treatise on *Emotion and Meaning in Music* (1956), Leonard Meyer discusses the philosophy of musical meaning, and the way in which it is communicated. Meyer explores the opposing philosophies of musical meaning; that of the absolutist/formalist, which asserts that musical meaning lies exclusively within the context of the work itself, and, that of the referentialist/expressionist, who argue that musical meanings refer to the extramusical world of concepts, actions, emotional states, and character. Meyer proposes a compromise position that claims both emotional and intellectual meanings. It is Meyer’s position that the relationships evident in the music itself can account for feelings and emotions in the listener. A major focus of Meyer’s work is with how listeners experience uncertainties in music. As a listener already has existing musical expectations of a particular musical style, alterations of the expected progressions in a piece of music can be perceived as a deviation from the norm. These deviations can be emotional stimuli for the listener. Meyer states that when the music deviates from the expected course, it “arouses tendencies and thus fulfils the conditions necessary for the arousal of affect” (p.31). Meyer believed that the principal affective character of music lies within the unfolding events within the music itself.

Building on Meyer’s work regarding the expectation theory, Mandler (1984) suggests that physiological arousal triggers an automatic cognitive search for meaning. This process involves prediction of future events on the basis of existing evidence. If an unexpected event occurs which interrupts a predicted pattern, neural arousal occurs,
which then triggers the brain’s search for meaning. Music listening incorporates this expectation of future musical events (Kaminska & Mayer, 1993). Sequences in music reinforce expectation of repeated musical events. The sequential structure and form of music is integral to preserve the coherence of music. However, music must also have a certain degree of unpredictability to remain interesting to the listener. The brain’s attempt to find meaning results in physiological arousal, which in turn generates an emotional experience (Kaminska & Woolf, 2000).

A more recent treatise on expectation in music has been proposed by David Huron (2006). Huron expands on Meyer’s ideas with his own theory of expectation, ITPRA, which stands for five different processes: Imagination, Tension, Prediction, Reaction, and Appraisal. The processes of Imagination and Tension are related to the anticipation of an event. Huron connects Prediction, Reaction, and Appraisal to the outcome of events. He argues that statistical learning is a key factor in the development of musical expectations. Statistical learning is the view that people become sensitive to the probabilities of the physical environment in which they live, thereby allowing them to acquire knowledge about the future probability of rhythmic and tonal events in music (McMullen & Saffran, 2004; Saffran, Johnson, Aslin, & Newport, 1999, as cited in Huron, 2006).

Narmour (1990) has proposed the melodic expectancies are shaped by universal principles. The two main principles that he identifies are registral direction and intervallic difference. Registral direction states that small intervals are expected to continue in the same registral direction, but large intervals are expected to change registral direction. Intervalllic difference states that small intervals are expected to be
followed by an interval that is similar in size (within 2 semitones if registral direction changes, within 3 semitones if registral direction stays the same. Large intervals imply an interval that is at least 3 semitones smaller if registral direction changes, and at least 4 semitones smaller if registral direction stays the same. When an interval moves to a third note that is the same or close (within 2 semitones) to the first note, it is called registral return. Narmour also identified two other principles of melodic expectation. *Proximity* is defined as less than or equal to 5 semitones between any two notes. *Closure* is said to occur when there is a change in registral direction, or movement to a smaller interval.

Narmour's principles of melodic expectancy were tested by a subsequent study (Thompson, et.al, 1997). The researchers found strong support for the principle of registral direction, but weak support for the principle of closure. They also found strong support for an extended model of melodic implication, proposed by Krumhansl (1995) and Cuddy & Lunney (1995).

In an attempt to clarify and organize the above-cited interactions between music and emotions, Juslin and Vastfjall (2008) have presented a theoretical framework which identifies six mechanisms through which music listening may induce emotions. The authors point out that many studies have been conducted on the perception of emotion in music, (Clynes, 1977; Cooke, 1959; Langer, 1957), those studies do not necessarily address how music induces an actual feeling of emotion in the listener. Juslin and Vastfjall propose that the induction of emotion in music should be investigated separately from the perception of emotion in music. The authors begin by defining emotion as a "brief but intense reaction to an event or change in the external environment". This reaction includes a cognitive appraisal of the external event, followed by a subjective
feeling about the event (e.g., a feeling of fear or anger). This feeling then triggers physiological arousal (e.g., increase in heart rate) and an outward expression of the internal emotion (e.g., screaming, crying). This outward expression is followed by an action (e.g., running away). Following the action phase, there is a period of regulation (e.g., the person attempts to calm themselves). The authors present their theory of six underlying emotional mechanisms. The first mechanism is brain stem reflex, which is the process of emotional induction by music because one or more of the acoustical features of music (such as sudden, loud or dissonant sounds) are perceived as an important and urgent event in the external environment. This causes physiological arousal. The second emotional mechanism is evaluative conditioning. This is where an emotion is felt by the listener simply because that particular piece of music has been repeatedly paired with either positive or negative emotions. This is a special type of classic conditioning, wherein a certain piece of music may have occurred repeatedly at the same time as an event that consistently produced, for example, happiness. Over time, the music becomes associated with that event, thereby giving the music itself the ability to induce the emotion of happiness. The third mechanism is emotional contagion. This is when a listener perceives the emotional content of the music, and then mimics the emotional expression internally. Kallinen & Ravaja (2006) have reported evidence that music with a particular emotional expression can induce the same emotion in the listener. The authors suggest that emotional contagion may occur through mirror neurons, discovered in recent studies of the premotor cortex (di Pellegrino et al., 1992). Visual imagery is the fourth emotional mechanism, which refers to emotion being induced when the listener produces visual images while listening to music. This mechanism is unique
because the listener is able to influence the emotions induced by the music. Some researchers suggest that musical features such as repetition, predictable melody, harmony, and rhythm, and slow tempo may be most effective in producing visual imagery (McKinney & Tims, 1995). The fifth emotional mechanism is episodic memory. This is a process where a listener feels an emotion because the music reminds the listener of a particular event in their life. Other studies also confirm that music can evoke memories in listeners (Gabrielsson, 2001; Sloboda, as cited in Blood & Zatorre, 2001). Finally, the sixth mechanism is musical expectancy, which is when an emotion is induced in a listener because certain features of the music either confirms, violates, or delays their expectation about what the music will do next. Musical expectancy refers to expectancies within the syntax of the music itself, which includes the theories or rules of music (Narmour, 1991; Patel, as cited in Juslin & Vastfjall, 2008). Juslin and Vastfjall point out that a better understanding of the underlying emotional mechanisms that interact with music may be very important for such applications as music therapy and physical and subjective well being (Juslin & Vastfjall, 2008).

Specific Musical Elements and Corresponding Emotional Response

Since it is clear that music affects the listener emotionally, the question arises as to whether there exists a relationship between specific musical elements and corresponding emotions. Juslin proposes that there must be attributes of music which are consistently associated with certain emotions, and which can then be used to communicate the emotional intentions of the composer to the listener (Juslin, 1997). Many elemental attributes of music have been postulated as possibilities for conveying
emotion, including tempo, mode, harmony, dynamics, pitch, articulation, timbre, and melodic line (Wedin, 1972). Studies have traditionally focused on one or two musical elements in isolation.

In a study on depression and anxiety, Hanser (1996) found that symptoms of depression, distress and anxiety were significantly reduced with a music listening program. Hanser stated in the discussion, however, that “there is little known about the reason why one piece of music affects one individual one way, and another individual differently”. She went on to state that formal elements of music, such as tempo, dynamics, and timbre, as well as familiarity and preference of the listener seem to interact to determine the effectiveness of the response (Hanser & Thompson, 1994; Hanser, 1996).

Bonny did extensive work using specifically programmed pieces of music along with guided imagery in order to bring about a desired emotional psychological effect (Bonny, Savary, 1973; Bonny, 1989). Although Bonny did not individually isolate and classify all the particular musical elements which she believed elicited the desired effect, she did prescribe specific pieces of classical music containing the musical features that she proposed were effective for corresponding emotional effects.

McKinney (1994) replicated some of Bonny’s findings in an extensive study, and found treatment effects of the prescribed music with guided imagery. The experimental group reported significantly less anxiety than the control group.

Kallinen (2005) conducted a study examining whether basic emotional music excerpts could be identified, and how those emotional excerpts are organized. Results suggested that pieces are easiest to locate from the repertoire of tonal music, rather than
modern atonal pieces. It was also found that sadness and joy are more easily recognized in music than anger, fear, and surprise. Other researchers have noted that subjects tend to confuse fear and anger (Terwogt & Van Grinsven, 1991; Robazza et al., 1994). Kallinen pointed out that the results of his study suggest that the emotional quality of music is based on some cultural background information, but also on structural characteristics, such as tempo, articulation, tonality, and harmony. Kallinen used a self-organizing map (SOM) developed by Kohonen (as cited in Kallinen, 2005), wherein similar emotions are seen as close together and dissimilar emotions are seen as far apart.

