YOU CAN CALL ME AI

AN EXPERIMENTAL STUDY ON HOW EMOTIONAL RESPONSE IS AFFECTED BY PERCEIVING MUSIC TO BE COMPOSED BY ARTIFICIAL INTELLIGENCE

LINN CERVELL

HUGO JENNERHOLM

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You Can Call Me AI: An Experimental Study on How Emotional Response is Affected by Perceiving Music to be Composed by Artificial Intelligence

Abstract**:**

This thesis examines how emotional response is affected by perceiving music to be composed by artificial intelligence (AI). Through a theoretical framework, based on previous research in music and emotion, the aim is to contribute to the research on AI music by focusing on cinematic music and how emotional strength is affected by the perceived composer, AI, or human. We created an experiment based on three musical pieces in the cinematic genre. Two of the pieces were composed by AI and one was composed by humans. Participants were asked to guess which piece(s) were composed by AI and which piece(s) were composed by Humans. They were also asked to report the emotional strength of the "basic" and "aesthetic emotions" they experienced.

The empirical results seem to indicate that there is no difference in emotional strength between the perception of AI music (AIM) and human music (HM). In addition, gender, musical interest, technological interest, and attitude appear to not influence the relationship between perception and emotional strength in any direction. We also found that people, in general, were unable to distinguish AIM from HM. Our first implication is that companies that use music to influence their consumers can freely explore AIM in their emotional communication. Our second implication is these companies can thus benefit from economies of scale, lower labor costs, and new innovative business models, without the risk of interfering with emotional strength. The avenues for future research are diverse and much remains to be discovered in this technological shift in music.

Keywords:
Emotions, Music, Artificial Intelligence, Aesthetics, Technology, Attitude, Musical knowledge, Video games, Film, Music Psychology

Authors:
Linn Cervell (24379)
Hugo Jennerholm (24873)

Tutors:
Patric Andersson, Associate Professor, Department of Marketing and Strategy

Examiner:
Hanna Berg, Research Fellow, Department of Marketing and Strategy

Bachelor Thesis
Bachelor Program in Business & Economics
Stockholm School of Economics

For any inquiries, please contact 24379@student.hhs.se or 24873@student.hhs.se.

Contents

1. Introduction

Since humans have existed, it seems music has, too. Historically, rhythmic and harmonic structures have been essential for communicating emotions and for our survival as a species. Today, the effect music has on people is still the same, but with one essential difference; it is one of the largest grossing industries in the world.

The first paradigm shift in the music industry was the invention of writing harmonic structures down on paper. Various forms of writing down music have existed for thousands of years, but when what we know of today as printed "sheet music" was invented, music became a service and a good, simultaneously. The second paradigm shift was the record, which enabled music to be heard in its original form anywhere and at any time. For the first time in history, people did not have to be in the same physical space as the performer.

In 2018 the album "Hello, World" was released by the artist SKYGGE. It was the first musical piece to be composed by artificial intelligence (AI), through a software program that analyzes the patterns of other musical pieces to create its own. The release received varying responses. Some were excited and claimed it to be the start of a new musical revolution, a paradigm shift within the creative industries, while others were more hesitant and anxious (Avdeeff, 2019). If the record allowed the distribution of music to be scaled, some might say AI music (AIM) is the process of scaling human creativity itself. The third paradigm shift will undoubtedly influence the music business, and to understand how actors should adapt their business it is essential to understand how the new shift will affect the consumers of music.

The purpose of this thesis is to examine if the perceived composer of a musical piece (AI or human) can affect the strength of the emotions that arise while listening to music. If the main purpose of music is to evoke emotions, how is that affected by the perception of the composer of said music? And how can the industry adapt to the psychological effects it may or may not have on its consumers? We aim to understand what kind of effect a perceived AIM composer has on the emotional response of consumers of music.

This thesis aims to build upon previous research within music psychology, of which many papers have been written by Professor Patrik Juslin, head of the Music Psychology Group at Uppsala University. His research on musical psychology will be extended by incorporating how artificial intelligence in music affects our emotional responses. Through the results from this thesis, we aim to contribute research that all marketers that use music to influence consumers will find insightful to navigate the new music landscape.

1.1. Background

1.1.1. The Cinematic Music Industry

To be able to study emotions in music, we have chosen to focus on video game music, film scores, and 'background' or 'anonymous' music. These genres of music are typically more anonymous and more solely focused on evoking emotions in the listener (Douek, 2013). We have chosen to create an overall name for these categories, what we call "cinematic music". We had the opportunity to interview an established video game music composer who gave us more information about the video game music industry in Sweden. Personal communication has been combined with information from a seminar with two video game composers (Export Music Sweden, 2022).

The composer we interviewed explained that music in video games has three main functions: to guide the player's emotions, to steer the pace of the player, and to evoke a sense of immersion. Music can create a psychological state which can make a stressful part of the game even more stressful, or calmer if the event is "too stressful". This can either increase or decrease the chance of certain choices being made, or the success/failure rate in a game. AIM can be especially useful in a game setting because of the interactive relationship between the player and the game. AI-generated music would allow for the music to be custom-generated even further to fit what is going on in the game at the given moment, how the player is interacting with the environment, and change depending on the response of the player. This level of highly interactive music has the potential to revolutionize how music is experienced in games. When asked what challenges might arise in technological shifts, she explained that one of the greatest skills of a composer is the ability to tackle many different genres and styles of music. Another aspect is the value of having your own personal, identifiable style as a composer, which can make a composer stand out from the crowd.

Music in film is similar to video game music with the difference that there is, most often, no direct interaction between the viewer and the media. However, interactivity is becoming a more and more widespread element in movies and series, as well. The Netflix film "Bandersnatch" from 2018 was one of the first full-scale films where the audience was able to choose what lines the actors would say, and therefore have an impact on how the story unfolded and how the music sounded. One of the composers at the ExMS seminar believed we might see more of these types of media in the future. (Export Music Sweden, 2022).

1.1.2. The Rise of Artificial Intelligence in the Music Industry

The very first example of using machine learning to create AIM was developed as early as 1957. It was developed by a man named Max Mathews, who during an intermission of a piano concert had been challenged by a friend who had suggested that a computer could perform the music. Earlier attempts at music created by computers had been made, but the programming language developed by Mathews became the first step to creating what we today know as AIM. (Kirke et.al., 2010)

Modern AIM can at times sound indistinguishable from HM. Yet, it follows the same process of learning by analyzing existing musical scores. One company that has pioneered the creation of music through artificial intelligence algorithms is AIVA, a tech startup based in Luxembourg. In a TED talk in 2018, co-founder Pierre Barreau (2018) explained the process of creating music through machine learning, a branch of artificial intelligence. Using deep neural networks, the virtual music program AIVA looks for patterns and constructs a model by using training data from 30 000 musical compositions. From existing music, the program tries to infer what should come next after those bars of music. Once AIVA gets good at predicting which notes should come after which, the program constructs a set of mathematical rules, based on a certain type of music, to create original musical compositions. Barreau also mentions that music is highly subjective. To teach AIVA how to tailor the music to the right person, mood or preference, the model uses 30 different category labels for each score such as note density, mood, and musical eras. By using this data, the model can compose music based on very precise directions, so much so that in the future we might accept fully automated "personalized soundtracks for our lives". While full automation of music is a while away, producers are currently using AI-based assistance tools in the production of music. For example, software companies such as Izotope and Waves have created successful mixing and mastering tools to help music producers, thus integrating HM and AIM in a way that might not be perceived by the listener.

1.1.3. A Broader Perspective on AI Music in Marketing

Video game revenue worldwide in 2021 amounted to over $180 billion (Clement, 2022) and according to Adgate (2022), total entertainment spending in the US increased 14% in 2021 to $37 billion. At the same time, global box office revenue added up to $21 billion in 2021 (Navarro, 2021). The importance of music in these types of media is, as we have established, large. Through interaction, automation, and personalization AI has the potential to change the industry dynamics. New business models can earn corporations increased revenue, current business models can become more efficient, and consumers can enjoy music in a new interactive environment.

The same principles that apply to film and video games also apply to companies in all industries that use music to influence and affect their consumers. Emotions are an essential aspect when you want a customer to go from a neutral to an aroused state to take the desired action. In addition, most actions are based on emotional rather than rational communication as explained by Erik Modig (Doctor in creative advertising and researcher at the Center for Consumer Marketing at Stockholm School of Economics) in his book "*Bang for the Buck*" (2017). Since music is one of the most common stimuli to trigger an emotional response, understanding what arises emotions is essential. Thus, understanding how AI influences music consumers is not only valuable to the film and video game industry, but to music marketing in all industries, and the marketing field as a whole.

1.1.4. Research Questions

AI in music creates a new type of complexity within the music industry. To understand how to utilize AI in the music industry and in marketing in general, understanding

consumers' perception of AI, and thus their emotional responses is vital. Thus, the following research questions have been posed:

- Does perceiving music to be composed by artificial intelligence affect the strength of the consumer's emotions?
- Does gender, interest in music, tech interest, or attitude moderate the effect between perception and the strength of the consumer's emotions?

1.1.5. Scope

We aim to contribute to the research on AIM by focusing on cinematic music and how emotional strength is affected by the perceived composer. Given the formal requirements and limited time of a bachelor thesis, we will not be focusing on which individual types of emotions arise, nor the difference in the ability of the actual music, or true composer, to evoke emotions. This would require a large sample of different music pieces and a more extensive psychological experiment. The question of whether an AI composer or an HM composer has a better ability to create emotions is of interest for future research, but this thesis will focus on whether the perception of AIM or HM can affect emotional strength.

We will not be analyzing the intentions of consumers, their demand for AIM, nor how their intention to buy or listen to music is affected. Emotional strength is measured as a general necessary step to create consumer demand, but explicit intentions for taking such actions will not be researched. Furthermore, we focus on music in the cinematic music industry. The reason for this is the special traits that film and video game businesses possess that make them particularly suited for AI to make an impact, see 1.1

1.1.6. Research Contribution and Purpose

A large portion of research within music psychology has focused on how emotions within the music are affected by the content of the music through aspects such as genre, dynamics, and the coding within. The listener's gender, music interest, tech interest, and attitude have also been studied. However, it seems that the listener's perception of the composer has not been studied to the same extent. Research within marketing has focused on how emotional response and perception of the messenger (such as uniqueness, originality, and authority) affect behavior. This thesis aims to bridge the gap between music psychology and marketing, by studying the aspects of how the perceived messenger, artificial intelligence, or humans, in this case, affect the emotional response. This in turn will have implications for consumer behavior.

By studying specifically cinematic music, we aim to provide an answer to whether acknowledging the consumer of the use of AIM is beneficial for companies in their marketing efforts, or whether the nature of the composer is better left unknown. If perceiving music to be composed by AI decreases their emotional strength, and a company wants to use AIM in their business, they should avoid acknowledging the AI composer. If it instead enhances or creates an indifferent effect on emotional strength,

they might benefit from making consumers aware of this aspect in their marketing- or at least, do not need to be afraid to provide this information.

1.1.7. Disposition

In the following sections of this thesis, we propose a combined theoretical framework based on previous research to navigate emotional response to music, as well as a theoretical connection from music to marketing and consumer influence. We then present our method of research, which includes the design of our experiment and an overview of our gathered data. Lastly, we present our empirical findings on emotional response in section 5 and an analytical discussion and conclusion in section 6.

