Music as Evidence for a Creator

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A Senior Thesis submitted in partial fulfillment
of the requirements for graduation
in the Honors Program
Liberty University
Spring 2019

Acceptance of Senior Honors Thesis

This Senior Honors Thesis is accepted in partial fulfillment of the requirements for graduation from the Honors Program of Liberty University.

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Abstract

Throughout history, mankind has made music. While music is artistic, it is also scientific and informed by natural occurrences within the physical world. Mathematical relationships between frequencies, the harmonic series, the materials necessary to build musical instruments, and naturally measured time provide bases for the musical elements of pitch, timbre, and rhythm. Though scientific discovery can inform the practice of music, the origin of music cannot be explained through scientific or evolutionary means because music is not a necessity for survival. The fact that music does exist and has natural bases suggests that music is designed, and its elements were placed in the physical world by a Creator who is beyond that which is physical.

Music as Evidence for a Creator

Introduction

There are many differences among people of the world, but music is a cultural aspect that they all have in common because it is made by all people. Despite differing interpretations, music is not the result of mere chance. Nature contains several elements of music which inform musical practice while still leaving room for creativity. However, the origin of music cannot be explained scientifically. By looking beyond the physical universe, one can see that music is designed and suggests the existence of an intelligent Creator.

What is Music?

Any discussion of a topic should start with a clear definition of that topic. Music presents a challenge because its many aspects and cultural ideas make it difficult to define.[1] While many definitions exclude styles or aspects of music, others seem to be too inclusive. The twentieth century Avant-Garde composer John Cage reexamined the traditional distinctions between music and sound.[2] His work *4'33"*, which is four minutes and thirty-three seconds of silent listening, is meant to express the idea that the ambience of the performance space is itself the music. This line of thinking is inclusive but seems contrary to centuries of musical composition and discovery. For the purposes of this

1. Philip Ball, *The Music Instinct: How Music Works and Why We Can't Do without It* (Oxford: Oxford University Press, 2012), 9.

2. Stuart Chapman Hill, "A "Sound" Approach: John Cage and Music Education," *Philosophy of Music Education Review* 26, no. 1 (2018), http://ezproxy.liberty.edu/login?url=https://search-proquest-com.ezproxy.liberty.edu/docview/2056423877?accountid=12085.

thesis, music will be defined as the human organization of sound in a manner which is purposeful and involves pitch, rhythm, and timbre.

Purpose

Music is purposeful. Composer Paul Hindemith once stated that "Music that has nothing else as its purpose should neither be written nor be used."[3] Music can have several purposes or functions. Music is often used to accompany dance. In fact, in some areas of the world, there is no distinction between music and dance. They are considered the same with no words to distinguish between the two. Music has social functions that allow groups to express emotions and participate in rituals. Music can provide a socially acceptable means of communicating controversial ideas or behaviors[4].

Interestingly, as Philip Ball pointed out, "music does not have to be enjoyed."[5] The functions of music are not always recreational. For example, music can be used as a form of communication. This application is most evident in the use of the talking drum in some African regions to communicate specific information over great distances. While entertainment can be, and often is, a purpose of music, it is by no means a requirement.[6]

Pitch

Another element of music is pitch. Pitch should not be confused with melody. Pitch refers to the highness or lowness of sounds in music whereas melody refers to a

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3. Ball, *The Music Instinct,* 11.

4. Ibid.

5. Ibid., 5

6. Ibid., 11

succession of pitches. A more scientific definition of pitch would describe it as vibrations. Much like disturbing a body of water creates waves in the water, a disturbance in the air creates invisible waves that send vibrations through the air. These vibrations are interpreted as sounds which is why they are called sound waves.[7] The number of times a sound wave moves up and down in one second determines frequency which is measured in cycles per second or Hertz (Hz).[8] The greater the frequency of a vibration, the higher the pitch. For example, all notes in western music are tuned relative to concert A, the A above middle C. The common frequency used for concert A in the United States is 440Hz. A pitch an octave higher has twice the frequency. This means the A one octave above concert A would be 880Hz. This is true for all octave relationships. All other intervals have ratio relationships as well. These will be discussed in detail later.

Rhythm

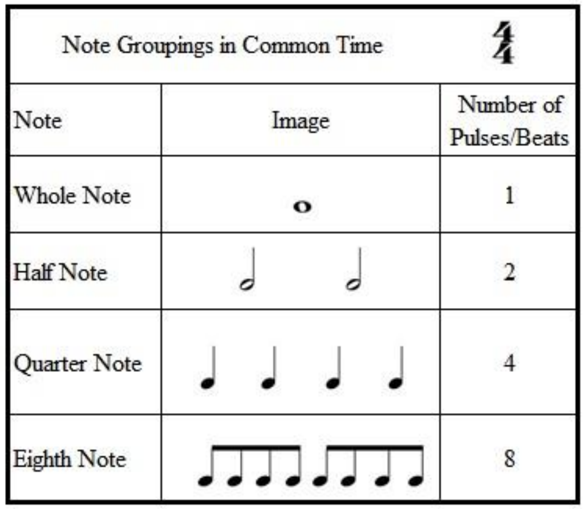
Pitches alone do not result in music. Additional systems are necessary. One such system is rhythm. While pitch deals with the highness or lowness of a sound, rhythm deals with how music moves through time and is achieved through the use of notes with specific durations.[9] Related to rhythm is meter which refers to groupings of pulses in music. Meter is indicated in notated music through the use of time signatures. In a time signature, the top number tells how many pulses are in each measure, and the bottom number tells what kind of note is assigned to each pulse. For example, 4/4 time has four

7. Leo Samama and Dominy Clements, *The Meaning of Music* (Amsterdam: AUP, 2016), 27.

8. John Sidtis, *The Cambridge Encyclopedia of the Language Sciences*, ed. Patrick Colm Hogan (Cambridge University Press, 2011), "PITCH."