A method for analyzing musical tension was devised by Nielsen (1983), wherein the listeners pressed tongs together to indicate the degree of tension experienced. The tension curves were related to dynamics, timbre, melodic contour, harmony, tonality, and repetition. A similar study found tension judgments correlated with melodic contour, note density, dynamics, harmony, tonality, and music-theoretic expectations (Lerdahl, 1988, 1996).

Melodic and rhythmic complexity has been studied as a factor in the differentiation of emotional judgments in music. In two related studies by Smith (2001, 2004), results indicate that music with a higher degree of complexity may be more effective than a less complex piece of music for the reduction of stress. Listeners who were exposed to repeated presentations of Mozart’s *Eine Kleine Nachtmusik* and Steven Halpern’s *New Age Serenity Suite* reported more psychological relaxation and less stress after listening to the more complex Mozart piece. Smith suggests that this may be because when listening to complex music, the brain is engaged in finding the meaning in the music, thus providing sufficient distraction from anxiety. Conversely, Berlyne (1971)
found that listeners preferred music stimuli which was perceived to have a middle level of complexity. Other researchers have found that melodies containing more repetition and fewer variations of melodic contour, that is less complex melodies, are associated with positive and peaceful emotions. More complex melodies, those with less repetition and more variation of melodic contour, were associated with anger and sadness (Crozier, 1974; Imberty, 1974; Vitz, 1966). Regular, repetitive, smooth-flowing rhythms have been associated with positive moods, while irregular rhythms have been associated with negative moods (Hevner, 1935; Rigg, 1964).

The range of pitches in a piece of music has been found to influence listeners’ perception of emotion in music. Pieces with a wider pitch range may be perceived as unpredictable, therefore producing a higher level of arousal. Music that contains a more narrow distribution of pitches may be easier to process, perhaps because the pitches can be processed in one auditory stream (Bregman, 1990). Studies show that listeners expect the pitches in melodies to be in close proximity (Cuddy & Lunney, 1995; Krumhansl, 1995; Narmour, 1990, 1991; Schellenberg, 1996; Thompson, Cuddy & Plaus, 1997). These studies suggest that music that meets the expectations of a narrow melodic pitch range are associated with positive emotions, and those with a wider melodic pitch range are associated with negative emotions.

Studies examining timbre as a factor in determining emotional meaning show that music perceived as happy was described by the listeners as having a “bright” timbre, whereas music perceived as angry was described as having a “harsh” timbre. Music perceived as having no musical expression was characterized as having a “cold” timbre (Gabrielsson & Juslin, 1996). In a study examining the timbre of violin, timpani, and
voice, researchers reported that the subjects were more sensitive to sadness and fear expressed by the violin and voice, and more sensitive to anger in improvisations expressed by the timpani (Behrens & Green, 1993).

In an influential study on the emotional character of major and minor modes in music, Hevner (1935) attempted to empirically evaluate the traditional assumption that there are differences in the affective qualities of the major and minor modes. She states that major modes have been associated with dynamic force, expressions of joy and excitement, and have connotations of hope, strength, and happiness. Minor modes have been traditionally said to be considered passive, weighty, and likely to express feeling of sorrow, grief, mystery, and calmness. Hevner investigated the effects of the two modes wherein the musical material used consisted of two versions of the same composition, one written in the major key, and one in the minor key. The results of her experiment led her to conclude that the above stated historically assumed characteristics of major and minor modes were confirmed.

The premise that major mode and fast tempo is associated with happiness, and minor mode and slow tempo are associated with sadness was given additional empirical support in a related study investigating the relationship between mode, tempo, and affective values (Della Bella, Peretz, Rousseau, & Gosselin, 2000). The researchers found that children from five years of age were able to discriminate between sad and happy musical excerpts. Children who were five years old relied only on the tempo of the music to make the distinction between the two emotions. Children between six and eight years old had results similar to the adult group, who used both tempo and mode to distinguish between happy and sad. This seems to be in concurrence with previous
studies that suggest that sensitivity to tempo occurs at an earlier age than sensitivity to modality (Gerardi \& Gerkin, 1995; Gregory et al., 1996; Imberty, 1969 as cited in Della Bella et al, 2000). This may suggest that perception of tempo may be more inherent, while perception of mode may be more of a product of learning.

A foundational examination of emotional meaning of the melodic line was conducted by Cooke (1959). Cooke believed that the melodic line was the most important element in the emotional expression of music, and that the system of tonal relationships form the basis of the expressive language of music. Cooke examined combinations of two or more notes in Western music between the fifteenth century and the present time. He chose pieces where the composer indicated the intended expressed emotion in another historical text. He isolated sixteen consistent examples of melodic line, each line being associated with a particular emotional meaning. Cooke assigned vocabulary to each of these examples, such as “an assertion of sorrow” or a “burst of anguish” (Cooke, 1959, P.122).

A direct test of Cooke’s theory was conducted by Gabriel (1978). Participants were asked to rate goodness of match between Cooke’s sixteen basic melodies and his descriptions. Results did not support Cooke’s theory, as the appropriate pairings were not found to be better matched than random pairings. Gabriel suggests that melody is a device which stores other elemental attributes of music such as intervals, mode, contour, and rhythm, and that it may be more useful to examine each of these elements one by one. One criticism of Gabriel’s findings is related to the fact that he used sine waves rather than real music as stimuli, which have no harmonics, something that Cooke advocated were the unconscious basis of the tonal system.
In an attempt to address the reservations about the Gabriel (1978) study, Kaminska and Woolf (2000) devised a methodology that simplified the task requirements and used more natural stimuli. Findings did provide evidence of discrete emotional meaning carried by melodic line, which was Cooke’s general thesis. However, there was not sufficient evidence to answer the question of whether the specific examples of melodic line identified by Cooke actually convey the emotion intended by his verbal descriptions. The exception to this is the dimension of Sorrow-Joy, which did correlate significantly with Cooke’s predictions.

Four harmonic intervals, the major 2\textsuperscript{nd}, major 3\textsuperscript{rd}, the perfect 4\textsuperscript{th} and perfect 5\textsuperscript{th}, were rated for emotional meaning by listeners in a study by Oelman & Laeng (2008). They found that different intervals received significantly different profiles, and that emotional judgments of the intervals were reliable. From the three experiments in this study, common adjectives used to describe the major 2\textsuperscript{nd} included unsatisfied, sad, annoying, and active. Words frequently used to describe the major 3\textsuperscript{rd} were calm, pleasing, bright, hopeful, and happy. The perfect 4\textsuperscript{th} was described as vigorous, clear, robust, and unsatisfied. Adjectives describing the perfect 5\textsuperscript{th} included clear, definite, inflexible, and serious. The authors suggest that their findings provide support that (1) whether presented in isolation or in the context of a musical piece, intervals can carry emotional meaning, and (2) such meaning appears to be shared by listeners from different musical traditions.

Schellenberg and Trehub (1996) compared the emotional effect of intervals with simple frequency ratios to intervals with complex frequency ratios. The perfect 4\textsuperscript{th} (5 semi-tones) has a frequency ratio of 4:3. The perfect 5\textsuperscript{th} (7 semitones) has a frequency
ratio of 3:2. Both of these intervals have a simple frequency ratio. The tri-tone (6 semitones) has a complex frequency ratio of 45:32. The researchers tested nine month old infants with harmonic and melodic 4ths, 5th, and tritones. Findings showed a processing predisposition for intervals with simple frequency ratios, which is to say that the infants in this study preferred the intervals that are considered consonant (4ths and 5ths) over the interval that is considered dissonant (tritone). The authors suggest that these results show a biological basis for the preference of certain intervals, both historically and cross-culturally.

Costa, Ricci Bitti, and Bonfiglioli (2000) studied the expression of emotions associated with the 12 harmonic intervals presented in isolation found within the octave. The intervals were presented in harmonic form in both low and high registers. Significant correlation was found between interval and register for thirds, perfect fourths, and sixths. These intervals, when presented in the high register resulted in expression of positive emotions. The same intervals presented in the low register were associated with moderately negative emotions. For intervals that are considered clearly consonant (octaves, fifths) or dissonant (seconds, augmented fourths, and major sevenths), register was not a factor. This seems to suggest that dissonant intervals are more able to overcome the factor of register than consonant intervals.

In a subsequent study, Costa, Fine, and Ricci Bitti (2004) hypothesized that the expression of a particular emotions is associated with a distinct pattern of interval occurrences. They found that melodies that have a strong tonality, without tritones, and with a greater occurrence of perfect fourths and minor sevenths were evaluated as more pleasant and agreeable than melodies that did not follow this formula. Melodies with a
greater occurrence of minor seconds and tritones, as well as intervals larger than the octave, were evaluated as more dynamic and unstable. Unisons and perfect octaves were rated as strong for expressing energy and power.