2. Definitions

Artificial intelligence: Artificial intelligence is the ability of a computer program that exhibits traits of the human mind such as learning and problem-solving. (Copeland, 2022)

Machine learning: Machine learning, in artificial intelligence (a subject within computer science), is a discipline concerned with the implementation of computer software that can learn autonomously. (Hosch, 2022)

Deep learning (deep neural networks): Deep learning is a subset of machine learning, which is a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain to "learn" from large amounts of data. (IBM Cloud Education, 2020)

Emotional strength: The strength, positive or negative, of which our emotions are experienced.

Cinematic music: An overall term used in this thesis to describe video game music, film scores, and background or anonymous music.

Background or anonymous music: Music intended to be listened to passively, in the background to create an ambiance or a mood.

Major scale: The major scale is a diatonic musical scale with 7 notes.

Minor scale: The minor scale is a diatonic musical scale with 7 notes that unlike the major scale features a minor third scale degree.

Iconic coding: The type of coding that evokes basic emotions. The first and most powerful source of perceived emotion. (Juslin, 2013b)

Intrinsic coding: Intrinsic coding involves harmonic and dynamic relationships within the music such as dynamics, tempo, variation, intensity, and harmonics. These tools can create feelings such as tension, release, and climax. (Juslin, 2013b)

Associative coding: Associations made while listening can cause associative coding. Elements in musical pieces (such as a melody or a specific instrument) can create emotions if that element has been repeatedly paired with other meaningful stimuli or events in a person's past. (Juslin, 2013b)

Basic Emotions: Emotions that are similar to emotions experienced in daily life and that include discrete emotions such as happiness, sadness, interest, and surprise. (Juslin, 2013b)

Emotions: This term is used to refer to a quite brief but intense affective reaction that usually involves several sub-components – subjective feeling, physiological arousal, expression, action tendency, and regulation – that are more or less 'synchronized'. Emotions focus on specific objects such as events, music, or film, and last minutes to a few hours (e.g., happiness, sadness). (Juslin & Sloboda, 2010 adapted in Juslin 2013a)

Aesthetic Judgement: This term is used to refer to a subjective evaluation of a piece of music as a form of art based on an individual set of subjective criteria. Aesthetic judgment creates aesthetic emotions. (Juslin & Sloboda, 2010 adapted in Juslin 2013a)

Feeling: This term is used to refer to the subjective experience of emotions or moods. (Juslin & Sloboda, 2010 adapted in Juslin 2013a)

Preference: This term is used to refer to more long-term affective evaluations of objects or persons with a low intensity (e.g., liking of a particular piece or style of music). (Juslin & Sloboda, 2010 adapted in Juslin 2013a)

3. Theoretical Framework

This section includes the theoretical framework that our thesis aims to build upon and extend. We will begin by exploring literature within music and marketing psychology and summarize the previous theoretical framework in an applicable model. Through the framework, we will develop hypotheses that support our questions of research.

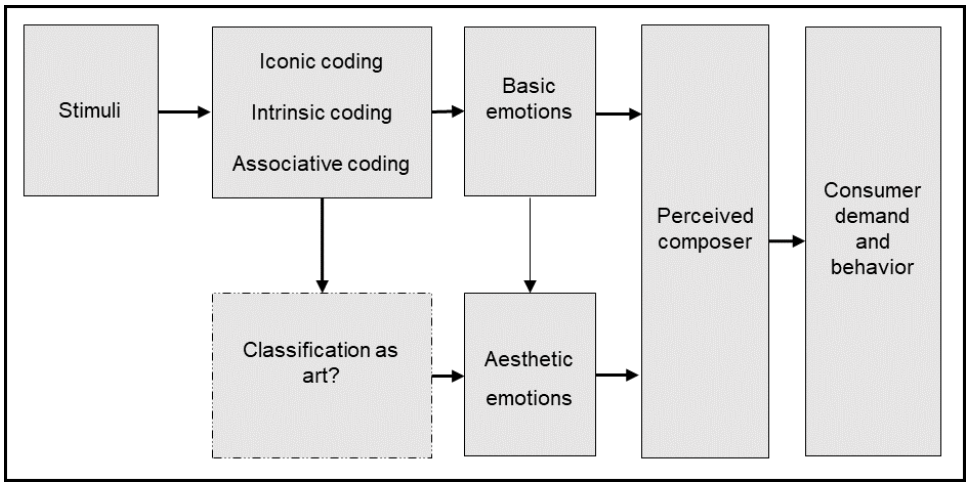
3.1. Music Psychology Theory

The earliest empirical studies on emotion perception in music appeared already in the 1890s, but it was not until the 1930s that studies became more frequent (Gabrielsson, 2002). Music psychology is a broad term that can be applied to many different fields such as music performance, music in marketing, musical preference, health benefits of music, and music education. When researching music and emotions specifically, however, we continuously encountered studies made by Professor Juslin, head of the Music Psychology Group at Uppsala University. We have therefore chosen to base much of our thesis on the literature and research made by him. This section will present some of his research on music and emotions, followed by some of the critical arguments that have been made in these studies.

From these theories, we will conduct deductive research to further expand the knowledge within music psychology in a new technological context. This will be done by an experiment that measures musically induced emotions, together with the element of AI-composed music. The studies and articles that will be discussed have all been retrieved from the library database of the Stockholm School of Economics, Google Scholar with a few exceptions for other media or press articles.

Figure 1 presents a combined theoretical framework we will utilize in our thesis. We have created this figure based on research by Professor Juslin (2013a, 2013b), Juslin & Västfjäll (2008), Modig (2017), and Heath (2012). We have adapted it to the scope of this thesis. Although some studies show that some people do not feel any emotions at all when listening to music (Juslin & Laukka, 2004), most listeners do experience them in musical contexts. These emotions can be divided into two different categories: basic emotions and aesthetic emotions. Basic emotions influence aesthetic emotions. Both follow a process of interpreting stimuli through different mechanisms we will discuss in the following section. We have extended the emotional mechanisms by adding the stage of perception, “Perceived composer”, as well as the emotional effect on consumer demand and behavior. Until the Perception stage, most of the processes occur unconsciously. The Perception stage however is a conscious rationalization formed by the emotions created. To some degree, the Perception stage is processed at the same time as the Aesthetic emotions stage (which is partly a conscious evaluation). The process of affecting consumer behavior should therefore not be seen as a strictly chronological, static set of stages, but rather a flow of mechanisms that to some extent flow in and out of each depending on the person, the situation, and the music. The last stage is based on marketing theory and will be discussed further in section 3.1.6.

Figure 1: A combined theoretical framework of emotional response to music



3.1.1. Music Makes You Feel Emotions

Professor Juslin's research focuses on how and why emotions arise when people listen to music and how different components in music have different effects on the type of emotions that arise. Together with David Västfjäll, professor in cognitive psychology at Linköpings University, he has created a framework to explain how these emotions arise in the brain, called the BRECVEM framework (Juslin and Västfjäll, 2008) and later adjusted by Juslin (2013a) to include aesthetic emotions. The framework explains the underlying, unconscious mechanisms that happen in the brain when it is exposed to the different types of stimuli in the music. These psychological mechanisms are what create emotions.

Emotions refer to an affective reaction that can involve a subjective feeling, physiological arousal, expression, action tendency, and or regulation. Joy, sadness, and excitement are examples of emotions. We define emotional strength as how "strongly an emotion is felt, or how much of an emotion a person feels. For more explicit definitions, see section 2.

3.1.2. Basic Emotions

Basic emotions are defined as the type of emotions that we experience in our daily lives, such as joy, sadness, and anger. Basic emotions also include more complex emotions within each category such as nostalgia, hope, and humility. Each category of emotions can be allocated to important instincts of human survival such as danger (fear), competition (anger), loss (sadness), social cooperation (happiness), or caregiving (love), (Juslin, 2013b).

Historically, basic emotions have been of lesser or more evolutionary importance to human survival and occur in most cases of studied musical listening. This is what Juslin calls “iconic coding” in music. These emotions can arise without the requirement of any musical knowledge from the listener and are the most powerful type of emotion. They occur across many different types of cultures, and recognition of iconic coding can be shown in 3-4-year-olds. (Kastner & Crowder, 1990). Another form of complex emotions is “mixed” emotions” (ex. simultaneously experiencing happiness and sadness) which also occur but in a minority of the time. (Gabrielsson, 2011), as cited in Juslin 2013a.

Emotions evoked in music can also be explained by ‘intrinsic coding’, which refers to certain elements of a musical piece that involve changes in dynamics, tempo, intensity, and harmonics. The relationships between tones, for example, is why a melody in major scale sounds “happy” and a melody in minor scale sounds “sad”. (Lerdarhl & Krumhansl, 2007; Larson & VanHandel, 2005 as cited in Juslin 2013b).

A further complex, personal level of emotions arises from associative coding: when sounds create an association. For example, listening to music you loved as a teenager might create strong feelings for you, but not for someone who has never heard it before. To an extent, associative coding is therefore dependent on what a person has experienced previously. The more complex the emotions are, the more they depend on associative coding through culture, social, and personal context.

3.1.3. Aesthetic Emotions

Aesthetic emotions are less common than basic emotions. They describe a set of feelings that arise when humans judge, among other things, the skillfulness, beauty, and originality of artistic content. When these criteria are judged to be strong enough, an aesthetic judgment takes place. Typical aesthetic emotions are awe, admiration, and wonder over the technical skill or beauty of a piece. Although aesthetic emotions are constructed from a higher cognitive function, they too, are often (but not necessarily) influenced by basic emotions (Juslin, 2013a). For an aesthetic emotion to occur: the listener must first recognize the music as a piece of art to be able to evaluate the music on a set of aesthetic criteria. Through these criteria, the consumer evaluates the music and makes an aesthetic judgment.

Aesthetic emotions require a higher degree of perceptual and cognitive input to develop an aesthetic attitude and to even be able to classify the content as art. Some pieces, according to Juslin, invite to this initial classification to a higher degree than others. Evaluating the aesthetics of a piece involves judging the artist, and in this case, the composer of a musical piece. How well has the composer succeeded in creating a beautiful piece? How original have they been? With this thesis, we want to explore whether the perception of the composer affects the chances of an aesthetic attitude being developed.

3.1.4. Knowledgeable Consumers

Professor Juslin suggests that "engaged listeners", including people with musical knowledge, tend to experience aesthetic emotions to a higher degree than people who do not have this type of knowledge. They are more likely to be guided by their preferences and judgment of the art, while "passive" listeners might be more unconsciously affected by their basic emotions. They simply experience the emotions rather than consciously evaluate the quality of the music. (Juslin, 2013a)

If such a distinction can be made, a parallel can be drawn to previous marketing research in consumer expertise. Objective 'expertise' has been found to be a predictor of product evaluation (Cordell, 1997). One example is what D'Alessandro and Pecotich (2013) call "expert" consumers in their study on wine tasting. In their research, they realized that their consumers could be divided into two groups: expert consumers and novices. Knowledgeable tasters (experts) were able to use their knowledge to form analytical reasons as to why the quality differed between different wines, and their arguments proved consistent across wines. The less knowledgeable consumers had trouble deciding on the quality of the wine, as well as formulating clear reasons for the points of evaluation. The two separate groups also used different cues to make their evaluation. Novices were for example found to rely more often on extrinsic cues such as the country from which the wine originated, rather than a brand name.