9. Justin London, "Rhythm," *Grove Music Online*, 2001, https://doi-org.ezproxy.liberty.edu/10.1093/gmo/9781561592630.article.45963.

pulses, or beats, per measure. Each pulse is equal to a quarter note (Since 4/4 is the most common meter, the notes are named based on the fraction of the measure that they encompass.) Figure 1 shows the groupings of different types on notes in 4/4 time.



Note Groupings in Common Time 4/4		
Note	Image	Number of Pulses/Beats
Whole Note		1
Half Note		2
Quarter Note		4
Eighth Note		8

Figure 1. Note Groupings in Common Time

Rhythm and meter work together because they are both divisions of time. Often, rhythm operates within meter by dividing up the pulses into smaller sections; this is achieved by using the different types of notes such as those seen in Figure 1. However, rhythm is not merely random groupings of notes into meter. Especially in music with text, rhythm needs specific points of emphasis to make sense; the same is true of poetry. This emphasis is achieved by the use of rhythmic structures such as the iamb, trochee, dactyl, and anapest.[10]

Iamb refers to an alternating pattern of a weak beat followed by a strong beat. An example of iambic music would be the Christmas song “I Saw Three Ships” where the emphasis is on every second syllable such as the words “saw” and “ships.” The opposite of an iamb is a trochee which is made up of an alternating series of a strong beat followed

10. Ball, *The Music Instinct,* 214.

by a weak beat. A trochee can be seen in the verses of the hymn “Love Lifted Me.” A dactyl is a repeating set of three beats in which the first is strong and the second and third are weak. The children’s song “The Grand Old Duke of York” exemplifies the use of dactylic rhythm. Lastly, an anapest is the opposite of a dactyl consisting of two weak beats followed by a strong beat. The children’s song “Ten in the Bed” uses Anapests throughout.[11] The examples mentioned above can be seen in Figure 2.

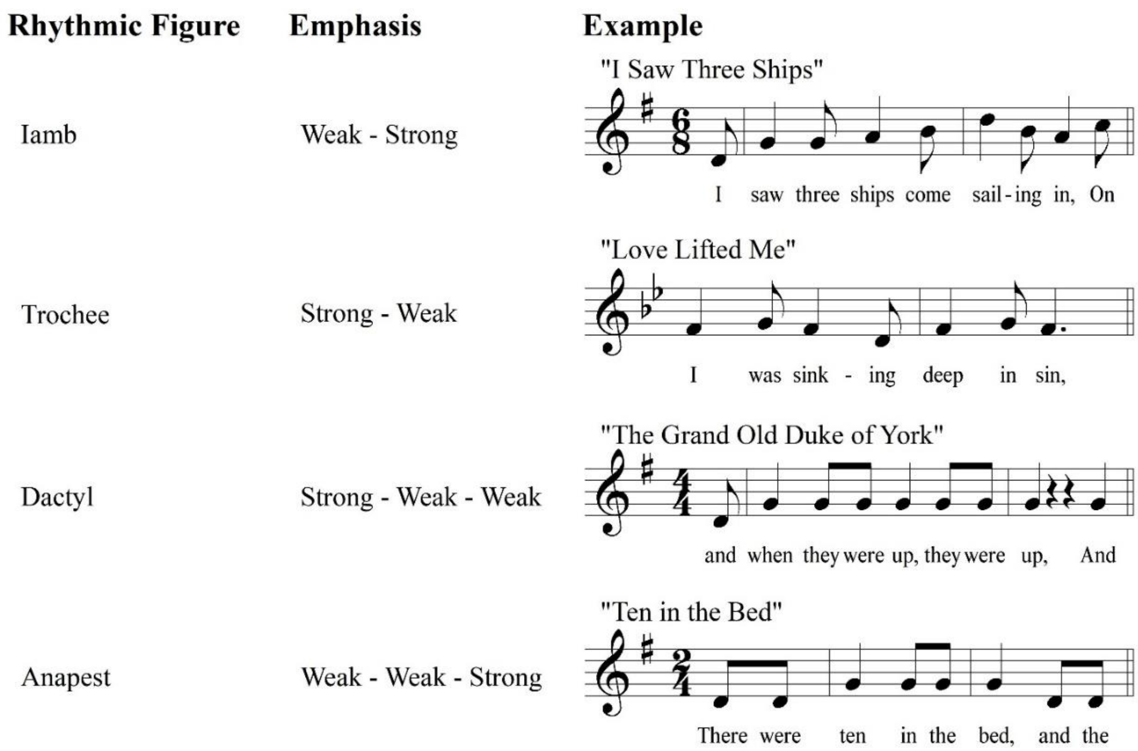


Figure 2. Common rhythmic figures as used in “I Saw Three Ships,” “Love Lifted Me,” “The Grand Old Duke of York,” and “Ten in the Bed.”

The use of rhythmic figures establishes a sense of expectation in listeners. Expectations do not always match up with reality. Some composers seek to confuse the listener’s sense of beat by manipulating the tactus. Tactus refers to the beat someone

11. Ibid.

would clap while listening to music. Usually, the tactus lines up with the meter, but sometimes composers intentionally create a discrepancy between the perceived beat and the actual beat. This is done to add tension to a piece of music or to express the emotion of the moment.

The opening notes of Beethoven's *Fifth Symphony*, which can be seen in Figure 3, provide an excellent example of this metrical deception. Most people are familiar with the four-note figure that begins the work; in fact, the mention of the piece may even cause them to sing "Da – Da – Da – Daaaaaa…" However, many do not realize that Beethoven's *Fifth Symphony* begins with silence. The first note is perceived to be a strong beat, but the truth is that the first beat falls on a rest. This adds to the sense of tension throughout the first movement of the work. Beethoven, as well as other composers such as Leonard Bernstein, Rodgers and Hart, and even rock bands such as Led Zeppelin employ this use of rhythmic trickery to effectively communicate the mood of a given section of music.[12]

Figure 3. Rhythmic deception in Beethoven's *Fifth Symphony*

12. Ibid., 217-218.

Timbre

Another element of music is *timbre*. It refers to the quality or "color" of a sound. If two instruments play the same note at the same volume but sound different, then they have different timbres.[13] The timbres of musical instruments are often described with words such as dry, dark, warm, or bright. There are various elements which contribute to the timbre of an instrument such as the materials from which an instrument is constructed (which will be expanded upon later) and playing technique.