Expression in a musical performance has been shown to affect listeners’ emotional perception (Juslin, 2000). Juslin proposes that the relative scarcity of research on this subject may be related to a lack of tools necessary to capture the communication process that takes place in an expressive musical performance. Performance expression can be defined as “the small and large variations in timing, dynamics, timbre, and pitch that form the microstructure of a performance and differentiate it from another performance of the same music” (Palmer, 1997, p.118). Research has shown that the artistic interpretation of a performance does influence listeners’ perception of the music (Bengtsson & Gabrelsson, 1983; Clarke, 1989; Sloboda, 1983, as cited in Juslin, 2000). The timing of a musical piece has a strong tendency to be dictated by the structure of the phrase (Juslin, 2000), as when there is a decreased tempo at the end of a phrase. This indicates that expressive variations in the timing are functioning to clarify the structural form of the music. The question arises as to whether expressive elements in a musical performance also contribute to the emotional impact of the piece. Music psychologist Carl Seashore stated that “deviation from the exact...is the medium for the creation of the beautiful -for the conveying of emotion” (quoted in H.G. Seashore, 1937, p.155, as cited in Juslin, 2000). Several authors have confirmed in their studies that expressive variations do contribute to the listeners’ emotional perception (Gabrielsson, 1995; Julsin, 1997; Shaffer, 1992). By analyzing the synthesis of several music performances, it has been demonstrated that performers use tempo, sound level, and articulation to express
specific emotions (Juslin, 1997). Previous studies showed that different emotions were associated with different expressive cues. Anger was associated with fast tempo, high sound level, legato articulation, and a small level of variability in articulation. Sadness was associated with slow tempo, low sound level, legato articulation, and small articulation variability. Happiness was associated with fast tempo, high sound level, staccato articulation, and much articulation variability. Fear was found to be associated with slow tempo, very low sound level, staccato articulation, and much articulation variability (Gabrielsson & Juslin, 1996; Juslin, 1993).

Juslin (2000) proposes that there are two main factors that influence the use of expressive cues in music. The first factor is brain programs for vocal expressions of emotions. Studies of monkeys and humans brain lesions have shown that there is evidence of brain programs that initiate and organize vocal expressions (Jurgens & von Cramon, 1986; Ploog, 1986, as cited in Juslin 2000). It would seem then, that music performances that convey the strongest emotions are those which sound the most like the human voice. The second factor influencing expressive cues is social learning. Juslin explains that performers learn links between acoustic musical cues and extramusical features such as body language and motion.

While most studies examine the emotional effects of one musical feature, Webster & Weir (2005) explored the interactive effects of mode, texture, and tempo in a single experiment. The mode, texture, and tempo were manipulated to determine the interaction between each musical feature. Results indicated that the effects of mode, texture, and tempo were interactive in nature, and produced a reliable three-way interaction. Music
presented in major keys with a simple melodic texture, or at a fast tempo were rated
happier than those in minor keys with a thick harmonized texture, or at a slow tempo.

Emotional Terms and Categories Used for Describing Musical Emotions

Ekman (1982) defined six universal emotions for encoding facial expressions.
They are: anger, soothing, disgust, fear, happiness, sadness, and surprise. These
emotional categories may not be the best suited for music moods, however, as some
commonly expressed music moods such as calming and soothing, are missing (Hu,
2010). Hevner (1936) attempted to create music mood categories by devising a
categorical model that was a circle of adjectives meant to describe musical moods. She
suggested the eight following categories:

Table 1, Hevner's Adjectives of Musical Moods

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>spiritual</td>
<td>pathetic</td>
<td>dreamy</td>
<td>lyrical</td>
</tr>
<tr>
<td>lofty</td>
<td>doleful</td>
<td>yielding</td>
<td>leisurely</td>
</tr>
<tr>
<td>awe-inspiring</td>
<td>sad</td>
<td>tender</td>
<td>satisfying</td>
</tr>
<tr>
<td>dignified</td>
<td>mournful</td>
<td>sentimental</td>
<td>serene</td>
</tr>
<tr>
<td>sacred</td>
<td>tragic</td>
<td>longing</td>
<td>tranquil</td>
</tr>
<tr>
<td>solemn</td>
<td>frustrated</td>
<td>yearning</td>
<td>quiet</td>
</tr>
<tr>
<td>sober</td>
<td>depressing</td>
<td>pleading</td>
<td>soothing</td>
</tr>
<tr>
<td>serious</td>
<td>gloomy</td>
<td>plaintive</td>
<td></td>
</tr>
<tr>
<td>heavy</td>
<td>dark</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
humorous    merry    exhilarated    vigorous
playful     joyous     soaring     robust
whimsical  gay       triumphant  emphatic
fanciful   happy     dramatic   martial
quaint     cheerful  passionate  ponderous
sprightly  bright    sensational majestic
delicate   agitated  exalting
light      exciting
graceful   impetuous
restless

While Hevner’s adjective cycle model is primarily categorical, other researchers have developed dimensional models. These models contain both valence (e.g., happy-unhappy) and arousal (active-inactive). Russell (1980) developed a dimensional model consisting of 28 emotion adjectives consisting of both valence and arousal dimensions.

In their study of perceptual determinants for music and emotion, Peretz, et al. (1998) reduced the emotional categories to happy and sad. Although they did acknowledge that there are obviously other emotional responses to music, they chose the most “simple and salient dichotomy” for their study of an individual with brain damage (Peretz, et al., 1999), believing that the happy-sad categories leave the least room for confusion.
Research conducted by Schoen & Gatewood (as cited in Hu, 2010) showed that the most frequently reported music emotions from a pre-selected list were sadness, joy, rest, love, and longing. The least reported music moods were disgust and irritation.

Hu (2010) assimilated major mood categories that were derived from an internet tagging site (last.fm). The categories included calmness, gloominess, mournfulness, cheerfulness, glee, meditatively, confidence, excitement, anxiety, anger, compassion, desolation, fear, hatred, happiness, hopefulness, sadness, aggressiveness, romance, and surprise. Hu suggests that a comparison of social-tag mood categories and psychological models should be studied further in order to identify the common grounds between the models. Hu points out that the vocabulary of some of the classical models is outdated, and is more appropriate for classical Western music than for contemporary genres.

In their research on emotions that are evoked by music, Zentner, et al. (2008) attempted to consolidate the terms and categories of emotions that have been used in describing the effect of music on the listener. In four inter-related studies, they developed Geneva Emotional Music Scale (GEMS), a domain-specific instrument to measure musically induced emotions. The results from the four inter-related studies were nine emotional terms, which were placed into one of three categories, making this a dimensional model. The researchers categorized the emotional terms as follows:
Table 2, Geneva Emotional Music Scale

<table>
<thead>
<tr>
<th>Sublimity</th>
<th>Vitality</th>
<th>Unease</th>
</tr>
</thead>
<tbody>
<tr>
<td>wonder</td>
<td>power</td>
<td>tension</td>
</tr>
<tr>
<td>transcendence</td>
<td>joyful activation</td>
<td>sadness</td>
</tr>
<tr>
<td>tenderness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nostalgia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>peacefulness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In two studies, Zentner, et al. found that the above model of music-elicited emotions accounted for these emotions better than the basic emotion models commonly used in previous studies.

Many studies cited above have correlated particular musical features (such as intervals, mode, tempo, melodic line, etc.) with specific emotions. It seems clear that both the individual elements of music and the combination of all elements of music effect the listener on an emotional level. Even if the listener does not actually “feel” an emotion, most listeners are able to perceive and identify the intended emotion of the music. This is an important distinction, as identifying an emotion conveyed by external stimuli and actually experiencing that emotion internally, are two very different behaviors and involve distinct neural circuitry.

The primary aim of the present study is twofold: (1) To explore whether or not listeners can accurately identify the intended emotion of a segment of music that is unknown to them, and (2) To explore the strength of emotion communicated by four targeted musical features; harmony, melody, rhythm, and expressive elements. (For this study, expressive elements are defined as dynamic variation, phrasing, and articulation.)
The following research questions will be investigated

1. Will an intended musical emotion be consistently identified by the subjects?

2. Will Condition 1 (all targeted musical elements present) demonstrate the most strength for conveying the intended emotion?

3. Which of the four targeted elements will be the strongest determining feature in communicating the various emotional categories?

METHOD

Subjects

Subjects were recruited from various community and church organizations by general public announcements accompanied by printed flyers that were distributed at church, school, and community events (See Appendix A). Subjects were volunteers between the ages of 18 and 99, who were able to commit to one session of approximately one hour. The informed consent document excluded those participants who had a current diagnosis of psychosis, or a neuro/psychiatric event. Forty-one subjects volunteered. The subjects received no compensation. The Western Michigan University HSIRB consent form was signed by each subject (See Appendix B). In addition to this, the subjects indicated consent electronically at the beginning of the website survey.

Subjects’ ages ranged from 22 – 81. The mean age of the subjects was 52. There were 29 female and 12 male subjects. Subjects were asked to fill out a brief
questionnaire, indicating their first name, age, gender, and musical background (See Appendix C). None of the subjects were professional musicians, but all had been exposed to general music, choir, or band in school.