Consumer expertise has also been studied in other areas, such as the decision-making process of fund investors. (Li et al., 2018). Li et al. found that consumer expertise positively correlates with the perceived value of investments. In their case, the expert judgment required professional knowledge to be able to perceive more value in an investment. Although this is a seemingly entirely different field than that of music, it might be applicable to our research as well. In that case, "Perceived value" might be similar to Aesthetic Judgement.

Applying this concept of knowledgeable consumers to music listeners: an expert listener might be defined as a person who knows music theory, and musical composition, can play an instrument or is sensitive to harmonies, melodies, and tones. The question is, do aesthetic emotions have a higher tendency to arise in knowledgeable consumers, and will their "preference" towards either HM or AIM distort this judgment?

3.1.5. Other Approaches to Emotional Response in Music

Emotions in music is a large field with many passionate researchers. This has led to many disagreements within the field, of which we will discuss a few.

Cespedes-Guevara & Eerola (2018) claim that music often does not evoke basic emotions, but instead a set of music-specific emotions that are completely different from the ones we experience in everyday life. Juslin disagrees with this statement but says that it is true that music evokes a higher "frequency" of emotions than in other contexts, and that there is skewness towards "positive" emotions in music listening. This, he explains, might be due to the context in which music is listened to (Juslin, 2011). Cespedes-Guevara & Erola also disagree with the view that basic emotions stem from a certain type of coding within the music and claim that there is not enough

evidence for the evolutionary “human survival” explanation for basic emotions. Instead, basic emotions must be analyzed in their specific contexts.

The term “aesthetic judgment” is not entirely consistent within the field either. Some even neglect the existence of aesthetic judgment entirely. John Dewey describes this in “Art as Experience”, (1934), as cited in Popova (2016);

> “Flowers can be enjoyed without knowing about their interactions of soil, air, moisture and seeds of which they are the result”

One can appreciate art without knowing exactly why. We do not believe beauty has to be understood to be experienced. In the case of AIM, if an aesthetic judgment required knowing how machine learning works, it would be impossible for most people to evaluate the music. Similarly, only highly educated musicians would be able to judge the quality of music. Aesthetic judgments must be possible for everyone to make. If we define the quality of music as ’the ability to evoke emotions, the quality will differ depending on who that person is, and art is therefore subjective.

There is a general debate on exactly how terms are to be used if there exists enough empirical data to accept certain theories, and what questions researchers should focus on. Juslin explains a few possible reasons for this. One is that the field of music is applied in a general sense when it is in fact complex and involves many specific, different areas. Miscommunication arises when researchers talk about different things, instead of the same phenomenon within music. We have attempted to focus on the specifics of emotional strength, as described in section 1.1.5.

3.1.6. How Emotional Response Affects Consumer Behavior

Emotions are of importance since they are the basis for many of our actions. If companies want to affect consumers, they must first understand their emotions. Doctor and researcher Erik Modig explains this through what he has named the “Influence Matrix” (Modig, 2017). It contains the three different states of mind, roughly translated as: “the analyzer”, “the fast thinker”, and “the emotional being”. These different states of mind have their separate customer journeys, even though they overlap to some degree. “The emotional being” firstly reacts, unconsciously, to stimuli and forms a perception of whatever they are shown. Secondly, conscious emotions of varying strength are evoked, which in turn are connected to motivational factors such as relations, social status, identity, and other associations. These create a demand and a drive to seek out the product or service that can fulfill their desire. Some of the most successful ads are those that manage to evoke these emotional mechanisms in the consumer, to make the customer buy their product or service. Modig has created these concepts partly based on “Seducing the Subconscious” (Heath, 2012). In Heath's book, he cites neuroscientist Damasio (2003) who has developed a model which explains the emotional impact on a consumer’s decision-making process. Emotions are automatically activated in all decisions and are described as an influential gut feeling or intuition. “Although decisions still come from our rational mind, it is effectively driven by our emotion,” Heath explains, in the interpretation of Damasio’s research.

Achar et al., (2016) describe the effect that emotions have on decision making through integral emotions (embedded i.e the category, brand and content of an advertisement) and incidental emotions (emotions that arise through personality, historical events and/or environment). Incidental emotions affect seemingly unrelated consumer decisions through processes such as enhancing message compatibility, changing temporal focus and mindsets. Integral emotions can affect consumer behavior through modifying the person's concept of self and through contagion effects. The authors also mention an experiment on the matter (Bagozzi & Moore (1994), in which anti-child abuse public service announcements that used empathetic appeals were more effective in creating an incentive to help, than "rational" announcements.

In Bagozzi et al., (1999), the authors present the concept of "Thinking" vs. "feeling" advertisements, of which the first kind has been found to be more important for developing an attitude towards the ad (in low involvement settings). Incorporating feelings also enhance the memorability of the ad, which can affect consumer incentives to behave in the desired way. Consumer behavior is also discussed in Di Muro & Murray (2012). They describe; "consumers in a pleasant mood will tend to choose products that are congruent with their current level of arousal, while those in an unpleasant mood will tend to choose products that are incongruent with their current level of arousal". Applying this to the results we will retrieve, we assume that emotions in music therefore have consequences on the consumer's future desires and behavior.

Since music also is a consumer good, the same processes can be seen in music consumers. You listen to a piece and experience basic emotions that perhaps appeal to your self-identification, that creates a demand to listen to the music again, or you search the same artist's catalog to find a music piece that can create the same reaction. For music in video games, you might want to buy a certain game because its music was written by a specific composer (to whom you have associated with certain types of emotions), or you might want to play a game even longer simply because you want to hear the music. "The analyzer" mindset might be more applicable to the mechanisms in aesthetic judgment. It involves a higher level of processing, reasoning, use of knowledge, and comparison. These components lead to an evaluation of the value of the content. An emotional bias can affect this reasoning, perhaps similar to how basic emotions affect aesthetic emotions. In music, this can be applied to the classification as art and evaluation of aesthetic criteria in a musical piece.

Being innovative is another aspect that Modig explains is crucial for attention. If a person perceives AIM to be innovative, regardless of the fact if it is or is not, this might increase their engagement. On the contrary, if AIM is perceived to be less innovative, it might decrease attention. This knowledge could be of use for the cinematic music industry, as engagement with the storyline and sequences is very necessary.

3.2. Hypotheses

Through combining these theories in music and emotion, two null hypotheses have been formulated. These aim to capture the concept of emotions in music but in a new technological context, as an attempt to decrease the uncertainty around technological

advancements in the music industry. Basic and aesthetic emotions arise through different mechanisms, as explained in 3.1. The theoretical framework does not suggest that the perception of the music composer will affect these types of feelings. Thus, we want to highlight this question in the following hypotheses.

H1: Mean of basic emotions will not differ between the perception of human music composition (HM) or AI music composition (AIM)

H2: Mean of aesthetic emotions will not differ between the perception of human music composition (HM) or AI music composition (AIM)

We believe AI-composed music has reached a level today that in many cases is unidentifiable from human-composed music. The technology is highly advanced and has achieved a level of sophistication that is difficult to identify from music composed by humans. The perceived composer of the music will be difficult to identify, and therefore not something that will distort the emotional strength. Thus, emotional strength will not differ.

Gender, music interest, tech interest, and attitude will also be analyzed, in interaction with perception, regarding their influence on emotions. These include gender, technological interest, musical interest, and attitude toward artificial intelligence in a creative setting. These are the only variables on an individual participant level that we will analyze. We want to avoid formulating a set of null hypotheses around gender, music interest, tech interest, and attitude due to their absence of them in the theoretical framework. We are unsure how these will interact with perception, but still, believe that it is valuable to understand if gender, music interest, tech interest, and attitude affect the interaction between perception and emotional strength.

4. Method

The following section will introduce the structure of the experiment and how we have considered reliability, validity, and data quality in the thesis. Finally, we will present the tools and methods we use to analyze our empirical data.

The question we aim to answer is whether believing a musical piece to be written by AI or a human has any effect on the strength of basic or aesthetic emotions. A quantitative self-report research method was chosen, using a discrete model of emotions. The method of researching emotions in music through this model was deemed suitable due to its ability to gather larger amounts of data in an effective way. This model has been one of the most popular methods of researching emotions in music during the last two decades (Juslin & Sloboda, 2010). Other methods of studying emotional responses were disregarded due to time-consuming restraints. For example, although a qualitative interview with each participant about their emotional response could have provided more depth (such as descriptions of what associations arise, more nuanced emotions, and feelings that might have been excluded in our research), this method would not be possible given the time and resource constraints of the bachelor thesis format.

4.1. Experiment

We created an experiment based on three musical pieces in the cinematic genre. Two of the pieces were composed by AI and one was composed by humans. 57 participants partook in the experiment. Through our institution, we were able to find 37 students, consisting of two classes, that were willing to participate in a supervised experiment guided by us. One session was held for each class in which everyone in that class was gathered in the same physical classroom, to partake in the experiment. The remaining 20 participants consisted of 16 colleagues and 4 people from personal connections. The 16 colleagues were gathered in a physical space to conduct the experiment, and the 4 people from personal connections were supervised in a digital space over Zoom. All participants were of similar age and had some level of higher education.

The musical pieces we used were “Free Spirit” created by the AIM company AIVA, “Darkness of Light” by Seccession Studios, and “Caretaker” by AIVA. These pieces were chosen based on preliminary research regarding attention span, how well the pieces represented cinematic music, and how similar they were to each other. The average attention span was concluded to a 30-40 second time limit. This limit was considered short enough to ensure that all respondents were engaged throughout the whole time, but still long enough to create an emotional response. The musical pieces were perceived to be of relatively equal musical quality, contain similar dynamics, and be of similar musical content. The purpose of this was to limit any interference in the results due to personal preference or music-technical differences in the musical pieces.

Participants first received the link to the experimental survey through their digital device. They were asked to have their own individual listening devices available, from which they could listen to the musical pieces. After a brief introduction to the research, they began the experiment by clicking the link. After the survey introduction and the

initial questions on GDPR (to which they were asked to consent), participants could test the volume and sound through a question on sound recognition based on identifying the correct animal sound. After the sound was controlled, participants followed the same process for the three musical pieces: they listened to the music, guessed who or what had composed the music (AI or Human), and rated their emotional experiences on a Likert scale from 1 to 7. Participants did not know who the true composer was. Throughout the survey, participants were allowed to fill out each question at their own pace and were allowed to ask us questions if anything was unclear or malfunctioned.

The emotional experience was divided into two categories, basic emotions, and aesthetic emotions. The options of emotions that were available for the self-report section of the experiment were selected from previous research in music psychology by Kreutz (2000), Juslin & Laukka, (2004), and Lindström et al., (2016), as cited in Juslin (2013b). The chosen basic emotions were those that were the most commonly induced. However, "fear", "tenderness" and "anger" were excluded. "Fear" was considered to be similar to "anxiety" as it belonged to the same "family" of emotions (Juslin, 2013; Lindström et al., 2016). Anger was not as common as the other emotions, and Tenderness was considered to belong to the same family as Love. Since most participants would not be native English speakers, nuances in options would risk not being recognized. A flow chart of the survey has been attached in appendix 1).

