Bachelor Degree Project

UNIVERSITY
OF SKÖVDE

1977

**DOES QUARTAL HARMONY
AFFECT THE MOOD IN
COMPUTER GAMES?**

**Påverkar kvartalharmonik
stämningen i dataspel?**

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Abstract

The background explains musical concepts of consonance, dissonance and quartal harmony which are the central parts of this work. Emotion in- and application of music is explained as well, to give an understanding to how the music is being used.

The problem is what was studied, and the method shows how it was to be studied. The goal of this work was to see what kind of harmony is better at inducing stress in a player playing a game, quartal or triad harmony. Two different harmonizations of the same songs were composed and implemented into a game sequence. Semi-structured qualitative interviews were held to collect data.

The result of this study showed that both harmonizations induced the same amount of stress, not leading to any concrete answer.

Keywords: music, harmony, quartal, triad, immersion.

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1 Introduction

Dissonant and consonant harmony can be used to create tension and release, and other factors such as pitch, tempo and structure when combined with consonance and dissonance creates certain expressions (Alf Gabrielsson & Erik Lindström 2011), making the listener feel different emotions while partaking in music. Emotion in music has been used by to create immersion in multimedia, such as film and video games.

This paper researched the difference between how quartal and triad harmony used in a top-down shooter boss fight affected the players, with the intention of inducing stress. Tests were conducted to find a relationship between harmony and emotion by the use of a game prototype. The gathered data was analysed and compared to see if there's a correlation.

2 Background

2.1 Consonance and Dissonance

Consonance and dissonance are different harmony structures used to create tension and release in music. Ernst Levy (1985, p.39) poses that in order to define consonant and dissonant harmony, we have to assume "[...]that everybody agrees to unique naturally consonant character of the [minor and major] triad.". He continues by arguing that the consonant character expression can be defined as an impression of restfulness, but also notes that chords that are not perfect triads are sometimes also used as consonant closing chords. Levy (1985, p.39) notes that triads can also be used to create an impression of tension and as an example he references a half-cadence (Figure 1), where the fifth step doesn't resolve.
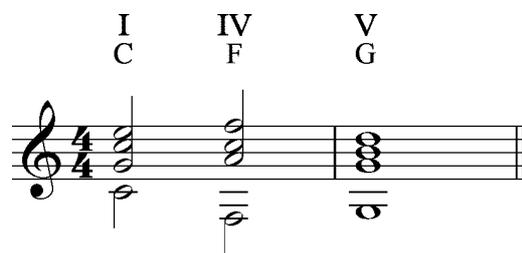

Figure 1: Half-cadence in C-major

Levy (1985, p.39) sums up these observations by saying that the triad is consonant but may be used as a dissonance and that all other chords are dissonant, but may be used as consonances.

2.1.1 Consonant and Dissonant Intervals

Vincent Persichetti (1961, p.13) describes intervals as having constant physical properties but that the usage changes depending on the working context to which they belong. He explains that scientists within the field of acoustics have observed degrees of tension between intervals, and this came to be known as the "[...]concept of the relative consonant-dissonant qualities of intervals" (Persichetti 1961, p.14).

The concept of consonance and dissonance may vary from one age to another or depending on style of music. But the notes of an isolated interval has a basic quality, the intervals own physical properties of sound waves and overtones (Persichetti 1961, p.14).

The consonant and dissonant intervals are based upon the overtone series, which is generated when an isolated tone is sounded. Working from the tempered scale, the upper overtones are considered dissonant and lower ones considered consonant. This has been reduced by the use of the chromatic tempered scale which scaled it down from unlimited intervals to twelve intervals (Persichetti 1961, p.14).

Persichetti describes the intervals as open and soft consonances, sharp and mild dissonances and neutral or restless (Figure 2). He states that the tritone and perfect fourth are difficult to classify out of a musical context, describing the tritone as neutral in chromatic passages and restless in diatonic passages, and the perfect fourth as being consonant in dissonant surroundings and dissonant in consonant surroundings (Persichetti 1961, pp.14-15).
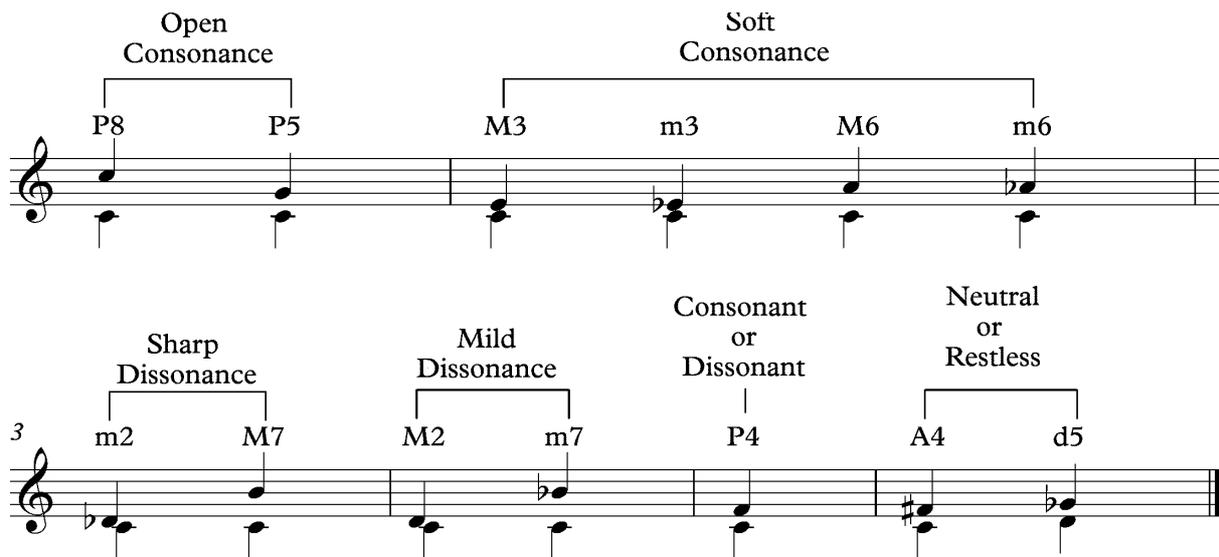
Figure 2: Intervals ordered by consonance-dissonance-either

2.1.2 Consonance and Dissonance in culture

Louis Braida, Peter Cariani, Bretrand Delgutte and Mark Tramo (2006, p.93) states that the term consonant semanticly overlaps with pleasant and beautiful. They explain that the basic concepts of consonance and dissonance applies to a wide range of music of the industrialized world, naming contemporary pop and theater as well as European music from the Baroque, Classical and Romantic eras.

