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Research Paper

Analyzing the Effect of Chord Progression and Instrument on Music in Perception of Emotion in Different Age Groups

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ABSTRACT

Psychoacoustics is the study of the relationship between physical characteristics of sounds and how they are perceived. Music has always been recognised as an outlet for one's emotions, listening to music helps increase focus and reduces stress. This impact is due to different characteristics like harmonic cadence being played and the tempo of the instrument. The present research paper explores how perception of music is influenced by the chords, and instruments used among different age groups and what emotion they associate this with. 3 chord progressions were played by 3 different instruments, and 9 audio samples were created and shared with 41 respondents through a survey. After listening to each audio, participants were made to choose a particular emotion they associated the audio with. It was found that progressions as well as instruments had an impact on the emotions one associates with. These findings can be applied in music composition, music therapy and audio engineering. These findings can be used to further the field of psychoacoustics by helping researchers track what specific characteristics of music can elicit certain physiological responses from people.

Keywords: *Progression, Chord, Emotion, Instrument, Music*

For centuries, music has played an important role in film and theater. This can be traced back to some of the earliest instances of theater, Shakespeare's play 'The Tempest, which features four musical compositions (Shakespeare, 2011). These compositions were used to highlight emotional themes portrayed in a scene, to bring about comic and musical relief from the more serious scenes, and to heighten emotion in charged and important scenes. Music has also been associated as a way of conveying emotion (Juslin, 2013).

Although music has greatly evolved and changed across time, cultures and geographical location there are still numerous similarities shared by music and musical systems across time. Ancient civilizations like the Greeks, Romans, Egyptians, Babylonians, and Hebrews shared a common musical system with intervals of fourths, fifths, and octaves (Nature, 1874). This similarity may be attributed to the mathematical basis of the harmonic interval system showcasing how the universal principles of music theory are common across cultures (Weiss & Taruskin,1984). However, despite this shared system, these cultures produced distinct and unique musical pieces.

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Another common trait among humans is the preference for consonant sounds over dissonant ones, a trait that distinguishes humans from other apes (Jones et al., 2010; McDermott et al., 2010). This preference for consonance has greatly affected music composition across the ages. Dissonant music has been used to build tension and intrigue while consonant music has been used to provide a conclusion and resolution to the tension (Zhang et al., 2022). This pattern of tension and release due to dissonance and consonance is heavily used in blues and jazz music and gives it its characteristic sound.

Psychoacoustics is a field of psychology and acoustics that studies how sound is interpreted and perceived by humans and the psychological and physiological responses to it. Psychoacoustics explores various characteristics of sound such as pitch, loudness, timbre, sound quality, spatial positioning etc and how their variation affects human perception of them.

Psychoacoustics plays a vital role in understanding the connection between music and emotions, and focuses on the concepts of "perceived emotions" and "induced emotions." Perceived emotions are those which listeners associate with a specific musical composition, while induced emotion represents the emotions listeners actually feel when exposed to the music. Various methods, including brain wave analysis, facial muscle activation, and self-reports, are used to measure emotion, with self-reporting being the primary method (Jones et al., 2010).

Perceived and induced emotions both are influenced by an individual's past experiences and memories associated with certain sounds. Furthermore, factors such as tempo, mode, loudness, pitch height, and timbre can all influence the perceived emotions of listeners (Jones et al., 2010). While previous research has explored the relationship between major and minor tonality and their impact on perceived emotion in music, little research has been done exploring how variations in timbre and the age of the respondents affect the perception emotion of a composition.

This study aims to explore how musical cadence, timbre, and sound quality changes influence the perceived emotions of listeners. Participants from different age groups will be exposed to three different chord progressions played on three different instruments. These chord progressions involve modulation in musical key, pitch, and cadence, while the choice of instruments will account for variations in timbre quality and tonality. After listening to each audio segment, participants will be asked to identify the emotions they perceived in the music.

METHODOLOGY

Aim of the Study

This study explores the between musical chord progressions, the instruments used for playing these progressions, and the resulting perceived emotional tones within the musical composition.

Research Design

This research adopts a survey-based approach, in which participants were made to listen to nine distinct audio samples. Each audio sample consisted of one of three chord progression, played by one of three instruments, leading to 9 audio samples. The study follows an exploratory design and aims to identify insights and patterns between the 3 age groups. In

this case, the independent variables are the nine audio samples, and the dependent variables are the perceived emotions of the participants and any discernible trends found through the analysis of the responses.