The average age of participants was 22 years old. 3 people did not fill in the age. Ten people were 20, six people were 21, fourteen people were 22, 8 people were 23, four people were 24, one person was 25, two people were 26, and one person was 27, 29, 37, and 39 respectively. 11 people were female, 40 people were male, and one person preferred not to answer.

Participants were also asked about their level of musical education and technological knowledge. However, we decided to exclude musical education due to the small sample size of 4 people that had studied music. Technological knowledge was deemed superfluous due to its similarity with technological interest and was thus also excluded.

4.2. Research Reliability

Reliability ensures that data and statistics that have been collected are measured correctly and consistently. In this thesis, internal consistency reliability has been estimated by using Cronbach's alpha. An alpha over .8 is typically used as a rule of thumb for what is acceptable, but many writers accept a slightly lower score according to Bryman & Bell (2011). Through running a reliability analysis, it could be concluded that Cronbach's alpha was larger than .8 for the aesthetic emotions in all of the musical pieces. However, the basic emotions had values between .5 and .7. Thus, the reliability for basic emotions is at a moderate level, but still less than what is usually considered acceptable, and is, therefore, a weakness in our thesis. Furthermore, it was identified that each emotion within the two categories had no direct outliers with regards to their alpha value, no emotion deviated more than .1.

Since the experiment was dependent on the fact that each participant experienced the music in the way we intended it to be experienced, we conducted the experiment in a supervised setting, carefully monitoring the process. By being present we could ensure that each participant listened to the entire piece, did not interact with each other, or had any problems during the experiment. Conducting the experiment with more participants would have helped us to generate a more accurate statistical model, however, given the constraints that supervised experiments entail we were unable to gather more participants during this time. We prioritized the quality of each respondent in the experiment rather than the number of respondents.

Finally, we chose to include three different music pieces in the experiment. This was to ensure some level of replicability in our experiment and increase the chance of accurate results.

4.3. Research Validity

Internal validity refers to the experiment's ability to measure what we set out to measure, and how the perception of AI- composed music affects emotional strength (Bryman & Bell, 2011). The emotional alternatives, as well as scales in our experiment, are commonly used in music psychology (Juslin & Sloboda, 2010). We, therefore, consider them to be valid for our study. Preliminary research indicated that aesthetic emotions were more complex and unfamiliar, thus we included a definition after each aesthetic emotion in the survey[1]. We did not find the need to define the basic emotions.

Since the experiment is dependent on the listening experience of the test subject, there was a risk that the order in which the pieces were presented would influence the result in some way. Thus, the order of the three pieces was randomized for each participant. In addition, there was a risk that familiarity with the music would impact the result. To mediate this risk, we asked each respondent if they had heard the music before. 1 person stated that they had definitely heard "Darkness of Light" before, and one person stated that they had definitely heard "Caretaker" before.

External validity refers to the extent one can draw general conclusions from the experiment, beyond its specific context (Bryman & Bell, 2011). While this thesis examines specific questions related to AIM or HM to evoke emotions within music, general conclusions can be drawn about artificial intelligence in a creative setting. The implications of this thesis are thus relevant to anyone who wants to affect a consumer's emotional response using artificial intelligence.

[1] The following definitions of aesthetic emotions measured were: beauty (a combination of qualities, such as shape, color, or form, that pleases the aesthetic senses), originality (the quality of being novel or unusual), expression (the action of making known one's thoughts or feelings), complexity (the state or quality of being intricate or complicated), artistic skill (the ability to use one's knowledge effectively and readily in execution),, emotional strength (strength of emotional response evoked), representation (how well the music represent the intended genre), and artistic intention (ability to portray the artistic message).

4.4. Data quality

To measure our data quality, we asked questions at the end of the survey on how meaningful, neutral, and formulated the questions were. Participants were given a set of statements they could either agree or disagree with to different extents. Of clear formulation, meaningfulness, and neutrality our weakest point was neutrality, see appendix 8. By test-running the experiment we attempted to ensure that all questions posed in the experiment were meaningful. Through discussions with peers, our tutor, family, and friends, we analyzed each question and option. Questions that were deemed confusing or irrelevant were removed.

Throughout the experiment, a set of attention control questions were asked. For example, for each piece, one question when responding to what basic emotions were felt was “It is important that you pay attention to this survey. Please select, “A little”.” Nearly all of these questions tested for full attention. Participants that did not answer control questions correctly were individually screened to make sure that their answers were still reliable. We were careful of excluding participants entirely due to the relatively low population count of 57 but had to exclude 5 people due to missing values, which left us with 52 participants. It is important to note that the quality of our data suffers from a low number of participants in some of the perception groups. For example, AIM for piece 1 only had 15 participants. This means that our statistical analysis has a risk of showing insignificant results due to the low power of the statistical tests.

4.5. Statistical analysis

All statistical analyses were performed in the statistical software program SPSS, version 28.

4.5.1. Independent variables

The main independent variable analyzed was whether the music was perceived to be AIM or HM. Other independent variables were gender, technological interest, music interest, and attitude towards technology being used in creative endeavors. As stated in 4.1, musical education and technological knowledge were excluded.

4.5.2. Dependent variables

The dependent variables were the chosen individual emotions included in the aesthetic and basic emotions category. Aesthetic emotions measured were beauty, originality, expression, complexity, artistic skill, emotional strength, representation, and artistic intention. Basic emotions measured were Joy, Sadness, Love, Pain, Loneliness, Humor, Anxiety, Calm, Nostalgia, and Love.

To measure emotional strength, we created an index for each category of emotions and each piece. Index variables were calculated as the average response to each emotional category, for each piece.

4.5.3. Significance

An alpha value of 0.001 was used for all statistical tests. The lower alpha is motivated by the low population count of N = 52, as well as the large number of statistical tests we performed. A higher significance level of 0.05 would risk showing significant results without enough support for it. (Dreber, 2021). Thus, we reduce the risk of receiving significant results that might be due to coincidence.

4.5.4. Comparing Means

Our aim was to analyze if there is a difference in the mean of emotional strength between AIM and HM. Because of the nature of our data, a T-test was deemed to be appropriate. The decision to perform a T-test was made since the scale of measurement follows a continuous scale (1-7) and the data was confirmed to be independent for all independent variables at a significance level of 0.05, see appendix 3. The distribution within the two groups was assumed to be the same, see appendix 2. However, our method has some flaws due to the low number of participants in some of the groups. For example, since N is below 30 in several groups, the Shapiro-Wilk test for normal distribution (see appendix 4) is less reliable for those groups. Thus, there are some potential flaws in our method of analyzing the data.

First, a one-sample T-test was performed to analyze if responses in the experiment differed from the midpoint of the scale with significance. Secondly, an independent-sample T-test was performed for each category of emotions in each piece to determine if there was a significant difference in mean between AIM and HM.

4.5.5. Effect size

To estimate the effect size between the two means, Cohen's d was considered in the statistical analysis. In our case, Cohen's d estimated the effect difference between perceived human or perceived AI-composer. We applied the rule of thumb of 0.2 to equal a small effect size, 0.5 to equal a medium effect size, and 0.8 to equal a large effect size. What should be noted is that measuring effect size works best with groups over n=50. Any sample sizes below risk causing inflated results in effect size. (Statistics How To, 2021). In our case, the total number of respondents was 52, but each independent variable, HM perception or AIM perception, had a lower number of observations. This is considered a weakness in determining the effect size of AIM perception. Note that differences in strength between individual emotions within each category were not analyzed.

4.5.6. Multiple Linear Regression Model

To analyze whether gender, musical interest, or technological knowledge had any effect on emotional responses, a multiple linear regression analysis was performed.[2] Nominal dummy variables were created for musical interest and technological interest, where the options (interest) "above average" and" far above average" were computed to 1, and far

[2] Two-way ANOVA test is another way to measure influence of background variables. We preferred multiple linear regression since it is easy to interpret the results and use them in a meaningful way.

below average to average were computed to 0. This allowed an interaction variable to be created to account for the effect that each independent variable had in combination with the perceived composer. The recalculation of nominal variables is a weakness in our statistical analysis since it reduces the nuance in the observations. By choosing to do this, we risked not capturing all differences in the alternatives for interest and knowledge. Categorizing the alternatives into only two different categories (interest or non-interest, knowledge or no knowledge) is a simplification of the data we collected in our survey (continuous), which risks losing the variance aspect of the different alternatives.

Responses on gender were also coded into binary variables, although four alternatives were available for the participants. Since only one participant responded "Prefer not to say" and zero respondents answered "non-binary", these responses were disregarded due to the small sample sizes. Participants with missing values in any of the questions were excluded from the analysis.

It is important to note that a combined regression test of gender, music interest, tech interest, and attitude might have achieved a more accurate and meaningful regression model, however, due to the small sample size of each variable, separate regression tests were deemed more reliable.
The following regression models were tested for each piece[3]:

$$Y_{Basic\ emotional\ strength} = \beta_0 + \beta_P X_P + \beta_Z X_Z + \beta_{INT} X_{INT} + \varepsilon_i$$

$$Y_{Aesthetic\ emotional\ strength} = \beta_0 + \beta_P X_P + \beta_Z X_Z + \beta_{INT} X_{INT} + \varepsilon_i$$

[3] P = perception, Z = gender, tech interest, music interest, or attitude, INT = P * Z interaction variable

5. Empirical Results

The empirical result from our experiment consists of four segments. First descriptive statistics and a boxplot will be presented to give an overview of the outcome of our survey. Then we will present a one-sample T-test to see if the mean of the responses of each index varies from the midpoint of the scale of each response alternative. Following this, an independent T-test will be presented to determine if there is a significant difference in the mean between AIM and HM perception among the two emotional categories for each musical piece. Finally, multiple linear regression analysis for each emotional category in each musical piece is used to determine if gender, music interest, tech interest, or attitude variables have any explanatory value in our model.

5.1. Descriptive Statistics

We asked respondents to first listen to a musical piece, guess if they thought the music was AIM or HM, and then rate the emotional strength they experienced. Table 1 presents the frequencies of independent variable "perception" distributed over each emotional category in each musical piece. In the first piece, which was the AI piece "Free Spirit" by AIVA, 29% of people guessed AIM and 71% guessed HM. In the second piece, which was the human piece "Darkness of Light" by Secession Studios, 52% of people guessed AIM and 48% guessed HM. In the final piece, which was the AI piece "Caretaker" by AIVA, 40% of people guessed AIM and 60% guessed HM. People were in general unable to guess the right correct piece. Piece 1 was AIM but most people guessed HM, piece 2 was HM but most people guessed AIM, and piece 3 was AIM but most people guessed HM.

Table 1. Descriptive statistics: frequencies of independent variable "perception" distributed over each emotional category in each musical piece

Independent variables	N_{AIM}	$N_{\underset{M}{HM}}$	$\%_{AIM}$	$\%_{\underset{M}{HM}}$	Most popular perception
Panel A: Descriptive statistics for music piece 1 (created by AI)					
Basic	15	37	29%	71%	HM
Aesthetic	15	37	29%	71 %	HM
Panel B: Descriptive statistics for music piece 2 (created by human)					
Basic	27	25	52%	48%	AIM
Aesthetic	27	25	52%	48%	AIM
Panel C: Descriptive statistics for music piece 3 (created by AI)					
Basic	21	31	40%	60%	HM
Aesthetic	21	31	40%	60%	HM

N = number of people that guessed AIM or HM.