Timbre is important because every instrument has a unique sound. This is why violinists will spend large sums of money to find the instrument that is just right. They want an instrument that sounds the way they think a violin should sound. Furthermore, changing the instrument on which a piece of music is played can drastically affect the character of the piece. Because of this, composers' selection of instruments is intentional; they pick instruments that effectively communicate the mood they wish to convey. For example, Russian composer Rimsky-Korsakov described the flute as "dull and cold" in the low register and "brilliant" in the high register; the bassoon he described as "sinister" in the low register and "tense" in the high register.[14] Since, timbre has the ability to affect the quality of sound, it is an essential element of music.

13. Murray Campbell, "Timbre (i)," 2001, http://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000027973.

14. Ball, *The Music Instinct,* 233.

Humanity

When defining music, makers of music should also be considered. Is music a uniquely human construct? Some animals, specifically birds and whales communicate in a way that seems to be reminiscent of music. In his 1871 book *The Descent of Man*, Charles Darwin wrote,

> On the whole, birds appear to be the most aesthetic of all animals, excepting of course man, and they have nearly the same taste for the beautiful as we have. This is shown by our enjoyment of the singing of birds… In man, however, when cultivated, the sense of beauty is manifestly a far more complex feeling and is associated with various intellectual ideas.[15]

In a study to determine whether birdsong is music, researcher Marcelo Araya-Salas listened to and recorded hours of songs from nightingale wrens. He compared the bird songs with several scales used in music to see if the birds' singing fit within standard musical practice. Only five of the eighty-one birds studied were remotely close to resembling music, so he concluded that birds do not make music.[16] Furthermore, while birdsong definitely serves a purpose, most notably attracting a mate, it is more like bursts of sound than music.[17] Though other animals can produce sounds that resemble music, the intentional organization necessary to make music in unique to humanity. While music is uniquely human, it is not simply made up; there are several phenomena in nature which have guided man in the composition and understanding of music.

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15. Charles Darwin, *The Descent of Man* (London: Murray, 1871), 467.

16. Marcelo Araya-Salas, "Is Birdsong Music?" *The Royal Statistical Society* 9, no. 6 (December 7, 2012), https://doi-org.ezproxy.liberty.edu/10.1111/j.1740-9713.2012.00613.x.

17. Ball, *The Music Instinct,* 23.

Musical Elements in Nature

Pitch

Music involves the organization of pitch, but the question remains: how do composers know what pitches to use; how are the total number of pitches, such as the twelve used in western music, determined; and why do some pitch combinations sound good or bad? To answer these questions, it is necessary to examine the history of musical practice and tuning systems which largely have their bases in nature.

While pitches are understood to be the notes of music, the distances between the notes are called intervals. The Greek mathematician Pythagoras, most known for his trigonometric theorem, discovered that intervals have mathematical relationships. The most basic of these relationships is the octave, the distance between two notes that sound the same, but one is higher. The octave has a frequency ratio of 1:2. The aforementioned concert A provides a simple example. Concert A has a frequency of 440Hz; the A one octave higher would be 880Hz because the ratio is 1:2. Pythagoras theorized that consonant intervals, in simple terms, intervals that sound *good*, are those with simple ratios which include the perfect fourth, whose ratio would be 3:4, and the perfect fifth, whose ratio would be 2:3. Adding to this, Pythagoras took the least common denominator of the ratios, which is twelve, and established that as the number of pitches in the octave. That is why Western Music still uses twelve pitches per octave.[18]

Pythagoras would demonstrate these ratios by plucking a tuned string. He would then place his hand on the string at different points which are consistent with his

18 . Philip Edward Stoltzfus, *Theology as Performance: Music, Aesthetics, and God in Western Thought* (New York: T & T Clark International, 2006), 19.

proposed ratios. By doing this, he would change the string into two shorter strings that, when plucked individually, would produce the pitches consistent with their ratios.[19] This is the same concept used in modern instruments such as the guitar which is played by using the hand on the neck to change the length of the strings thereby changing the pitch. This is perhaps more clearly seen on the hammered dulcimer which features two bridges one of which is positioned so that the string produces the interval of a perfect fifth when played on both sides. It would be expected that the hammered dulcimer bridge would be positioned at exactly 2/3 the length of the string, but Pythagorean ratios were found to have issues.

The Pythagorean concept of the scale, a grouping of consecutive pitches, was established by starting on a given pitch, called the tonic, moving down by a perfect fifth, then returning to the tonic and continually moving up by perfect fifths until seven pitches have been used. For example, starting on C, the Pythagoreans would move down a perfect fifth to get F then continually move up by perfect fifths to get G, D, A, E, and B. When this is put in order starting on C, the resulting scale is C, D, E, F, G, A, B: the C major scale. According to the Pythagoreans, this mathematical consistency meant that music was a branch of mathematics which was built into the world.[20]

Unfortunately, the Pythagorean scale is not mathematically consistent. To describe this, it is first necessary to describe two intervals: the major second (whole tone) and the minor second (semitone). The closest distance between two pitches is a semitone; two semitones make a whole tone. A major scale is built by starting with the root then

19. Ibid.

20. Ball, *The Music Instinct,* 47 – 48.

adding two whole tones followed by a semitone, then three whole tones, and another semitone to return to the root. This is most simply exemplified by the C major scale whose pitches correspond to the white keys on the piano. The notes used in the scale are called diatonic notes; the notes between those are called non-diatonic. In the case of C major, the black keys are the non-diatonic notes. They are named based on their adjacent notes. A note one semitone lower than a given pitch is called flat (b), and a note one semitone higher than a given pitch is called sharp (#). Therefore, the note between F and G can be labeled both as F# and Gb.[21] Figure 4 shows the diatonic and chromatic notes of C major on a piano keyboard.