Tools used

Each audio sample was created using the 3 following chord progressions

1. C Major, G major, A minor, F major
2. C minor, Bb major, Ab major, G major
3. C major, Db major, Gb major, Ab major

TheAnd the 3 following MIDI instruments

1. Guitar
2. Grand Piano
3. Strings

Each chord is played and sustained for 1 second total before moving on to the next in the progression. Each progression is repeated a total of 4 times. After listening to the audio sample, participants are made to choose one emotion from the following emotion wheel. Each response is simplified into one of 7 broader categories, which are

1. Bad
2. Sad
3. Happy
4. Fearful
5. Angry
6. Disgusted
7. Surprised

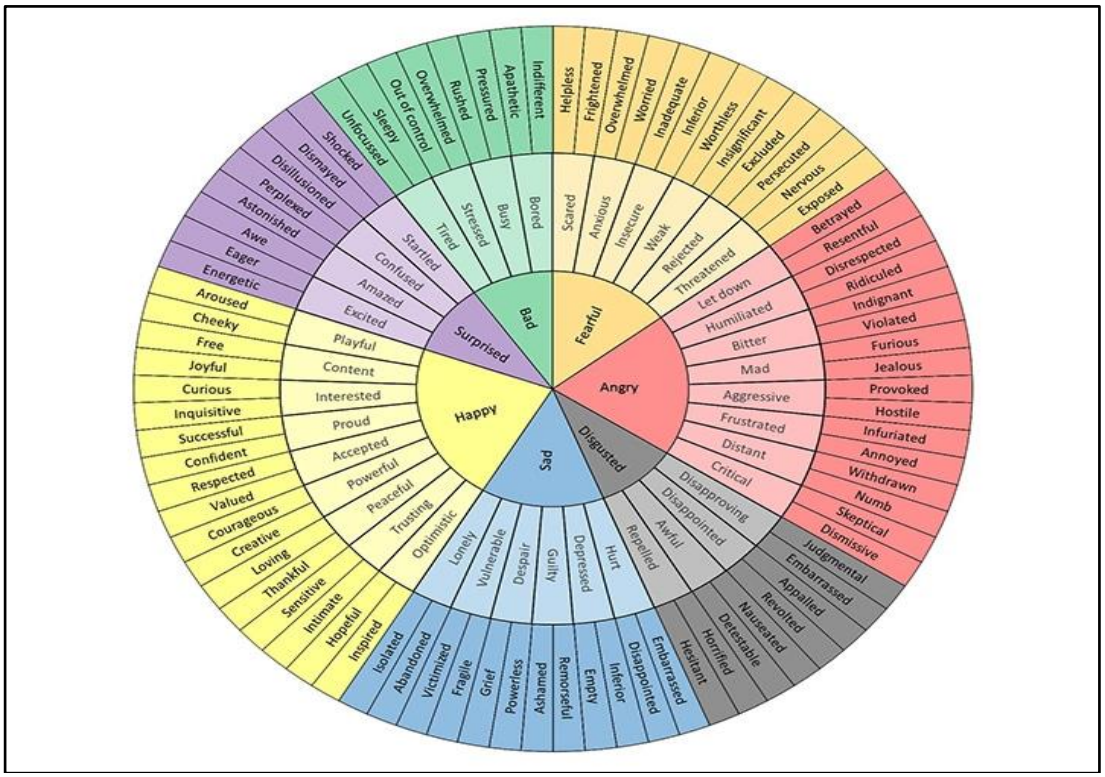

Figure 1: Chart of Perceived Emotions

Consent and Ethical Issues

Informed consent was taken from participants for data collection. Confidentiality and privacy of the respondents were maintained; no data would be disclosed to a third party. No identifiers, such as names or pictures, were disclosed in the article or while conducting the study. Ethical guidelines of research were followed.

Sample

The sample consists of 40 participants chosen using convenience sampling. were recorded and analyzed. Of these 40 people, 12 were between the ages 20-30 (30%), 12 were greater than 40 years old (30%), and 16 were between the ages of 5-19 (40%).

Data collection procedure

A google form was sent out to all participants, which they were required to fill out. The google form contained all 9 audio samples and an attached image of the emotions wheel for participants to use as a reference.

Data analysis strategy

The results were divided based on age category and audio then tabulated. The resulting tables will be analyzed to uncover any possible connections between participants' age, musical chord progressions, the choice of instruments, and the perceived emotion of the particle musical composition.