Graph 1 presents a boxplot of each emotional category in each piece. Aesthetic emotional strength was generally higher than basic emotional strength. From the descriptive statistics, we can see that basic emotional strength was the highest for HM, and aesthetic emotional strength was the highest for AIM. However, due to the small sample size of musical pieces, we cannot draw any direct conclusions regarding how actual AIM or HM influence emotional strength. The result may simply have to do with technical aspects of the music in question, or other variables we do not measure. Lastly, we can state that the spread of the data is larger for aesthetic emotions than for basic emotions. This implies that there are some variables that in some way influence how individuals' aesthetic judgment. We found two outliers in aesthetic emotions for music piece 3, *Aesthetic3* = 2.25 and *Aesthetic3* = 2.75. Removing these observations did not yield a significant result in any T-test.

Graph 1. Boxplot: emotional strength of each emotional category in each piece.

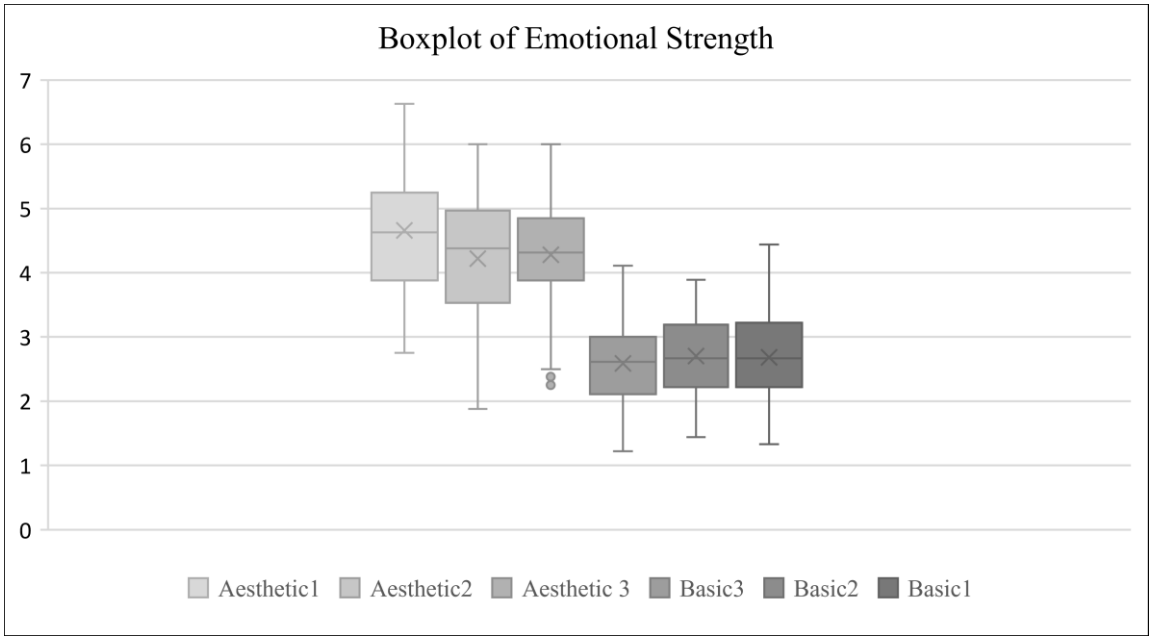


Table 2 presents the mean and standard deviation of each emotional category in each musical piece. Indicated by a negative mean difference (MD) HM perception, in general, seemed to evoke stronger basic and aesthetic emotions than AIM.

Table 2. Descriptive statistics: Means and standard deviations of each emotional category in each musical piece

Independent variables	M_{AIM}	M_{HM}	MD	SD_{AIM}	SD_{HM}
Panel A: Descriptive statistics for music piece 1 (created by AI)					
Basic	2.57	2.73	-0.16	0.74	0.72
Aesthetic	4.33	4.79	-0.45	1.13	0.96
Panel B: Descriptive statistics for music piece 2 (created by human)					
Basic	2.61	2.80	-0.19	0.62	0.66
Aesthetic	3.96	4.49	-0.53	1.13	0.82
Panel C: Descriptive statistics for music piece 3 (created by AI)					
Basic	2.38	2.72	-0.34	0.70	0.62
Aesthetic	3.84	4.57	-0.73	1.00	0.56

** = two-tailed p <.001 for independent t-test (test of difference in mean between AIM and HM). Numbers are rounded to two decimal points. MD = difference in mean between AIM and HM. See table 1 for the number of participants in each group (AIM or HM).*

Table 3 presents the frequencies of the other independent variables. Something to note here is the uneven distribution of gender. 11 women and 40 men respectively took part in the experiment.

Table 3. Descriptive statistics: frequencies and percentages of other independent variables

	N	%
Respondents	52	100%
Gender		
Male (0)	40	21%
Female (1)	11	77%
Prefer not to say (missing)	1	2%
Musical interest		
No (0)	25	48%
Yes (1)	27	52%
Tech interest		
No (0)	20	39%
Yes (1)	32	61%
Attitude		
Negative (0)	17	33%
Positive (1)	35	67%

Gender, music interest, tech interest, and attitude *have been calculated to binary numbers (0 = man, 1 = women, 0 = low, 1 = high, 0 = negative, 1 = positive).*

5.2. Mean Difference Analysis

We performed a one-sample T-test to see whether the outcome of each index differed from the midpoint of the scale. Incomplete answers were excluded. Two outliers have been removed, see 5.1.

Table 4 presents the result of the one-sample T-test. All indexes differ from the midpoint of 4 (1-7 scale) with significance, except for aesthetic emotions for music piece 2 (*MD* = 0.22, *t*(52) = 1.53) and aesthetic emotions for music piece 3 (*MD* = 0.28, *t*(52) = 2.38). This may be a result of coincidence due to the high number of tests we performed and the scale we chose.

Table 4: One-sample T-test at test value = 4

Groups	M	MD	SD	t	95% CI	N_{AIM}	N_{HM}
Panel A: Emotional strength for music piece 1							
Basic	2.68	-1.32*	0.72	-13.13	-1.52, -1.12	15	37
Aesthetic	4.66	0.66*	1.02	4.64	.37, .9	15	37
Panel B: Emotional strength for music piece 2							
Basic	2.70	-1.30*	0.64	-14.65	-1.48, -1.12	27	25
Aesthetic	4.21	0.22	1.02	1.53	-.07, .50	27	25
Panel C: Emotional strength for music piece 3							
Basic	2.59	-1.41*	0.67	-15.19	-1.60, -1.23	21	31
Aesthetic	4.28	0.28	0.84	2.38	.04, .51	21	31

** = p <.001. Numbers are rounded to two decimal points. MD = difference between mean and test value.*

To test the extent to which the perception of whether AI or a human composer wrote the musical piece affects emotional response, we performed an independent t-test for each emotional category in each music piece. This was to determine if there was a significant difference in mean between the two categories “HM perception” and “AIM perception”. Incomplete answers were excluded. Two outliers have been removed, see 5.1. One test is performed for each emotional category for each piece, which calculates to six tests. The independent variable is the perception, and the dependent variable for each test is the emotional strength index for each piece.

Table 5 presents the result of the independent T-test. The test revealed that participants that guessed that the music was AIM had the same emotional response as those that guessed that the music was HM for all emotional categories in all music pieces. Thus, H1 and H2 are supported. Lastly, Cohen’s d indicated a large effect size for indexes 2 and 3, as well as a medium effect size for indexes 1, 3, 5, and 6. However, as mentioned in the method section, Cohen’s d usually overestimates effect sizes for sample sizes below 50 within each group. The effect size is thus most likely relatively moderate.

Table 5: Independent-samples T-test for the mean difference between AIM and HM.

Groups	MD	Cohen's d	t	95% CI	N_{AIM}	N_{HM}
Panel A: Emotional strength for music piece 1						
Basic	-0.16	0.73	-0.72	-.61, .29	15	37
Aesthetic	-0.45	1.00	-1.47	-1.07, .17	15	37
Panel B: Emotional strength for music piece 2						
Basic	-0.19	0.64	-1.08	-.55, .16	27	25
Aesthetic	-0.53	0.99	-1.91	-1.08, .03	27	25
Panel C: Emotional strength for music piece 3						
Basic	-0.34	0.66	-1.85	-.72, .03	21	31
Aesthetic[4]	-0.59[5]	0.72	-0.02	-1.08, -.10	21	31

** = two-tailed p <.001. Numbers are rounded to two decimal points. MD = difference in mean between AIM and HM. See table 1 for the number of participants in each group (AIM or HM).*

H1	The mean of basic emotions will not differ between the perception of human music composition or AI music composition	Supported
H2	The mean of aesthetic emotions will not differ between the perception of human music composition or AI music composition	Supported

5.3. Multiple Linear Regression

To find out to what extent gender, music interest, tech interest, and attitude influence the relationship between perception of AIM or HM and emotional strength, a multiple linear regression analysis is performed for each emotional category in each music piece. The model consists of perception, the gender, music interest, tech interest, or attitude variable, and a perception/gender, music interest, tech interest, or attitude interaction variable. Gender (0 = man, 1 = women), musical interest (0 = no, 1 = yes), technological interest (0 = no, 1 = yes), and attitude (0 = negative, 1 = positive), have been recalculated to nominal variables.

Table 6 presents the result of the linear regressions. Removing the outliers (that can be seen in graph 1) did change the result of our regression analysis. Musical interest, which at first seemed to significantly indicate a lower emotional response for piece 3 if the music was perceived to be HM (p <.001), was revealed to be insignificant at p = .03. Since only 1 person answered "prefer not to say" on gender, that individual was excluded as well. No emotional category shows a significant result for any of the three pieces. Adj.R^2 is never higher than .25 for any regression test. Thus, in our model,

[4] Equality of variance is assumed for all index except aesthetic piece 3.
[5] New MD after removing outliers.

gender, music interest, tech interest, or attitude, in interaction with the perception of the composer, did not affect the strength of basic or aesthetic emotions.

Table 6. Multiple Linear Regression: the difference in emotional strength toward the two categories of emotional response with gender, music interest, tech interest, and attitude in interaction with perception. AdjustedR^2. Standardized coefficients

Independent variables: perception and gender, music interest, tech interest, and attitude interaction variable[6]								
	Gender		Music interest		Tech interest		Attitude	
Dependent variables: Emotional strength	β_{INT}	$Adj.R^2$	β_{INT}	$Adj.R^2$	β_{INT}	$Adj.R^2$	β_{INT}	$Adj.R^2$
Emotional strength for music piece 1								
Basic emotions	-.37	-.01	.33	-.03	-.02	-.04	-.20	-.03
Aesthetic emotions	.06	-.01	-.13	.01	.10	-.01	-.11	.05
Emotional strength for music piece 2								
Basic emotions	.26	-.01	.04	-.03	-.03	-.02	.16	-.01
Aesthetic emotions	.02	-.00	-.04	.01	-.25	.04	.03	-.02
Emotional strength for music piece 3								
Basic emotions	-.33	.08	-.25	.03	.37	.04	-.23	.03
Aesthetic emotions	-.31	.11	-.77	.25	-.31	.12	-.27	.11

** = p <.001. Numbers are rounded to two decimal points.*

5.4. Other Observations

After each musical piece, participants had the opportunity to comment on their listening experience. 23 % of participants chose to do this for each piece. Both basic and aesthetic emotions are described, and cinematic associations are common. In addition, some describe a negative attitude to technological elements such as quantization and MIDI-instruments and a positive attitude to human elements such as choirs. Some respondents also relate and compare the pieces to cinematic music they had heard before. See appendix 5 for the observations.