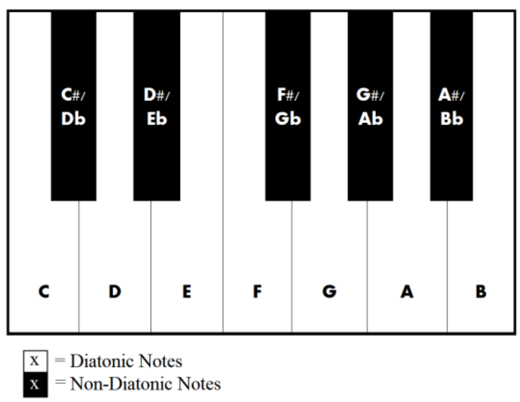

Figure 4. Diatonic and Chromatic notes on the piano

The first issue with Pythagorean tuning is that, while F# and Gb are supposed to be equal, there is a mathematical inconsistency. A whole tone should equal two semitones, but in Pythagorean tuning, it does not. Moving two semitones from a given pitch would involve the fraction of $(256/243)^2$ which is not equal to the whole tone ratio of 9/8. To visualize this inequality, a diagram known as the circle of fifths will be used.

21. Alfred Blatter, *Revisiting Music Theory: A Guide to the Practice* (Hoboken: Taylor and Francis, 2012), 6-7.

The circle of fifths is a visual representation of the twelve tones separated by the interval of a perfect fifth. Using Pythagorean tuning, moving by perfect fifths cannot be represented as a circle because the ratio inequality prevents it from closing. It is more accurately represented by a spiral. In Pythagorean tuning, the farther one gets from a starting pitch, the more inconsistent the tuning becomes.[22] Figure 5 shows the circle of fifths and the Pythagorean spiral of fifths.

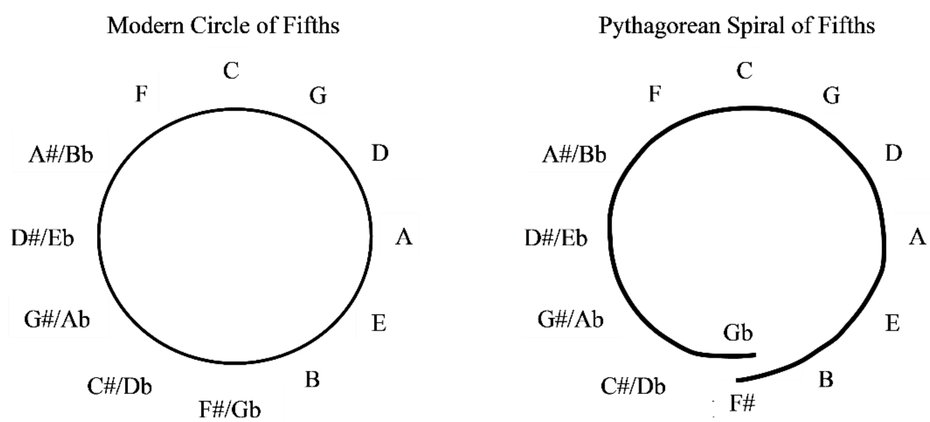

Figure 5. Modern Circle of Fifths compared to Pythagorean Spiral of Fifths

Despite this complication, Pythagorean tuning remained common. However, as musical preferences changed, thirds and sixths became acceptable consonances. Still believing that consonant intervals had to have simple ratios, the ratios for thirds and sixths were changed from 81:64 to 80:64 (5:4) and 27:16 to 25:15 (5:3) respectively. This compromise resulted in a new set of complications. Specifically, this system resulted in two possible ratios for the whole tone: 9:8 and 10:9 which was still not equal to two semitones. In response to this, Vincenzo Galilei, the father of Galileo Galilei, proposed

22. Ibid., 54.

changing the semitone's ratio to 18:17. However, this resulted in an octave ratio of 1:1.9855 which meant that all intervals were out of tune. It was becoming increasingly clear that simple ratios would need to be abandoned.[23]

The solution to the tuning issue is a system called equal temperament. Since it was agreed that an octave should maintain a 1:2 ratio, the solution was to divide that ratio into twelve equal parts making the ratio for a semitone the twelfth root of two ($2^{1/12}$). Since this number is irrational (unable to be defined as a fraction), it cannot be represented by a simple ratio, but it results in consistency between pitches across all octaves with ratios very near their Pythagorean equivalents. For example, the perfect fourth in equal temperament has a ratio equal to about 1.3348 as opposed to the Pythagorean 1.3333, and the perfect fifth has a ratio equal to about 1.4983 as opposed to 1.5. While equal temperament has replaced Pythagorean tuning, Pythagoras can still be credited with laying the foundation that, with a little modification, resulted in a tuning system that is consistent and reliable in all octaves.[24]

As pitch refers to the frequency of a given sound, harmony refers to multiple pitches sounded together. Harmony has a natural basis which influences the selection of pitches. Before continuing, it should be noted that harmony was not included in the definition of music. It is, however, still relevant to the definition as it is a natural byproduct of pitch which also influences timbre. There is a natural, acoustic phenomenon known as the harmonic series. If someone were to sit at a piano and press one key, one

23. Ibid., 58-60.

24. Ibid., 61.

pitch would be heard. In reality, several other pitches sound as a result of that one note being played. These pitches form the harmonic series.

As the name suggests, each pitch in the series is known as a harmonic. The first harmonic is called the fundamental. This pitch corresponds with the key pressed on the piano; it is the strongest harmonic and often the only one heard. The harmonics that follow the fundamental are called overtones. The first overtone is one octave above the fundamental, the second overtone is a perfect fifth above that, the third overtone is a perfect fourth above the second and two octaves above the fundamental, the fourth overtone is a major third above the third overtone, and the fifth overtone is a minor third above the fourth overtone.[25] Figure 6 shows the harmonic series built on C up to the fifth overtone.

