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Communication of Emotion in Music

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Author Note

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Abstract

The communication of emotion in music has been shown to be dependent on musical structure and emotional prompting with lyrical messages. This study seeks a new approach to researching the communication of emotion in music by creating musical samples that are based upon the sound wave frequency parameters of emotive speaking. An electronic survey containing six different emotive musical samples was conducted to gather listener interpretations of the intended emotional quality. Further research is needed to properly distinguish the parameters of emotive frequencies in order to provide for exposure of the functionalities of this phenomenon.

Acknowledgements and thanks to: Dr. Steve Reagles, Prof. Adrian Lo, Dr. Daniel Cronn-Mills, Dr. John Lindberg, Dr. Kristen Cvancara, Prof. James Dimock, my family, Soli Deo gloria.

“If you want to find the secrets of the universe, think in terms of energy, frequency and vibration.”

— Nikola Tesla

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Preface

This study seeks to find a means to measure the communication of emotion in music to a listener by creating a musical communication measuring tool using samples of music based upon the sound wave frequency of vocalized emotional speech. Using samples of music coded to contain musical structures that are confined to emotional wave frequency parameters the listener indicates their interpretation of the intended emotional quality.

The results will help music therapists use what Timmers and Ashley (2007) called "purposively created music" (p. 119) to enhance patient treatment. This study seeks to contribute and also advance research involving emotion and music. Applying the concept to other studies may enable researchers to bridge their questions between the disciplines by having a new window to perceive the role of music in the hard-wiring of the brain.

Fundamentally, we will gain an insight into human nature. Music is an omnipresent factor in modern society and awareness of the connections humans have with music also teach us about our social environment. Questions relating to human neurological functioning will be aided by having another confirmation of the frequencies of emotion and confirmation that music can be written to purposively aide our emotions. Finally, a new understanding of the nature of harmony will be brought to light.

Chapter 1: Introduction

The main concepts to be explained in this study are what Timmers and Ashley (2007) called "Purposively created emotional music" (p. 119) and the discussion of what cues give the brain the signal of emotional affect as discussed by Klaus R. Scherer in numerous studies (Scherer 1986; Scherer 2003; Scherer & Oshinsky, 1977; Scherer & Zentner, 2001).

The standpoint of the investigator is that of a curious observer who wanted to explore the communication of emotion in music. This investigator believes that musical notes written to mimic the frequency of emotional speech will be interpreted by the listener as having emotional quality. This investigator also believes that the concept of music as an inducer of emotions is exaggerated. Rather, the frequencies that musical statements reside in harmonize with our learned thought patterns, and blend with the flurry of sensation in the brain to cause an emotional feeling. Musical notes individually contain frequency values which can be used as a control mechanism for studying the effects of music upon the listener.

This study seeks the question:

R1: To what degree does purposively created emotional music communicate emotion?

1.1 Communicating Emotional Quality

Communication research on the topic of music and communication is scattered, with previous studies addressing music as a form of rhetoric. In these studies, music is separated into categories of music and lyrics, and viewed to contain persuasive devices, where the lyrical message is primary focus (Rodnitzky, 1969; Sellnow, 1999; Sellnow & Sellnow, 2001; Calhoun, 2005).

If music is to be considered a distinct class of human communication, however, which has a communicative and rhetorical dimensions distinct from other discursive forms, it is

essential to consider the musical structure in and of itself apart from the verbal dimensions of music. Among the problems confronting researchers is that musical composition carries an effect that a listener can indicate but may yield biased results from musical preference. Traditional music theory pays no mind to the frequency values of the notes that are played opting rather for structural variances, referred to as acoustical cues, and popular or random musical choices in previous studies would produce loose results due to the listener filtering the music through their own cultural expectations (Meyer, 1956, p. 262).

In communication research, paralanguage is the classification of sound utterances that accompany human communication. Trager (1961) contributed a typology toward furthering new directions of research within communication studies.

Two main categories of paralanguage according to Trager (1961) are voice qualities and vocalizations. Voice qualities involve, "pitch range, pitch control, rhythm control, tempo, and other phenomena," presenting the category of phenomena under investigation (p. 18).

Pitch height is treated as a separate category from using pitch to add emphasis on a spoken sentence. With examples of tonal languages, Trager (1961) suggested pitch height will be a factor of the paralanguage of a spoken voice, and in further research, "the phenomena of pitch height will presumably interact with those of pitch range" (p. 19)"

Sifting through data involved in the communication of emotion in the voice, combined with research in music and emotion studies, and effects on the brain from listening to music, questions can be answered with the amount of data present. Fundamental to the investigation has been Scherer (2003) and other researcher's work into the emotional speaking voice.

In a pioneering study, Scherer and Oshinsky (1977) conducted a study to test the validity of a previous study which provided, "a first indication of the nature of cue utilization in cognitive

inferences of emotion from auditory cues" (p. 332). Their study sought to test acoustic cue utilization using classical musical pieces which were played by a music synthesizer and independently coded for "subjective ratings of emotional expressiveness" (p.333).

The results of this study presented an ability to expand on the research of acoustical cues to signal emotive quality in auditory information. Scherer and Oshinsky (1977) detailed a "curvilinear relationship" that may exist between "acoustic parameters and the kind and degree of emotion inferred" (p. 342).

Also, Scherer and Oshinsky (1977) justified their use of music as a parameter to study emotional inference based on acoustical cues by stating, "All of the acoustic cues that were manipulated in this study are major vocal cues. The amplitude, pitch, and duration parameters are directly comparable to similar acoustic parameters of speech" (p. 342).

Such justification is a precursor for the present study, but in a different direction. Acoustical cue research in music is plentiful.

As Scherer and Oshinsky (1977) continued, "It may thus not be unduly optimistic to assume that similar results will be found in studies using stimuli that more closely approximate real speech" (p. 342). At the time, Scherer and Oshinsky were unsure of the actual mechanism being used to interpret the auditory information as speech or music, but they note, "the general agreement as to the effects of these cues across contexts suggests that a mechanism common to both speech and music perception is at work" (p. 343). Figure 1 shows the collection of the acoustic parameters and the emotions that were associated with them from this study.

Figure 1. Emotional attributions significantly associated with acoustic parameters

Acoustic parameters of tone sequences	Direction of effect	Emotion rating scales listed in decreasing order of associative strength
Amplitude variation	Small	Happiness, pleasantness, activity
	Large	Fear
Pitch variation	Small	Disgust, anger, fear, boredom
	Large	Happiness, pleasantness, activity, surprise
Pitch contour	Down	Boredom, pleasantness, sadness
	Up	Fear, surprise, anger, potency
Pitch level	Low	Boredom, pleasantness, sadness
	High	Surprise, potency, anger, fear, activity
Tempo	Slow	Sadness, boredom, disgust
	Fast	Activity, surprise, happiness, pleasantness potency, fear, anger
Envelope	Round	Disgust, sadness, fear, boredom potency
	Sharp	Pleasantness, happiness, surprise, activity
Filtration cutoff	Intermediate (few)	Pleasantness, boredom, happiness, sadness
level (number of harmonics)	High (many)	Potency, anger, disgust, fear, activity, surprise

Figure 1. Emotional attributions significantly associate with acoustic parameters and the verbal descriptions of the reflected emotional value. (Scherer and Oshinsky, 1977, p. 339).

At the time, Scherer and Oshinsky (1977) were unsure of the actual mechanism was being used to interpret the auditory information as speech or music, but they note, "the general agreement as to the effects of these cues across contexts suggests that a mechanism common to both speech and music perception is at work (p. 343)."

Scherer presented research in the fundamental frequency concept, F0 (F zero) to quantify the sound frequency patterns of the emotional voice (Scherer, 1986; Banse and Scherer, 1996; Scherer, 2003). Results did show the human voice follows parameters of wave frequency to indicate emotional value in their speech. Scherer (2003) explained how this applies to the creation of sound in the human voice, "without such distinguishable acoustic patterns for different emotions, the nature of the underlying speaker state could not be communicated

reliably" (p. 231). Studies found listeners could indeed interpret emotional values in utterances when they followed the appropriate acoustic pattern, and the pattern is determined by frequency (Paeschke, Kienast, & Sendlmeier, 1999). Scherer (1995) refined this concept as a basis by explaining that the vocal utterances of our primal urges became organized to contain emotional meaning, "Thus in speech, changes in the fundamental frequency (F0), formant structure, or characteristics of the glottal source spectrum can, depending on the language and the context, serve to communicate phonological contrasts, syntactic choices, pragmatic meaning, or emotional expression (p.236).

I came to the conclusion that another perspective from communication research into music can unify the data by creating music that will attempt to have an emotional effect upon the listener based upon Scherer's and others research into the fundamental frequency concept, using purposively created emotional music. This idea stems from a study in which the researchers created musical embellishments in order to signal emotional response (Timmers & Ashley, 2007). 'Purposively created' refers to the structure of the music, not emphasizing the notes by following the classical or standard melodic paths, but by emphasizing notes by writing the music within coded sound wave frequencies. The music must contain melodic anonymity to not sound like a piece of the music the listener has already formed an opinion about.

The key to creating purposively created music (Timmers & Ashley, 2007) is the concept of emotional prosody. "Emotional prosody is a set of acoustic parameters of speech directly influenced by affect such as mean amplitude, segment and pause duration, mean F0, and F0 variation" (p. 119), which coincides with Van Den Broek (2004) using the F0 to be the determinant of emotional prosody in speaking voices. As can be seen in Table 1, Van Den Broek (2004) diagramed mimicked emotive communication.

Figure 2. *The Raw F0-Signals of Respectively a Mimicked Happy (Left) and Mimicked sad (Right) Voice.*

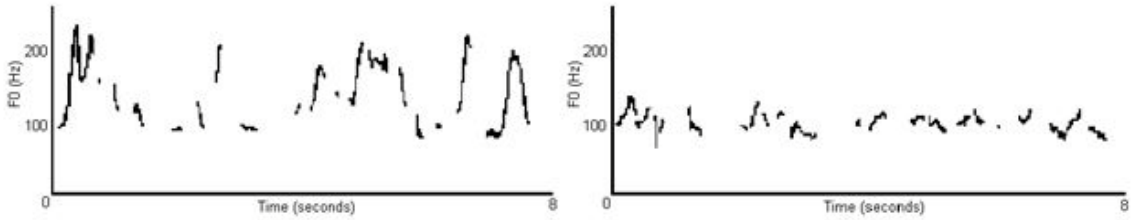


Figure 2. *The Raw F0-Signals of Respectively a Mimicked Happy (Left) and Mimicked sad (Right) Voice.* *Van Den Broek (2004) extracted the F0 range from spoken emotive speaking to produce this graphed analysis (p 120).*

1.2 Musical Cues vs. Musical Frequency (Hz)

In past research, arguments about what makes music contain emotional value have arisen. Musical cues can fall under a variety of definitions. Some studies have focused on structure in music as referring to the way the notes are placed on a musical scale, while others examine structural features such as timbre, volume, and environmental factors. This study takes the time to present the different sides of the findings to show that using the fundamental frequency concept to confine the musical structure within a harmonic range will yield more accurate results.

Neurological studies have gathered data involving the areas of activation in the brain while listening to music. These findings show a linkage of neurons involved in both music and speech creation, and also that the brain uses the same areas of the language center to process information regarding both speech and music. With these findings a logical connection to speech

and music arises, and also a justification of attempting to view musical communication as being contained in the frequency parameters of the musical notes (Scherer, 2003).