RESULTS AND DISCUSSION

The results of the survey showed that there was a large variation between the perceived emotions between audios as displayed below.

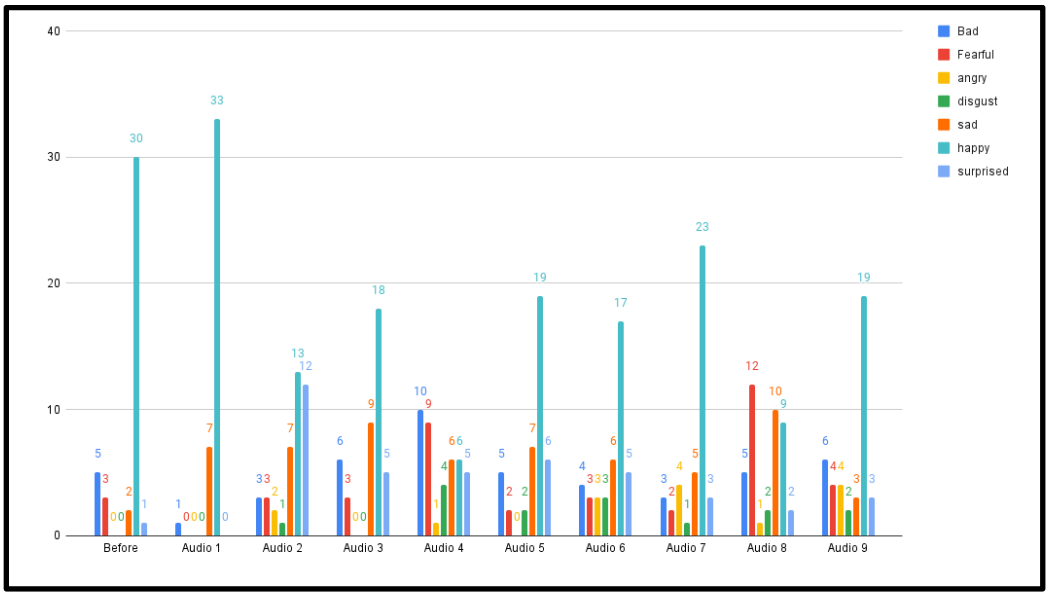

Figure 2: Graphical representation: Perceived emotion of all respondents (N= 41)

In Figure 2 it can be seen that before listening to the samples, the participants reported their emotional state was Happy, Sad, Bad and Angry. The majority of participants perceived audios 1 to 9 as **happy,** with respective percentages of 80.4%, 31.7%, 43.9%, 46.3%, 41.6%, 56%, and 46.3%. Audio 4 (14%) and Audio 8 (21.9%) were not majorly perceived to be happy. In all audios a minimum of 3 people perceived the audio to be sad. Furthermore, all

audios except audio 1 were perceived as fearful, bad and *surprised*. Anger and disgust were the emotions which were least associated with the audios, it was associated with audio 2, audio 4 and, 8, 7, whereas disgust was associated with audio 6, audio 7 and 9. The rest of the audio samples were not perceived to be angry by any of the respondents.