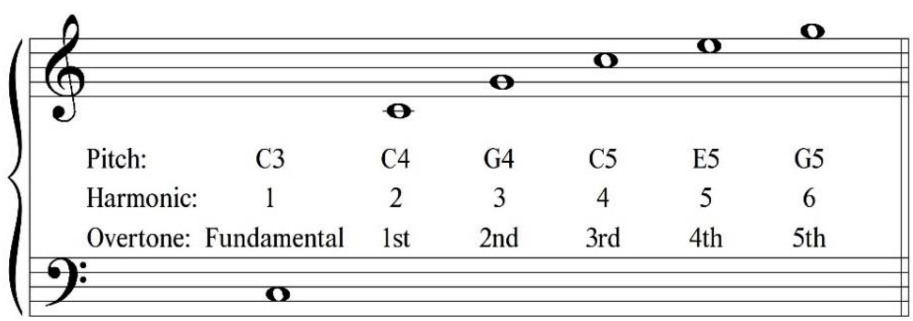

Figure 6. The harmonic series built on C. The numbers following the pitches correspond to their octaves on a standard 88 key piano.

As the harmonic series progresses, the intervals between the harmonics become gradually smaller and the harmonics themselves become gradually weaker and less detectable. Interestingly, when the first several harmonics are put together, they form a

25. Antoni De Villasante Tapias, "The Dual Nature of Sound as Raw Material of Music," *Naučno-Pedagogičeskoe Obozrenie* 4 (2014): 89-90.

major triad which is a three-note chord composed of the root note (harmonics one, two, and four), the third note (harmonic five), and the fifth note (harmonics three and six) of a diatonic major scale. The major triad is among the most basic of all chords. Figure 7 shows a C major triad.

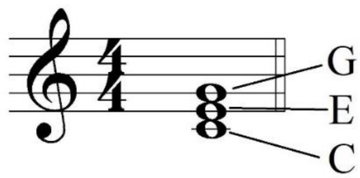

Figure 7. C Major Triad

While the major triad is the clearest harmony within the harmonic series, the building blocks for other chords are contained within the series as well. In western tonal music, most chords are built by stacking notes in intervals of thirds. There are two types of thirds: major thirds, (five semitones) and minor thirds (four semitones). Chords are constructed by combining major and minor thirds. For example, a major triad is made by stacking a minor third above a major third. A minor triad, in contrast, is made by stacking a major third above a minor third. A diminished triad is the combination two minor thirds, and an augmented triad is the combination of two major thirds.[26] The four types of triads and their interval relations can be seen on the top line of Figure 8. Some chords consist of more than three notes. In those chords, the notes above the fifth (the third note from the bottom) are referred to as extensions. Extensions are created by adding more major or minor thirds above the highest note.[27] The bottom line of Figure 8 shows the examples of chords with extensions.

26. Blatter, *Revisiting Music Theory*, 99-104.

27. Ibid., 140-146.

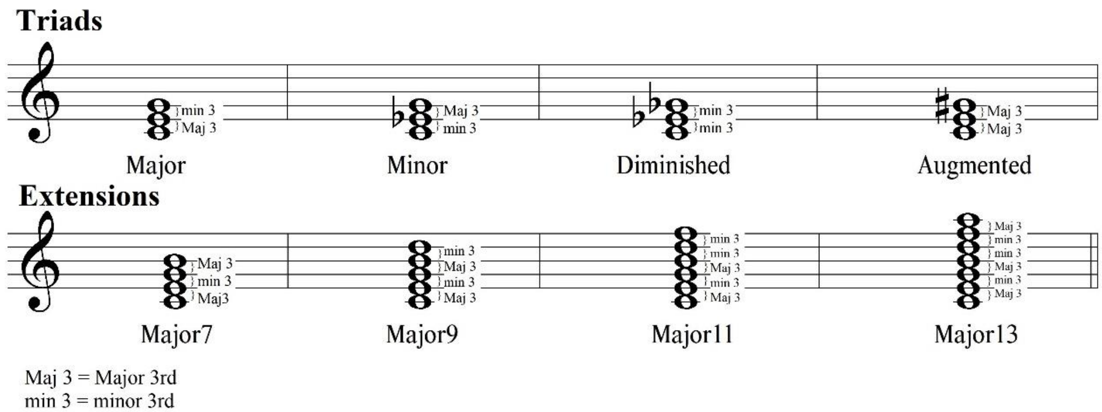

Figure 8. Triads and Extensions built on C.

In addition to containing major triads and the building blocks for other chords, the harmonic series also provides guidance for simple harmonic progressions (the succession of harmonies one after another). To understand this, one must recognize that the intervals of a perfect fourth and a perfect fifth are inverses of one another. If someone plays a C key on a piano and moves up a perfect fourth, they will hit an F; if they move from the F up a perfect fifth, they will hit another C. The harmonic series emphasizes the intervals of the perfect octave, perfect fourth, and perfect fifth.

Every pitch has its own set of overtones, and the sequence of intervals between the overtones are the same for all pitches.[28] In the harmonic series, the root and the fifth are the most prevalent. To continue using C as an example, the earliest harmonics sound the pitches C and G (See Figure 6). G is the fifth note in the C major scale. As a fifth, it can be reached by moving clockwise from C around the circle of fifths (Figure 5). If one moves counter-clockwise from C around the circle of fifths, an F will be reached. Just

28. Tapias, "The Dual Nature of Sound as Raw Material of Music," 91.

like G is the fifth note of C major, C is the fifth note of F major and is therefore a strong harmonic of F which is also the fourth note of C major.