This study utilized musical sample surveys based upon the acoustic parameters of Van Den Broek's (2004) study and combined these ranges with musical notation according to the frequency value indicated on the graph, and the range of those values. The resulting musical sample was one that mimicked the spoken acoustic parameters in a form of musical tone. Sound frequencies were matched with the level of frequency based on a musical note at or in the same range. This provided a complete musical statement, not written with consideration of musical structure.

The survey was then distributed among three groups of sample populations who were divided according to their level of musical knowledge: General, Middle, and Upper level music knowledge. These groups were chosen to test the validity of the survey as respondents who were familiar with their own ideas of emotionally "good" music would be highly critical of obscurities and inconsistent tones that may cue an incoherent emotional quality.

The survey results suggest that emotional quality is communicated to the listener through music, but to a degree that the music must follow previously conceived notions of that emotional quality. Limitations of the study are clues to proper interpretation of this phenomenon since a large number of participants are needed, and Cultural demographics must also be accounted for. This survey also provides a temporary solution to elicit more extreme emotional responses from subjects, by creating music within a certain frequency range to mimic an uncomfortable emotional quality, such as fear.

Chapter 2: Literature Review

This literature review will address how previous research has addressed the relationship between communication, music, and emotion through the Brunswikian lens model, and to measure the phenomenon using Scherer's concepts. To date, scholarly research is advancing the study of music and emotion, unfortunately, unification in research is lacking.

This literature review will first examine music from the perspective of the Brunswikian Lens model which conceptualizes music as a vessel which contains emotional messages. This model frames the concept of how music can contain an emotional message as promoted by Scherer (2003).

The second topic will address the contending views of how music is both interpreted by the listener and perceived by the listener in research. The results of these studies allow for the continuation of the idea of emotional quality contained in music and the additional knowledge of the connections of various kinds of music centered studies and studies pertaining to the emotions of the listener. These connections embolden conclusions and hypotheses.

Third, this literature review will address the progress of research from neurology and studies that have focused on the brain's reaction to listening to music. Since this material is technical, emphasis is placed on research that has investigated the results of emotional stimuli involving music in the brains of listeners. Also, some awareness of how the brain appreciates and uses music is helpful to further frame the idea that music can communicate emotional quality.

Before concluding, this review will focus on psychological perspectives of how music can facilitate emotional communication. These perspectives guide further research on how the processes of musical stimuli and the reactions of the brain are linked.

Previous investigators have used both qualitative and quantitative means for predicting phenomena involving music, which allows for two different scenarios to view the effects of feeling emotion while listening to music. In one scenario, music is a form of rhetoric being argued to have a message that invokes persuasion, where the lyrical message is primary focus (Rodnitzky, 1969; Sellnow, 1999; Sellnow & Sellnow, 2001; Calhoun, 2005). In the other scenario, music is seen as a tool for examining emotional parameters in neurological and psychological studies (Scherer, 1995; Cook, 2007; McCrae, 2007; Spackman, Fujiki, Brinton, Nelson & Allen, 2005; Gosselin, Peretz, Johnsen, & Adolphs, 2007; Schellenberg, 2008; Özdemir, Norton, & Schlaug, 2006; Grewe, Nagel, Kopiez, & Altenmüller, 2007). One tool in particular, the Brunswikian lens model, is able to be applied to communication research with the musical structure as the primary focus (Scherer and Oshinsky, 1977).

2.1 The Brunswikian Lens Model and Scherer's Guidance.

The Brunswikian Lens Model illustrates the mediation which takes place in response to receiving a communication in a chaotic environment, where the mediator is using particular cues to distinguish meaning (Scherer, 2003). Some cues are focused with the lens, and others pass through. This model is primarily used to facilitate variables concerning spoken communication, but the criteria used by the model allow for the application to a musical message as well as a spoken message. The model contains these criteria:

- There must be dynamic activity
- The organism requires a lens (A mechanism that can receive input from the chaotic environment, and has the ability to "instrumentalize vicarious functioning"
- Mediation must be flexible and tolerant toward ambiguity

- the “human lens” makes use of “vicarious functioning”
- Brunswick notes “the lens model affects both the divergent and convergent parts” (as cited in Scherer 2003)”.

In these terms, the Brunswikian lens model is an adaptable structure, which is able to illustrate how the ear functions as a lens to interpret communication, and then, of how cues from music are interpreted by the brain.

The ear is the lens mechanism that must gather a wide range of sound (Beer, 2007), which may contain cues that signal emotional response (McCrae, 2007; Spackman et al., 2005), either out of recognition or association within the mind of the listener (Juslin & Sloboda, 2001; Juslin & Västfjäll, 2008,). In terms of how a message is received and processed, the Brunswikian Lens Model shows what criteria needs to be involved in the communication of the message in any medium and environment.

Music can function to create an environment (Timmerman et al., 2008, Bicknell, 2007), subjecting the listener to ambiguities. The listener’s responses follow the music as it may diverge, as previous research has shown (Stein, 2007).

Previous research, such as Scherer (1995), used the Brunswikian lens model to clarify understanding about the research paradigms that involve communicating emotion in speech. Again, the Brunswikian model is helpful because looking for emotion in speech is an entirely communicative act; “without such distinguishable acoustic patterns for different emotions, the nature of the underlying speaker state could not be communicated reliably” (Scherer, 2003, p. 231).

Scherer (1995) reviewed the parameters of measuring emotional quality in the speaking voice, and conceptualizes of the connections to music. Scherer wrote, “Similarly, in music [as in

speaking], melody, harmonic structure, or timing may reflect the composer's intentions, depending on specific traditions of music, and may simultaneously induce strong emotional moods" (p. 236). The idea of a linkage between the brain's systems of sound utterances alongside language production "into a single underlying production mechanism, vocalization, has proven to be singularly efficient for the purpose of communication" (p. 236).

Scherer (1995) also summarized previous research conclusions, "If listeners are able to recognize vocally portrayed emotions [with actors] with better than chance accuracy, one should be able to determine which acoustic cues they perceive and use in the process of attributing emotion to a speaker" (p. 237).

Scherer (1995) listed the strategies "used to determine the importance of various acoustic cues in the judgment process" (p. 237).

1. Electro acoustic or digital equipment to analyze the waveform for surveys.
2. Low-pass filtering of the speech sample (-300-400 Hz) "restricting the information to the fundamental frequency range" (p. 237-238).
3. "The recent development of electronic sound synthesis procedures allows for systematic experimental manipulation of different acoustic cues" (p. 238).

The third method listed was referencing the study by Scherer and Oshinsky (1977) in which manipulations of speech samples detailed the acoustic cues that signal emotion in speech.

Continuing this research, Scherer (1995) explained that previous research has used actual voice samples, and manipulated the voice samples based their F0 range. Scherer highlighted this find,

> Of all the variables studied, F0 range had the most powerful effect on judgments. Narrow F0 range was seen as a sign of sadness or absence of specific speaker attitudes. Wide F0 range was consistently judged as expressing high arousal, producing attributions of strong negative emotions such as annoyance or anger, or for the presence of strongly developed speaker attitudes such as involvement, reproach, or emphatic stress. (p. 239)

Scherer went on to note

> The vocal cues that indicate arousal or activation are similar across different emotions (p. 241).” Continuing, “However, because judges are able to recognize the individual emotions on the basis of vocal cues alones, there must be acoustic characteristics that differentiate the various emotions in addition to indicating arousal. (p. 241)

Finally, Scherer concluded with comments concerning the direction of study for the communication of emotion in music, “If the origin of music is indeed to be sought in the emotional expressions of the human voice, it should be human vocal music -singing- that should be most prone to evoke strong emotional feelings in the listener” (p.242). Scherer’s direction was to use the opera as a place to begin.

With this direction, Scherer (1995) detailed the nuances of having a believable performance to effectively transmit an emotional quality in music, as in singing, which may not be performed the same way twice, rely on the skills of the singer, and is dependent on the musical score (p. 242-243).

Scherer (1995) also included, “As in speech research, three spate issues need to be addressed (p. 243).” These issues are:

1. Inference: i.e., the ability of the listener to perceive emotional quality in a lyrical piece or in the singer’s performance (p. 243).

2. The nature of the acoustic cues used in this inference process
3. The underlying externalization or encoding of the emotion, i.e., the actual covariation of a composer's emotional script…" (p. 243).

Scherer (1995) laid the basis for the present study by inferring, "One possibility [to induce emotion from music singing] is to use a correlational method, as used in speech research, to establish the link among different acoustic configurations as found in emotionally expressive utterances via objective analysis, and correlate these with listener judgments" (p. 245). Although Scherer suggested using clips from movies to gather emotionally expressive music samples, the technology of the time no doubt presented limitations to that idea.

Interestingly, Scherer (1995) hinted at the ideal form of study for this topic writing, "The issue concerning emotional impact of music might well be amenable to empirical study by linking listener judgments to objective data concerning perceptual input" (p. 245).

Scherer (1995) noted the importance of using "portrayal or encoding methods" (p. 245-246) that will properly represent the intended emotion. He suggested suing actors to accomplish a set method of creating emotional music, since display of intense emotions may be interpreted as construed, or not deliberate.

Intriguingly, Scherer (1995) concludes by calling on interdisciplinary work from "speech scientists, psychologists, electrical engineers, musicologists, and performing artists" to bring together all facets of this topic. Stating, "In this spirit, it might well be profitable to link the study of emotion expression in the speaking and singing voice much more closely than has been the case to date" (p. 246).

The lens of the ear has a monumental job of navigating through the world of sound. The brains of the hearing are subjected to constant sounds and the messages that the brain needs to

recognize are imbedded in this environment. The brain uses the lens of the ear to filter out its needed messages.

2.1.2 The lens' environment.

If the ear is acting as a lens, what factors from the environment influence the communication of emotion in music? Previous studies have progressed from measuring arousal levels when exposed to music as opposed to silence and identifying patterns of arousal, to "self-reports of emotional impact, enjoyment, and familiarity" (Carpenter & Potter, 2007, p. 342). This is useful to examine since the lens of the ear is constantly processing information and reacting to it.

Carpentier et al. (2007) developed a study about sexually suggestive lyrical content and its influence upon a person's perceptions of others. Building on previous research of, "mechanisms behind the potential effects of music," the authors used a model similar to Berkowitz's (1984) model of aggression association (p. 3). This research about priming mechanisms, "has demonstrated that a concept that is activated, or primed, through exposure to a word, sentence, or news story will become the most salient criterion used in making later judgments (p. 3). The researchers claimed to find evidence of a priming effect but failed to answer parameters upon the study, warranting further investigation. These are: the quantity of the message given in short segments of selected songs; the listeners' interpretation of the segments or, "individual differences that may affect the influence of sexually charged pop music on judgments" (p.13). Interestingly, the study "did show a gender preference in artist selection related to whether the songs were filled with or devoid of sexually suggestive music" (p. 13). This study lends merit to the importance of understanding the mixture of music and lyrics and the effects on the listener.

Beginning their publication, Timmerman et al. (2008) attempt a clarifying view that "as a mode of communication, popular music creates socially shared meanings by exploring and celebrating a state of awareness or consciousness which a particular audience identifies with as an expression of its emotional and moral precepts" (p.116). This study utilized Social Learning theory and Excitation Transfer theory to explore the influences of the music upon learning from the environmental stimulants that influence the emotions (Timmerman, et al., 2008. p. 304). Social Learning theory is based on interactions with the environment, "The learning comes not from direct experience, but instead is vicarious; that exhibited behavior, as well as the rewards and punishments associated with the action in the fictional account, serve as a model for the consumer" (p. 305). The listener is absorbing information and learning the attributed attitudes and behaviors from the environment, music contains another source to identify with a person's schema.