They explain that the widespread popularity of western pop universal competence in cognitive functions that makes the listener associate certain intervals with different emotions and meaning and explains that experimental results suggest similar attributes across different cultures (Braida, et al 2006, pp.93-95).

2.2 Quartal Harmony

Quartal harmony is the practice of superimposing intervals of the fourth. Vincent Persichetti (1961, p.95) explains that a basic three note chord by fourths can be created in 3 ways: perfect-perfect, perfect-augmented, and augmented-perfect (Figure 3). The terms perfect and augmented refer to the interval between notes, a perfect fourth would mean that the interval between the root note and the fourth is 5 semitones and an augmented fourth would mean the interval between the root and fourth is 6 semitones.
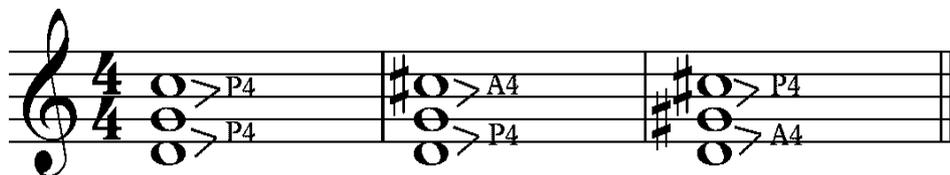

Figure 3: From left to right: perfect-perfect, perfect-augmented and augmented-perfect fourths

The perfect-perfect chord is most commonly used in a consonant structure because of the equality of the perfect fourths, and the mildness of the minor seventh (Persichetti, 1961, p.96).

3

Four-note chords by perfect fourths adds the tenth to the chord, which Persichetti (1961, p.101) says is a consonant interval. Adding a major third on top of a three-note chord by fourths gives a consonant sounding chord, while a minor third makes it dissonant.

Persichetti (1961, p.104) describes that superimposed perfect fourths are consonant until the six-note chord. Chords using six notes or more starts to contain dissonance along with three-, four- and five-note chords with augmented fourths.

2.2.1 Application of Quartal Harmony in Music & Media

Anna M. Gawboy and Justin Townsend (2012) analyse how *Prometheus, Poem of Fire,* op.60 (Alexander Scriabin 1911) is based on stacked fourths through the use of the "mystic" chord. Leonid Sabaneev (cited in Gawboy & Towsend 2012) described *Prometheus* as being constructed from transpositions of the "mystic" chord. The "mystic" chord is made up (when stacking intervals) by the root, augmented fourth, diminished fourth, augmented fourth, perfect fourth, perfect fourth.

Gawboy and Townsend (2012) explains that Scriabin used his synaesthetic (ability to hear notes as colors) to include a part for colored lights in *Prometheus*. This was used as a counterpoint between music and visuals.

The song Tarkus (Keith Emerson, Greg Lake & Carl Palmer 1971) by Emerson, Lake & Palmer features quartal harmony throughout. The song is split up in 7 parts which tells a story through the song, with different parts indicating different story elements. Quartal harmony is heavily featured in the parts Eruption, Iconoclast and Manticore.

The game *Final Fantasy VI* (Square 1994) opens with a cinematic accompanied by the song Omen (Nobuo Uematsu 1994). An organ can be heard playing ascending fourths while the camera pans down from dark clouds and thunder. When the title of the game is shown, the organ instead starts playing chords.

At 3:42 in the song The Path That Divides (James LaBrie, Mike Mangini, John Myung, John Petrucci & Jordan Rudess 2016) by Dream Theater, they depict a sword fight and amplifies the intensity of the fight by having the keyboard play a melody using quartal harmony.

The official trailer (Nintendo 2016) for *The Legend of Zelda: Breath of the Wild* (Nintendo 2017) starts with a girl saying "open your eyes". The camera fades from black and starts showing different landscapes from the game, accompanied by a piano playing quintal chords, which if inverted would be quartal chords.

2.3 Emotion

Alf Gabrielsson & Erik Lindström (2011, pp.367-368 & 383-392) summarized the results of more than 100 studies that researched the relationship between musical structure and emotional expression. They explain that asking how to achieve a certain expression is a complex question, as factors that make up music may work independently in an additive way or interact with each other in different ways (Gabrielsson & Lindström 2011, p.392). They state that "[...] most of this research deals with Western classical music." (Gabrielsson & Lindström 2011 p.368).

Gabrielsson & Lindström summarize harmony by saying that dissonant and complex harmony may be associated with unpleasantness, sadness, vigour, tension, anger and excitement and consonant harmony with expressions such as happy, relaxed, graceful, serene, dreamy, serious and majestic. They discuss that harmonic intervals show similar

results to this concerning dissonance and consonance, but when looking at pitch intervals, large intervals are "perceived as more powerful than small ones" , and that the octave is strong and positive while the minor second is the most sad (Gabrielsson & Lindström 2011, pp.389-390) .

Pitch shows similar results to harmony, although with a couple of contradictions. Gabrielsson & Lindström describes how high pitch may be associated with the same factors as simple and consonant harmony, but adds on surprise, potency, anger fear and activity, while low pitch shares factors with dissonant and complex harmony while adding boredom and pleasantness. They state that the contradiction may be dependant on the musical context (Gabrielsson & Lindström 2011, p.390) .