[6] The following regression models were tested for each song:

$Y_{Basic\ emotional\ strength} = \beta_0 + \beta_P X_P + \beta_Z X_Z + \beta_{INT} X_{INT} + \varepsilon_i$

$Y_{Aesthetic\ emotional\ strength} = \beta_0 + \beta_P X_P + \beta_Z X_Z + \beta_{INT} X_{INT} + \varepsilon_i$

P = perception, Z = gender, tech interest, music interest, or attitude, INT = P * Z interaction variable

6. Discussion

The thesis has aimed to answer the following questions:

- Does perceiving music to be composed by artificial intelligence affect the strength of the consumer's emotions?
- Does gender, music interest, tech interest, or attitude moderate the effect between perception and the strength of the consumer's emotions?

Through previous research by scholars such as Professor Juslin and Doctor and Researcher Modig, we have created an experiment to determine the effect that the perception of AIM or HM composer has on the strength of the emotional response. This section will examine the empirical results of the experiment by using the theoretical framework we established in section 3 and present the implications for the music industry and the marketing field at large. Finally, we will present the conclusion of this thesis.

6.1. Analysis of Results

In the empirical analysis tests for difference in mean between AIM and HM were performed. Furthermore, we complimented the statistical model by setting up multiple regression models where gender, music interest, tech interest, and attitude were included. Lastly, we presented other observations gathered from the participants of the experiment. The purpose of this was to include possible aspects we did not measure in our survey and to give a more nuanced picture of the connection between the perception of the composer and the consumer's emotional response.

6.1.1. Perception

No significant difference seems to be present between AIM and HM perception for any of the pieces. From the three pieces we presented, it is difficult to draw a clear conclusion as to why emotional strength did not differ significantly. One explanation is the fact that AIM has reached a certain level of sophisticated composing techniques today that it is becoming increasingly more difficult to distinguish from HM, and thus the perception of the two will not affect emotions either.

This seems to indicate that the quality of the music seems to have a greater effect on emotional response than the perceptions of AIM or HM. Today's music industry is already highly integrated with technology through midi-instruments, loops, and automation, so an AIM development might be considered natural to our studied participants. However, from the qualitative observations, "human" elements still seem to hold value in themselves. For example, one observation associated the choir instrument with "humans" and explained it to have a more authentic feeling. In another observation, the mere "feeling of technology", despite that the music might be composed by a human, was associated with less authenticity and therefore a weaker aesthetic judgment.

The aesthetic emotions were experienced by a larger portion of the participants than basic emotions were. One possible explanation for this is that although aesthetic emotions are influenced by basic emotions, they can also arise when no basic emotions are felt, (although a certain degree of emotions was felt amongst all participants). If a participant felt very little when listening to the music, they could still appreciate the aesthetic criteria of the piece.

The reasons why certain participants experienced weaker or stronger emotions can vary greatly. For one participant, associative coding could create an intense emotional reaction, while for another, that same association could create a weak emotional reaction. One person's emotions might be formed from intrinsic coding with the piece, while another might be most affected by the iconic coding. From our qualitative responses (see appendix 5) we see signs of some of these mechanisms, where aesthetic criteria were mentioned several times. Many participants reported cinematic associations, which can be assumed to be due to a combination of intrinsic and associative coding within the pieces. Moreover, the basic emotions described are typical feelings that cinematic, video game and film music try to evoke, so we can assume that both the AIM and HM pieces in this study partially succeeded with their purpose as film music.

However, it is important to consider that the insignificant empirical results might be caused by the low number of participants in each category, AIM, and HM. While the lack of significant results could be explained by the sophistication of artificial intelligence in music, it could also be a result of the low number of participants, since they might not be considered large enough to draw any certain conclusions.

6.1.2. Other variables

Looking at our other explanatory variables, neither music nor tech interest showed any significant interaction effects on the relationship between perception and emotional strength. This goes against our described theory on "expert consumers" in section 3.1.4, which describes that consumer with high expertise in a certain area experiences stronger aesthetic emotion. Moreover, "expert consumers" in our experiment do not seem to have a greater ability to form an aesthetic judgment than a less interested consumer, which further emphasizes anyone's ability to make an aesthetic judgment. However, our result might be limited by our low number of observations at N=52. Another explanation is simply that interest is not a good predictor of knowledge.

6.2. Conclusions and Implications

There seems to be some evidence that suggests that communicating emotions through music is no different depending on the perception of AIM versus HM. This aligns with a positive view on technological development in the music industry; that AIM can be a valuable tool for composers, listeners, and everyone who uses music in their business. Thus, our first implication is that businesses using AIM can influence consumers to act in the desired way without interfering with their emotional strength.

Following this, our second implication is that AIM can therefore be used to decrease costs, increase production efficiency, and allow new innovative business models. While humans might still play a role in major blockbuster films or video games, parts of the production process will benefit from automation through scale efficiencies and lower labor costs. For example, major entertainment companies may purchase licenses or algorithms and enable large quantities of music to be generated and automated in an instant, without any human interaction. Moreover, personalization may create entirely new opportunities in video games. For example, certain games might analyze the behavior of the player and create a personalized soundtrack tailored to that person's playstyle. Given that AIM does not seem to distort basic nor aesthetic emotions, game developers and film creators alike can use the new technological tools freely, without interfering with the emotional response.

As mentioned in section 1.1.1, AIM might not be able to tackle the same variety of genres as a human composer, nor create their own "personal style" to the same extent. But as technology develops, it might not be long until AIM composers reach that level of sophistication. Regarding the personal style aspect, one can perhaps question if anything is truly "original" as HM composers also base their ideas on the music they have heard before.

It is important to note that the power of the statistical analysis is relatively low. Hence, we call for further research to investigate if our results hold true and can be replicated.

6.3. Limitations

The way our experiment was conducted has some limitations that should be considered. Firstly, the context in which the experiment was conducted might have influenced the participant's response. For most participants, the environment in which the experiment was conducted was an academic environment. Not only may this (often considered a stressful environment) have had an impact on the participant's level of attention, but the environment is not similar to the environment in which cinematic music is typically enjoyed. Less attention on the survey as well as an "out-of-place" experience may have created less intentional evaluation of the perceived composer, and thus no large difference in emotional arousal. The social surrounding may also have had an effect as musical emotions often differ if we listen individually or if we listen in the presence of others. Perhaps one or both categories of emotions were affected by the ability to "tune in to their feelings", while simultaneously picking up on other people's feelings.

The choice of participants might also have influenced the result. The group we studied was narrow, both in terms of age, nationality, and level of education. Furthermore, a large majority of the group identified as male. A more diverse group of participants might have provided a more accurate result.

In addition, a larger sample size would have enabled a more accurate statistical analysis. Because of the low number of participants, the power of our statistical analysis is somewhat low. Thus, the chance of receiving insignificant results is higher. This is essential to take into account since we found no significant empirical results. In addition, a larger sample size would have led to better conclusions overall from our

regression model based on gender, music interest, tech interest, and attitude. A regression model of gender, music interest, tech interest, and attitude together would probably have a higher explanatory value.

Moreover, it should be noted that cinematic music is most often paired with visual imagery. This may have influenced the strength in emotions. Without visuals, cinematic music might be considered to only serve half of its purpose. However, incorporating the visual aspect would have made our experiment more complex.

The last major limitation of our thesis is that we studied perception rather than actual influence from AIM. The reason for this was the limitations regarding time and resources set by the bachelor thesis format. Research on actual influence would have been a more complex project and would need more participants, a wider selection of music, and a more complex theoretical framework based on emotional influence.

6.4. Future Research

Since the AIM music industry is in a very early stage, research regarding how the market is going to function will be necessary moving forward. Will algorithms be developed in-house or be outsourced to companies specializing in AIM such as AIVA? Will new actors that capitalize on the innovation emerge, or will established giants take the lead? Furthermore, research into power dynamics and market structure will be interesting to find out how the current landscape will change. Will composers be able to use AI tools for their benefit, or will the shift pose a risk of them losing their jobs? Research in other fields such as accounting and finance will be necessary as well. For example, one particularly interesting aspect is the pricing of AIM. Will entertainment companies rent licenses? Or will they buy algorithms? In other words, how do you price infinite creativity?

More research is needed in the field of music psychology regarding AIM. This thesis focused on the perception of AIM or HM, but the actual ability of AIM to evoke emotions requires more in-depth research. Research into aspects such as genre, programming language, and AIM training data can also help us understand what capabilities AIM has in the music industry.

Thus, the topic of artificial intelligence in music is an interesting research field and many questions remain unanswered. The avenues for future research are diverse and much remains to be discovered in the third paradigm shift in music.

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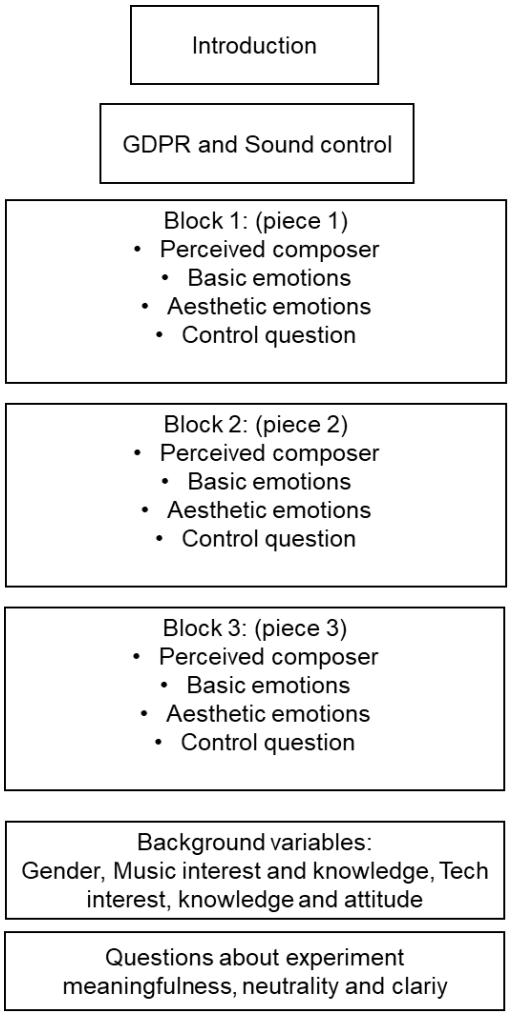
8. Appendices

Appendix 1: Survey Flow



Appendix 2: Levene's Test for Equality of Variances

Groups	F	p
Panel A: Emotional strength for music piece 1		
Basic	0.00	.95
Aesthetic	1.65	.20
Panel B: Emotional strength for music piece 2		
Basic	0.22	.64
Aesthetic	2.70	.11
Panel C: Emotional strength for music piece 3		
Basic	1.00	.32
Aesthetic	7.42	.01

Equality of variances can be assumed when p >.05. Numbers are rounded to two decimal points.