Excitation transfer theory refers to music as a stimulus. For example, "loud dance becomes a shared environmental experience for those at a club that both creates and reinforces a particular feeling" (Timmerman, et al., 2008. p. 307). Music facilitates a set of reactions that motivate the listener. Priming also gives subjugation to the amount of influence imposed. Music can provide stimulation at an unconscious level, which in turn reveals music as having a greater impact than the lyrical meanings (p. 309). The results of the study show that subjects did produce survey results that showed their actions were influenced by the music they preferred to listen to, finding a specific correlation with anti-social outcomes (p. 320).

The following example illustrates how the ear is used to collect sound in a busy environment. Beer (2007) produced a grounded theory reconceptualizing how scholars view the use of mp3 players, because mp3 players are now fully integrated into modern society. Studies

such as this are beginning to look at how the constant access to music changes a person. Instead of a viewpoint of the personal music device being used to block outside sound from the listener, MP3 players are, "an integral part of the audio web in which we are constantly enveloped" (p. 843). Beer drew connections between music and the "urban soundscape," where the environment of sound can be recorded and emulated or manipulated. Some composers use portable devices to create music while others capture lyrical connections through shared experience (p. 849). The setting in which music may be playing also contributes to the "soundscape" (p. 850). Beer proposed the mp3 player gives the listener more autonomy in an environment filled with sounds. The mp3 player shows less use as a method of withdrawal from the outside world, and more of a, "temporary or imperfect sanctuary from what is going on" (p. 862).

Simun (2009) moved this concept one step forward by surveying the listening habits of a small group of Londoners, drawing from Bull's (2001) urban soundscape concept, where the listener is fighting against the environment of sound and learns to disassociate (p. 925). Simun (2009) included a criticism from Hosokawa (1984) who envisions the concept of personalized music as a "mobility of Self" (as cited in Simun, 2009. p. 929). "To conceptualize both object and music solely as products of the culture industry, imposing the ideology of capitalistic society, is to limit understanding of what happens as users bring the mp3 into their everyday lives" (Simun, 2009, p. 929). The subjects of the study gave responses with themes pertaining to a listener's ability to shut out the environment and the mp3 player being a nonverbal cue for others to heed, also to gain the sense of navigational presence.

Navigational presence refers to the listener's use of music to add setting to the physical places they travel in and live, "The use of music to control mood enables users to enjoy surroundings they may otherwise disengage from by helping them gain control over their relation

to the urban environment" and, "The MP3 serves as a management tool" (Simun, 2009, p. 932). Simun also discussed how MP3 listening practices can be "both 'emancipatory' and pacifying,'" where listeners are interacting with their environment on their own terms (p. 936).

While the above example gives an idea of what type of environment the lens of the ear encounters, and how the human manipulates the initial focal variable through personal music, we look to see how music can contain auditory cues that will indicate emotional quality and are communicated to the listener.

2.2 Cues that Signal an Emotional Response.

If music is intentionally used to influence an audience's emotions in media, does this mean the audience will perceive and interpret the emotional quality?

2.2.1 Cultural differences.

Meyer (1956) conducted research for publication concerning "an examination and analysis of those aspects of meaning which result from the understanding of and response to relationships inherent in the musical progress rather than with any relationships between the musical organization and the extramusical world of concepts, actions, characters, and situations" (p. 3). This research gathered the 20th century knowledge of music and classified the features that contribute to all music structure, including features of the musical scale, timbre, and tone. Of the evidence toward an emotional response in listeners, he wrote:

> Although the volume and intercultural character of this evidence [testimony, behavioral reactions] compels us to believe that an emotional response to music does take place, it tells us almost nothing about the nature of response or about the causal connection between musical stimulus and the affective response it evokes in listeners. (p. 6)

Meyer did crucial work toward furthering the study of the connections between emotion and music. Meyer took careful consideration of cultural differences, using an example that to able to have music radiate across cultures, the music needs to be able to be recognized to reflect a common idea, such as death, to be able to reciprocate the intended emotion (p. 260). The idea of connotation coming from music is the recognition that a music piece is intending to reflect a moment. About connotation, Meyer interjected, "In general, the more markedly the elements of a sound pattern diverge from neutrality, the more likely they are to evoke connotations and the more specific those connotations are liable to be. (p. 264).

Chen, Zhou, and Bryant (2007) sought to find a deeper understanding of the connections of emotion and music by examining mood regulation through music listening. Subjects of previous studies have shown a tendency to regulate from a negative mood to a positive mood by engaging in an introspective awareness of self or by exposing themselves to incongruent materials (e.g. music). People may ruminate over their moods, and therefore take a longer time to shift focus from the negative state to the positive; they engage in music listening as a means to reflect and regulate their mood, sad moods are slowly regulated as the individual learns to cope, whereas a person in a melancholy state will listen to music reinforcing the sad state (p. 698-699). This study shows that a factor of time may be introduced to the results of testing for this experience, with the additional effect of the extent the listener is aware of their mood upon the results (p. 700). The results of the selective exposure to the happy songs remained fairly level throughout the test while the participants who were induced into a sad mood took more time to select happy songs, and by the end of the eight-minute test, all participants met the same level of happy song selective exposure (p. 706). Time as a factor of mood regulation only seems to allow time for the sad listener to switch to listening to happy music (p. 706). Ruminating listeners did

spend more time during the test listening to sad sounding music, but toward the end turned their selections to happy sounding songs (p. 707).

Hunter, Schellenberg, and Schimmack (2008) furthered these previous studies which have polarized results indicating happy and sad effects of music but not mixed feelings. The idea stems from the notion that people are not able to feel both happy and sad at the same time, rather they switch back and forth between feelings of happiness or sadness. The study uses excerpts of popular music in 30 second intervals presented to 40 undergraduate students. The students were asked to rate the feelings of happiness or sadness on a Likert type scale. Another experiment was conducted with different students using a 2-dimensional response grid. Both experiments confirm that music with conflicting emotional cues elicit conflicting feelings of happiness and sadness. The investigators found the music representing sadness caused the most conflicting results. The authors speculated the aesthetic appeal of music is in its ability to change emotion in its duration. Although some of the test subjects had musical training, the affective cues found in music are interpreted across cultures; therefore the results bring us one step closer to finding a systematic method for measuring the affect of music.

These results show that people do engage in self-regulatory mood repair as well as ruminate on sad sounding songs and over time will choose different sounding music which reflects mood repair. Some limitations to this study are in the amount of songs used for the happy and sad sounding categories and the amount of time allowed for the study (Hunter, et al., 2008. p. 709). The limitation of the time of music allowed for the participants to choose between songs is important to note simply because the participants might have ran out of selections of songs to listen to during the eight-minute study. Also, the selection of songs was from a top 40 list as well as a website list with songs that reflect happy and sad songs (p. 704). It is also helpful to note

that Timmerman et al. (2008) wrote about popular music and the listener, where the listener may also bring individual attitudes and attributed meanings to popular music as a result of familiarity.

2.2.2 Interpretation of emotion in music.

Tan, Spackman and Bezdek (2007) asked if hearing music before or after a character appears in a film conveys emotional content of the film character, which is the characteristic of an emotional primer. They conclude that viewers do interpret emotional content of characters in film when prompted with music. This was more prevalent with music played before the character was shown, and also occurred in a very small amount of time (15 seconds). The authors note that the amount of time of the musical samples might be a limitation to the study, but have shown a testing structure for musical affect when accompanied by visual information. Further examples of emotional interpretation are found in research with toddlers.

Boone and Cunningham (2001) researched the extent that toddlers are able to interpret emotion by asking if preschool children are able to encode signs of emotional meaning using a teddy bear. Using adult coders, the investigators were able to teach the children dance moves to show emotional content of music. The children were then told to dance the bear in the way they interpreted the music. The investigators found children as young as four were systematically varying their expressive movements. The significance of this study is the evidence that children receive emotional cues from audible information, and at an early age are able to detect and express those emotions. This data provides some evidence that emotional quality is able to be encoded and decoded in music, and communicated at an early age. What about in adults?

In research with adults, Ilie and Thompson (2006) studied dimensions of measurement for music and speech perception of emotion based on previous research from Sloboda (1992), Husain, Thompson, & Schellenberg (2002), which their guiding proposal explains, “expressions

of emotion are processed by general-purpose brain mechanisms that respond to acoustic features regardless of whether the stimulus input is music or speech" (p. 320) Findings show that speech and music are linked in this way, using, factors for measuring emotional perception in speech, such as valence, energetic cues, and tension arousal, the authors found their manipulations of these factors in relation to music do elicit variation of emotional interpretation of the stimuli. The authors take special note of how variations in pitch height of the sound and intensity reflect a similarity to infant-directed speech and a biological association between sound and emotion (p. 325).

Certain signals such as aesthetic chills and facial expressions are able to indicate an emotional response in the human body (McCrae, 2007; Spackman et al., 2005). Music's qualifying factors such as loudness and intensity have also been investigated (Patrick, Hunter, Schellenberg, & Schimmack, 2008). McCrae (2007) detailed the aesthetic chill,

> Apparently the first scientific study of chills was by Goldstein (1980), who conducted qualitative and quantitative surveys of what he called *thrills* in American samples. His results suggested that perhaps half the population was familiar with the experience, which they described as 'a chill, shudder, tingling, or tickling' …that might be accompanied by piloerection [or goosebumps, italics original] (p 6)

This reaction is then set against visual art, and poetry as a marker to being in a state of Openness, sharing a characteristics of individuals who "tend to be particularly sensitive to art and beauty, and they experience a wide range of feelings and emotions" (p. 6). McCrae (2007) then links this type of respondent with a potential affect from music, "For a very open person who cannot compartmentalize feelings, a sudden dramatic turn in the emotionally charged atmosphere of

music or drama may push emotional processing over some threshold and require release in the form of physical chills and gooseflesh" (p. 10).

An important thing to consider is how adults interpret their emotional responses to music. McCrae (2007) used cross-cultural data to define aesthetic chills as a universal indication to aesthetic experience. The author summarizes the factors that lead to an aesthetic chill as the personality characteristics of openness. Language differences also describe aesthetic chills in similar ways. The author determined the factors that mark aesthetic chills as a universal marker of openness to experience and calls for the use of the aesthetic chill to indicate an appreciation of an experience,

> Cross-cultural laboratory studies of chills in music would be even more informative, because they might identify universal features of music that are most likely to induce response. If, as Sloboda (1991) suggested, they tend to occur at transitional points, then the appraisal of novelty-complexity (Silvia, 2005) may be part of the experience. (p. 10)

This data shows a commonality in this reaction across adults in different cultures, and indicates the concept of the aesthetic chill is a common description of the phenomenon.

2.2.3 Perception of emotion in music.

An area where music is intentionally used to influence an audience's emotions, and perception of emotion, is visual media. Tan, Spackman and Bezdek (2007) shed light on the aspect of film music that conveys emotional content of the visual scene. Previous studies have been conducted to discover viewers' interpretation of emotions of film characters. This study asks participants if hearing music before or after a character is shown conveys emotional content of the film character, an emotional primer. Using 177 college students, the investigators

conducted a survey after showing edited excerpts of film with music that was coded to convey four emotions (happiness, sadness, anger, and fear). They account for other factors involved in viewing the film, such as facial expression of the character, physiological actions of the character, and setting of the film. They conclude that viewers do interpret emotional content of characters in film when prompted with music. This was more prevalent with music played before the character was shown, and also occurred in a very small amount of time (15 seconds). The authors note that the amount of time of the musical samples might be a limitation to the study, but have shown a testing structure for musical affect when accompanied by visual information.