Procedure

The music consisted of eight excerpts of original songs composed by the researcher. All musical excerpts were played by the same musician on a Steinway Model D grand piano. Excerpts were recorded in the WMU recording studio and then transferred electronically to a flash drive.

The researcher utilized the services of the Faculty Technology Center of Western Michigan University to create a website survey. The online survey was designed and facilitated by Julie Scott, E-Learning Administrator, Information Systems, Western Michigan University.

The survey consisted of an informed consent page, followed by forty questions. The pre-recorded songs were transferred from the flash drive to the website for the audio questions. Musical segments were then put into five randomized orders. Subjects were given verbal and written instructions on how to complete the survey (See Appendix D). Subjects were assigned which randomized order to select on the website.

Subjects were presented with 40 segments of music, each of 21 measures in length. The average time span of an excerpt was 30 seconds. Subjects were asked to select from the menu one of eight emotional terms that they thought the composer was
trying to communicate. Each of the eight song excerpts were presented in five distinct conditions, making a total of 40 musical segments for the entire study.

The eight songs were composed by the researcher specifically for the study (See Appendix E). The researcher utilized musical devices that are shown in the literature to be associated with certain emotions. Minor modes and slower tempos were chosen for the songs intending “Sadness” and “Distress/Tension”, while major modes and faster tempos were chosen for the songs intending “Happiness/Joy” and “Excitement/Activation” (Hevner, 1935; Gerardi & Gerkin, 1995; Della Bella et al., 2000). The composer chose to predominantly feature major thirds, perfect fourths and perfect fifths in the melodic lines of the songs intending positive emotions (Happiness, Excitement, Peacefulness, Dreaminess). Tri-tones, major and minor seconds, and major sevenths were used in the melodic lines of the songs intending negative emotions (Distress, Sadness, Restlessness). The eight songs composed by the researcher were intended to correspond to the eight emotional term selections that were provided for the subjects in the survey. (See Table 3)

<table>
<thead>
<tr>
<th>Intended Emotion</th>
<th>Brief Description of Musical Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Song 1 “Excitement/Activation”</td>
<td>Fast tempo, key of Eb major, syncopation</td>
</tr>
<tr>
<td>Song 2 “Tension/Distress” line</td>
<td>Harmonic dissonance, syncopation, disjunct melodic key of Bb minor, irregular tempo (fast/slow)</td>
</tr>
<tr>
<td>Song 3 “Happiness/Joy”</td>
<td>Some syncopation, fast tempo, key of F major, large upward melodic leaps</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Song 4 “Peacefulness/Calm”</td>
<td>No syncopation, key of Eb major, slow tempo, smooth melodic line, primarily stepwise motion</td>
</tr>
<tr>
<td>Song 5 “Dreaminess/Meditative”</td>
<td>Alternation between major/relative-minor modes, (F major, D minor) Slow tempo, smooth melodic line, no syncopation</td>
</tr>
<tr>
<td>Song 6 “Restlessness”</td>
<td>Syncopated rhythm, key of D minor, medium/fast tempo, winding melody</td>
</tr>
<tr>
<td>Song 7 “Longing/Tenderness”</td>
<td>No syncopation, key of D major, slow tempo, melody &amp; harmony alternate between major/minor modes</td>
</tr>
<tr>
<td>Song 8 “Sadness”</td>
<td>Slow tempo, key of G minor, Alternation between descending melodic steps and ascending melodic leaps</td>
</tr>
</tbody>
</table>

**Description of Variables**

The eight compositions were each presented in five distinct conditions. The five conditions are defined as follows:

**Condition 1 (Baseline)**

The musical segment is presented as originally written by the composer, with all four targeted elements (expressivity, rhythm, harmony, and melody) present.

**Condition 2 (Expressivity removed)**

The musical segment is presented with all expressive elements removed. For purposes of this study, expressive elements are defined as dynamic variation, phrasing, and variation of articulation (use of pedal, staccato, legato).
Condition 3 (Rhythmic Variation removed)

The musical segment is presented with no rhythmic variation, meaning the segment is played as unvarying quarter notes.

Condition 4 (Harmony removed)

The musical segment is presented with no harmony, meaning the chords are all removed. The melody is played with expressive elements and with the original rhythm, but with no underlying chords.

Condition 5 (Melodic Line removed)

The musical segment is presented with no melody, meaning the melody was not heard as a melodic line, but was only present in within the harmony. This condition sounded primarily like accompaniment without the melody.

The 40 excerpts were presented to the subjects in one of five quasi-randomized orders. Subjects were previously instructed that they were not necessarily to indicate any experienced (felt) emotion on their part, but to choose which emotional term that they thought best described the emotion the music was intended to convey, and then indicate how effectively it was conveyed.

Emotional Terms and Categories

For this study, the researcher used the basic Geneva Emotional Music Scale (GEMS) which was discussed in the literature review, with the following modifications: “Wonder” and “transcendence” were replaced by the “dreaminess/contemplative” term. “Nostalgia” was eliminated, as all songs were original and therefore not associated with a different era. “Power” was replaced by “excitement/activation”, and “joyful” was
renamed “happiness/joy”. Terms were slightly adjusted to help clarify the intended emotion that the composer/researcher intended (i.e., “calmness” was added to “peacefulness”, “happiness” was added to “joyful”, and “distress” was added to “tension”). In all cases, the terms were slightly adjusted in an effort to best fit the intended emotional mood of the eight songs that were written for this particular study.

The emotional terms that were provided as choices for the subjects in this study are listed below. They are grouped respectively in the three broad emotional categories (See Table 4).

Table 4 Emotional Terms and Categories

<table>
<thead>
<tr>
<th>Sublimity</th>
<th>Vitality</th>
<th>Unease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dreaminess/contemplative</td>
<td>happiness/joy</td>
<td>tension/distress</td>
</tr>
<tr>
<td>Tenderness/longing</td>
<td>excitement/activation</td>
<td>restlessness</td>
</tr>
<tr>
<td>Peacefulness/calmness</td>
<td></td>
<td>sadness</td>
</tr>
</tbody>
</table>

The subjects were not aware of the broad basic category that each emotional term falls under. They were only presented with the finer, more specific emotional terms. The subjects were provided with the 8 emotional term choices discussed above and asked to choose the one that they thought was being communicated.

When data collection was completed, the E-Learning Information Technology administrator transferred the data from the website to an excel document. This document in turn was transferred to the Statistical Program for the Social Sciences (SPSS) software program for statistical testing.
Although the subjects were given eight emotional terms from which to select their response, there was only one correct response, that being the emotional term intended by the composer/researcher. Therefore, all of the subjects’ responses needed to be placed into one of two categories; correct response and incorrect response. The researcher recoded all the incorrect responses as a zero. This step allowed the SPSS program to compare valid percentages of correct responses with incorrect responses for all the variables.

RESULTS

As the present study was interested in comparing the relationships between two categorical variables, (such as Song 1 Condition 1 x Song 1 Condition 2), the researcher determined that the Chi-square test would be used for examining the data in this study. Cramer’s V test is a measure of the strength of the association between two categorical variables, and is a variant of phi. (Field, 2009, pg. 784). Two by two comparisons were tabulated, comparing the baseline condition (condition 1) to each of the manipulations (conditions 2, 3, 4, and 5). This made for four two by two tabulations for each song. According to Cohen, when testing for association using Cramer’s V, values starting at .1 are considered to have a small effect. Values starting at .3 are considered to have a medium effect. Values starting at .5 are considered to have a large effect (Cohen, 1998, 1992, as stated in Field, 2009).

For this study, it is important to remember that the Cramer’s V test shows the strength of association between the baseline condition and each of the manipulations;
however, in order to determine if a certain musical element served to help the correct identification of an emotional term, or if in fact it in some way impeded the correct identification of an emotional term, one must look at the valid percentage of correct responses to verify if correct responses decreased or increased with the removal of said musical element. For example, in Song 2 (“Tension/Distress”), the removal of melodic line (condition 5) was shown to have a large effect (.5). One might erroneously assume that melodic line strongly contributed to the correct identification of the intended emotion. If one looks at the valid percentages, however, we see that this value represents an increase in correct responses when the melodic line was removed. Therefore, the melodic line in some way actually hindered the subjects from selecting the correct response to a large degree. This would then mean that for the intended emotion of tension/distress, melodic line had a large negative effect on the number of correct responses. The table (Table 5) below lists the effect size value for each comparison.