Appendix 3: Runs Test for Randomness

Groups	p	Observed Number of Runs
Panel A: Emotional strength for music piece 1		
Basic	.05	34
Aesthetic	.12	21
Panel B: Emotional strength for music piece 2		
Basic	.45	24
Aesthetic	.97	27
Panel C: Emotional strength for music piece 3		
Basic	.58	29
Aesthetic	.58	25

** = p <.05. Autocorrelation cannot be ruled out for p <.05. Numbers are rounded to two decimal points.*

Appendix 4: Shapiro-Wilk Test for Normal Distribution

Groups	p	Statistic	df
Panel A: Emotional strength for music piece 1			
Basic	.51	.98	50
Aesthetic	.33	.98	50
Panel B: Emotional strength for music piece 2			
Basic	.28	.97	50
Aesthetic	.18	.97	50
Panel C: Emotional strength for music piece 3			
Basic	.66	.98	50
Aesthetic	.60	.98	50

** = p <.05. Normal distribution can be ruled out when p >.05. Numbers are rounded to two decimal points. Note, two outliers have been removed for aesthetic piece 3.*

Appendix 5: Observations from participants

Musical piece 1 – "Free Spirit" by AIVA
"Felt like a movie theme before a war was about to happen"
"It felt a little off during the later segment when two sounds were overlapping"
"It sounded hopeful"
"Compared to the first piece, the usage of choirs does make it a bit more authentic and emotional. Also, the usage of AI or midi drums can be perceived as a bit more "human" than other data-generated instruments. Due to it being more quantized. With that said, better usage of "AI" generated music would be perhaps more effective in a composition like this.
Musical piece 2 – "Darkness of Light" by Secession Studios
"Confusing genres"
"More powerful and inspirational"
"I felt power"
"Felt like a movie theme before war was about to happen"
"Sounds like it would be in a fantasy movie"
"It felt motivating, powerful, and mighty. Like in a movie theme song composed by Hans Zimmer"
"Epic, Grand"
"Epic, awe-inspiring"

”Very powerful”
”Kind music for a group of people”
”It sounded like some epic fantasy tale music”
Musical piece 3 – “Caretaker” by AIVA
”Epic & Heroic”
“Powerful music that arouses the emotions”
“It felt more natural compared to the first piece”
“It does seem a bit generic and even though it may or may not be generated by AI, it does come off as midi-produced which gives me the impression of less authenticity and lack of emotions. In contrast with a performance of a real orchestra”
“Reminds me of Pirates of the Caribbean”
“Heroic“
“Adventure“
“Happy and hopeful feeling“
“Powerful“
“Felt like Game of Thrones“
“Epic, Grand“
“I think that the “feeling” alternatives aren’t fitting. They are all instilling excitement and awe. “
“Powerful“
“Can’t tell if it is joy or kindness“
“I think this song shows a lot of “hope” “
“Sounded like music for a pirate movie/game“
“How to train your dragon-core“

Appendix 6: Preliminary Research

The video game music industry in Sweden is growing rapidly and has a strong position and reputation in the industry. There are about 6000 video game companies in Sweden, there are only a few hundred composers. The reason for this is not that the profession is not attractive, but rather that the demand for new composers has not been high enough. One way this can be seen is through the process by which gaming companies acquire talents. Typically, a gaming company will either produce their music in-house or through freelancers, of which the latter method is more common. Companies will often hire many marketers/programmers, but only one composer.

According to the Game Audio Industry Survey (GameSoundCon, 2019), internationally, salaried employees within the European market (excluding the UK) earn about 40% of the amount employees in the US earn. Salaries are also to be defined by years in the industry, as well as gender. The video game music industry is heavily male-dominated. Freelancers enjoy a lower salary on average, but there is a greater spread between different freelancers than salaried employees. Some of the highest salaries are paid to freelancers, while a large group of freelancers struggles to make money. Many freelancers are put in a disadvantaged position because of this structure, and due to the expectancy that they should give up all of their intellectual property rights once the work is finished. Furthermore, freelancers present a piece of music that they then can “pitch” to companies, with hopes of being hired. This implies that they sometimes have to create music without any compensation being guaranteed.

The music can vary drastically between composers. The amount of music created can vary from anything to 10-15min of material, 30-40mins, to “50min and beyond”. The type of music and genre varies heavily as well, between minimalistic piano melodies and fully orchestrated symphonies. Likewise, film music can also vary drastically in length.

Interactivity is vital in video game music and is becoming more and more widespread in other cinematic media. The Netflix film “Bandersnatch” from 2018 was one of the first full-scale films where the audience was able to choose what lines the actors would say, and therefore have an impact on how the story unfolded and how the music sounded. The composer we interviewed believed that we might see more of these types of media in the future.

A few years ago, there was a sense of fear that “AI would take over composers' jobs, but recently the topic of discussion has “cooled off” among composers, she explained. When asked what her current attitude to AI music is, she believed that AI will instead become a tool to assist composers, similar to the transition from analog to digital instruments. *“That transition created so many new jobs, instead of shutting people out”.* She believed AI will be able to create emotions, but not the complexity of ‘polarizing’ emotions, such as writing just the right amount of “calmer” music for a tense battle, or “mixed emotions" contained in the music. She also described a concern that AI music will not be original enough. *“If they all draw references from the same databases, will it all sound the same? (…) Another challenge for AI is that a composer's greatest strength can sometimes be the ability to tackle many different genres, which AI might not be able to do to the same extent.”*

We also interviewed an established industry professional who is active in music industry research, music journalism, and a partner in an AI program aimed to develop the music industry. He explained that a future where AI-music is an integral part of the industry is not at all unimaginable. *“Historically, technology has always developed humans. Everything from basic calculations and edits to video and photo effects was previously only possible by humans, but technology has automated all these kinds of processes and even become superior to humans.”*

“Strictly technologically speaking, there are no obstacles in the way for data technology to develop in such a way that the music it creates both becomes objectively and subjectively superior.” IP paints a picture of a future 100 years from now, with a hologram version of Elvis Presley, performing “new” Presley music based on his famous catalog in a hologram or android-like type of presence. The question is, what will people think about AI music? Will it create the same feelings?”

“Today, we’ll have to see AI-music as a tool that can improve music”

“The attitude towards AI-music varies a lot within the industry. Musicians that are used to working “the new way” with midi-instruments, stems, loops, and collaborating online might be more comfortable than those who work more traditionally with their primary instrument. The latter group has a more cautious attitude and are perhaps starting to feel threatened by these ongoing technological advances.”

He has been in discussions with cinematic music composers who describe a feeling that “new technology is removing the human part of creativity”.

A certain category within music, what IP calls “anonymous music”, (music intended to be listened to passively “in the background”): with their main purpose of creating ambiance has already reached this type of auto-generated technology, he explains. *“In commercials, video games… we’ve already reached that point.”* This is the type of music IP believes AI-music mainly will continue to grow in, but also in background music, physical stores, and other public spaces. One example of this is the successful industry leader ELIAS, leading the development of “adaptive” music within the gaming sector.

“This type of music, the mass-produced kind, doesn't require humans. Expensive salaries, equipment… if we can auto-generate software that can create the same product for us instead then we should do that!”

“We have to separate music between this mass production, auto-generated sector, and the music that is genuinely humane, with its imperfections. The question is, will our attitudes to these human imperfections change? Will we accept and love these variations and flaws, or will they be intolerable in a world where everything is perfect?”

“Music development hasn’t historically developed linearly, but instead “jumped steps”. We’re currently in a sort of “mutation phase” where many several different new technologies are being developed simultaneously, AI, AR, biotechnology, Metaverse, blockchain… are all contributing to a new paradigm shift. Those of us who have worked for a very long time within the industry might have trouble keeping up”

Appendix 7: Survey

Start of Block: Introduction

Q1
Emotions in Music
Welcome to this survey regarding music created by artificial intelligence in the film and video game music industry. This survey aims to determine emotional response to AI music and music composed by a human.

You will hear 3 different musical compositions. After each composition we will also ask you a few questions regarding the song you just heard. It takes about 10 minutes to answer the survey. Do not reflect too much on each answer. If a question is difficult to answer, try to answer it to the best of your abilities. Please answer all questions truthfully, without trying to remember what you answered before. All answers will be treated confidentially.

This study is part of a thesis project in marketing in the bachelor program in Business & Economics at the Stockholm School of Economics. The result of the survey will be shared in a final thesis. If you have any questions about the survey, please contact Hugo Jennerholm at *24873@student.hhs.se*

Thank you for your participation.

Hugo Jennerholm, BSc student, Stockholm School of Economics
Linn Cervell, BSc student, Stockholm School of Economics

For every completed participation we will donate 3 sek to UNHCR.

End of Block: Introduction

Start of Block: GDPR

Q2
Please read the following information about The General Data Protection Regulation (GDPR)

Project: BSc thesis in Business & Economics
Year and semester: 2022, spring term
Aim of the study: To understand differences in emotional response between artificial intelligence composed music and human

composed music
Students responsible for the study or interview: Hugo Jennerholm, BSc student, (24873@student.hhs.se); Linn Cervell, BSc student (24379@student.hhs.se)
Supervisors and department at SSE: Patric Andersson, Associate professor, Department of Marketing and Strategy
Supervisor e-mail address: patric.Andersson@hhs.se
Type of personal data about you to be processed: initials, age, gender, level of education

Information relating to GDPR As an integral part of the educational program at the Stockholm School of Economics, enrolled students complete an individual thesis. This work is sometimes based upon surveys and interviews connected to the subject. Participation is naturally entirely voluntary, and this text is intended to provide you with necessary information about that may concern your participation in the study or interview. You can at any time withdraw your consent and your data will thereafter be permanently erased. Confidentiality. Anything you say or state in the survey or to the interviewers will be held strictly confidential and will only be made available to supervisors, tutors and the course management team. Secured storage of data. All data will be stored and processed safely by the SSE and will be permanently deleted when the projected is completed. No personal data will be published. The thesis written by the students will not contain any information that may identify you as participant to the survey or interview subject. Your rights under GDPR. You are welcome to visit https://www.hhs.se/en/about-us/data-protection/ in order read more and obtain information on your rights related to personal data.

Page Break

Q3 Have you taken part of the information provided above and consent to take part in this study?

- ○ Yes, I have taken part of the information provided above and consent to take part in this study (1)
- ○ No, I do not want to take part in this study (2)

Q4 Please write your initials and today's date if you chose the alternative "I have taken part of the information provided above and consent to take part in this study"

_____

End of Block: GDPR

Start of Block: Test

Q5 To see whether or not your sound is working, press play and answer the question below.

Q6 Which animal sound did you hear?

- ○ A lion (1)
- ○ An elephant (2)
- ○ A horse (3)

Page Break

End of Block: Test

Start of Block: Musical Composition 1

Q7 You will now listen to a piece of music by pressing the play button below. After the song is finished, please proceed to the next page.

Song 1

Page Break

Q9 Do you think this music was created by an artificial intelligence composer or a human composer?