2.3 Reactions of the Brain While Listening to Music.

Baumgartner, Esslen, and Jäncke (2006) directed us closer to understanding emotion in music by investigating brain activity when presented with two types of medium: pictures and music. Both samples included highly emotional examples and were used to elicit emotional response in the test subject. Samples without the visual stimuli yielded a result that "music elicits intense emotional responses that activate brain regions thought to be involved in reward/motivation, emotion and arousal…These brain structures are known to be active in response to other euphoria-inducing stimuli…" (p.34-35). Reactions of emotion from listening to music and the physical changes accompanying them reveal music to be "particularly powerful in eliciting such changes" (p.35). Such findings strengthen the legitimacy of the effect of music upon a listener's emotions, and the possibility that music contains a quality that has an effect on a listener's emotions. More neurological studies lend extensive contributions to document actual brain activity in response to hearing music.

2.3.1 Appreciation of musical stimuli.

Özdemir, Norton, and Schlaug (2006) published results of a visual brain scan showing areas of the brain that signal activation when receiving spoken and sung stimulus. Brain scans provide a hidden detail of the listening process and in this study, the investigators found brain activity hinted at a sharing of neurons for the processing of spoken and sung input. Aphasic patients were a catalyst for the study as they are able to "sing the words of a song, but cannot speak them" (p. 634). Functional Magnetic Resonance Imaging (fMRI) depicted similar regions of the brain that are activated while listening to spoken word and music (p. 630). While this data presents a picture of what happens in a person's brain while listening to music, it does not tell us what is happening in their mind. This data lends some security in assuming that music is able to communicate emotions, because the brain appears to not be separating the areas where it is processing the information.

Brown, Martinez, and Parsons (2006) showed the production of language and music also hints at similar areas of the brain being activated. They conducted positron emission tomography (PET) scans on "amateur musicians spontaneously generating and vocalizing melodic or sentential phrases in response to unfamiliar auditorily presented melody or sentence fragments" (p. 2792). These results show humans encode messages in similar areas of the brain. Such messages contain emotive content and this study has shown similar areas of the brain are activated when producing messages. Not at this time were they able to draw the conclusion that humans encode emotion for both music and speech in the same areas of the brain, but these results indeed hint at that assumption.

Schellenberg, Peretz, and Vieillard (2008) shed light on a previous study of the liking or disliking of music in terms of happy and sad sounding music. That previous test concluded participants were able to describe their preference as an inverted "U" shape of liking a stimulus.

Repeated exposure to a piece of music is liked for a while, and then disliked after it becomes redundant and the listener is bored, only to eventually come back to liking it again. This study chose to test subjects for focused and incidental listening conditions in order to find out if subjects chose happy or sad sounding music and the causes of why they did so. The investigators tested undergraduates in a laboratory setting, giving them tasks of picking out audible words while listening to excerpts of electronically produced music as well as instrument produced music. The results show the students chose sad sounding music after they had completed the more distracting task of identifying words. The authors indicate this is significant in the fact that people may choose sad sounding music to fit the mood they are in, or to alleviate their stress by listening to a non-arousing form of music. The authors also note that the aesthetic value of the music might be a factor in the choosing of a particular mode of music. In terms of preference, the human brain is looking for cues to gather in order to discern a feeling

The appreciation of music can be observed in extreme situations, where mental ability is under scrutiny to effect physical ability. Roy, Peretz and Rainville (2008) sought to find if pleasant sounding music reduces pain in subjects and if unpleasant music increases pain. The study uses a previous testing scale for subjects to rate their emotional states while experiencing different levels of heat exposure. The investigators are looking to see if a relationship between low reports of stimuli coincides with exposure to pleasant music. They find their examples of pleasant music was able to decrease the stimulus of pain in subjects, while the unpleasant musical examples showed no significant results. Their findings confirm the reliability of the process for determining the level of emotional valence, or preference, of music, while also demonstrating these factors of music can decrease the sensation of pain. The authors suggested

more research into the benefits of the analgesia and have shown music interacts strongly with the human psyche.

2.4 Music and the Facilitation of Communication.

Emotion focused research in psychology is a key to understanding how music facilitates communication.

Stein (2007) provided a psychological perspective on the communication of emotion through music. The argument is rooted in the similarities of music to language; it is a language of emotions. The author contends, "this *verbalization of music*… audio-symbolically conveys affect and ideation derivative of early life" (p. 60). The author forms this contention through Anzieu's (1974) notion of the skin ego saying the audio sensations we receive in the womb form a *sound image of self*, or "the inchoate self emerges from a sound bath composed of acoustical stimuli both from within the baby and its external environment" (Stein, 2007. p. 64) Recalling three examples of patients who have had troubled pasts and use music as a mechanism to cope, the author elaborates on how the connection with the patients' trauma and their method of using music is rooted in their memory of their acoustical environment. Sound plays an important factor in human development, and the mingling of comfort, fear, and other factors of childhood development are linked to emotional expression for these patients. The author believes these patients are hearing the emotions that were suppressed in their childhood, using their current music to release themselves from that trauma. Music is a release mechanism; it carries all the emotional elements of an individual and conveys them in a free and almost intoxicating form.

Framing the concept within theory, Stein (2007) summarized this psychoanalytical argument, "This…endorses a reconceptualization of unconscious nonlinguistic (and nonverbal) communications in the psychoanalytic dialogue, suggesting they can be fruitfully heard and

understood as idiolectic sonic renderings of individual interiority" (p. 83). Here, Stein has given credibility to the notion that a communication is indeed integrated in the exchange of music and listener. In conclusion of the study, Stein (2007) also describes the mental process, in which this production can occur,

> The mind's ear can in hallucinatory fashion conjure the sound of counterpoint or a full orchestra, letting us internally hear sounds or music-past or present, real or imagined, of complex polyphony, harmonic color and texture. The polyphony of intrapsychic audition and intravocalization captures elements of primary process mentation without dilution or distortion. (p. 83)

Stein was saying that the way humans visualize music in complex ways surpasses the body's physical limits of creating that sound, giving a substance to the emotional quality that was the instigator of that sound.

Bicknell (2007) viewed the emotional qualities of music as a social construct; music is something that is intrinsically human, a mechanism that orientates us to our human characteristics. Dividing this approach into a definition of an emotional response, music and social bonding, neurobiology of social bonding, and intimacy, Bicknell frames the affect of music into an all encompassing form of art. Music is able to strengthen the emotional ties between humans, which cause physiological reactions in the brain equated with reward systems and pleasure, and produce a resulting affect feeling of closeness, a commonality of feeling between listener and music (p.19). The listener becomes close, or intimate, with the music by relating emotional feelings to it. Music cannot be intimate with the listener, as this would make music to be an entity. Bicknell (2007) also framed the affect of music, strengthening the assumption that music is able to communicate an emotional quality. One question is then

presented pertaining to the universality of such a phenomenon, which is whether or not an emotional quality can be contained in music which is universally acceptable, and is able to recognized and expressed accurately representing the intended message?

2.4.1 Music inducing emotion.

Juslin & Västfjäll (2008) lent perspective to the "research on musical emotions, where, "The literature presents a confusing picture with conflicting views on almost every topic in the field (p. 559). These theoretical arguments are drawn between Becker (2001), Peretz (2001), and Noy (1993), who addressed the emotional response, to Koelsch (2005) who, "observes that emotions to music may be induced 'quite consistently across subjects,' yet Sloboda (1996, p. 387) regarded individual differences as an 'acute problem.'" (Juslin & Västfjäll, 2008, p. 559). The most intriguing argument comes from Scherer (2003), who, "claims that 'music does not induce basic emotions'" (Juslin & Västfjäll, 2008, p. 559). This claim is refuted by Panksepp and Bernatzky (2002), and Sloboda (1992). The authors then turn the discussion to filling the gap of finding the mechanisms of how music induces emotions. Emotional processing can stem from wanting to complete a goal, and some theorists believe that cognitive appraisal is the better explanation of the phenomenon. Cognitive appraisal is the induction of emotions based on interactions of dimensions of appraisal for emotional quality, such as setting (p. 560). The primary argument is stated, "We reject these views on both theoretical and empirical grounds, and claim that music can induce a wide range of both basic and complex emotions in listeners via several psychological mechanisms that emotions to music share with other emotions" (Juslin & Västfjäll, 2008, p. 561). The authors used the term "psychological mechanism," defined as, "any information processing that leads to the induction of emotions through listening to music. This processing could be simple or complex. It could be available to consciousness or not.

However, what the mechanisms discussed here have in common is that they become activated by taking music as their 'object'" (Juslin & Västfjäll, 2008, p. 560). This objectification of music is the association of emotion with the sound because of the personal recognition and processing of memories associated with that sound.

Juslin & Västfjäll (2008) then proceeded to outline "evidence from different kinds of sources to show that, despite claims to the contrary, music *can* induce emotions [italics original]" (see p. 562), a theoretical framework of six psychological mechanisms, and hypotheses of how emotions are induced (p. 563), with considerations for future research (p. 561). The six mechanisms are: brain stem reflexes, evaluative conditioning, emotional contagion, visual imagery, episodic memory, and musical expectancy; and, as the authors suggest, induce emotion by combining with cognitive appraisal (p. 563). The mechanisms are used as a beginning framework, "they should be regarded as complementary ways through which music might induce emotions (p. 563).

2.4.2 Music through the lens.

Scherer (2003) uses the Brunswikian lens model to clarify understanding about the research paradigms that involve communicating emotion in speech. The Brunswikian model is helpful because looking for emotion in speech is an entirely communicative act, "Without such distinguishable acoustic patterns for different emotions, the nature of the underlying speaker state could not be communicated reliably" (p. 231). Scherer (2003) summarized in detail the studies that concern extracting these emotional cues out of human speech, studies that are looking at ways to find "differentiation of emotions in acoustic patterns apart from arousal" (p. 234). Scherer (2008) noted that frequency distribution has been scarcely studied and,

> As argued by Scherer (1986), it is possible that F0, energy, and rate may be most indicative of arousal whereas qualitative, valence differences may have a stronger impact on source and articulation characteristics. (p. 233)

Another important factor to look at is the variances of emotions that occur in everyday life, which is related to emotional intensity or different kinds of the same emotion. Previous studies have shown,

> recognition accuracy [of emotion] for vocal expressions is generally somewhat lower than that of facial expressions….recognition of emotion from standardized voice samples, using actor portrayals, attains between 55% accuracy and 65% accuracy, about five to six times higher than what would be expected by chance. (p. 236)

These results reflect the advancements of looking at emotion and the voice, where psychological and speech communication studies are working out the parameters of the topic. These fields have developed theoretical positions upon which to base perceptions of the phenomenon of a listener's emotional perception through acoustic cues, as well as provided the basis for further research. These types of theoretical viewpoints are what validate measurements of vocal emotional patterns based on multiple types of variables. As Scherer (2003) concluded, "Neuroscientists and speech scientists could benefit from advances in the psychology of emotion, allowing them to ask more subtle questions than that of different acoustic patterning of a handful of so-called basic emotion" (p. 250).