Tonal melodies were shown to be joyful, dull and peaceful and atonal melodies were angry. Collier and Hubbard (cited in Gabrielsson & Lindström 2011, p.388) claimed that pitch height and direction of movement within a scale may be more important than mode/key when expressing happiness. Gabrielsson & Lindström (2011, pp.388-390) adds that major modes may be associated with happiness and that minor modes may be associated with sadness in young listeners, saying that minor may also be associated with other expressions, and minor mode might convey a feeling of dignity.

The musical form of a piece might also be important when trying to evoke emotions. High complexity may evoke feelings of tension or sadness, while low complexity may be associated with relaxation, joy or peace. Factors that increases tension may include repetition, condensation, pauses and sequential development (Gabrielsson, A. & Lindström, E. 2011, p.391).

2.3.1 Emotional Differences in Timbre

Gabrielsson & Lindström (2011, p.389) suggest that tones with many higher harmonics may convey anger, fear, disgust or surprise, while tones with few, low harmonics may feel sad, boring, happy or pleasant and suppressed higher harmonics may feel tender and sad. Behrens & Green (cited in Gabrielsson & Lindström 2011, p.389) found that a singing voice or violin best conveyed sadness while a violin conveyed fear and timpani anger.

Gabrielsson & Lindström (2011, p.389) notes that there is no systematic research on the different emotions that different timbres influences.

2.3.2 Emotion in Originality

Dean Keith Simonton as part of his research studied originality within two-note transitions and how they affect emotion. He compiled a list of 15618 melodies by classical composers and analysed the most common two-note transitions between the first six notes, giving five transitions per melody (first note to second, second to third etc.) (Simonton 2011, pp.348-354).

Simonton explains that all melodies are transposed to either C major (for major melodies) or C minor (for minor melodies). Simonton says that the three most common transitions, which accounts for about 17% of the two-note transitions, are dominant-dominant (GG), tonic-tonic (CC) and dominant-tonic (GC), while chromatic notes that aren't in either the major or minor modes are improbable, "[...]only F# appearing with any frequency whatsoever." (Simonton 2011, p.350).

His research leads him to the conclusion that the more original the transition between notes, the "[...]more likely to evoke emotional reaction in listeners." (Simonton 2011, p.354). He concludes his research by stating that the studies were not specifically dedicated to scrutinize the relationship between emotion and music and that the correlation between originality and other factors are not perfect (Simonton 2011, pp.361-363).

2.4 Application of Music in Multimedia

Music in games can be used in different ways to evoke emotions. To be able to fully compare different harmonizations it's important to know what tool sets can be used to implement the music into media.

Annabel J. Cohen (2011, pp.879-908) analysed the functions of music in multimedia context. While she focuses her research on music in film as a factor of inducing emotions, Cohen (2011, p.891) states that it can be used in other multimedia contexts as well, making her research applicable for video gaming as well. A few of the different functions Cohen (2011, pp.879-908) discussed (that may be relevant when applied to video games) are that music can be used to direct attention, motifs can be used to familiarize a viewer with characters, events or environments, or be used to induce emotion.

2.4.1 Application of Music in Video Gaming

Karen Collins (2008, p.128) notes that while audio in games usually has the same function as it has in films, that there are distinct differences. She says that while music in film is often closely tied to the edit, it's not usually so in games due to unpredictable aspects of games.

Collins (2008, p.130) states that a particularly important use of sound in games is to help the player identify goals and set certain objects in focus. She notes that usually sound effects more commonly fills this role, but that leitmotifs often are used as a way of helping the player to identify characters, environments, moods and objects. Collins proceeds to give a few examples from *The Legend of Zelda: Ocarina of Time [OoT]* (Nintendo, 1998) which includes lesser enemies having the same of similar music, and beneficial items have the same or similar-sounding cues. She (Collins, 2008, pp.131-132) adds that *OoT* uses musical themes as a key role, such as the themes recurring in several places to hold together different scenes, which gives the game a sense of continuity across the weeks the game takes to finish.

Collins (2008, p.132) writes that music can enhance the structure of a game and she provides examples such as direct structural cues such as bridges or links between scenes. It can be used to tell a player that they should have completed a segment of a game and that the game is waiting for the player to exit the area.

Winifred Phillips (2014, p.98) poses that to effectively play certain games the player needs to be in a specific mindset and that while the game can inspire this mindset, music can help the player get into the mindset. She says that "Music can serve an important role by simulating the state of mind required to be in the zone[the specific mindset]" (Phillips, 2014, p.99).

Phillips (2014, pp.102-103) argues that in certain genres of games, such as Role-Playing Games (RPGs), it is the composers job to support and enhance the realism of the world in that game to help the player become fully immersed. She states that the focus of the composer should be to enhance the world created by the development team by surrounding the player with aural details about the nature of the games setting, helping to build the world along with all the other elements.

Phillips (2014, pp.105-106) describes Action-Adventure games, among other genres, gives an experience of making the player feel like their pulse is rising and that the music should reflect the pacing and energy level of the gameplay. She says that action-adventure games sometimes have breaks between combat sequences where the player has defeated one wave of enemies, but there's more to come. To not slow down the game, she argues that music can infuse the game with an overall momentum. If the music is still playing after a combat sequence, it would tell the player that the combat isn't over just yet, keeping the player alert on the situation.

2.4.2 Non-linear Music in Video Gaming

One technique of creating non-linear music for games is horizontal re-sequencing (Phillips 2014, p.188). Music is often though of as a horizontal stretch of time, as is usually the case of graphic interfaces in digital audio workstations. Horizontal re-sequencing uses segments of musical compositions and when certain events happen in the game, the current segment switches to another one. Phillips (2014, p.188) says that this is usually done with markers that are placed at designated points in the music to tell the game where switching music would be feasible.

An example of this can be found in a game-play video of *OoT* (SlaskPrask 2015). At the beginning of the video, the dungeon music can be heard. After he exits the door and gets closer to the ledge, an off-screen enemy can be heard because of the increasing volume of the enemy music, which is triggered by the distance of the player.