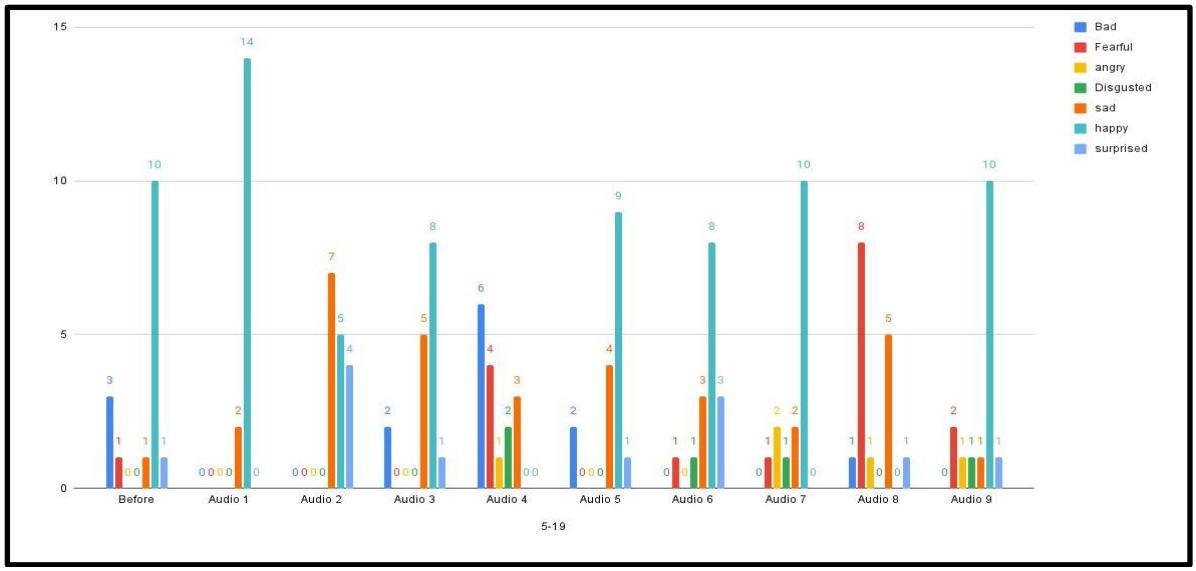

Figure 3: Graphical representation: Perceived emotion of respondents aged 5-19 years old (N=41)

In Figure 3 it can be seen that the majority of the participants were happy **62.5%** before listening to the audio samples, with the rest being bad **(18.7%)**, fearful, sad, surprised **(6.25%).** Out of all the audios, only audio 2 (31.2%) was not perceived to be majorly *happy*, while audio 4 and audio 8 were not perceived to be *happy* by any participants. Furthermore, all the videos were perceived to be *sad* by at least one person. The emotions least associated with the audio were *disgust* and *anger*. Only audios 4,7,8 and 9 were perceived to be *angry*, while only audios 4,7, and 9 were perceived to be *disgust.*

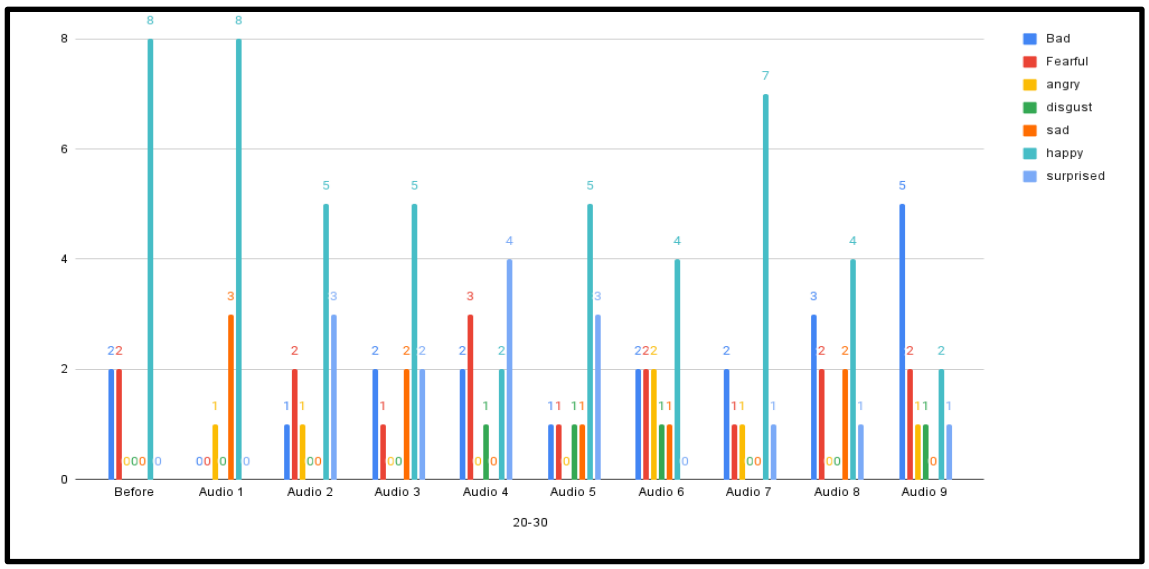

Figure 4: Graphical representation: Perceived emotion of respondents aged 20-30 years old (N= 12)

In figure 4 it can be seen that before the participants listened to the audio, they were happy **(66.6%),** bad **(16.6%)**, and fearful **(16.6%).** Out of all the audios only audio 4, and audio 9 were not majorly perceived to be *happy*. Furthermore, all audios except audio 1 and audio 6 were perceived to be *surprised* and only audios 1,3,5, and 8 were perceived to be *sad.* The emotion least associated with any of the audios were *anger* and *disgust* with no more than 2 people selecting those emotions for any one particular audio. Furthermore, the emotions *anger* and *sad* were not picked more than 3 times for any one particular audio.