Bicknell (2007) wrote:

> I take music to be a fundamentally social phenomenon; however it is so often associated with private contexts and personal memories that its use can be mistakenly seen as primarily an expression of self-hood. A framework of ecological naturalism [a social

> construction of reality type] allows us to integrate experimental results from neurology (studies of individual brains) with findings from the social sciences, all while recognizing the social nature of music. (p. 6)

2.6 Conclusion

One study in particular had alluded to the ability to code emotion into musical examples. Timmers and Ashley (2007) used musical ornamentation as a mechanism to convey emotion in music. Summarizing previous research, including studies mentioned above, the authors highlight two theories of the relationship of emotion and music, "While the first is concerned with the recognition of an emotional character based on acoustic or cultural cues, the second concerns emotional tension build-up and release over time" (p. 118). Ornamentation is a feature of Baroque music used by the performer to add emotional qualities to performance. The use of ornaments has been written about by C.P.E. Bach (1753) and this distinction is what the authors use to determine the emotional qualities of ornamentation (p. 118). For the study, they instruct accomplished musicians to practice a Handel sonata with ornaments that convey four types of emotional qualities (happiness, sadness, anger, and love) based upon a previous study's distinction. The performers record their interpretations using the Baroque ornaments and the investigators then code the results by analyzing the musical score. The investigators then play the recordings to music students who then indicate the extent to which they think the music represents one of the four emotional qualities. The investigators find happiness and sadness were more easily recognized than anger and love. The study concludes with the finding of the ability to encode emotional qualities into music with ornamentation.

Following this study by Timmers and Ashley (2007), where performers were to interpret emotional meaning based upon the musical ornamentation in a Baroque Style sonata, the present

study will investigate to what degree a listener will be able to recognize an emotional quality that has been purposively encoded in a piece of music.

Chapter 3: Method

A survey was created to investigate whether an emotional quality could be elicited in the interpretation of a listener with musical samples, not written to adhere to western traditional musical structures, but according to the sound frequency values of pitches. Van Den Broek's (2004) study provided the acoustical parameters and ranges needed to match tones on the musical scale with the frequencies contained in the emotive speaking voice.

3.1 The Megahertz Levels of Emotion.

Van Den Broek (2004) developed the Emotional Prosody Measurement which evaluates the emotional characteristics of the voice through acoustical analysis for purposes of psychological evaluation. The parameters of this measurement are explained as follows:

> The rate of vocal fold [cord] oscillation (respectively, 100Hz in adult men and about 200 Hz in adult women) determines the F0 (also named fundamental frequency of pitch) of the sound produced. The acoustic energy generated then passes through the vocal tract … where it is filtered …. Accomplished by a series of bandpass filters, which are termed formants…. these formants are independent of the F0. The F0 is determined by the vibration rate of the vocal folds (the source). Formants, on the other hand, are determined by the vocal tract (the filter). The independence of source and filter is one of the key insights of modern speech acoustics. (p. 119-120)

The F0 is the focus of the study, and emotional prosody is the "affective information of one's voice" and prosody is specifically defined as "the 'rhythmic and intonational aspect of language'" (p 119).

In order to gain better results, Van Den Broek (2004) validated the measurement by using test subjects who read stories aloud, and also having the test subjects relive the read experiences

aloud (p. 120). Subjects, who were "diagnosed as having a Panic Disorder with Agoraphobia" were asked to read stories being, "respectively anxiety triggering (by use of anxiety triggering words) and being neutral" (p. 121). These stories were recorded with mixing of conditions of stories, between anxiety inducing and neutral.

In another block of analysis, subjects went through a reliving of emotion, conducted like the first therapy session and also containing moments of neutrality and relief. Subjects filled out an evaluation of their experienced distress from reading, while the recording is spliced into increments, based on these anxiety-inducing times and neutral times, which provide a sense of relief, between stories (Van Den Broek, 2004, p. 121). These results were compared to the written test called the Subjective Unit of Distress (SUD) which "consists of a score form on which the participant can mark his or her level of experienced tension, on a scale of 1 to 10" (Van Den Broek, 2004, p. 119).

The Emotional Prosody Measurement (EPM) was taken by recording a speech sample, filtering out the noise, then, "A Fourier Transformation is applied to extract the F0-signal from the (complete) speech signal. Last, the variability of the F0 should be determined by, for example, the *standard deviation (SD)* of the F0-signal *(SD-F0)*" (Van Den Broek, 2004, p. 119, italics retained):

Figure 3. *Processing Scheme for Emotional Prosody Measurement (EPM).*

Figure 3. *Processing Scheme for Emotional Prosody Measurement (EPM). This is the filtering method From Van Den Broek's (2004) study which extracted base frequency values of emotive speaking voice (p. 119). Also, see* ***Table 1****.*

The subjects in the study were emotionally charged by the stories they read, and relieved of that tension when under a neutral condition. While they were under these conditions, this study shows that although their self reported indication of tension was not an indicator of the emotional quality (happiness or anxiety) of their voice. The underlying mechanism, the F0, is remaining constant as indicating, "With this analysis the opposite behavior of both SUD and the variability of F0 became even evident" (Van Den Broek, 2004, p. 123).

The final analysis was, "In combination, the two measures can … make a complete and reliable diagnosis of both the coping style and the emotional well being of persons" (Van Den Broek, 2004, p. 124). The frequency of a person's voice (Hz) will be higher on this measurement when tension is low, as if the subject were to sound at ease.

3.2 Scherer Combined with Van Den Broek.

I observed these speech results could be notated by the contours of music, and created music that is based on a vocal pattern of emotive quality, residing in the same F0 range of sounds as indicated by Van Den Broek's (2004) initial investigation.

The samples of music were derived from these measurements, based on the indicated level of Hertz (Hz) displayed in the waveform from Van Den Broek's (2004) study.

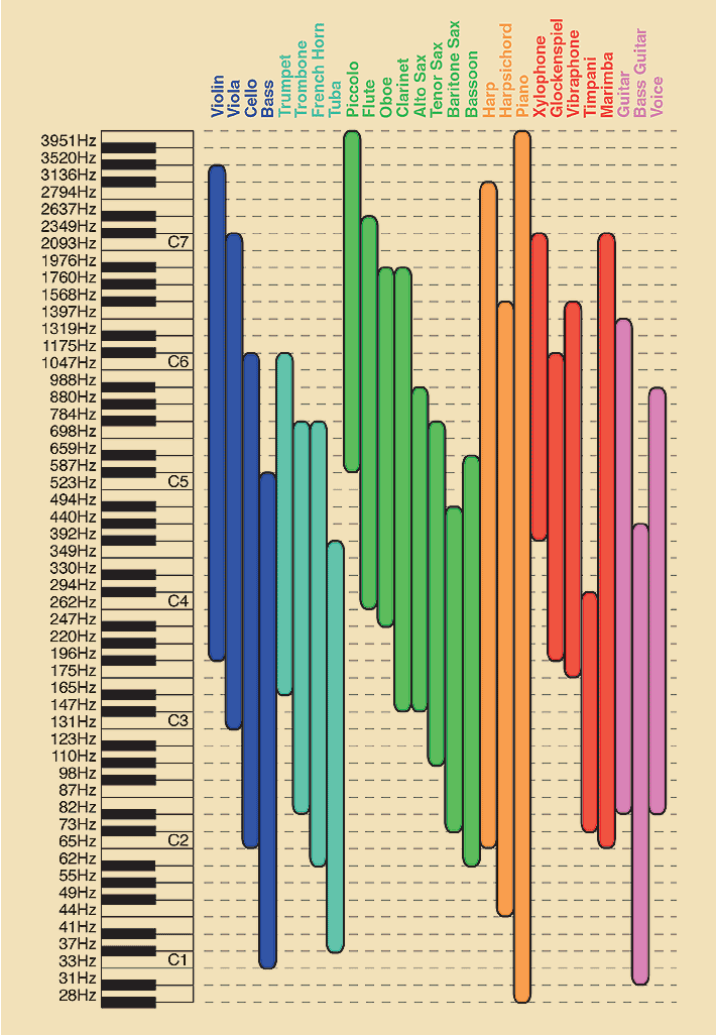
Particularly important to the purpose of the present study is that Scherer and Oshinsky (1977) observed their samples resided in a range of 168-345 Hz and 296-617 Hz (p. 342).

The frequency chart in Table 1 is from the website of a company named Har-Bal that creates software for audio mastering equalization for studio recording. This investigator chose this source because the numerical ranges are needed for this comparison. Therefore, the internet was searched one dark night for a website that would have these numbers readily available and credible.

The voice is shown to have a range beginning at 82Hz and ending at 988 Hz. This range is about 4 octaves, in musical terms, and in terms of middle C, begins two scales higher. This range matches data provided by Van Den Broek (2004). This chart also shows musical instruments that have range in the same level as the voice, as well as share the same frequency for a musical note.

Table 1.

Frequency Chart



Note: Data acquired from the following website: http://www.har-bal.com/index.php?/frequency-chart.php accessed August, 2012.

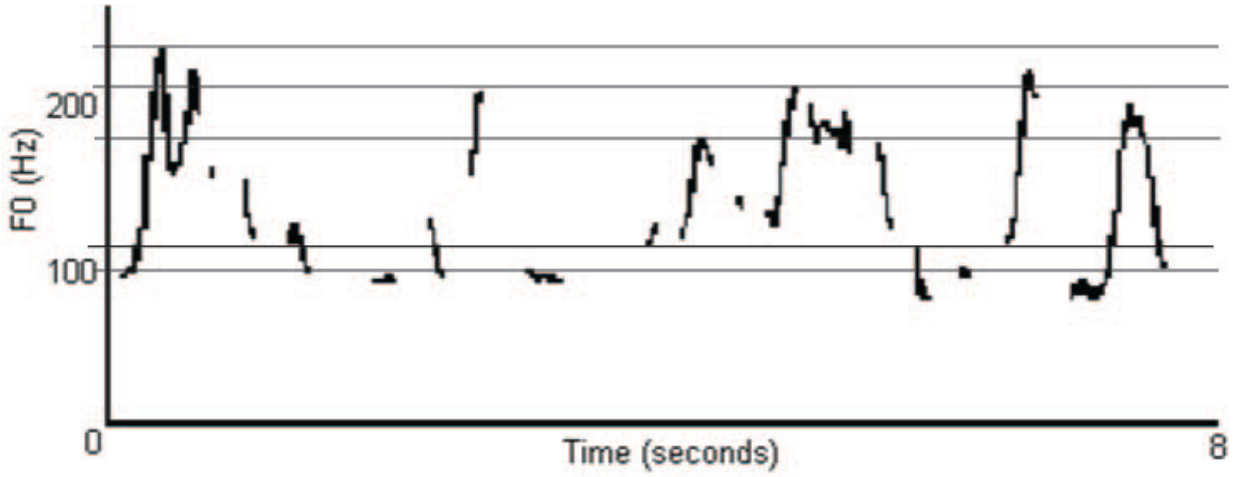
Combining the Hertz levels recorded in Van Den Broek's (2004) data with the Hertz levels of musical notes as shown in **Table 1**, I was able to mark musical notes in place of the vocal F0 information.