In western tonal music, the most basic harmonic progression starts on the tonic (the triad built on the first note of the scale). It moves to the subdominant (the triad built on the fourth note). Then it moves to the dominant (the triad built on the fifth note) which resolves back to the tonic. In C major, these chords are C, F, and G respectively. These chords, though in a different order, are spaced apart by the interval of a perfect fifth. Notes a fifth away from each other have overlapping overtones, which is why they seem to sound good together. Going back to Pythagoras, his idea of simple ratios as ideal intervals was based on the fact that those intervals, specifically fourths and fifths, sounded good, or *consonant*, together. While there are certainly other reasons why harmonic progressions move the way they do, the overlapping harmonics play a role in making them sound pleasant to most listeners.[29]

Timbre

Overtones also have an effect on the timbres of musical instruments. As mentioned earlier, the earliest notes in the harmonic series are usually the strongest and easiest to detect by ear. However, that is not always the case. In the construction of musical instruments, instrument builders are able to manipulate the strength of different harmonics to achieve an ideal sound for the given instrument. For example, the clarinet's strongest harmonic is the fundamental, but the first overtone is significantly weaker than both the fundamental and the second overtone. Similarly, the third overtone is weaker,

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29. Blatter, *Revisiting Music Theory*, 113.

than the second or fourth overtones.[30] The dominance of odd numbered harmonics gives the clarinet its signature sound. Similarly, bright sounding instruments such as trumpets are strong in high harmonics. Stringed instruments, such as violins, are able to be manipulated by the use of specialized bow techniques to adjust the harmonic response and, therefore, modify the timbre.[31]

Variation in the timbre of a musical instrument can also be controlled by the choice of building materials. This is best illustrated by describing stringed instruments. Wood selection for stringed instruments is vital for achieving an ideal sound. An instrument's sound quality can be altered by changing the material from which the instrument is constructed. There is a class of wood species known by musicians and instrument builders as *tonewoods*. These woods are named because they have specific structural and resonant qualities which are ideal for the construction of musical instruments.

The most important wood in stringed instruments is the one chosen for the soundboard (the top of an acoustic stringed instrument). The soundboard has the greatest effect on the timbre of the instrument.[32] To function properly, the soundboard must be strong enough to withstand the forces placed on it by the strings and flexible enough to respond to the vibrations of the strings. Spruce is the typical choice of soundboard wood though other woods have been used with success.[33]

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30. Dominique Paret and Serge Sibony, *Musical Techniques Frequencies and Harmony* (London: ISTE, 2017), 60.

31. Ball, *The Music Instinct,* 230.

32. Trevor Gore, "Wood for Guitars," *Proceedings of Meetings on Acoustics* 12 (2011): 8, doi:10.1121/1.3610500**.**

33. Mark French, *Technology of the Guitar* (Boston, MA: Springer, 2014), 234-236.

In stringed instruments, the wood responds to the vibrations generated by the strings. In other instruments, the wood itself is the source of the vibrations. This is the case with keyboard percussion instruments such as xylophones and marimbas. These instruments have wooden bars which are struck with mallets. The wood chosen for the bars must be able to clearly and loudly resonate a specific pitch. Traditionally, rosewoods have been used due to their excellent resonance. However, the increasing scarcity of rosewood has led builders to turn to other woods such as padauk as well as synthetic materials. While these alternative materials can make good sounding instruments, most percussionists would agree that rosewood is a superior option.[34] This goes to further illustrate the point that not all woods are equal in terms of musical qualities, but there are some woods present in nature that are ideal for making instruments.

Rhythm

In addition to pitch and timbre, rhythm has a basis in nature. As mentioned earlier, rhythm deals with the movement of music through time. The note durations shown in Figure 1 represent different ways of dividing time. Natural examples of divided or measured time give guidance to rhythm. Modern scientific understanding reveals that time is measured astronomically based on the movement of Earth and the Moon. The Moon revolves around Earth which rotates while simultaneously revolving around the sun. Every rotation of the Earth is a day. Even without clocks, days can be measured by observing the cycle of light and dark. Every time the earth circles the Sun, a year occurs.

34. Murray Campbell, Clive Greated, and Arnold Myers, *Musical Instruments: History, Technology, and Performance of Instruments of Western Music* (Oxford: Oxford University Press, 2007), 218.

Every revolution of the Moon around the Earth is a lunar month. The lunar month is not the same as the calendar month, but it did influence the month durations used in the modern calendar.[35] The year, the month, and the day have the clearest natural bases, but mankind has used intellect to create further subdivisions. Years are divided into months, months are divided into weeks, weeks into days, days into hours, and hours into minutes. These divisions of time are reminiscent of the divisions of time used in music.

Musical elements such as pitch, timbre, and rhythm can be observed in nature. Ratios and the harmonic series inform the organization of pitch. The harmonic series and natural materials such as the tonewoods influence timbre. And natural divisions of time such as the day and the year resemble rhythm. While the practice of music is influenced by nature, are there any benefits to its existence?

Music and the Human Brain

Before describing the effects of music on the brain, a common misunderstanding regarding this relationship must first be addressed. Some people believe that listening to music makes people smarter. This belief is the result of a misinterpreted study. In 1993, a study was conducted to test the effect of music on temporal reasoning (the ability to turn physical objects in to mental images). Thirty-six college students were divided into three groups. One group worked in silence, one worked while listening to relaxing instructions, and the third group worked while listening to a Mozart piano sonata. The results from the Mozart group were noticeably higher with the effects lasting about ten to fifteen minutes.

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35. Ian Ridpath, *A Dictionary of Astronomy*, 2nd ed. (Oxford University Press, 2012), s.v. "Month," http://www.oxfordreference.com.ezproxy.liberty.edu/view/10.1093/acref/9780199609055.001.0001/acref-9780199609055-e-2456?rskey=GeEHMy&result=1.

When these findings were released, the "Mozart Effect" became a popular topic. Discussion of this topic often takes the study out of context and claims that listening to music improves brain performance. Additional studies determined that different types of music have varying effects. In the Mozart sonata, the specific rhythms, tones, and patterns were the cause of the improved brain function.[36] While the test does not indicate that music makes people smarter, it does demonstrate that certain types of music can cause a temporary increase in cognition.[37]

Beginning in the mid-1990s, research into the relationship between music and brain function was conducted. Researchers discovered that music has the ability to engage numerous complex processes within the brain that could be transferred to nonmusical applications. For example, musical rhythm is able to facilitate an improvement in motor control. One study on Parkinson's disease revealed that patients were able to synchronize their steps with rhythmic pulses. These synchronization patterns could be retained for a period of time when they were taken off medication. Other studies involving patients with cerebral palsy, Huntington's disease, and other diseases which inhibit motor control provide strong evidence that musical rhythmic stimulation is able to influence and regulate movement.[38]

Music also has mental benefits beyond the treatment of disorders. Music is able to improve brain coherence, the connectedness between the two hemispheres of the brain.[39]

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36. Alex Bennet and David Bennet, "The Human Knowledge System: Music and Brain Coherence," *Vine* 38, no. 3 (2008) doi:10.1108/03055720810904817.