3 Problem

Previous studies shows that games and film use music in several different ways and most of them intend to evoke emotions from the player. There are several building blocks to use to create music that evoke emotions which gives composers many different ways to create songs depending on how they chose to do so.

This research paper explores how the use of quartal harmony can evoke the same intended emotion as triad harmonies evoke in a top-down shooter and the question that this paper posed is:

- Will quartal harmony or triad harmony be the most effective when trying to intentionally induce stress from a player playing a top-down shooter game?

The purpose of this research is to initiate a discussion on how contemporary music techniques, such as quartal harmony, can be used to expand the game composers toolbox.

3.1 Method

3.1.1 Artefact

To answer this question, an artefact was developed. The main artefact is a short segment of a 2D top-down shooter game, with hand drawn-graphics and with gameplay influences from party-fighers such as the *Super Smash Bros.*(HAL Laboratory 1999-) and 2D shooters like the *Contra* (Konami 1987-2011) series. In the artefact the player started at the centre of a square island, where parts fall off as the time progresses. While the players goal was to not fall off, their main objective was to fight the boss (Figure 4). The player was forced to focus their attention to these two elements as well as randomly generated enemies, which are depicted as smaller versions of the boss.

Figure 4: Tesla-Boss

Other artefacts was produced during this as well, which includes a fully scored sheet-music of the two versions of the songs that were composed and used in the main artefact. The structure and tempo of the two song versions are identical, the melodies are slightly modified and the harmony is completely rearranged.

The structure of the fight is straight forward, but the music changes depending on the health of the boss. Because of this, the structure of the songs are non-linear with 2 segments, one

for when the boss has between 100-50% health and one for when the health gets reduced below 50% (Figure 5).

Figure 5: Melody themes for the boss.

The instrumentation for the two versions are identical. The instrumentation is synthesiser-based, using *Ominsphere* (Spectrasonics 2008-2015), with the addition of sampled drums from *Addictive Drums 2: Rock & Metal Edition* (XLN Audio 2014-2018).

Using instruments with different timbres might change the result (Gabrielsson & Lindström 2011, p.389), but since the question asks for differences in quartal harmony and triad harmony, if the instrumentation stays the same, the result should contain the same difference as if both versions were to use only a single timbre instrumentation.

3.1.2 Qualitative Method

To answer the question at hand, semi-structured qualitative interviews was conducted, which Anne Galletta (2013, p.45) describes as a way to incorporate both open-ended and set questions, which helps to gather data from the participants experience, as well as data that is guided by constructs from the research discipline.

This method was chosen because of it's strength and versatility that allows for exploration of specific dimensions in the research question. "The semi-structured interview is instrumental for creating openings for a narrative to unfold, while also including questions informed by theory." (Galletta 2013, p.177).

The study consisted of 1 female and 6 male participants ranging from the ages 20 to 28. Their cultural background are western, with the only differences being that they're either from Europe or America. Participants were chosen based on their availability during the weeks the interviews were conducted, as well as their musical culture. The interviews were held using *Discord* (Discord Inc. 2015-2018) or *Skype* (Skype Technologies 2013-2018) due to the financial limitations of this paper.

The participants, which were be divided into three groups, played through the segment with different music conditions. The first group, the control group, played through the artefact without music while the other two groups played with quartal harmonized music and triad harmonies respectively. They were instructed on how to play the game to optimize the collected data, and asked if they wanted to record their session. It was important to make sure that the participants understood what they should do and under what conditions, which due to limitations may be difficult to correctly convey or set up due to everything being done over voice chat.

At the start of the interview, the participants were informed about the purpose of the interview and thanked for participating. They were given a consent form informing them of ethical aspects, as well as their right to not answer a question and that they could leave whenever they want. They were also asked for consent to record them, and if given consent, the interview was recorded.

The structure of the questions were based on a questionnaire by Claudia Bullerjahn & Markus Güldenring (1994), with modifications to account for video games where their questionnaire referenced film (Appendix A). The questionnaire was based on Bullerjahn & Güldenring's questionnaire because of how it is focused on how music effects their participants, which is close to what this study wanted to find out. They structured their questionnaire by dividing it into four parts. The first parts consisted of gathering the participants personal information, the second part about the participants media competence. The third part contained closed-category questions along with three open-ended questions. The fourth part contained questions about past musical experience, such as training on a musical instrument, frequency of listening to music etc. (Bullerjahn & Güldenring 1994, p.107).

Before the participants started playing the game, they were asked some personal information, such as sex, age, profession, current mood and country of origin. Secondly, they were asked a bit about their gaming competence, how often they play and what their preferred genre of gaming is.

After they played the game they were asked what their current emotional state is, which if needed was followed up by asking why they are feeling this way. The third part contained some closed-category questions about the artefact, where they discussed how the music fits the situation and difficulty etc. It also include a few open-ended questions:

    (a) How did your mood change during the fight?

    (b) How did the music (or lack thereof) influence your choices?

Lastly they were asked questions regarding their musical background, if they play or have played a musical instrument, attends concerts and musical preferences. If the range of their musical backgrounds vary greatly, the data collected may show incorrect results.

3.1.3 Problems of Method

The sample size of the tests are small, and might not reflect on multiple different types of people, such as greatly different preferences in music, game genre and musical background.

The tests and interviews were not conducted in person. This may have caused confusion upon the participants when explaining how to play the artefact. The differences in audio quality due to headphones or speakers may have affected the result as well.

4 Implementation

When the artefact was in the beginning of development it was made for a completely different context. It was a 2D top-down Action Role Playing Game (ARPG), using complex systems for music and gameplay. The ARPG was discontinued because of disagreements between developers. A new artefact was quickly developed using the game *Limited Power – Unleashed* (Nicolas Bäckström, Pontus Johansson, Samuel Lindsköld, Jakob Löwenberg, Samuel Torslund & Kevin Vingéus, 2018) as the base game.