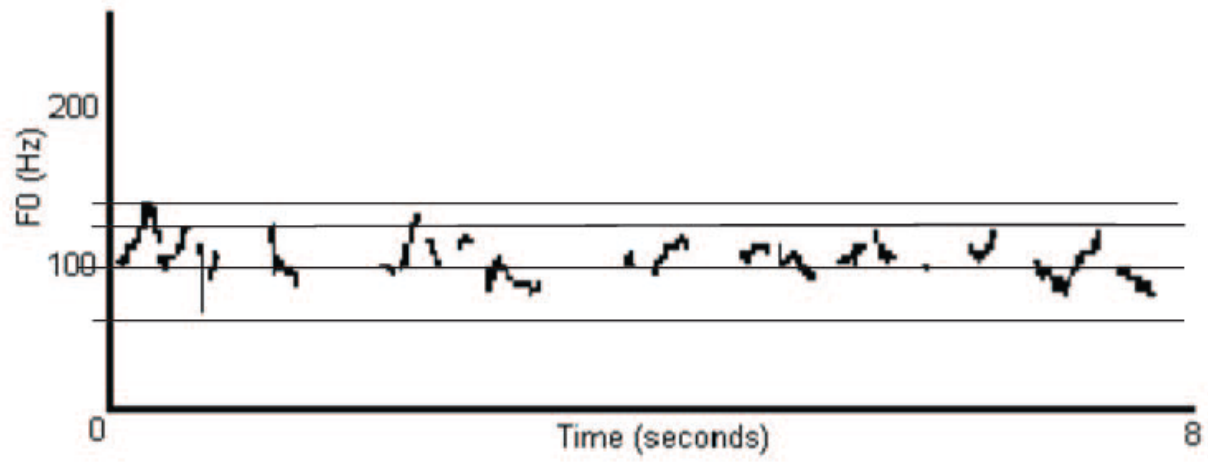
Patterns of mimicked happy and sad speech F0 levels in Figure 1, provided by Van Den Broek (2004), showed the mimicked happy voice contains troughs and peaks in its wave form between 100 Hz and a little over 200 Hz. The waveform took particularly steep changes and fluctuates rapidly between high and low levels of sound. The mimicked sad voice resides in a range between 150 Hz and dropping below 100 Hz, with a waveform that stays close within this range yet fluctuates in a tight pattern.

Below (**Table 2**) are the same graphs, with superimposed lines to mark the peaks and valleys of the waveform.

Table 2.

Figure 1 Graph With Superimposed Lines.





Note: Lines mark peaks and valleys of waveforms. These levels give an estimate of the range needed to mimic the waveform.

Notated musical qualities written to purposely demonstrate an emotion are used to determine measurable elements for study that are able to be duplicated (Timmers & Ashley, 2007), and Baroque counterpoint music follows distinct rules for harmonic structure which provide the framework for a complete musical statement.

Using the frequency values of musical notes, coinciding with the frequency range of the human voice, analysis can be conducted on the rate the listener can guess a purposively written emotional quality in a piece of music.

The participant is presented with eight musical samples. These samples contain music the same length of time, following counterpoint rules, as well as abstract music examples written within the harmonic range necessary to produce the emotional value.

3.3 Music Notation.

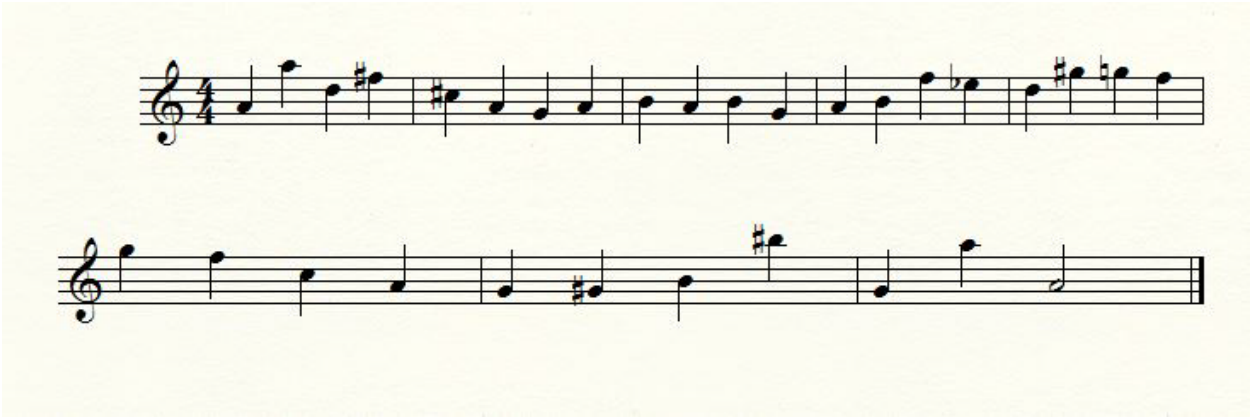
Using the free software trial program *Finale NotePad 2012* musical notes were arranged on a musical notation staff digitally, guided by patterns in the peaks and troughs of the waveform

from Van Den Broek's (2004) study. A peak, trough, or valley, or break in the waveform constitutes as a musical note at that matching frequency (Hz) value.

Examples for the 'happy' category cannot have a music note with a value lower than 100 Hz, in which the note "G" ranges.

Table 5.

"Happy" Musical Sample.

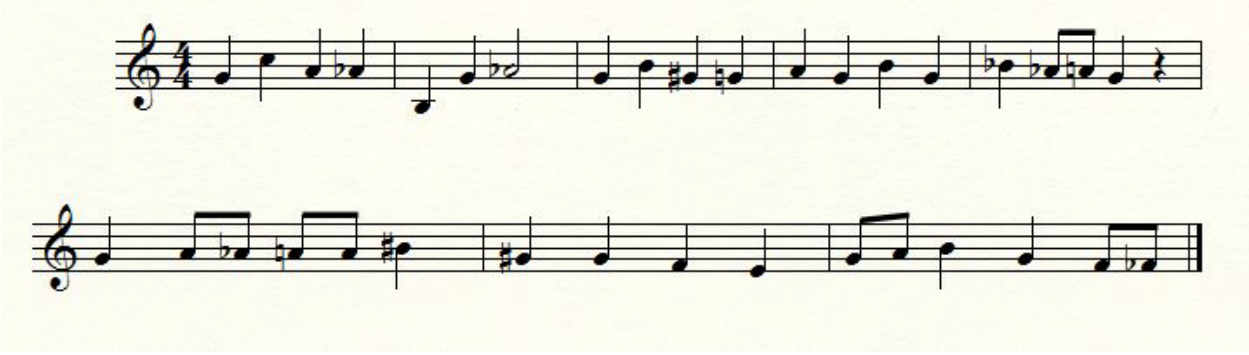


Note: also labeled "Music Sample 1."

Likewise, a musical example for the 'sad' music must not have a note with a value higher than 150 Hz, in which the note can be written as an "E flat".

Table 6.

"Sad" Musical Sample.



Note: also labeled "Music sample 2."

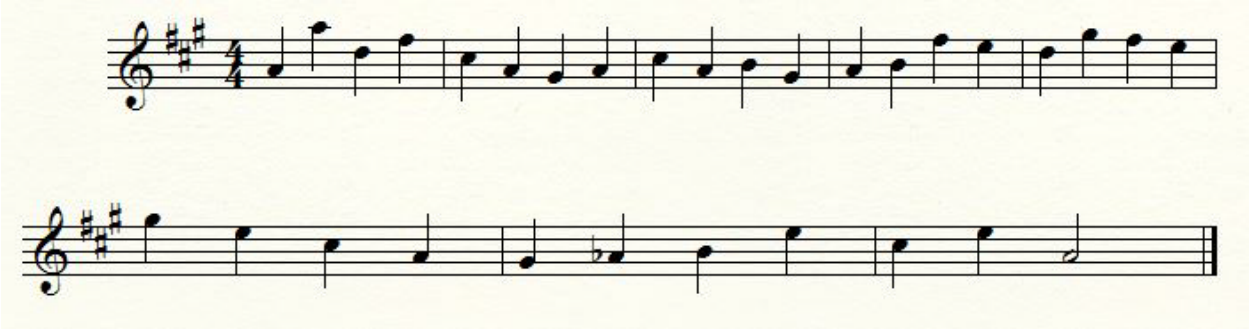
3.3.1 Diversification of samples.

In order to diversify the samples of music, this investigator used the samples derived from Van Den Broek (2004) as a basis to rewrite the samples using basic musical notation rules. The notes are contained in the pre-described harmonic parameters, based on their frequency levels, measured in Hertz (Hz).

Sample 1 was rewritten as Sample 3 in the key of A major. The music follows the same tempo as the original sample with few embellishments. This sample will function as a variation on the original by offering the listener an opportunity to use the same interpretation for a piece of bona-fide music. To also be sure to reflect the happy emotional quality of its written purpose, the music is written in the major key, with most intervals contained within the harmonic scale.

Table 7.

"Happy" Musical Sample Revised.

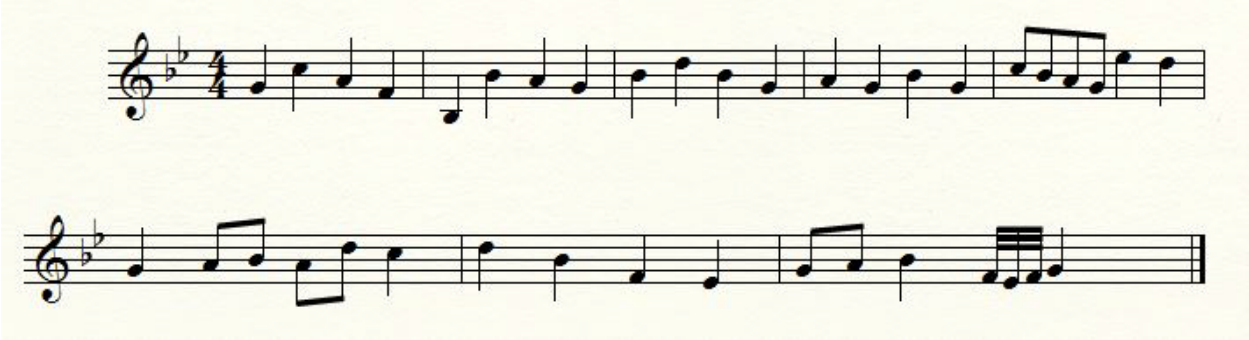


Note: also labeled **"**Music Sample 3."

Sample 2 was rewritten as Sample 4 in the key of G minor. The music follows the same tempo as the original sample with few embellishments. This sample will function as a variation on the original by offering the listener an opportunity to use the same interpretation for a piece of bona-fide music. To also be sure to reflect the sad emotional quality of its written purpose, the music is written in the minor key, with most intervals contained within the harmonic scale.

Table 8.

"Sad" Musical Sample Revised.

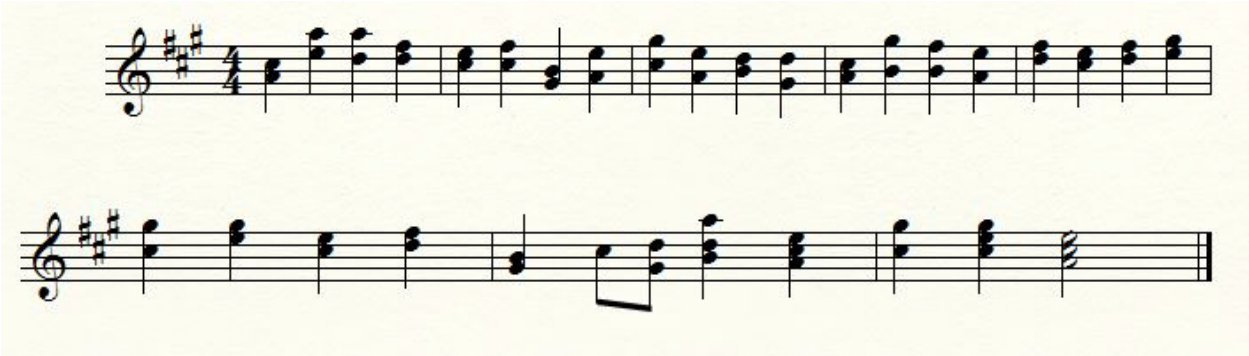


Note: also labeled "Music Sample 4."