*Table 5 – Cramer’s V Association Results*

<table>
<thead>
<tr>
<th>Song Excerpt/ Intended Emotion</th>
<th>Comparison of Condition 1 (Baseline) with Condition 2 (Expressivity Removed)</th>
<th>Comparison of Condition 1 (Baseline) with Condition 3 (Rhythm Removed)</th>
<th>Comparison of Condition 1 (Baseline) with Condition 4 (Harmony Removed)</th>
<th>Comparison of Condition 1 (Baseline) with Condition 5 (Melodic Line Removed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excitement/Activation</td>
<td>.241 (s-)</td>
<td>.442 (m+)</td>
<td>.025 (w+)</td>
<td>.020 (w-)</td>
</tr>
<tr>
<td>Tension/Distress</td>
<td>.065 (w-)</td>
<td>.439 (m-)</td>
<td>.316 (m+)</td>
<td>.50 (l-)</td>
</tr>
<tr>
<td>Happiness/Joy</td>
<td>.289 (s-)</td>
<td>.120 (s+)</td>
<td>.071 (w-)</td>
<td>.156 (s-)</td>
</tr>
<tr>
<td>Peacefulness/Calmness</td>
<td>.050 (w+)</td>
<td>.244 (s+)</td>
<td>.493 (m-)</td>
<td>.025 (w+)</td>
</tr>
<tr>
<td>Dreaminess/Meditative</td>
<td>.063 (w-)</td>
<td>.375 (m-)</td>
<td>.235 (s-)</td>
<td>.482 (m-)</td>
</tr>
<tr>
<td>Restlessness</td>
<td>.375 (m-)</td>
<td>.411 (m-)</td>
<td>.169 (s-)</td>
<td>.141 (s-)</td>
</tr>
<tr>
<td>Longing/Tenderness</td>
<td>.149 (s-)</td>
<td>.284 (s+)</td>
<td>.423 (m-)</td>
<td>.075 (w-)</td>
</tr>
<tr>
<td>Sadness</td>
<td>.056 (w+)</td>
<td>.523 (l+)</td>
<td>.169 (s+)</td>
<td>.311 (m+)</td>
</tr>
</tbody>
</table>
DISCUSSION

The researcher will discuss the implications of the association values and the valid percentages of correct responses from the data. The valid percent shows what percentage of subjects (out of the subjects that completed each cell) chose the correct response, and whether the percentage of correct responses increased or decreased with the removal of one of the musical elements. The association value shows the strength of association between the variables, thereby indicating to what degree the musical element affected the subjects’ ability to choose the correct emotional term.

Discussion of Research Question One

The first research question being investigated was whether or not subjects could consistently identify the specific emotional term that the composer was trying to convey. Over 50% of subjects correctly identified the specific emotional terms in 4 out of 8 songs in the baseline condition. When the researcher looked at the larger, basic emotional category (sublimity, vitality, and unease) however, the percentage of correct identification was much higher for the baseline condition. Eighty percent or more of subjects correctly identified the basic emotional category in 5 of the 8 excerpts presented. In the three remaining excerpts, 66.7% correctly identified the correct basic category in
Song 7 and 54.5% of subjects correctly identified the basic category in Song 8. The lowest percentage of correct identification of the basic emotional category was for Song 6. Song 6, which was intended to convey restlessness, falls into the basic emotional category of unease. The results indicated that subjects found Song 6 particularly difficult to categorize. For example, 49.9% chose emotional terms that fall under the sublimity category, 23.4% chose emotional terms that fall under the vitality category, while only 26.7% chose emotional terms that fall under the correct basic category of unease.

The researcher suggests that the data indicates that under the baseline condition (all elements present), there is strong support for correct identification of the broad emotional category, but not for the more specific emotional terms used in this study (See Table 6).

*Table 6, Comparison of Specific Emotional Term and Basic Emotional Category*

<table>
<thead>
<tr>
<th>Song/Intended Emotion</th>
<th>% of Correct Responses Specific Emotional Term</th>
<th>% of Correct Responses Basic Emotional Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Song 1 Excitement</td>
<td>65.7%</td>
<td>94.3% (Vitality)</td>
</tr>
<tr>
<td>Song 2 Tension</td>
<td>62.1%</td>
<td>82.7% (Unease)</td>
</tr>
<tr>
<td>Song 3 Happiness</td>
<td>56.3%</td>
<td>81.3% (Vitality)</td>
</tr>
<tr>
<td>Song 4 Peacefulness</td>
<td>37.5%</td>
<td>95.8 (Sublimity)</td>
</tr>
<tr>
<td>Song 5 Dreaminess</td>
<td>16.0</td>
<td>80.0% (Sublimity)</td>
</tr>
<tr>
<td>Song 6 Restlessness</td>
<td>16.7%</td>
<td>26.7% (Unease)</td>
</tr>
<tr>
<td>Song 7 Tenderness</td>
<td>27.3%</td>
<td>66.7% (Sublimity)</td>
</tr>
<tr>
<td>Song 8 Sadness</td>
<td>50.0%</td>
<td>54.5% (Unease)</td>
</tr>
</tbody>
</table>
These findings may indicate that subjects find it harder to choose specific terms when there are subtle differences in the language nuance of the emotional terms. In choosing the emotional terms for this study, the researcher attempted to find a balance between Hevner’s 65 adjective categorical model (Hevner, 1935) and the simplified model of “happy/sad” used by Peretz (Peretz et al, 1998). The researcher felt that the terms in the GEMS dimensional model (Zentner, 2008) are less arbitrary than those in the Hevner study, but gave more information than the “happy/sad” model. Based on present results, however, it appears that subjects in this study found some of the terms to be somewhat arbitrary.

Discussion of Research Question Two

The second research question investigated whether the baseline condition would be the strongest indicator of correct identification of emotional term. If the baseline condition (all elements present) was the strongest condition for influencing correct identification, one would expect the percentage of correct responses to decrease when manipulations occurred (specific musical elements removed). However, correct identification actually increased with some manipulations (removal of certain musical elements).

The researcher examined the valid percent of correct identifications in the baseline condition (songs 1 – 8, condition 1). The remaining 32 musical segments where manipulation of some kind occurred were then examined (songs 1 – 8, conditions 2 – 5). Correct identification increased 20 times out of 32 manipulations (63%) from the baseline condition. Correct identification stayed the same as the baseline condition for 1 time out
of 32 manipulations (.03%). Correct identification decreased from the baseline condition 11 times out of 32 manipulations (34%). When the musical segments were manipulated by removing one of the four targeted musical elements, correct identification of emotional terms actually increased across all songs for 63% of manipulations. This may indicate that the presence of all the targeted elements (expressive elements, rhythmic variation, harmony, and melodic line) may mask or interfere with the identification of the intended emotion. Listeners may find it easier to recognize an intended emotion when the musical texture is simplified. There were two songs for which condition one (baseline) was the strongest indicator of correct identification. One was the song intended to convey peacefulness, and the other was the song intended to convey sadness. In each of these songs, the percentage of subjects who identified the emotional term correctly decreased in 3 out of the 4 manipulations. This may suggest that the emotions of peacefulness and sadness are more dependent on the interaction of all the musical elements for proper identification than are the other emotional terms in this study.

The fact that the baseline condition was not necessarily the strongest condition for percentage of correct responses serves to confirm that manipulation of individual musical elements actually did have an effect on the communication of an intended emotion.

Discussion of Research Question Three

The third research question investigated which of the four targeted elements had the strongest influence on identification of correct emotional term, and whether certain musical elements are correlated more strongly than others in influencing a particular emotion. Results will be discussed for findings of conditions across all songs.
As stated previously, if correct responses increased with the removal of a musical element, then we assume that that musical element was not effective in providing the musical cues to influence correct responses or it may have actually impeded (negatively influenced) correct responses. Conversely, if correct responses decreased with the removal of a musical element, it is likely that that musical element was a positive influence for choosing the correct emotional term, as the subjects found it more difficult to choose the correct term when that musical element was no longer detected. (See Table 7)

<table>
<thead>
<tr>
<th>Song/Intended Emotion</th>
<th>Condition 1 Baseline</th>
<th>Condition 2 Expressivity removed</th>
<th>Condition 3 Rhythmic Variation removed</th>
<th>Condition 4 Harmony removed</th>
<th>Condition 5 Melodic Line removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excitement/Activation</td>
<td>65.7%</td>
<td>89.3%</td>
<td>40.0%</td>
<td>52.4%</td>
<td>70.8%</td>
</tr>
<tr>
<td>Tension/Distress</td>
<td>62.1%</td>
<td>62.5%</td>
<td>83.3%</td>
<td>52.9%</td>
<td>72.7%</td>
</tr>
<tr>
<td>Happiness/Joy</td>
<td>56.3%</td>
<td>69.6%</td>
<td>43.5%</td>
<td>60.0%</td>
<td>68.8%</td>
</tr>
<tr>
<td>Peacefulness/Calmness</td>
<td>37.5%</td>
<td>24.0%</td>
<td>29.47%</td>
<td>38.1%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Dreamy/Meditative</td>
<td>16.0%</td>
<td>25.0%</td>
<td>20.0%</td>
<td>16.7%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Restlessness</td>
<td>16.7%</td>
<td>25.0%</td>
<td>29.0%</td>
<td>17.4%</td>
<td>40.0%</td>
</tr>
<tr>
<td>Longing/Tenderness</td>
<td>27.3%</td>
<td>34.6%</td>
<td>24.0%</td>
<td>40.9%</td>
<td>29.2%</td>
</tr>
<tr>
<td>Sadness</td>
<td>50.0%</td>
<td>43.3%</td>
<td>38.5%</td>
<td>50.0%</td>
<td>20.8%</td>
</tr>
</tbody>
</table>
Condition Two Removal of Expressivity

In Song 1, (“Excitement/Activation), expressivity was found to have a small negative effect for influencing excitement (.241). When expressive elements were removed, correct responses increased to 89.3%. This may be because the pedal, phrasing and dynamics obscured the regular driving rhythm that is characteristic of this piece, which have been found to help cue positive moods such as excitement (Hevner 1935; Rigg 1964).