4.1.1 Gameplay Development

The artefact was initially developed as a part of the *Global Game Jam* (Global Game Jam, Inc. 2018) during January 26-28th 2018 in *Unity* (Unity Technologies, 2005-2018). During this time there was no plan to use *Limited Power – Unleashed* (Bäckström, et al 2018) as a base for the artefact, so there was no plans on how gameplay or audio was going to be used in relation to this study. The core mechanics of enemy spawning, weapon drops and the ground falling off were however developed during the *Global Game Jam*.

When *Limited Power – Unleashed* (Bäckström, et al 2018) was decided upon as the base for the study, a few changes were made to shift the focus from a multiplayer 2d shooter to a single player "boss-fight". The changes were a game mode switch implementation, making it possible to switch between different game modes from the main menu (however, in the artefact this is disabled), and in-game logic to allow a "boss-fight" to be the focus instead of player versus player.

The concept of the "boss-fight" is an extension of the multiplayer enemy-spawn system, which once in a while will spawn a bigger version of the randomly generated enemies. The boss in the artefact is an even bigger version of one of these enemies, with its health and attack raised.

4.1.2 Melody Composition

The first draft of the music was to the previously mentioned ARPG artefact. This music did only get to the stage of melodies (Figure 6) and was discarded at the same time as that artefact was dropped.

Figure 6: Melodies drafted for the ARPG artefact.

The second draft of the music was composed soon after the *Limited Power – Unleashed* (Bäckström, Johansson, et al 2018) based artefact was programmed. Two different melodies

were composed using the C-minor pentatonic scale as a base, extended by using the major fourth and major seven. The C-minor pentatonic scale is built by the root, the minor third, the perfect fourth, the perfect fifth and the minor seventh.

The first of these melodies (Figure 7) is based on the scale and extensions. The melody is based on the motif of two eight notes followed by a pause and another eight note. During the last three notes of the third bar there is an ascending arpeggio by fourths using only notes from the C-minor pentatonic scale.
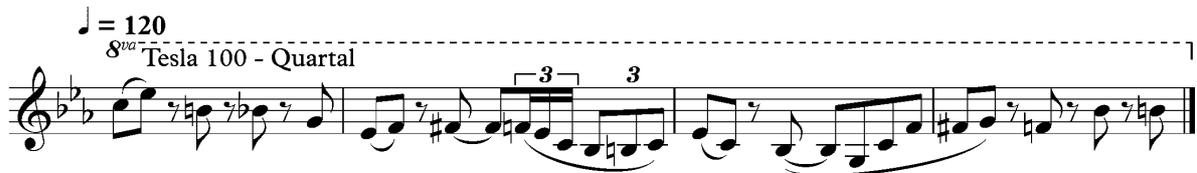
Lead 1 (Square)

Figure 7: The first boss melody.

The second melody (Figure 8) is based on the same rhythm motif at a faster tempo. During the third bar a sixteen note run based on both an ascending and descending arpeggio by fourths are present. During the descending arpeggio the melody diverges from the C-minor pentatonic extended scale, adding a D-note as a transition to the Eb-note after it.

Figure 8: The second boss melody.

4.1.3 Triad Harmonization

After both of the melodies were composed, the work on harmonizing began. The composition of the triad harmonization for the first melody (Figure 9) started of with a C-minor followed by a G7#9 to accentuate the B and Bb in the melody in the first bar. The G7#9 transitions into bar two to an Ab using a deceptive cadance and when the melody rises to the augmented fourth, the chords accentuate this with a B-major chord, which then descends a half step down to the Bb. The third bar starts of with an Ab ascending to a Bb and in bar four it descends to an F-minor before ending with a G7 borrowed from the C-harmonic minor scale. The bass follows the chords with additional passing notes.

Figure 9: First melody triad harmonization.

The second melody (Figure 10) was harmonized using the bass as a starting point during the first two bars. The chromatically descending bassline is harmonized by C-minor, B-major, Bb-major, F-major with an A as the root note before descending a whole note down to a G7. The third bar starts off with an Ab-major descending a minor third down to an F-minor, and then from Eb-major to C-minor. The fourth bar starts with an F-minor to a Bb-major and on the third to last sixteenth note borrows the G7 from the C-harmonic minor scale.

Figure 10: Second melody triad harmonization.

After the triad harmonization was completed, the drum track was programmed, following the chord rhythm and at some occasion following the melody line. An example of this would be during the third bar of the second melody.

4.1.4 Quartal Harmonization

The quartal harmonization for both of the melody followed the same basic rhythms as the triad harmonies. The first melody harmonization (Figure 11) is based on the root note and two stacked fourths from the root with the first chord of the second bar being an exception, stacking three fourths. The harmony was composed by ear and based on consonance and dissonance, trying to balance them both evenly.

Figure 11: First melody quartal harmonization.

The second melody (Figure 12) follows the same consonance-dissonance balancing. The same chromatic bassline as in the triad harmonization is used up until the last two notes of the second bar, where it continues down chromatically down to the G-root of the third bar.

Figure 12: Second melody quartal harmonization.

