The Effect of Music on Atmosphere and Purchase Intentions in Video Games

Bachelor Thesis

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Abstract

This exploratory study investigates the effect of music on the perceived characteristics of a game environment and on customers' in-game (microtransaction) purchasing intentions. Participants were asked to play one of three variations of a game, each with a different style of music including one without music. Subjects' responses to the following questionnaire indicated that music and atmosphere (perceived characteristics) are significantly correlated. No evidence was found that the various styles of music playing in the background had an influence on the perception of the game or on the participants' purchasing intentions. Two control variables, age and past microtransaction behavior, did however show a significant effect on the amount participants were willing to spend. With certain age groups intending to spend significantly more than others and players who made purchases in other games in the past also being prepared to spend more on the in-game items from this experiment.

Keywords: music, games, consumers, microtransactions, purchasing, atmosphere

Preface

This thesis is the final research project of my Bachelor of Information Science at the Utrecht University. The project was conducted from February 2020 to June 2020.

I would like to express my gratitude to everyone who contributed to this project and provided help along the way. Thank you to all the participants who took part in my experiment and to everyone who shared it and spread the word. Thank you to my supervisor Peter van Kranenburg, who continuously provided guidance and insight along the way, was there to answer my questions and helped me from veering off course. Thank you to Roos Boekelman, who helped with designing a majority of the artwork in the game. Thank you to Iris Ren for providing helpful and constructive feedback. And finally, thank you for reading this, I sincerely hope you enjoy it.

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1 Introduction

Music is everywhere. With Americans spending more than four hours a day listening to it [1] and nine out of ten social media users relating their activity to music [2], there is no denying that it plays a big role in our society. Due to this it comes as no surprise that music is a commercial success, and it shows: the music industry made up for more than 11 billion dollars in the U.S. alone in just 2019. Of which the vast majority, 89%, was through digital services such as iTunes, Spotify, Deezer, etc. [3] This not only shows its massive commercial potential, but also represents the digital nature of our modern world. This paper focuses on that commercial potential in a digital environment, aiming to research if and how music is able to influence participants behavior in a digital commercial setting.

Previous research has already suggested that music does indeed have an influence on participants' behavior in physical commercial environments, having an effect on people's purchase intentions and their perception of the atmosphere. This paper continues that research, but puts it in a new light with the focus on digital technology, which has become a staple for our current day and age. Two possible functions of music in digital commercial environments are investigated, the first being the effect of music on the atmosphere (perceived characteristics) of the digital environment and the second being the purchasing intentions on microtransaction items in the same digital environment. The environment of choice for this project is a simple mobile-like video game. Games often implement microtransactions (small purchases that provide in-game items) and inherently feature music. This makes them the perfect candidate for a digital commercial environment for this research, since store elements and music are naturally present unlike for example a web-shop where music is less common.

To summarize, the context of this research paper is as follows: Imagine there is a (mobile) video game that features in-app purchases, also known as microtransactions. The goal is to have players purchase these and spend as much money on them as possible. Is it possible to influence the in-game buying behavior of the players, stimulating them through the use of in-game background music? With this in mind the research objective is to discover if background music in video games is able to influence the in-app purchasing behavior of players by exposing test subjects to various types of background music (and absence of music) and to see how it affects their buying intentions. Based on the hypotheses the influence of the same background music types on the perceived atmosphere of the videogame will also be researched.

The core main research question boils down to: *Is background music in video games able to influence players' purchasing intentions therein as well as their perception of the atmosphere?*

This thesis is structured as follows. First a literature review will be presented in section 2. Following this, the project's conceptual model will be presented in section 3. Section 4 then raises the various research questions of this project. Section 5 then elaborates on the experiment setup and the various methods implemented to test the relation between the project variables. The results of this experiment are analysed using various tests in section 6. The final section (7) then discusses the outcome of this analysis as well as the various limitations of this research as well as opportunities for possible future research.

2 Literature

Section 2 provides insight in the various literature and research that this project was inspired by and based upon. It introduces various concepts and elements explored throughout this research such as the music genres and their effects on purchasing intentions and perceived atmosphere. It also introduces games, microtransactions and purchasing behavior therein. On top of that it raises and discusses the hypotheses formulated for this research project based on the literature.

2.1 Music, atmosphere and purchase intentions

Music has been suggested to have a positive influence on buyer behavior, with experiments indicating that classical music can be used to increase customer spending in restaurants, student cafeterias and wine stores. Areni and Kim suggested that customers purchase more expensive wine, (in value, not quantity) while exposed to classical music, based on their experiment [4] where they played different genre songs, top 40 and classical, in a wine cellar and compared shopper's behavior.