When expressive elements were removed from Song 2 (“Tension”/Distress”), correct responses stayed essentially the same (valid % increased by .4%, effect size value .065), therefore; expressivity was not a factor for providing cues for the emotion of tension.

The removal of expressivity from Song 3 (“Happiness/Joy”) caused correct responses to increase by a small amount (Cramer’s V .289). Therefore, expressivity seemed to interfere with subjects’ ability to recognize the intended emotion to a small degree.

Removal of expressivity from Song 4 (“Peacefulness/Calmness”) had very little effect (.050, Cramer’s V) on the listeners’ ability to choose the correct intended emotion. In this study, expressivity appears to not be a strong influence for communicating the emotion of peacefulness/calmness.

Correct identification of the emotional category was not affected by the removal of expressive elements in Song 5 (“Dreaminess/Meditative”) to any notable degree, suggesting that listeners may not have been getting their musical cues from the expressivity.
When expressivity was removed from Song 6 (“Restlessness”), correct responses increased by 8.3%, which was a medium effect size value (.375). This indicates that expressivity interfered with the subjects’ ability to choose the correct emotional term of restlessness, as subjects found it easier to correctly choose “restlessness” without expressive elements in the excerpt.

Correct responses increased to a small degree (.149 Cramer’s V) when expressivity was removed in Song 7 (“Longing/Tenderness”). This indicates that the subjects found it easier to identify the correct “longing/tenderness” term without expressivity.

In this study, expressivity was not a factor in helping listeners correctly identify the emotional term “sadness” (Song 8). The effect size value was .056, which a weak effect. The listeners were clearly receiving the musical cues of “sadness” from a musical element other than expressivity.

Summary of Condition Two
Expressive elements were removed to find whether these elements were or were not helpful in influencing correct identification of intended emotional term. When the expressive elements were removed in all of the songs, correct identification increased for 6 out of 8 songs. Subjects generally found it easier to correctly identify the intended emotion without the element of expressivity. Therefore, there was a tendency in this study showing that expressive elements were not helpful in correct identification for excitement, happiness, tension, dreaminess, restlessness, and tenderness. Findings in this study indicate that expressive elements may particularly interfere with identification of
excitement, happiness, and restlessness, as correct identification of these emotions increased with the removal of expressive elements. The strongest result in this condition was a medium effect for expressivity in music on the intended emotion of restlessness (.375).

Condition Three Removal of Rhythmic Variation

Rhythm appears to have a notable effect for the communication of excitement. When rhythmic variation was removed from Song 1 ("Excitement"), correct identification decreased to 40%. This is a medium effect (.442) in the Cramer's V test. The researcher suggests that the regular, driving, repetitive rhythm in this piece was most influential in providing cues for the emotion of excitement.

Correct responses increased by 21.2% when rhythmic variation was removed from Song 2 ("Tension/Distress"), indicating that the rhythm patterns of this piece actually may have hindered the identification of "tension". The researcher suggests that when the rhythm was played as unvarying quarter notes, the subjects were better able to attend to the cues for harmony and melody. Therefore, rhythmic variation was not a strong factor in communicating the emotion of tension.

When rhythmic variation was removed from Song 3, ("Happiness/Joy"), correct responses decreased by 12.8%. The Cramer’s V effect size value showed this to be a small effect (.120). This indicates that rhythm is helpful in providing musical cues for the emotion of happiness. The strongest condition for influencing correct selection of "happiness" was rhythmic variation. This is in concurrence with previous studies showing rhythm to be a strong influence in positive emotions (Hevner, 1935; Rigg, 1945).
Although tempo was not one of the targeted elements of this study, there is ample evidence in the literature that fast tempos are a strong indicator for positive emotions. As the tempo for this piece was relatively fast, this most likely combined with the rhythmic variation to account for correct responses of “happiness”.

When rhythmic variation was removed from Song 4 (“Peacefulness/Calmness”), correct responses decreased by 8%. The effect size value for this condition was .244, a small effect. This indicates that rhythmic variation had a small effect on helping the subjects choose the correct response. This may be because the rhythm in this piece is rather unvarying and un-syncopated, and both the tempo and harmonic rhythm are relatively slow. Therefore in this song, there is not much difference between the baseline presentation of the song and the presentation in condition three.

For Song 5 (“Dreaminess/Contemplative”), there was a medium effect (.375 Cramer’s V) on the subjects’ ability to choose the correct emotional term under condition three. Subject responses increased with the removal of rhythmic variation, indicating that rhythm interfered with their ability to correctly identify the “dreaminess/contemplative” emotion. Subjects appeared to find it easier to attend to the emotional cues being provided by the harmony and melody when rhythm was removed. However, manipulating the rhythm to unvarying quarter notes caused an interesting tendency in wrong responses. When rhythmic variation was removed, 32% of the subjects chose “restlessness”, rather than “dreaminess/contemplative”. The researcher suggests that the slow rhythmic changes, the long extended notes, and the slow tempo of this peace provided cues that pointed the subjects to emotional terms in the broad category of Sublimity, but when the piece was presented in all quarter notes, it had the effect of
speeding up the tempo and the harmonic rhythm, thus pointing the listeners to choose an emotional term in the broad category of Unease. This concurs with other studies that have found that slow tempo and regular rhythms tend to elicit a low arousal state such as “dreaminess” or “peacefulness”, and faster, irregular tempos tend to elicit a higher arousal state (Hevner; 193, Hanser & Thompson; 1994, Hanser, 1996).

Correct responses increased by 12.3% with the removal of rhythmic variation for Song 6 (“Restlessness”). This was a medium effect (.411 Cramer’s V). This indicates that, to a medium degree, rhythm interfered with the subjects’ ability to correctly identify the emotional term of restlessness.

When rhythmic variation was removed from Song 7 (“Longing/Tenderness”), correct responses decreased to a small degree (.284 Cramer’s V). This means that rhythm was a factor in helping the subjects correctly identify the emotion of “longing/tenderness”. This particular song is relatively slow and has no syncopation, so at first glance one would wonder why rhythm would influence the listeners to choose the correct emotion, even to a small degree. The researcher suggests that it is the soothing, predictable, sequential rhythmic patterns in this piece which helped the subjects to choose “longing/tenderness”. When those patterns were removed, it was less easy for the subjects to choose correctly.

Rhythm appeared to have a strong effect in influencing the listeners’ ability to choose the correct emotional term of sadnness (Song 8). When rhythmic variation was removed, correct responses decreased to a large degree (.523 Cramer’s V), thus indicating that the rhythm was a strong factor in influencing correct responses. The
researcher suggests that, as in Song 7, the slow tempo, and the predictable, sequential rhythmic patterns in Song 8 were evocative of "sadness" to the listeners.

Summary of Condition Three

When rhythmic variation was removed, correct responses decreased for 5 out of 8 songs. This indicates that rhythmic variation has a tendency to help the listener identify the intended emotion. Correct identification of the "excitement" song decreased by 25.7% under this condition, which is a medium effect (.442 Cramer's V). Rhythm had a medium effect for influencing correct recognition of the "happiness" song. These two findings suggest that rhythm has an association with the communication of excitement and happiness in music, both of which fall under the broad category of Vitality. This correlates to previous studies that have found that regular, repetitive, smooth-flowing rhythms have been associated with positive moods, while irregular rhythms have been associated with negative moods (Hevner, 1935; Rigg, 1964). This would seem to confirm that when rhythm patterns are removed, identification of positive moods becomes more difficult.

In addition to having a positive effect on influencing recognition of "excitement" and "happiness", rhythm was also found to have a small positive effect on "peacefulness" (.244) and a small positive effect for "longing/tenderness" (.284). In this study, the largest effect of removal of rhythmic variation was a positive effect for influencing recognition of "sadness" (.523). Although this is somewhat surprising, as sadness has traditionally been more associated with harmonic mode than with rhythm, the researcher
suggests that the slow tempo, and the predictable, sequential rhythmic patterns in Song 4, Song 7, and Song 8 were helpful in the communication of “peacefulness”, “longing/tenderness”, and “sadness”. This correlates with the findings of Narmour and Meyer regarding expectancies in music (Meyer, 1956, Narmour, 1991).

Condition 4 Removal of Harmony

Harmony appeared to have relatively no influence in providing cues for excitement (.025 Cramer’s V). Although this song (Song 1) was in a major mode, the listeners were apparently able to perceive the major tonality of the piece without the harmony. The researcher suggests that most likely they were able to perceive the major modality from the melody.