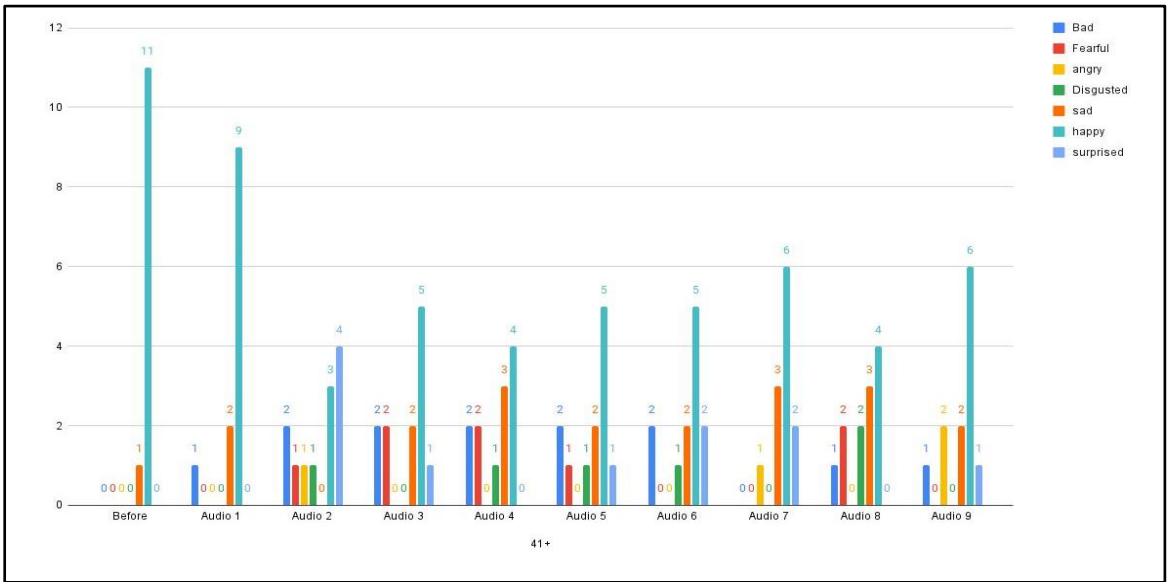

Figure 5: Graphical representation: Perceived emotion respondents aged 41+(N= 12)

In Figure 5, we can see that before any of the respondents listened to the audio, the majority of them were happy (91.6%), while the rest were sad (8.4%). In this age category, all audio samples were perceived to be happy by at least 3 people. Furthermore, all audios except audio 2 were perceived to be sad. This sample had an almost equal distribution of the emotions "bad," "anger," and "disgust." In this category, the emotion least associated with any audio was once again anger and disgust, with no more than 2 people picking the emotion for any one of the audio tracks.

DISCUSSION

In this section, the results based on three categories, the respondents age, the instrument playing the audio, and the chord progression in each of the audios will be discussed. Across the audios it can be seen that the audio which was perceived to be *happy* by the most people was the one consisting of the chord progression C CG Am F. All the above chords are in the same musical key. The progression Cm Bb Ab and G was perceived to be both *happy*, and *fearful* in many of the audios. These chords are all in the same key but it is a minor key.

Thus, it can be inferred that a chord progression sounds more pleasant if all the chords are in the same musical key, and that the major key is perceived to be more pleasant than the minor key. Similar findings were found in a study done by (Parncutt, 2014). In the study major chord progressions and minor progressions were rated by listeners as pleasant or unpleasant and the levels of consonance and dissonance for each progression was measured. It was found that respondents rated the minor chord progression as unpleasant more often than major ones , and that minor progressions had a higher level of calculated dissonance. Studies

have shown that the sequence of major, minor, and augmented chords can affect the perception of dissonance, with chords less than a semitone apart creating a more negative impression on listeners (McDermott et al., 2010).

Audio 1,3, and 7 all consisted of the same progression C G Am F but were all played on different instruments. Audio 1 was played on the piano, audio 2 was played on the strings, and audio 3 was played on the guitar. It can be seen that the sample played by the piano was perceived to be happy by the largest majority, followed by the progression using the guitar and then the strings. It can also be seen that in the sample played by strings, there is a sharp increase in the number of people who chose 'bad' as the emotion and 'surprised' as the emotion. In the sample using the guitar, the majority was 'happy', and the rest of the emotions were almost equally distributed, except sad, which stands out from the rest.