37. Ball, *The Music Instinct*, 251.

38. Michael Thaut, *Rhythm, Music, and the Brain: Scientific Foundations and Clinical Applications* (New York: Routledge, 2008), 63-67.

39. Bennett, "The Human Knowledge System."

When the hemispheres are coherent, the brain's systems can perform optimally with limited wasted energy, resulting in an optimal state for learning. Some speculate that the human brain is actually hardwired to respond to music. This claim is based on the fact that children are able to respond to music and recognize melodies and tones when they are as young as three months old. Researchers even suspect that the brain may have specialized areas specifically for music, but findings are inconclusive.[40]

What is not speculation is the fact that music engages the entire brain. As mentioned earlier, the brain has two hemispheres. These hemispheres are divided into four lobes. The frontal lobe deals with planning, perception, and spatial skills. The temporal lobe deals with memory and hearing and houses the hippocampus (where long-term memory is stored) and the auditory cortex (the first place that sound is processed). The parietal lobe deals with various forms of sensory information. Lastly, the occipital lobe deals primarily with vision processing. Other parts of the brain affected by music are the cerebellum, which controls emotional response and motor control, and the amygdala which also deals with emotion.[41]

When a sound is heard, information is sent from the cochlea to the primary auditory cortex. The information is then sent to various other regions of the brain. Pitch intervals are sent to the temporal lobe, and the cerebellum recognizes pulse and rhythm. The thalamus checks the signal for danger before sending it on to the amygdala to determine the proper emotional response. The hippocampus brings up memories which are evoked by the music. The prefrontal cortex anticipates what will occur in the music

40. Ibid.

41. Ball, *The Music Instinct,* 242-243.

and builds anticipation. Some additional parts of the brain are used specifically by the performers of the music. The visual cortex is used to read music, watch a conductor, and watch other musicians in an ensemble. The sensory cortex allows musicians to feel their instruments.[42] These mental processes demonstrate that music engages the whole brain.

The Source of Music

Some people, such as the researchers mentioned earlier who are looking for a part of the brain devoted solely to music, seek to discover an evolutionary benefit to music, but none have been found. While the theory of evolution is a highly debated subject, one of the key elements which most people agree to be sound science is natural selection. Charles Darwin described natural selection as the "preservation of favourable individual differences and variations, and the destruction of those which are injurious…"[43] Essentially, a trait which increases the chances of survival or reproduction is more likely to be passed on than one that does not. This is not the case with music. While some people may claim that they cannot live without music, the truth is that music does not increase the chances of survival. Darwin himself commented on how music cannot be explained by natural selection in *The Descent of Man* in which he wrote:

> As neither the enjoyment nor the capacity of producing musical notes are faculties of the least use to man in reference to his daily habits of life, they must be ranked amongst the most mysterious with which he is endowed. They are present, though in a very rude condition, in men of all races, even the most savage; but so different is the taste of the several races, that our music gives no pleasure to savages, and their music is to us in most cases hideous and unmeaning.[44]

42. Ibid., 244.

43. Charles Darwin, *The Origin of Species by Means of Natural Selection; Or, The Preservation of Favoured Races in the Struggle for Life* (London: John Murray, 1875), 63.

44. Darwin, *The Descent of Man*, 733.

Since evolution deals with how physical life progresses within the universe, perhaps it is necessary to consider a force, or a being, outside of the physical universe when searching for a source of music.

Music as Evidence for a Creator

Music is Designed

The apparently inexplicable existence of music seems to indicate that music is the result of design. The existence of musical patterns and phenomena in nature suggest the work of an intelligent agent. Intelligence is a key indicator of design.[45] In his book, *God's Crime Scene*, cold-case detective and Christian apologist J. Warner Wallace described a designed object as one that is "created intentionally and planned for a purpose."[46] He described the characteristics of designed objects that are used when examining a crime scene for evidence: Dubious Probability (Given Chance), Echoes of Familiarity, Sophistication and Intricacy, Informational Dependency, Goal Direction (and Intentionality), Natural Inexplicability (Given the Laws of Physics and Chemistry), Efficiency/Irreducible Complexity, and Decision/Choice Reflection. While not all characteristics must be present to demonstrate design, the presence of multiple characteristics presents a compelling argument for design.[47] Several of the characteristics of design are observed in music.

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45. Fazale Rana, *The Cell's Design: How Chemistry Reveals the Creators Artistry* (Grand Rapids, MI: Baker Books, 2008), 37.

46. J. Warner Wallace, *Gods Crime Scene: A Cold-case Detective Examines the Evidence for a Divinely Created Universe* (Colorado Springs, CO: David C Cook, 2015), 95.

47. Ibid., 95-97.

Dubious probability refers to the unlikely chances of a given object coming together without outside interference. As established earlier, music cannot be explained by evolutionary processes, so the chances of music occurring by chance are slim. Similarly, music displays *natural inexplicability*. While the raw materials for music are present in nature, there are no natural processes that necessitate those materials to come together to form music. This makes the formation of music by natural processes alone highly improbable.

The definition of music used here is the human organization of sound in a manner which is purposeful and involves pitch, rhythm, and timbre. This definition has several required elements such as humanity, organization, purpose, pitch, rhythm, and timbre. If any of these is not present, the subject being described is not music according to this definition. Using birdsong as an example, an object or phenomenon may resemble music without being music itself. That said, Birdsong could be an example of *echoes of familiarity*. While birdsong does not involve all aspects of music, it does bear similarities to music and could inspire musicians in their writing. Of course, it should be noted that there are many varied definitions of music. However, these other definitions also have qualifications, so music, regardless of definition, is *irreducibly complex*.