4.1.5 Implementation

The music was recorded and produced in *Cubase* (Steinberg,1989-2018) followed by implementation in *Fmod Studio* (Firelight Technologies, 2012-2018) (Figure 13). The implementation consists of two tempo markers, one for 120 BPM and one for 140BPM. Within the markers are two loops and in the first loop is a transition marker, and in the other is a destination marker where the transition transitions to.
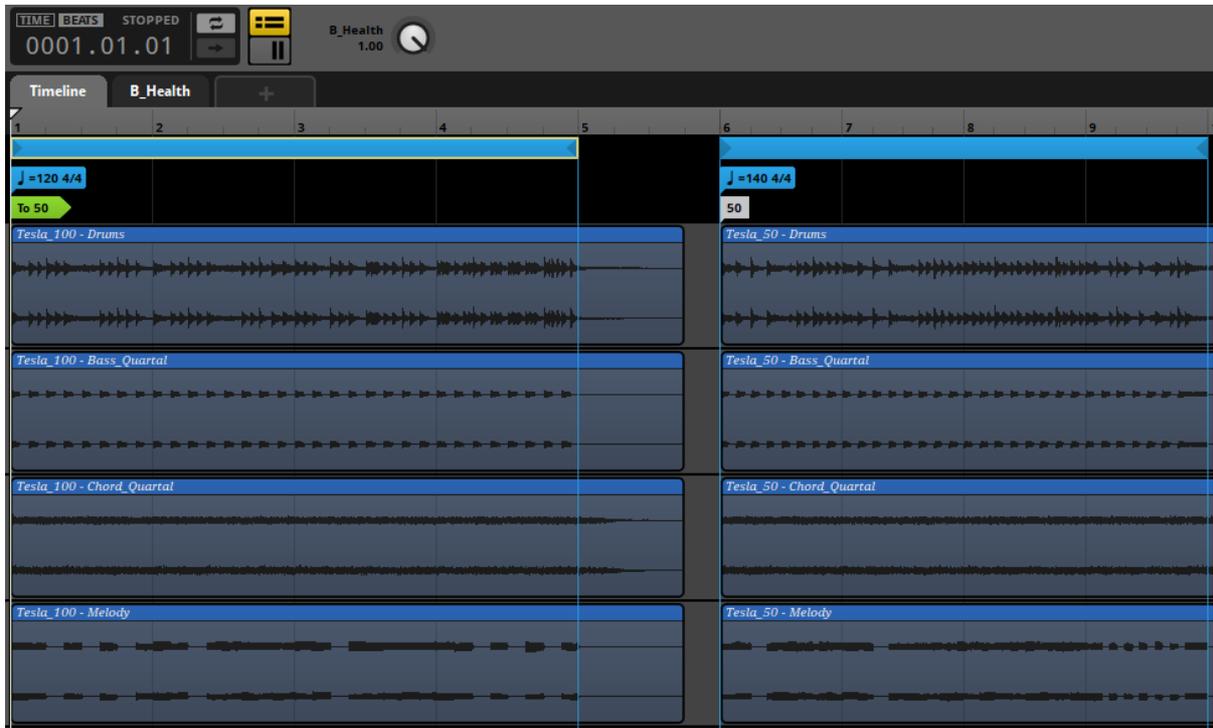

Figure 13: Fmod event view.

The Fmod event uses one parameter, which is, in Unity, coded to look at the health of the boss and when it is lower than 50%, it transitions from the 120BPM section to the 140BPM section upon the four bars having been played. The two different events for quartal and triad harmony are identical, with the only exception being the bassline and harmony.

5 Evaluation

5.1 The Study

Since the chosen research method was semi-structured qualitative interviews, the interviews were held one on one. The questions were asked in order of the questionnaire (Appendix A) from section 1 and 2 followed by the play session and then the interview resumed through section 3 to 5. The data was then compiled into a spreadsheet (Appendix B). The open questions were analysed and structured into keywords while single answer questions were transferred into the spreadsheet as is.

5.1.1 Background data

The ages of the respondents does not vary a lot, with 57.1% being between the ages 20-24 and the remaining 57.1% being between 25-30 (Figure 14). 85.7% of the respondents were male and only 14.3% were female (Figure 14) .
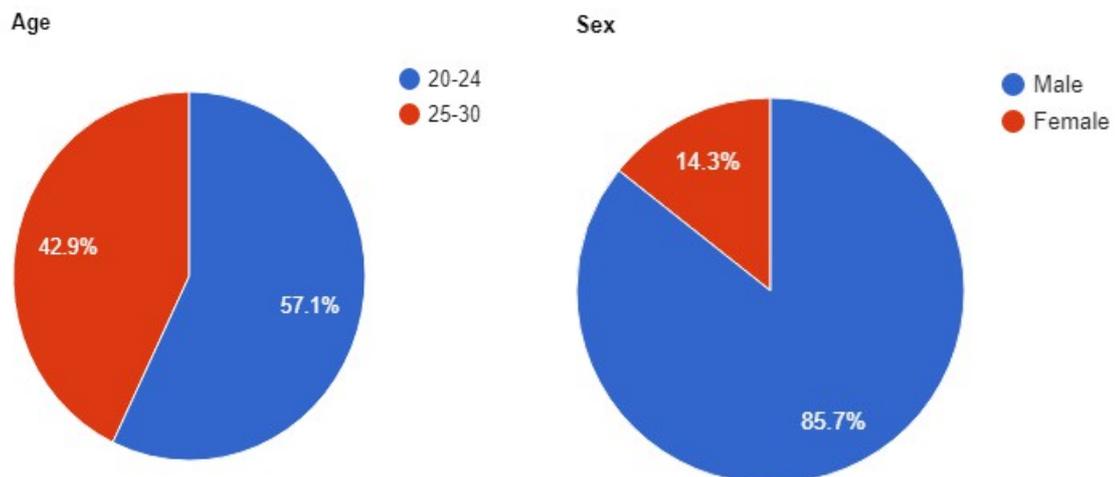

Figure 14: Age and Sex of the respondents.

The data about profession (Appendix B, row 5) shows that 3/7 of the respondents are students and 2/7 are programmers. Preferred music genres (Appendix B, column 15) shows that 5/7 respondents prefer the genre (or sub-genres of) rock, noting that respondent 5 (Appendix B) prefers metal and respondent 2 prefers energetic pop/electronic music. The respondents music listening habits (Appendix B, row 14) shows that all respondent listens to music daily.
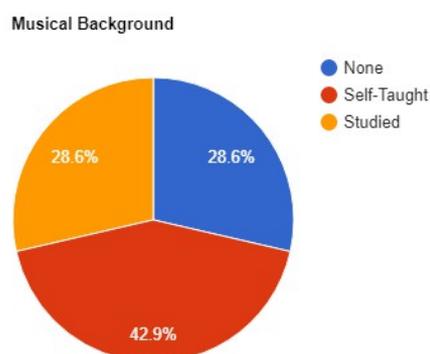

Figure 15: Musical background, studied or self-taught.