Audio 6, 2, and 4 all consisted of the same progressions Cm Bb Ab G, although they were played by the piano, guitar and strings, respectively. Audio 6 was mostly 'happy' with the other emotions evenly distributed, with *sad* standing out. Audio 2 was still majorly 'happy' but was closely followed by 'surprised' and 'sad. Audio 4 was majorly 'bad', closely followed by 'fearful', and then sad.

Audio 5, 9, and 8 all consisted of the same progression C Db Gb Ab, although played respectively by piano, guitar, and strings. It can be seen that both audio 5 and 9 have the same number of 'happy' and almost the same distribution of the other emotions. Audio 8 on the other hand has the greatest majority of 'fearful', closely followed by sad.

Similar results are seen in a study wherein people from different age groups were made to listen to the same melody, played by various western instruments which listeners would be familiar with (Hailstone, 2009). It was found that people perceived the violin to be *sad* as compared to the guitar and piano (Hailstone, 2009). A possible reason for this could be the lack of distinct chord changes in strings. When a piano and guitar are played, it is very distinct when one chord changes to another, but in strings the change is not so distinct. One chord melds into another leading to a more *mysterious* and *unsettling* sound.

Emotion Observed	**Avg Across Age 5 to 19 yrs**	**Avg Across Age 20 to 30 yrs**	**Avg Across Age 41 Plus yrs**
Happy	44%	38.8%	38%
Sad	23%	8.3%	17.5%
Bad	7.6%	16.6%	12%
Fearful	11%	13%	7%
Disgust	3.6%	5.5%	5.5%
Anger	3.6%	3.7%	3,6%

Figure 6: Graphical representation: Average perceived emotions per audio (N= 41)

As study the emotions perceived across age groups, find that in the age group of 5 to19 years, happiness is the highest at 44% and progressively decreases as the age increases. The second highest emotion expressed across is Sad. This is at 23% in the age group 5 to 19 yrs. and is at 17.5% in Age group 41+. However, in the age category of 20 to 30 years, this is replaced by the emotion of Bad. Fearful as an emotion shows a slight increase from 11% to 13% over the 5 to19 yrs., and moving onto the 20 to 30 yrs. group. However, it falls to a 7%

in the 41yrs., plus age group. On the other hand, disgust as an emotion shows a slight increase across age groups, increasing over the first 2 age groups. Anger, the least observed emotion across the age groups, is at a similar average of 3.6% to 3.7% across all 3 age groups.

It is seen that the age group of 5-19 had the highest percentage of audios being perceived as sad while the age group of 41+ has the lowest percentage of audios being perceived as the same. This is also seen in (Castro & Lima, 2014) where participants from different age categories were made to listen to different audios. It was seen that there was a steady decrement in the perception of sadness with an increase in age . It is also seen that the age group 5-19 had the highest percentage of audios being perceived as *happy; this* large split between opposing emotions can be attributed to hormonal changes as seen in (Koelsch, 2011).

CONCLUSION

This study analyzes how variation in certain musical characteristics such as chords being played in a progression, instrument played in a progression, and a listener's age affect the emotion they associate the audio with. It was found that chords being played in a major key were perceived to be the happiest, followed by those in a minor key, and lastly, progressions with chords not from the same musical key were perceived to be associated with negative emotions the most commonly. Furthermore, it was found that when a progression was played with stringed instruments such as a violin, it was associated with negative emotions more often than if the same progression was played using an instrument such as a piano. It was also found that respondents from younger age categories chose perceived audio to be *happy* more often than those in older age categories.

A limitation of this study is the small sample size. Furthermore, the responses could have been affected by social bias and personal experience and connection to certain types of music. This study does not measure physiological responses to listening to the audio and this relies on responses from respondents regarding the choice of emotion. Furthermore, this paper only studies how the change in a few characteristics affects the emotion an audio is associated with. Further research should be conducted to investigate how the variation of other characteristics, such as timbre, spatial positioning and so on., affects the perceived emotion of audio. Research should also be conducted into how these findings can be used to further the knowledge in fields such as music therapy for pain and PTSD management. This paper furthers the field of psychoacoustics by exploring how various characteristics of audio affect how they are perceived. Further research can be done in the field of psychoacoustics to explore the variation in physiological responses to audio rather than the subjective responses. Further research can also include other musical characteristics such as spatial positioning, loudness and tempo.

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Conflict of Interest

The author(s) declared no conflict of interest.

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