Sample 3 was rewritten as Sample 5 in the key of A major. The music follows the same tempo as the original sample with several embellishments. The embellishments are added notes to function as harmony with the original melody. This sample will function as a variation on the original by offering the listener an opportunity to use the same interpretation for a piece of music written with counterpoint harmonization. To also be sure to reflect an enhanced happy emotional quality of its written purpose, the music is written in the major key, with most intervals contained within the harmonic scale.

Table 9.

"Happy" Musical Sample Harmonized.

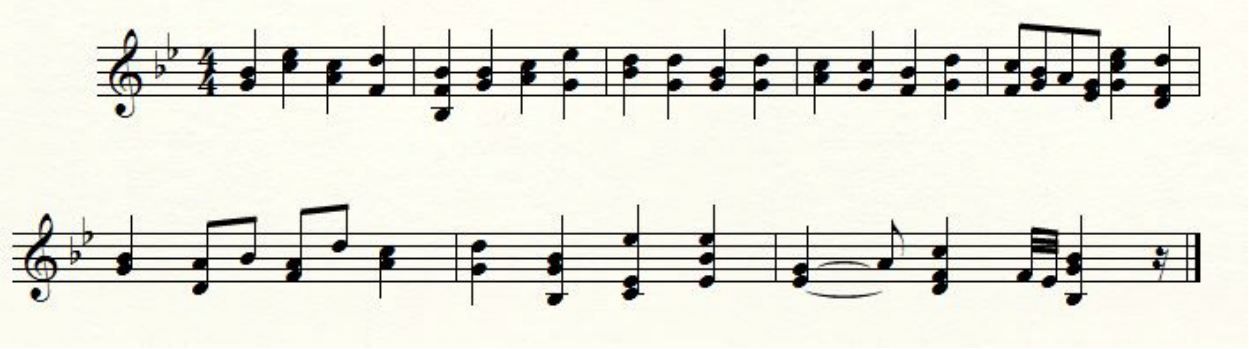


Note: also labeled "Music Sample 5."

Sample 4 was rewritten as Sample 6 in the key of G minor. The music follows the same tempo as the original sample with several embellishments. The embellishments are added notes to function as harmony with the original melody. This sample will function as a variation on the original by offering the listener an opportunity to use the same interpretation for a piece of music written with counterpoint harmonization. To also be sure to reflect an enhanced sad emotional quality of its written purpose, the music is written in the minor key, with most intervals contained within the harmonic scale.

Table 10.

"Sad" Musical Sample Harmonized.



Note: also labeled "Music Sample 6."

3.3.2 Music recording.

Using the same software program, *Finale NotePad 2012* (2012) to play the music samples using a MIDI piano keyboard sound, The investigator recorded the audio sample with the software program *Adobe Soundbooth CS4* (2009) into audio files an average length of eighteen seconds. The recordings were made at an average decibel rate of -7.23 and up to -8 db. The samples were then exported into a Windows Audio/Video file (wav.).

3.4 Survey Creation.

The musical samples were converted to a video format using the software program *Adobe Premiere Pro CS4* (2009). The video samples were created to have minimal influence on the test subject by having a black background, and showing three messages in white text during the playing of the sample music. Three message prompts are displayed in the video. The first message acts to prompt the subject to prepare to listen to the sample. The second message displays the question during the playing of the music. The final message thanks the participant and/or informs or prompts the subject of the next step. The video clips were then uploaded to the website Youtube.com (2013). Participants will choose to best interpret the music from a list of four choices: happy, sad, fight, flight, ambiguous, and "other" with a field for a typed answer.

Using the online survey hosting site FreeOnlineSurveys.com (2013) an account was created to host the survey questions and data gathering platform. This site allows for questions to be created and tracked for free, as well as a video URL web address to be embedded from another site such as YouTube.com (2013). The survey was created online through the website FreeOnlineSurveys.com (2013) and published to the web with three separate URL addresses. The different URL addresses were distributed to the three categories of sample populations. The website software from FreeOnlineSurveys.com gathered the data from the different URLs according to the separate categories of participants.

For the six musical samples, three represented happy sounding music, and three represented sad sounding music. Samples were edited to be 30 seconds each, which provided for a short musical statement.

Happy sounding music samples were varied according to their musical structure. One sample was Atonal, that is, not containing strict musical structures or patterns. Another sample was Tonal, that is, containing basic musical structure which causes a pattern to emerge which

sounds more "musical" than an atonal piece. The final sample was written with accompanying intervals of notes primarily in the 3rd and 5th position of a tonal scale. This causes a layered sound and allows for two different melodies to be present in one intertwined sound, further referred to as "Harmonized."

Sad sounding music samples were varied according to their musical structure. One sample was Atonal, that is, not containing strict musical structures or patterns. Another sample was Tonal, that is, containing basic musical structure which causes a pattern to emerge which sounds more "musical" than an atonal piece. The final sample was Harmonized, producing a layered sound and allowing for two different melodies to be present in one intertwined sound. Particularly for music written in a minor key, as were these Sad music samples, harmonized tones can produce a listener reaction that has no negative connotations at all.

Survey questions were put into no specific order in which the listener would be able to listen to random examples of happy or sad music samples played through the embedded YouTube clip. This ordering was chosen to have a variation in the samples, but also to allow for a uniform answer set with a central idea of being happy or sad.

The revised and harmonize versions will allow for the investigator to measure for the level of emotion the listen chooses to indicate. This investigator predicts the participants will choose write in the "Other" selection, with a submitted description of the interpreted emotion.

3.5 Participants and Distribution

Participants will be students of Minnesota State University of college age who are enrolled in courses involving different levels of music knowledge. Participant categories are: General level of music expertise, Middle level of middle expertise, and Upper level of music expertise.

Surveys were distributed through the online academic site D2L, in which the classes were provided a page to read the Consent Waiver and proceed to following the URL link to the survey. Subjects were not directly compensated for participating.

Survey results were collected from 45 participants in three categories of musical knowledge. The categories were: General level musical knowledge, Middle level musical knowledge, and Upper level musical knowledge. Surveys did not vary in their content, so each sample group received the same survey.

General level musical knowledge surveys were distributed among Communication Studies students, who represent a general level of musical knowledge. This group was considered a general level for the reasons that they were not n the music department, and they were a class which did not consist of upperclassman students.

Middle level music knowledge surveys were distributed among music students who were enrolled in beginning music theory classes. These participants were considered middle level knowledge due to the greater understanding of musical structures and tones, and they were a class which did not consist of upperclassman students.

Upper level music knowledge surveys were distributed among students who were enrolled in music performance classes. There participants were considered upper level knowledge due to their working knowledge and understanding of musical structures and tones. This class may have included some upperclassman.

Chapter 4: Results

Surveys were collected and tallied by the software from the hosting site FreeOnlineSurveys.com (2013). The investigator invested a membership fee to retrieve the numerical values and text responses and downloaded the files to Microsoft Excel spreadsheet files.

Survey results were then organized into a spreadsheet to observe the trends of the average scores for each survey question.

4.1 Data Analysis

A paired-samples T Test was conducted to determine if significant difference existed in the perceptions of the samples of music among the different groups. Means of the Likert scale answers from the participant groups were also graphed to see if a relationship between participants' answers existed. Finally, a textual analysis was conducted to look for similarities in the emotional descriptions given by participants.

The paired-samples T test was conducted to compare all six musical samples emotional qualities in the responses of participants with varying degree of musical knowledge.

There was no significant difference in the means for the Happy Atonal music sample between the three groups of participants ($M=3.64$, $SD=.683$); $t(35)=.809$, $p = .454$. These results suggest the musical sample was interpreted similarly by groups.

There was no significant difference in the means for the Happy Tonal music sample between the three groups of participants ($M=3.22$, $SD=.712$); $t(2)=1.483$, $p = .241$. These results suggest the musical sample was interpreted similarly by groups.

There was no significant difference in the means for the Happy Harmonized music sample between the three groups of participants (M=2.64, SD=.906); t(41)=1.301, p = .284**.** These results suggest the musical sample was interpreted similarly by groups.

There was no significant difference in the means for the Sad Atonal music sample between the three groups of participants (M=3.55, SD=.810); t(30)=.275, p = .762**.** These results suggest the musical sample was interpreted similarly by groups.

There was no significant difference in the means for the Sad Tonal music sample between the three groups of participants (M=3.21, SD=.843); t(37)=.074, p = .928**.** These results suggest the musical sample was interpreted similarly by groups.

There was significant difference in the means for the Sad Harmonized music sample between the three groups of participants (M=2.72, SD=.724); t(38)=3.380, p = .045**.** These results suggest the musical sample was interpreted differently by participant groups. Deeper analysis of the means show the General level music knowledge participants' and the Upper Level music knowledge participants' means differed from the Middle level music knowledge group.

The General level group mean (M=2.57) for this Sad Harmonized music sample suggests participants interpreted this sample to have characteristics associated with a degree of happiness. The Upper level group mean (M=2.50) for the same sample suggests this group interpreted the music as having a greater degree of happiness than the General level group did.

4.1.2 Mean Frequency Analysis

Analysis of the mean frequencies was conducted to determine if participants interpreted each musical sample with similar emotional values.

Table 11. Means of Participant Groups

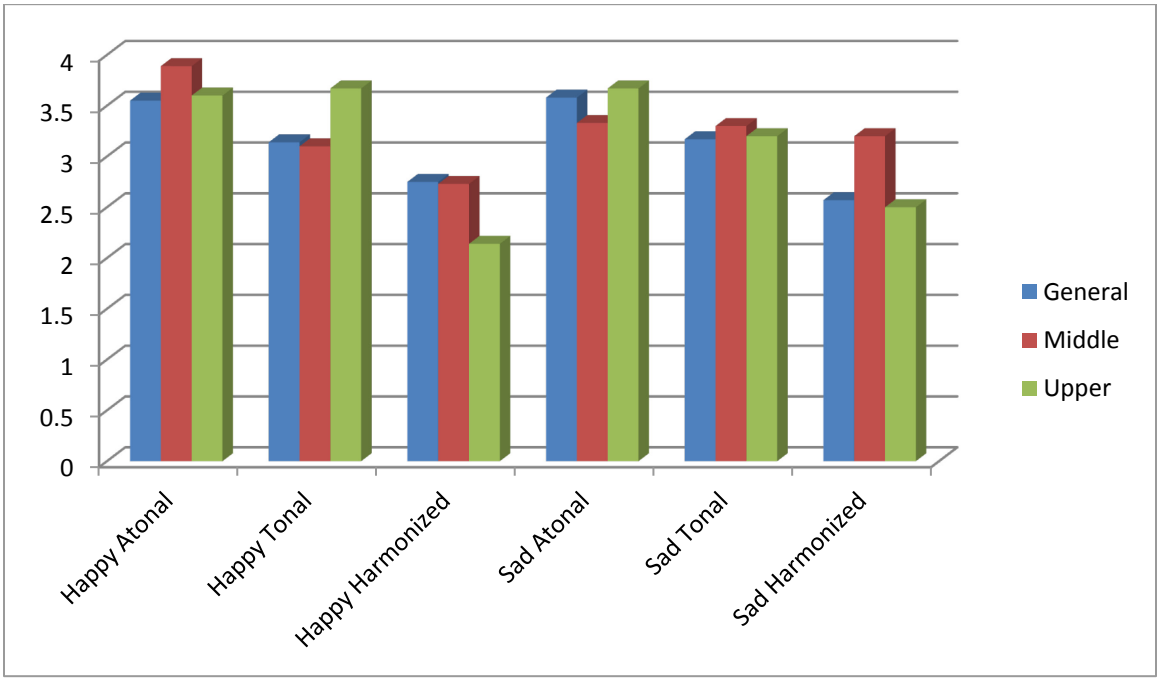


Table 11. Means of participant groups on a scale of 0-5

Mean frequency reflects the relationships between participant interpretations between groups. Mean variables of 0 through 2 indicated happy interpretations of the samples and mean variables of 3 through 5 indicated sad interpretations of the musical samples.