There was a medium effect (.316) found for harmony in Song 2 (“Tension/Distress”). When harmony was removed, the subjects found it more difficult to identify the correct emotional term. The harmonic mode in this piece is minor, and the chords and melodic intervals are heavily laced with those that are considered dissonant (tritones, minor seconds, major sevenths) (Costa et al., 2004). The researcher concludes that in because of the dissonance built into the harmony of this piece, harmony had a notable influence in determining correct responses for “tension”.

Harmony had relatively no effect for influencing the correct response of “happiness/joy” (Song 3). This is somewhat surprising due to the many findings in literature that associate major modality with happiness (Hevner, 1935; Rigg, 1964; Gerardi and Gerkin, 1995; Della Bella et al., 2000). The researcher suggests that the listeners were able to detect the major modality of the piece from the melody. This combined with the rhythmic features of the song were enough to provide sufficient
musical cues to influence the listeners’ correct responses, and that the harmony was superfluous in this piece.

A medium effect for harmony (.493 Cramer’s V) was found for Song 4, (“Peacefulness/Calmness”). This would indicate that the major mode and consonant harmonies contributed to correct identification of the intended peaceful emotion. The harmonic mode is major, with relatively simple (triadic) chords, as opposed to more complex color chords.

Removal of harmony in Song 5 (“Dreaminess/Meditative”) was shown to have a small effect (.235) on the listeners’ ability to choose the correct emotional term. This is likely due to the alteration of major and minor modes in this particular song. Although the effect was small with the removal of harmony on the percentage of correct responses, it is noteworthy that the removal of harmony seemed to confuse the listeners, as their responses were spread out over all of the choices when the harmony was removed. This indicates that harmony helped them to hone in on the “dreaminess/meditative” choice.

Removal of harmony had a small effect (.169) on correct responses for Song 6 (“Restlessness”). Correct responses increased to a small degree, thereby indicating that harmony may have interfered with the listeners’ ability to choose the correct emotional term.

Removal of harmony had a medium effect (.423) on the subjects’ ability to choose the correct term of “longing/tenderness” (Song 7). When harmony was removed, correct responses increased, thereby indicating that harmony was interfering with other musical elements that may have been giving the cues for “longing/tenderness”, such as melodic line and rhythm. This song utilizes both major and minor chords in the harmony,
therefore the harmony may have been confusing to the listeners. The researcher suggests that with the removal of harmony, the subjects could better focus on the melody, which was intended to be evocative of longing/tenderness.

Harmony was found to have a small effect (.169) on influencing correct responses for Song 8 (“Sadness”). Correct responses decreased when harmony was removed, which indicates that harmony was in fact having an effect in providing musical cues for the emotional term of “sadness”. The harmony in Song 8 is in minor mode.

Summary of Condition Four

The two songs for which the presence of harmony in the song influenced the listeners to choose the correct response were for Song 2 (“distress/tension”) and Song 8 (“sadness”).

Condition Five Removal of Melodic Line

The melodic line was not helpful in Song 1 (“Excitement/Activation”) for giving cues of excitement, as there was virtually no effect on correct responses (.020) when the melodic line was removed.

Removal of melodic line in Song 2 (“Distress/Tension”) increased correct responses to a large degree, (.50), which indicates that the melodic line by itself was not helpful (in fact, may have hindered) the ability to identify “tension”. The researcher suggests that the harmonies and rhythm are the musical elements that help listeners identify “tension/distress”, rather than the melodic line.
When the melodic line was removed from Song 3, subjects were better able to identify “happiness/joy” to a small degree (.156). This indicates that the melodic line was not providing the musical cues that helped in correct identification of happiness. This is likely due to the fact that the listeners were instead finding the musical cues for happiness from the harmony and the rhythmic features.

When the melodic line was removed from Song 4 (“Peacefulness/Calmness”), correct identification decreased by 10.2%. This shows that the subjects found it easier to identify the song as “peaceful” when the melody was heard. The melody in this song is sequential, and the contour is basically stepwise, with very few intervallic leaps. A narrow pitch range, with the pitches in melodies in close proximity, fulfills the listener’s expectations, and has been shown to produce positive emotions with a low arousal (Cuddy & Lunney, 1995; Narmour, 1990; Schellenberg, 1996).

Removal of the melodic line in Song 5 (“Dreaminess/Meditative”) increased correct responses by 17%, which may suggest that the melody obscured the musical cues for the correct choice. This was a medium effect (.482 Cramer’s V). The melody may have been the musical element influencing the listeners toward choosing the “longing/tenderness” most often for this song. The melody in this song fluctuates between a major and minor mode, generally moves stepwise, and employs frequent use of major seconds, minor seconds, and perfect fourths.

When the melodic line was removed from Song 6 (“Restlessness”), correct identification of the emotional term increased by 23.3%. The Cramer’s V test value was a small effect (.141). This suggests that the melody line may have been giving false cues for other (incorrect) emotional terms. When melodic line was removed, the listeners
were better able to hear the “restlessness” of the rhythmic features. The rhythm in this song is somewhat irregular and mimics the feel of a Latin dance. However, the melody strongly outlines the minor modality and employs primarily stepwise movement, therefore providing cues that apparently distracted from the intended emotion of restlessness.

There was virtually no effect (.071) on correct responses when melodic line was removed from Song 7 (“Longing/Tenderness”), indicating that melody was not a strong influence either way in this song.

Melody was a notable influence in the correct choice of “Sadness” (Song 8). The correct responses dropped by 29.2% when the melodic line was removed. This is a medium effect (.311 Cramer’s V). This would indicate that in this song, melody strongly influenced the correct choice of “sadness”, as subjects were much less able to choose the correct emotion when the melody was removed. The melodic line in this piece is essentially descending in nature, and strongly outlines the minor mode. Minor seconds, major seconds, and minor thirds are the most frequently used melodic intervals. These intervals have been shown to be perceived as “unsatisfied and sad” (Oelman & Laeng, 2008). There are occasional unexpected leaps that expand the pitches into a wider range. Musical passages with a wider melodic pitch range are associated with negative emotions (Cuddy & Lunney, 1995: Krumhansl, 1995; Narmour, 1990, 1991; Schellenberg, 1996).

Summary of Condition 5

The songs for which melodic line influenced the subjects to make correct responses were “peacefulness” and “sadness”. “Sadness” was a particularly strong
finding, as correct identification decreased by 29.2% when the melodic line was removed. This was a medium effect (.311). Therefore, in this study, the melodic line in the “sadness” song was more effective than the harmony in communicating sadness.

Conclusions

When specific music elements are removed from the presentation of a piece of music, it has an effect on the listener’s ability to determine the intended emotion of the music. In this study, when one of the four targeted musical elements (expressivity, rhythm, harmony, melodic line) were removed, correct selection of the intended emotion either decreased or increased. When correct responses increased when a particular element was removed, we conclude that that particular element was not helpful, or may have even hindered the listeners’ ability to choose the correct emotional term. Conversely, when correct responses decreased when a particular element was removed, we conclude that that particular musical element was effective in influencing the listeners’ ability to choose the correct emotional term, as it was more difficult for the subjects to make the correct response without the benefit of that musical element.

In this study, rhythm was the musical element most often found to influence in the selection of the correct emotional term. Rhythm was found to be effective in providing musical cues for the intended emotions for five out of eight songs, including “excitement/activation”, “happiness/joy”, “peacefulness/calmness”, “longing/tenderness”, and “sadness”.

Harmony was found to have a notable effect on the selection of the correct emotional term for two out of eight songs, including “tension/distress” and “sadness”.

54
Melodic line had the effect of influencing subjects to choose the correct emotional term for the song of "sadness".

In looking at each of the eight songs/intended emotional terms, we can see which musical element was most effective in positively influencing the correct responses (See Table 8)

Table 8 Most Effective Musical Element per Song/Intended Emotion

<table>
<thead>
<tr>
<th>Song/Intended Emotion</th>
<th>Most Effective Musical Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Song 1, Excitement/Activation</td>
<td>Rhythm</td>
</tr>
<tr>
<td>Song 2, Tension/Distress</td>
<td>Harmony</td>
</tr>
<tr>
<td>Song 3, Happiness/Joy</td>
<td>Rhythm</td>
</tr>
<tr>
<td>Song 4, Peacefulness/Calmness</td>
<td>Rhythm</td>
</tr>
<tr>
<td>Song 5, Dreamy/Contemplative</td>
<td>No clear effect</td>
</tr>
<tr>
<td>Song 6, Restlessness</td>
<td>Rhythm</td>
</tr>
<tr>
<td>Song 7, Longing/Tenderness</td>
<td>No clear effect</td>
</tr>
<tr>
<td>Song 8, Sadness</td>
<td>Melody</td>
</tr>
</tbody>
</table>

Limitations/Suggestions for Further Study

One limitation of this study would be the relatively low number of subjects, which in part contributed to insufficient number of responses in some of the data cells. Some of the missing values in some of the cells were most likely to have occurred because subjects did either not “save” their responses on the website survey after every choice, as instructed, or because they did not complete the survey, therefore
there were insufficient responses for some of the cells. Another limitation could be the method in which the variables were manipulated. That is, the researcher removed the various musical elements by altering the performance of each condition. Computerized, digital removal of harmony, melodic line, expressivity, or rhythmic variation may have been preferred for more controlled results.