Most respondents had some experience of music by studies or instrument. Most had taught themselves (42.9%) and some had educationally studied music (28.6%). 28.6% had no musical education (Figure 15).

6/7 respondents were shown to play games daily, with only one playing only a few days per week (Figure 16).
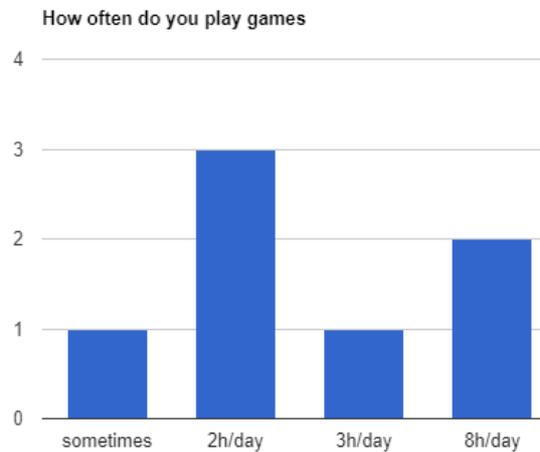
Figure 16: The respondents gaming habits.

42.9% of the respondents are shown to prefer action-adventure games while the remaining 57.1% preferring other genres, such as strategy, arcade, rhythm or role-playing games (Figure 17).
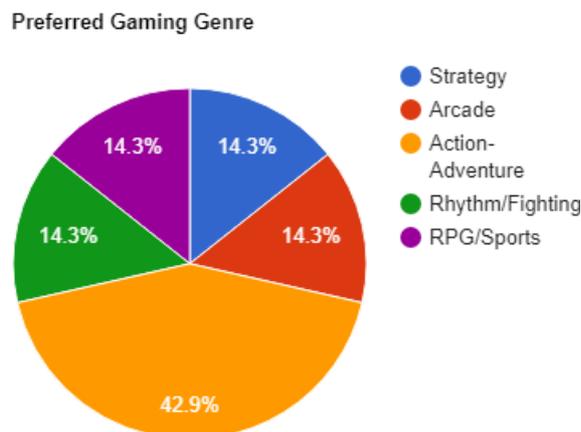
Figure 17: The respondents preferred gaming genres.

5.1.2 Gameplay data

Respondents 2, 3, 4, 6 and 7 reported being happy or neutral before the gameplay session, while respondents 1 and 5 felt bored and hungry respectively. Respondents 3 and 4 also reported that while being happy, they also felt tired and groggy respectively (Apendix B, row 7).

After the gameplay session respondent 1 reported that they felt slightly confused stating that "Nothing is clear, but I'm happy to have beaten the boss". Respondent 1 also speculated that the music may have contributed to stress during the fight (Appendix B, row 19-22).

Respondents 2 and 4 reported that after the fight they felt proud and pleased and that the music may have helped them get immersed more into the game, matching the state of stress they felt while playing. Respondent 2 stated that they "felt more immersed and more comfortable with the game" due to the music while respondent 4 said that "it's possible it fit the fight so well it felt natural" (Appendix B, row 19-22).

The mood that respondent 3 stated they felt after the fight stayed "tired, but good" while saying that the music distracted them from the task, being "too busy and loud. It made it hard to focus, but it felt exiting". During the fight respondent 3 reported feeling confused because "the control-scheme is unintuitive" (Appendix B, row 19-22).

Respondent 5 felt happy after the gameplay because they beat the boss during their first try. When asked about how the music affected their playing, respondent 5 answered that "I didn't pay attention to the music so it probably fit the fight well". During the fight respondent 5 stated that they were pleasantly surprised about the game, but felt that the boss could have had more health (Appendix B, row 19-22).

Respondent 6 and 7 felt successful and happy respectively after the gameplay. During the fight both of them reported that they felt happy, with varying degrees of confusion and panic. Respondent 6 said that the lack of music made the fight "weird and awkward" while respondent 7 speculated that having music may have induced feelings of frustration when losing the fight (Appendix B, row 22).

5.2 Analysis

The goal of the different groups was to see if there's a difference in how quartal- and triad-harmony induced stress. All of the respondents had previous gaming experience, playing between 2 to 8+ hours per day, with only respondent 6 playing a few days per week (Appendix B). This was deemed to be in favour of the study as the respondents were not paying too much attention on how to play and the sessions were received as a relaxed gaming session. The respondents preferred gaming genre did not appear to affect the effects the music had on them.

The respondents musical backgrounds did not affect the result in a noticeable way. The assumption was that the respondents who were studying music would analyse the music on a theoretical level, this did however not occur. The respondents music genre preferences may have affected the data due to how the genre of the music in the artefact tends toward rock and electronic. The ages, sex and country did not seem to affect how the respondents perceived the music, giving several different emotions that occasionally overlap regardless of age, sex or country.

The moods before and after playing shows that the escalation of happiness comes from beating the boss, not being affected by the music.

In both the quartal and triad groups (Appendix B) the effect of the music on the respondents show varying results, not tending towards either one inducing any feelings more than the other. In contrast between music and no music, the result is that music in general may help induce feelings and help the player immerse themselves more in the game.

5.3 Conclusions

The data shows no tendencies of quartal- or triad-harmony inducing stress or other feelings better than the other, this may be due to a small sample size and same cultural background. It is clear that music immerses the player more and helps setting some kinds of feelings. Most of the feelings that were perceived during the gameplay shows that the respondents did feel differences in moods, but the mood after playing was due to successfully beating the boss and not being a result of the harmony.

The gameplay sessions were short and the sample size was small, which may have made the result not showing any particular tendencies in inducing stress between quartal- or triad-harmony. A bigger sample size and a longer gameplay session would potentially show more data in tendencies between quartal- or triad-harmony.