Participant groups recorded similar results only for the Happy Atonal, Sad Atonal, and the Sad Tonal musical samples. The comparison of the means suggest that participants interpreted the happy musical samples with a greater variance than the sad musical samples. This may be due to the presence of musical structures commonly associated with emotional qualities that are not strictly happy in nature.

The Happy Atonal musical sample was interpreted by participant groups as having a degree of sadness as the means range above the variable of 2.

The Happy Tonal musical sample was interpreted by participant groups with mixed results. The General and Middle level participants have similar means for this musical sample, while the Upper level group mean suggests a mixed interpretation of the sample.

The Happy Harmonized musical sample was interpreted by participant groups with similar and polarizing results. Means suggest an interpretation of a happy emotional quality (M=2.64). The Upper level participant means indicate a higher degree of interpretation of happiness for this sample.

The Sad Atonal musical sample was interpreted by participants similarly between groups. The means suggest an interpretation of a sad emotional quality (M=3.55).

The Sad Tonal musical sample was interpreted by participants similarly between groups. The means suggest an interpretation of a sad emotional quality (M=3.21).

The Sad Harmonized musical sample means between groups indicate mixed results. The General and Upper level participants interpreted this sample at a similar mean, but the Middle level participants interpreted this sample as having a greater degree of a sad emotional quality (M=3.20). General and Upper level participant group means suggest participants interpreted this sample as having a slight degree of happiness with the mean of the General group = 2.57, and the mean of the Upper Group = 2.50.

4.1.3 Textual Analysis

Textual analysis was conducted to note the trends of any written responses to a write-in "ambiguous" answer in the Likert scale survey question. Two additional questions provided the participant the opportunity to write in a description of the musical sample. The textual answers combined with the descriptions of the varying levels of emotional quality provide the investigator with closer views of the participants' interpretation of the musical sample.

For the Happy Atonal musical sample, participants in the General group indicated descriptions mixed between “happy,” “sad,” and “very sad.” Ambiguous answers from the Likert scale contained descriptions such as “feel odd,” and “confusing.”

Descriptive answers further revealed the divide between a happy and sad sound. Some participants indicated this sample was “abstract, melancholy, awkward, and ominous.” This sample rendered descriptions relating to descriptions relating to being afraid and confused. On two occasions, participants described the sample as “depressing.”

For the Happy Tonal musical sample, participants in the General group indicated descriptions mixed between “happy, very happy, sad,” with some ambiguous answers from the Likert scale contained descriptions such as “neutral, and satisfied.”

Descriptive answers represented a large scale of emotional quality depending on the interpretation of being happy or sad. For happy interpretations, General level participants used words such as “playful, peaceful night, cheery, soothing.” Middle level participants did use their musical knowledge to analyze the musical structure of this sample, and used descriptions such as “lullaby, light, satisfied, and content.” For sad interpretations, General level and Middle level participants used words such as “somber, scared, and angry.”

For the Happy Harmonized musical sample, participants indicated descriptions between “happy, very happy, and extremely happy,” with few indications of being “sad.” There were no ambiguous answers from the Likert scale.

Descriptions associated with events, such as “wedding” and “Christmas” music with “church” or “choir” interpretations appeared in the General participant group. General group participants also associated the sample, or “reminds me of my childhood” or “light hearted.” Some participants did indicate the sample had sad aspects that reminded them of “longing,

looking for something," or as "slow, sad," Although these participants indicated their interpretations as "sad," their descriptive answers were very similar to the idea of remembering something.

For the Sad Atonal musical sample, participants in the General group indicated descriptions mixed between "happy, very happy, sad, and very sad." There were no ambiguous answers from the Likert scale. Descriptive answers revealed the answers relating to sad interpretations hinted at a sound that, to the General group, was "mysterious, ugly sounding, and bland."

Middle level participants described this sample as "awkward, derriere, and puzzled," while other participants deemed the sample "sounded like joking" and was "not easy to listen to, gave an uneasy feeling." Upper level participants noted the structure of the music as well, using descriptions such as, "determined, frustrated" and "sometimes happy, sometimes sad."

The Sad Tonal musical sample indications were mixed between "happy, very happy, extremely happy, sad, and very sad" There were no ambiguous answers from the Likert scale.

Descriptive answers further revealed the divide between a happy and sad interpretation. Participants indicated happy interpretations as "triumphant, energetic, enlightening, and gleeful." Participants who indicated sad interpretations used words such as, "agitated, melancholy, bored, low, afternoon run, questioning." Middle level participants continued to comment on the musical structure of the sample.

For the Sad Harmonized musical sample, participants in the General group indicated descriptions between "happy, very happy, extremely happy," and a few indicating "sad." There were no ambiguous answers from the Likert scale.

Descriptive answers revealed General level participants interpreted the sample as being more “pleasant, joyful, and upbeat.” These results were similar to the Upper level results. The responses from the Middle level participants reveal the music of the sample confused them, indicating they hear both the major and minor chords. Textual responses such as “incomplete idea, pleasant to the ear, cheerful,” with some write in responses “more melodic, and consonant.” Other answers, such as “it starts out minor, but ends in major so it makes it confusing…” and “sad, minor melody but the accompanying notes lift it up…” indicate the harmonies in the sample played an important factor in the emotional interpretation of the musical sample.

4.2 Limitations

The main limitation to this study was the number of participants involved. For statistical analysis to have stronger conclusions, this type of test would need to be distributed to a vast amount of listeners with cultural demographics accounted for. The Upper level participant group had the smallest number of results in the total of surveys, which presented a great difficulty to differentiate results at the time of this study.

This particular test also may be limited by the nuances of musical structure. All of the sad musical samples registered on some level with participants as indicating a happy sound. The musical sample with the most musical structure, the Sad Harmonized sample, was interpreted as having very positive characteristics regardless of the incorrect musical direction. This is possible since the harmonized notes act as accompaniment to the basic musical structure.

In regards to the mixed emotional interpretations of participants based on the musical structure variances, the sample that was supposed to be the saddest, registered as the saddest. The sample that was supposed to register the happiest did register in kind. Indications from the Middle level participant group suggest that they were looking for the music to be “right,” that is,

to have a regular sound to it and to have clarity in musical structure. General level descriptions were suggestive of the listener's own associations with the sound, as they used descriptions that had to deal with direct emotional qualities from their own experiences.

Chapter 5: Discussion and Conclusion

R1: To what degree does purposively created emotional music communicate emotion?

The results of this study indicate that this question must be answered with a greater degree of musical structural attention based upon abstract, non-western, and western musical structures within the previously discussed harmonic frequency (F0) ranges. Within these ranges also, smaller ranges of musical pitch diversity would also contribute to a more definitive musical sample. That range may limit some musical structures, which is a testament to the varying emotions a listener can interpret in music.

This study sought to find if emotional quality could be purposively written into a musical sample based on the F0 value of emotive speaking as presented by Van Den Broek (2004). The results show that a more conclusive test would be to incorporate tested musical structures to signal upswings, dips, and transitions of pitches. This may still be done within the harmonic frequencies of the proposed ranges, but within narrower ranges still. Also patterns of pitch movements and the increments of frequencies they cross would provide a detailed look at what contributes to an emotional interpretation. This is due to evidence from this study that multiple emotions were indicated within single musical samples with varying degrees of indicated emotion. Also, vocal performance of the musical samples would provide for a more emotive delivery. Further study must deal with the influences of the harmonies of notes that play a factor in the interpretation of the emotional quality of the musical piece.

The fact that these musical samples were short in length, not strictly following western musical structure, and not previously heard by participants suggests evidence that the emotional content of music has some root in the harmonic frequency of the sound waves of the notes.

Unfortunately, this study does not have enough survey results to make a strong statistical argument for this phenomenon.

Further study is needed to discover the parameters that harmonic frequency plays in the influence of the emotions. Modification of the research method from the present study will benefit Communication Research branches that concern paralinguistic features of an emotive speaker. Musical frequencies may reveal basic structural sound frequencies that a listener subconsciously reacts to, or seeks out.

The role of sound wave frequency in human communication may be beneficial in speech and music therapy. Patients may find benefit if they are exposed to and utilize sounds that the brain reacts to as a positive and progressive message to speed recovery or stimulate memories. Emotive music also presents a vessel for the listener to remember their own interpretations of what they hear. Psychological therapists may benefit from this knowledge by having their patients present their interpretations for further analysis into their psyche or condition.

Musical frequency and its role in human emotion cognition may allow further research into the inner workings of the functions of the brain. Questions to ask across disciplines will focus on the role that frequency plays in all cognitive situations. Are emotive frequencies for emotional quality the same across cultures? What are the ideal emotive frequencies to aim for during a public speech? Do the same frequencies that trigger emotion for a single listener translate to the masses in a social situation? Do younger listeners interpret these emotional frequencies different than older listeners?

If indeed this phenomenon exists, and frequency parameters translate to the human brain as a contribution to an emotion, then perhaps this may be a clue to how humans learn their

emotions. In the womb, the fetus is subject to the same sound waves as the mother, including the mother's voice.

Finally, study into the sound wave frequencies of human communication will benefit the technological realm. Software may be integrated into computer intelligence, so that a sensor may be built to analyze the frequency of a human communication. In this way, the computer may be able to detect stress, or distress, or happiness, and provide an intelligent function in turn. This will greatly benefit society as our personal security relies on calling for help. In distress, we may not be able to properly voice command our smart phone to call the emergency line, and with a program that is testing the vocal quality for emotive content based on the frequencies of the voice, chance of survival may increase.

Conclusion

I believe this is research of the non-physical. Sound wave frequency is an example of descriptive physics. It is a way to describe the vibrations that our brain may interpret as auditory sensation. This very basic description hints at the greater mechanisms that function inside our brains to make sense of the outside sensation. Our brain must interpret the sound it receives and the only information it has to go by is that the sound wave is vibrating the air at different speeds. The resonant frequencies of our environment all contribute to the sensation of hearing, giving particular sound quality to everything.

This study may be providing evidence that the brain is taking cues from the sound wave frequencies it receives, and attributing meaning to those frequencies, even if the stimulus is not making the most sense. This alone is enough to encourage further study into this phenomenon because some people would like to know what frequency to listen to which would help them

change their mood, target a particular mood in the presence of others, or convey a desired emotional quality in a piece of art or presentation.

Further research must continue this cross-discipline study of music and communication. It is the hope of the investigators that studies such as this one will begin to contribute to the body of literature concerning the advancement of knowledge of the human communicative process and the role that music plays in the emotional health of an individual. Emotive frequencies may be a key turning point in research.

I will continue this research in a related fashion, as I also believe the characteristics of frequency are related to the movements of energy and electricity. Frequency is a catalyst of energy, and humans respond to frequency in different ways. The world and future of it are ready for this type of research.

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