The researcher suggests that further study of this nature limit the variables to focus on perhaps one or two musical elements, rather than four musical elements. It is also suggested that the number of songs/intended emotions be limited to three or four basic emotions, rather than eight songs/emotional terms. The researcher suggests that the subtlety of emotional terms was found to be arbitrary by many of the subjects, therefore more concrete and basic emotional terms would be preferred.
REFERENCES


59


APPENDIX A
RECRUITMENT FLYER
Volunteers Wanted!

I am a Western Michigan University candidate for Master of Music degree in music therapy. I am asking for volunteers to participate in an experiment being conducted this summer. Volunteer Subjects in this study will be asked to commit to one session of approximately one to one and one-half ($1 \frac{1}{2}$) hour(s) in length. The session will consist of listening to several short segments of pre-recorded music on a laptop computer, using ear-buds. Subjects will then answer two or three questions about each musical segment. Answers will be indicated by using a computer mouse to click on the appropriate box on the computer screen. This study will investigate how music communicates emotion.

The study will be conducted in the computer lab at Heritage Christian Academy, 6312 Quail Run Drive, Kalamazoo, Michigan, 49009. If you are willing and able to participate in this study, please check the sign-up sheet and sign your name next to the date and time that is most convenient for you. Please remember to include your name and contact information.

Thank you very much for your help in participating in this study. If you have any questions, please feel free to contact me.

Marilyn Moore  
(269) 680-7727  
Marilyn.m.moore@wmich.edu

Edward Roth  
1903 W. Michigan Ave.  
School of Music  
Western Michigan University  
Kalamazoo, Michigan 49008-
APPENDIX B

INFORMED CONSENT
Western Michigan University
Music Therapy

Principal Investigator: Edward Roth
Student Investigator: Marilyn Moore
Title of Study: Musical Elements Associated with Perceived Emotions

You have been invited to participate in a research project titled "Musical Elements Associated with Perceived Emotions." This project will serve as the student investigator’s thesis for the requirements of the Masters degree in Music Therapy. This consent document will explain the purpose of this research project and will go over all of the time commitments, the procedures used in the study, and the risks and benefits of participating in this research project. Please read this consent form carefully and completely and please ask any questions if you need more clarification.

What are we trying to find out in this study?
The purpose of the study is to investigate how emotions are communicated through music. We hope to determine if the primary emotion that the composer intended to convey can be consistently identified by listeners. We will also investigate which element of music (melody, rhythm, harmony, and expression) communicates emotion most effectively.

Who can participate in this study?
Participants in this study will be any male or female adult, ages 18 – 99. In order to be eligible to participate in this study, participants must not have a diagnosis of psychosis, or a neuro/psychiatric event. Volunteers who have this diagnosis are asked to not participate in this study.

Where will this study take place?
This study will be conducted in the computer lab at Heritage Christian Academy, 6312 Quail Run Drive, Kalamazoo, Michigan.

What is the time commitment for participating in this study?
The time commitment for participating in this study is approximately 1 – 1.5 hours. Volunteers will sign up for a date and time convenient for them.

What will you be asked to do if you choose to participate in this study?
Volunteers will be asked to listen to 40 short (45 – 60 second) musical segments. Musical selections will be played on a laptop computer. Volunteers will then be asked to use the mouse to answer two questions per each listening example. For the first question, you will be instructed to click on the emotional category that you feel the composer was intending to communicate. In the second question, you will be asked to indicate the degree (on a scale of 1 – 6) to which you think the musical segment effectively communicates an emotion.
What information is being measured during the study?
This section will describe the measurements that we are going to take during your participation in the study. We will be recording the answers that were indicated on the software program. We will study the data to determine the percentage of subjects who were able to determine the emotion that the composer was intending to communicate. We will also look at the emotional categories that were selected which did not match the intended emotion. Finally, we will look at the data from the degree of effectiveness scale, to investigate which musical element (melody, harmony, rhythm, expression) is most effective at communicating emotion.

What are the risks of participating in this study and how will these risks be minimized?
There are no known risks associated with participating in this study.

What are the benefits of participating in this study?
There is no direct benefit to the participants in this study.

Are there any costs associated with participating in this study?
Other than time, there are no costs associated with participating in this study.

Is there any compensation for participating in this study?
There is no compensation for participating in this study.

Who will have access to the information collected during this study?
The principal investigator and the student investigator will have access to the information collected in this study. Privacy of participants will be protected, as no names will be published in connection with this study. Data from this study will be kept in a locked file in the principal investigator’s Western Michigan University office, for a period of four years.

What if you want to stop participating in this study?
You can choose to stop participating in the study at anytime for any reason. You will not suffer any prejudice or penalty by your decision to stop your participation. You will experience NO consequences either academically or personally if you choose to withdraw from this study.

The investigator can also decide to stop your participation in the study without your consent.

Should you have any questions prior to or during the study, you can contact the primary investigator, Edward Roth, at edward.roth@wmich.edu. You may also contact the Chair, Human Subjects Institutional Review Board at 269-387-8293 or the Vice President for Research at 269-387-8298 if questions arise during the course of the study.
This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate in this study if the stamped date is older than one year.

I have read this informed consent document. The risks and benefits have been explained to me. I agree to take part in this study.

Please Print Your Name

Participant's signature  Date
APPENDIX C

SUBJECT QUESTIONNAIRE
Subject Questionnaire

First Name: __________________________

Age: ___________________ Gender: ______________________

Please indicate the best description of your musical background.

____ I have had no formal music training.

____ I have only been exposed to general music in school.

____ I studied music with a private teacher. If so, what instrument(s)?

I have participated in the following ensembles: (band, orchestra, choir, other, none)

I have a degree in music. ____ Yes ____ No

Use the scales below to answer the following questions:

I enjoy music.

\[
\begin{array}{cccccc}
\text{Not at all} & 1 & 2 & 3 & 4 & 5 & 6 \\
\text{Very Much}
\end{array}
\]

In my experience, music can communicate identifiable emotions.

\[
\begin{array}{cccccc}
\text{Not at all} & 1 & 2 & 3 & 4 & 5 & 6 \\
\text{Very Much}
\end{array}
\]

My musical-style preferences include:
APPENDIX D

WEBSITE INSTRUCTION SCRIPT
Marilyn Moore Thesis Survey – Website Instructions

Step One: Read and sign the consent form.
Step Two: Complete the Subject Questionaire. Return both forms to the investigator.
Step Three: Read the description of the survey and the instructions.
Step Four: Access the survey on line. The site is at:
http://homepages.wmich.edu/~m4moore3/
Step Five: At the bottom of the first page, select the Order number you have been assigned.

Order # ______________

Step Six: Click on “Yes” if you have signed the consent form. Click “Save” and proceed.

The procedure for pages 2 – 41 will be as follows:
1. Click where it says “click here to play music”.
2. Click on “open”, to open the music file.
3. Listen to the clip of music
4. Answer the first question by clicking next to the category that describes the emotion you think the composer is intending to communicate.
5. Answer the second question by clicking underneath the number that indicates the degree to which you think the emotion was effectively communicated.
6. If you have any comments, type them in the box provided.
7. Click on “save”. **YOU MUST SAVE AFTER EVERY SONG SEGMENT!**
8. Click on “next”, and repeat the same steps, until all 41 pages have been completed.

*Please remember, your answers do not necessarily indicate any experienced (felt) emotion, but only which emotion you think the music is trying to communicate, and how effectively each excerpt communicates that emotion. Please be careful not to “rate” the music based on whether you enjoyed a particular excerpt. This study is not investigating musical preferences, but rather if an intended emotion can be identified consistently in music, and how effective the various elements of music communicate that intended emotion.*

Thank you for volunteering for this study. Your participation is greatly appreciated. Please let me know when you have completed this on line survey. You may contact me at mmoore@hceaegles.org, or at 269 447-3297.

Marilyn Moore
APPENDIX E

ORIGINAL SONGS
Song 3 (Happiness/Joy) Condition 1

Song 3 (Happiness/Joy) Condition 2

Marilyn M. Moore
Song 3 (Happiness/Joy) Condition 5

Marilyn M. Moore

Song 4 (Peacefulness/Calmness) Condition 1

Marilyn M. Moore
APPENDIX F

RESEARCH PROTOCOL APPROVAL
Date: July 31, 2012

To: Edward Roth, Principal Investigator
   Marilyn Moore, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 12-06-21

This letter will serve as confirmation that your research project titled "Musical Elements Associated with Perceived Emotions" has been approved under the expedited category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may only be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., you must request a post approval change to enroll subjects beyond the number stated in your application under "Number of subjects you want to complete the study"). Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: July 31, 2013