- Artificial intelligence (1)
- Human (2)

Q10 How certain are you of your answer in the previous question?

- Very uncertain (1)
- Rather uncertain (2)
- Somewhat uncertain (3)
- Doubtful (4)
- Somewhat certain (5)
- Rather certain (6)
- Very certain (7)

Q11 Did you enjoy the music?

- Like a great deal (1)
- Like a moderate amount (2)
- Like a little (3)
- Neither like nor dislike (4)
- Dislike a little (5)
- Dislike a moderate amount (6)
- Dislike a great deal (7)

Q12 How well does the song you just heard portray...?

	Not at all (1)	Very little (2)	A Little (3)	Somewhat (4)	Rather a lot (5)	A lot (6)	A great deal (7)
Beauty (a combination of qualities, such as shape, colour, or form, that pleases the aesthetic senses) (1)	○	○	○	○	○	○	○
Originality (the quality of being novel or unusual) (2)	○	○	○	○	○	○	○
Expression (the action of making known one's thoughts or feelings) (3)	○	○	○	○	○	○	○
Complexity (the state or quality of being intricate or complicated) (4)	○	○	○	○	○	○	○
Artistic skill (the ability to use one's knowledge effectively and readily in execution) (5)	○	○	○	○	○	○	○
Emotional arousal (strength of emotional response evoked) (6)	○	○	○	○	○	○	○
Representation (how well the music represent the intended genre) (7)	○	○	○	○	○	○	○
Artistic intention (ability to portray the artistic message) (8)	○	○	○	○	○	○	○

Q13 How strongly did you feel the following emotions?

	Not at all (1)	Very little (2)	A little (3)	Somewhat (4)	Rather a lot (5)	A lot (6)	A great deal (7)
Joy (1)	○	○	○	○	○	○	○
Sadness (2)	○	○	○	○	○	○	○
Love (3)	○	○	○	○	○	○	○
Pain (4)	○	○	○	○	○	○	○
Loneliness (5)	○	○	○	○	○	○	○
Humor (6)	○	○	○	○	○	○	○
Anxiety (7)	○	○	○	○	○	○	○
Calm (8)	○	○	○	○	○	○	○
Nostalgia (9)	○	○	○	○	○	○	○
It is important that you pay attention to this survey, please select "A little" (10)	○	○	○	○	○	○	○

Page Break

Q14 Would you like to add something about your impression of the music?

_____

Q15 Have you heard this piece of music before?

- Definitely not (1)
- Probably not (2)
- Might or might not (3)
- Probably yes (4)
- Definitely yes (5)

Page Break

End of Block: Musical Composition 1

Start of Block: Musical Composition 2

Q16 You will now listen to a piece of music by pressing the play button below. After the song is finished, please proceed to the next page.

Song 2

Page Break

Q18 Do you think this music was created by an artificial intelligence composer or a human composer?

- Artificial intelligence (1)
- Human (2)

Q19 How certain are you of your answer in the previous question?

- Very uncertain (1)
- Rather uncertain (2)
- Somewhat uncertain (3)
- Doubtful (4)
- Somewhat certain (5)
- Rather certain (6)
- Very certain (7)

Q20 Did you enjoy the music?

- Like a great deal (1)
- Like a moderate amount (2)
- Like a little (3)
- Neither like nor dislike (4)
- Dislike a little (5)
- Dislike a moderate amount (6)
- Dislike a great deal (7)

Q21 How well does the song you just heard portray...?

	Not at all (1)	Very little (2)	A Little (3)	Somewhat (4)	Rather a lot (5)	A lot (6)	A great deal (7)
Beauty (a combination of qualities, such as shape, colour, or form, that pleases the aesthetic senses) (1)	○	○	○	○	○	○	○
Originality (the quality of being novel or unusual) (2)	○	○	○	○	○	○	○
Expression (the action of making known one's thoughts or feelings) (3)	○	○	○	○	○	○	○
Complexity (the state or quality of being intricate or complicated) (4)	○	○	○	○	○	○	○
Artistic skill (the ability to use one's knowledge effectively and readily in execution) (5)	○	○	○	○	○	○	○
Emotional arousal (strength of emotional response evoked) (6)	○	○	○	○	○	○	○
Representation (how well the music represent the intended genre) (7)	○	○	○	○	○	○	○
Artistic intention (ability to portray the artistic message) (8)	○	○	○	○	○	○	○

Q22 How strongly did you feel the following emotions?

	Not at all (1)	Very little (2)	A little (3)	Somewhat (4)	Rather a lot (5)	A lot (6)	A great deal (7)
Joy (1)	○	○	○	○	○	○	○
Sadness (2)	○	○	○	○	○	○	○
It is important that you pay attention to this survey, please select "A lot" (3)	○	○	○	○	○	○	○
Pain (4)	○	○	○	○	○	○	○
Loneliness (5)	○	○	○	○	○	○	○
Humor (6)	○	○	○	○	○	○	○
Anxiety (7)	○	○	○	○	○	○	○
Calm (8)	○	○	○	○	○	○	○
Nostalgia (9)	○	○	○	○	○	○	○
Love (10)	○	○	○	○	○	○	○

Page Break

Q23 Would you like to add something about your impression of the music?

_____

Q24 Have you heard this piece of music before?

- Definitely not (1)
- Probably not (2)
- Might or might not (3)
- Probably yes (4)
- Definitely yes (5)

Page Break

End of Block: Musical Composition 2

Start of Block: Musical Composition 3

Q25 You will now listen to a piece of music by pressing the play button below. After the song is finished, please proceed to the next page.

Song 3

Page Break

Q27 Do you think this music was created by an artificial intelligence composer or a human composer?

- Artificial intelligence (1)
- Human (2)

Q28 How certain are you of your answer in the previous question?

- Very uncertain (1)
- Rather uncertain (2)
- Somewhat uncertain (3)
- Doubtful (4)
- Somewhat certain (5)
- Rather certain (6)
- Very certain (7)

Q29 Did you enjoy the music?

- Like a great deal (1)
- Like a moderate amount (2)
- Like a little (3)
- Neither like nor dislike (4)
- Dislike a little (5)
- Dislike a moderate amount (6)
- Dislike a great deal (7)

Q30 How well does the song you just heard portray...?

	Not at all (1)	Very little (2)	A Little (3)	Somewhat (4)	Rather a lot (5)	A lot (6)	A great deal (7)
Beauty (a combination of qualities, such as shape, colour, or form, that pleases the aesthetic senses) (1)	○	○	○	○	○	○	○
Originality (the quality of being novel or unusual) (2)	○	○	○	○	○	○	○
Expression (the action of making known one's thoughts or feelings) (3)	○	○	○	○	○	○	○
Complexity (the state or quality of being intricate or complicated) (4)	○	○	○	○	○	○	○
Artistic skill (the ability to use one's knowledge effectively and readily in execution) (5)	○	○	○	○	○	○	○
Emotional arousal (strength of emotional response evoked) (6)	○	○	○	○	○	○	○
Representation (how well the music represent the intended genre) (7)	○	○	○	○	○	○	○
Artistic intention (ability to portray the artistic message) (8)	○	○	○	○	○	○	○

Q31 How strongly did you feel the following emotions?

	Not at all (1)	Very little (2)	A little (3)	Somewhat (4)	Rather a lot (5)	A lot (6)	A great deal (7)
Joy (1)	○	○	○	○	○	○	○
Sadness (2)	○	○	○	○	○	○	○
Love (3)	○	○	○	○	○	○	○
It is important that you pay attention to this survey, please select "Somewhat" (4)	○	○	○	○	○	○	○
Loneliness (5)	○	○	○	○	○	○	○
Humor (6)	○	○	○	○	○	○	○
Anxiety (7)	○	○	○	○	○	○	○
Calm (8)	○	○	○	○	○	○	○
Nostalgia (9)	○	○	○	○	○	○	○
Pain (10)	○	○	○	○	○	○	○

Page Break

Q32 Would you like to add something about your impression of the music?

_____

Q33 Have you heard this piece of music before?

- Definitely not (1)
- Probably not (2)
- Might or might not (3)
- Probably yes (4)
- Definitely yes (5)

Page Break

End of Block: Musical Composition 3

Start of Block: Background

Q34 How old are you?

_____

Q35 What is your gender?

- Male (1)
- Female (2)
- Non binary/ third gender (3)
- Prefer not to say (4)

Page Break

Q36 Have you studied a program that mainly focuses on music? If so, please indicate level of education

- Independent courses (1)
- Lower secondary school (grundskola) (2)
- Upper secondary school (gymnasium) (3)
- Undergraduate (kandidatnivå) (4)
- Graduate (masternivå) (5)
- Post-graduate (doktornivå) (6)
- I have not studied music (7)

Q37 Please indicate your level of interest in music

- Far below average (1)
- Moderately below average (2)
- Slightly below average (3)
- Average (4)
- Slightly above average (5)
- Moderately above average (6)
- Far above average (7)

Page Break

Q38 Please indicate your level of interest in new technology and innovation

- Far below average (1)
- Moderately below average (2)
- Slightly below average (3)
- Average (4)
- Slightly above average (5)
- Moderately above average (6)
- Far above average (7)

Q39 What is your attitude toward artificial intelligence in a creative setting?

- Extremely negative (1)
- Moderately negative (2)
- Slightly negative (3)
- Neither positive nor negative (4)
- Slightly positive (5)
- Moderately positive (6)
- Extremely positive (7)

Q40 Do you consider yourself to be knowledgable about artificial intelligence?

- Far below average (8)
- Moderately below average (9)
- Slightly below average (10)
- Average (11)
- Slightly above average (12)
- Moderately above average (13)
- Far above average (14)

End of Block: Background

Start of Block: Survey experience

Q41 Below are some statements regarding this experiment, please rate to what level you agree or disagree with the statements

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
The survey questions were clearly formulated (1)							
The response alternatives were clearly formulated (2)							
This research feels meaningful (3)							
The way the survey questions were formulated affected my response in some way (4)							
This survey was about music (5)							
This survey was about football (6)							

End of Block: Survey experience

Start of Block: Songs references

Q42 The musical compositions you heard were

Free Spirit - AIVA, 2019 (AI)
Darkness of Light - Seccession Studios, 2016 (Human)
Caretaker - AIVA, 2018 (AI)

End of Block: Songs references

Appendix 8: Respondents Evaluation

Groups	Mean
Meaningfulness of experiment	5.58
Neutrality of experiment	3.98
Clarity of questions	5.75
Clarity of response alternatives	5.88

The mean represents the average opinion about the following aspects of the survey. To measure our data quality, we asked questions at the end of the survey on how meaningful, neutral, and formulated the questions were on a scale of 1-7. Participants were given a set of statements they could choose to either agree or disagree with, to different extents. 3% disagreed and 9 % somewhat disagreed on the clear formulation of response alternatives. 2 % disagreed, 3 % somewhat disagreed on the clear formulation of questions. On meaningfulness, 3 % disagreed and 3% strongly disagreed that the research was meaningful. 12 % agreed with the statement that the way the questions were formulated affected their response in some way, and 22% somewhat agreed with this statement. 3 % strongly agreed that their response was affected. Of clear formulation, meaningfulness, and neutrality our weakest point falls on neutrality.