Music is also *intricate*. The evidence regarding the scientific nature and natural bases of music demonstrates the truth of this statement. The elements of music are engrained in nature. These elements could not become music on their own because they need human involvement. Humanity has spent centuries studying these elements and adjusting its understandings of music to fit the evidence. While not everyone comes to the same conclusions, the intricacy of music is clearly demonstrated through these studies.

Music also displays *intentionality* and *choice reflection*. Intentionality refers to purpose in design. The harmonic series has distinctly musical purposes that inform the practice of harmony; Pythagoras' discovery of mathematical relationships provided a basis for the modern tuning system; the tonewoods, while they can be used for other purposes, enable humans to build musical instruments. It is easy to see how the materials of music have intentional purposes. Similarly, these materials reflect choice because they were engrained in nature in ways that could be discovered.[48]

The one qualification for design that music does not seem to possess is *informational dependency*, but the other seven characteristics are present and provide a compelling argument for the design of music. However, it should be noted that the musical elements of nature are not perfect. Intervals do not perfectly conform to Pythagoras' theory of simple ratios; the harmonic series presents a limited view of harmony; and tonewoods can have variations that affect their musical effectiveness. Perfection is not a requirement for design. Imperfection in design is often attributed to entropy which is an aspect of the second law of thermodynamics referring to the amount of chaos and the decrease of potential energy within a system.[49] However, the apparent errors within nature's musical elements necessitates the ability to analyze, adapt, and problem solve. That necessity could also point to the existence of a Creator.

48. Ibid.

49. *National Geographic Science of Everything* (National Geographic Society, 2013), s.v. "Second Law of Thermodynamics," http://ezproxy.liberty.edu/login?url=https://search.credoreference.com/content/entry/ngeongse/second_law_of_thermodynamics/0?institutionId=5072.

The Creator's Image

Many creationists, especially Christians, believe that mankind was designed in the image of the Creator. Genesis 1:27 reads: "So God created mankind in his own image, in the image of God he created them; male and female he created them."[50] There is some debate as to the meaning of the word *image*. Some people believe it represents a physical similarity, but the significant variation in human appearance as well as the presence of physical disorders indicate that this does not refer to physical traits. It is more commonly accepted that image refers to non-physical characteristics. In *The Cell's Design*, Fazale Rana described four characteristics of image: innate morality, understanding of the existence of the spiritual, the ability to relate to other people and other creatures, and an advanced mental capacity. Of human mental ability, Rana wrote, "Humanity's mental capacity reflects God's image…human beings display intense creativity through art, music, literature, science, and technological inventions."[51] This mental component provides the greatest relevance to the pattern recognition and creativity that is necessary for the creation of music.

Just as the Creator is intelligent and creative, the people created in His image would also possess intelligence and creativity. Perhaps that is why the musical elements in nature lack perfection. Perhaps the Creator wanted His creation to use their intellect and creativity. Galileo Galilei once wrote "…I do not feel obliged to believe that that same God who has endowed us with senses, reason, and intellect has intended to forgo

50. Gen. 1:27 (NIV).

51. Rana, *The Cell's Design,* 40.

their use and by some other means to give us knowledge which we can attain by them."[52] Perhaps the Creator wanted His creatures to think and be creative like their Creator.

Music has been described here in a primarily scientific manner. In reality, music is more commonly considered an art than a science. Music has a dual nature as it is both scientific and creative. Similarly, mankind possesses both intellectual and creative ability. Frequently, people are characterized as either creative or intellectual. There is some merit to that division because some people are stronger in one area than the other, but all people are capable of creativity and intellect. It was mentioned earlier that music engages the entire brain. That fact illustrates the vastness of music. Music engages the whole human mind through its combination of intellect and creativity. This reflects the mind of an intelligent Creator.

Regarding Faith

Many people reject religion and creationism as a whole because they believe that it emphasizes faith over reality. In his book *The God Delusion,* Richard Dawkins referred to faith as "persistent false belief held in the face of strong contradictory evidence."[53] Faith should not be understood as belief despite evidence, but belief supported and strengthened by evidence. Faith, especially the Christian faith, involves the mind. In Mark 12:30, Jesus instructed His followers to "Love the Lord your God with all your heart and with all your soul and with all your *mind* and with all your strength."[54] Faith

52. "Letter," Galileo Galilei to Grand Duchess Christina, 1615.

53. Richard Dawkins, *The God Delusion* (London: Black Swan, 2016), 28.

54. Mark 12:30, NIV.

does not involve a fear of inquiry. In the book of Exodus, God shows miracles to the Israelites so that they believe and trust Him. Regardless of whether or not someone believes the Bible to be true, the Bible clearly advocates an intelligent faith. True blind faith is found in the denial of evidence.[55]

Conclusion: Examining the Evidence

Music contains an abundance of evidence that suggests the existence of a Creator. The practice of music is informed by natural phenomena that give insight into the use of pitch, rhythm, and timbre. These insights are sometimes specific but often allow for interpretation and variance. Furthermore, music is beneficial to the human brain and can be used as an effective treatment for various disorders. While there are scientific explanations for the ways in which music is practiced, there none for the origin of music. There is no evolutionary benefit to the existence of music, and attempts to find evidence otherwise have failed to deliver conclusive results.

The source of music must be explained by looking outside of the physical universe. Music exemplifies several of the characteristics of design. To recognize and use the designed elements of music, mankind must use intellect and creativity. This dual necessity suggests that mankind was made in the image of a creative and intelligent being who passed creativity and intelligence on to humanity. The natural materials and benefits of music when paired with the characteristics of design reveal that music points to the existence of a Creator. Additionally, the Christian understanding of faith, and the

55. Josh McDowell and Sean McDowell, *Evidence That Demands a Verdict: Life-changing Truth for a Skeptical World* (Milton Keynes: Authentic, 2017), xxxiv.

teachings of the Bible suggest that the most likely candidate to be that Creator is the God of the Bible.

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