6 Concluding Remarks

6.1 Summary

The presented work was done to initiate a discussion on how contemporary music techniques, such as quartal harmony, can be used to expand the game composers toolbox, by the way of testing if quartal- or triad-harmony would be the most effective when trying to intentionally induce stress from a player playing a top-down shooter game. To be able to get data, a prototype was created from the game *Limited Power – Unleashed* (Bäckström, et al 2018) with adjustments to gameplay and music. Two pieces of music were composed and harmonized in both quartal- and triad-harmony using the same melodies and semi-structured qualitative interviews were conducted along with a gameplay session.

The results of the interviews shows no tendencies towards either quartal- or triad-harmony, but it does show that both harmonizations induce feelings and deepens immersion. All respondents had prior experience playing video games and came from the same western cultural background. This was an intentional choice to make sure that the music composed through western harmonization techniques be experienced through people with western backgrounds, limiting the responses from being too different. The result also shows that the moods of the respondents after the game session is due to successfully beating the fight in the artefact.

6.2 Discussion

The participants of this study described the music as an element helping them get immersed in the game while the participants that didn't have any audio described it as weird, awkward and not conveying any particular emotions. Phillips (2014, pp.102-106) states that the composer should get the player immersed in the game, making them feel like they are a part of it.

The similarity between the results between the triad and quartal harmony may be because of the complexity of the harmony. Gabrielsson & Lindström (2011, pp.389-390) connected tension and excitement with dissonant and complex harmony. The triad harmony, while not using complex chords, uses a lot of jazz theory in the progression, playing with tension and release in a way not commonly used in popular music.

6.2.1 Gender, Cultural, Ethical and Societal aspects

The results of this study did not vary at all between different genders, this may however be due to a very small sample size. All of the participants came from a similar cultural background, so a comparison between how the different harmonies are perceived by people from different cultures can not be done, this would be something that would be interesting to test since the work by Gabrielsson & Lindström (2011) also focuses on western backgrounds.

In the greater society this study would not be of any relevance since the focus of the study was to test how different harmony affects people while playing a game. The study can be used as a tool set for composers to see how and what works when composing. The study does not touch on any ethical aspects, but due to the problem posed, inducing stress could be considered a health risk. This was during the interviews not considered because of the

gaming backgrounds of the participants, as looking at their gaming background showed that they play equally or more stressful games.

6.3 Future Work

Continued work using this study could yield better results, assuming that the sample size would be larger, with a better gender balance. This could help to validate the data collected by this study and to see if there's a correlation between harmonies and genders in general. Further studies could also benefit from having a wider cultural sample size. This would show how the different harmonies affect people throughout several cultures and may help composers to compose for different cultural consumers.

In the long-term, the artefact could have more balanced audio to not be considered too loud and busy. The boss-fight could be longer with detailed instructions on game mechanics and controllers, as to not have the participants playing have to focus on understanding how the game works. These changes would perhaps make the participants being more immersed in the gameplay and music which could yield better results.

Gaming companies could benefit from the results of this study. They could allow the composers more harmonic complexities without having to worry about the listener not understanding the music settings.

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Appendix A.

Questionnaire:

1:

Sex:

Age:

Profession:

Current Mood:

Country of origin:

2:

How often do you play games:

Preferred Genre of Gaming:

3:

What is your mood after playing:

Why:

4:

Did your mood change during the fight:

If yes, how:

Did the music influence your playing:

If yes, how:

5:

Musical background – ex. Studying music:

Do you play any musical Instrument:

Do you regularly attend music events – ex. Concerts, Festivals:

Music listening habits:

Music genre preferences:

Appendix B.

	Quartal:		Triad:			No Music:	
Respondent:	1	2	3	4	5	6	7
Age:	21	26	25	28	22	20	24
Sex:	M	M	F	M	M	M	M
Profession:	Student	Software Designer	Programmer	Delivery Boy, Italian Restaurant (*Not answered*)	Student	Student	Student
Country:	Sweden	Finland	Netherlands	USA	Sweden	Germany	Sweden
Pre play Mood:	Bored	Happy	Tired, but good	Groggy/Happy	Hungry	Neutral/Happy	Happy
Games:	8h/day	2h/day	3h/day	2h/day	8+h/day	Few Days/Week	1-2h/day
Preferred Genre:	Strategy	Arcade	Action Adventure	Action Adventure	Fighting Rhythm	Adventure	(J)RPG Sport
Musical Background:	Studying music at university	Studied guitar, Yousician [game]	Music as high school subject	Intro courses 10-15 years self learned Guitar	None	None	13 Years
Instrument:	None	Guitar Novice	Piano	Some bass and piano	No	Way back - Guitar	Bass, Vocals
Listening habits:	Few hours a day	Daily	Daily	Listens in car, enjoys and listens to game music while playing	Listens during free time mostly from rhythm games or spotify	Daily	Daily
Attends Musical Events:	No	If being forced to	Once/Month	Attends whenever there's anyone that's playing or festivals with friends	No, only if knowing anyone that's playing	No	Once/Month
Preferred Music Genres:	J-Rock	Energetic pop/electronic	Rock/Alt-Rock	Indie-Rock/mid 90s rap	Anything metal	Rock	Metal, Rock, Progressive
Play session related questions:							
Post-play Mood:	Slightly Confused	Proud	Tired, but good	More Awake, Pleased	Happy	Successful	More Happy
Why:	Nothing is clear. Happy to have beaten boss.	Found best way to defeat the boss.	*Not answered*	Because of beating the boss	Beat boss first try	Understood mechanics of game, beat boss	*Not answered*
Moods perceived during fight:	Confused to Happy	Stressed Calm Happy	Confused	Panic Stressful Calmed Down	Pleasantly Surprised, Interested in concept of game, Disappointment due to low boss hp	Confused Happy	Panicked, Surprised, Happy, Calm
Perceived effect of music:	Stressed, Disconcerted, Unsettled	Immersion, Comfortable, Bigger Experience	Busy, Loud Hard to focus, Exciting	Intense, Loud Mood setting Matched feeling of panic	Didn't pay attention to music, speculated that music could have felt natural to the fight	Weird Awkward	May have made it more frustrating when losing