North e.a. conducted multiple experiments. The first of which [5] demonstrated that customers of a restaurant spend more while exposed to classical music. This was the result of an experiment where classical music, pop music and no music (control condition) were played in a restaurant, and customer behavior per table was observed. Three possible explanations for these results were proposed by North e.a. [5]:

1. Classical music is synergistic with the environment, this synergy promotes spending.
2. The subjects like classical music and liking things promotes spending.
3. Classical music promotes an upmarket atmosphere.

Another experiment North e.a. conducted [6] showed that students were prepared to spend more on food items in their cafeteria while exposed to classical music and british pop. In the experiment classical music, british pop, easy listening music and no music (control condition) were played in a cafeteria. Students exposed to the music were asked to fill in a questionnaire in which they were asked how much they were willing to spend on cafeteria items. This experiment also tested to see if music could influence how the atmosphere of the commercial listening environment, in their case a cafeteria, could be perceived (through the same questionnaire), with results indicating that music is indeed capable of manipulating atmosphere perception.

This showed that participants who found the background music to possess the characteristic 'exciting' for example, then also found the cafeteria to possess the same exact characteristic.

All of the aforementioned experiments share multiple commonalities, but the core elements that remain consistent throughout all of them is the inclusion of two test conditions: *classical music* and *no music*. These two conditions shall also be included in this research project, with the addition of another group not found in the previously mentioned experiments: *ambient music*.

Ambient music is a genre of instrumental music that focuses less on musical structure or rhythm and more on the overall tonality and texture of the music through which it seeks to create a certain atmosphere or state of mind [7]. One of the pioneers of Ambient Music, Brian Eno, explained his approach in an essay [8] attached to his widely recognized album 'Ambient 1: Music for Airports': '*Whereas the extant canned music companies proceed from the basis of regularizing environments by blanketing their acoustic and atmospheric idiosyncrasies, Ambient Music is intended to enhance these. Whereas conventional background music is produced by stripping away all sense of doubt and uncertainty (and thus all genuine interest) from the music, Ambient Music retains these qualities. And whereas their intention is to `brighten' the environment by adding stimulus to it (thus supposedly alleviating the tedium of routine tasks and levelling out the natural ups and downs of the body rhythms) Ambient Music is intended to induce calm and a space to think. Ambient Music must be able to accommodate many levels of listening attention without enforcing one in particular; it must be as ignorable as it is interesting* [8].*'*

The nature of Ambient Music makes it very interesting to test against no music and classical music, as it has its own set of very distinct characteristics. On top of that, due to it being fundamentally linked to creating an atmosphere and immersion it is extremely fit not only as background music for a game but also especially for an experiment where the perception of atmosphere is tested.

Ambient music as a style is very broad, with many sub-genres and types. To narrow down the type of ambient music used for this project and to make sure all the ambient music used in the experiment was similar in style, all ambient music was selected from the same record label. This label was *AMG Records* [9], a popular label on YouTube with a large, easy to access and well-curated library of similar styled Ambient songs. The style of the chosen songs from that label could be described as instrumental and soothing, slow paced with a lot of atmospheric and organic sounds blended throughout the music.

2.2 Games and microtransactions

Mobile games have become a popular leisure activity, due to their convenience, portability and low cost [10]. Most mobile games are free and generate revenue through in-game advertising. Another common income source for games is the implementation of microtransactions, where in-game items such as cosmetic upgrades, levels, mechanics and more are put on sale. Sensor Tower [11] data shows that recently global consumer spending in mobile apps saw a massive growth of revenue, from $70.6 billion in 2018, to $82.5 billion in 2019 - an increase of 17%. Three quarters of all the in-app spending in 2019, an estimated $61.7 billion, was spent in mobile games across both stores. These numbers show that providing in-game purchasing possibilities to players, is a very fruitful way of making profit.

But what drives players to purchase them? Hsiao and Chen researched this [12] and found that a multitude of factors have the ability to heavily influence users' purchasing intentions. The most impactful factors, directly influencing the players' intention to make an in-app purchase, were loyalty to the mobile game and good price. Loyalty itself appeared to be influenced by certain perceived values of the game (playfulness, connectedness, access flexibility and reward), though only for already paying players. To the best of my knowledge seemingly very little research has however been conducted on the influence of music specifically on the intention of users to purchase in games. This paper aims to fill that gap.

2.3 Hypotheses

2.3.1 Hypothesis 1

Since music has been found to be able to influence the perceived characteristics of the listening situation in a physical commercial environment (the atmosphere in short) [6], it could be assumed that it might also have the same effect on the atmosphere of a digital game environment. Therefore, if affective responses to music have the ability to become associated with affective responses to a digital commercial listening situation, then each musical style should give rise to differences in the perceived characteristics of the game. In short, different musical styles should provide differently perceived atmospheres.

2.3.2 Hypothesis 2

If music is able to influence purchase intentions in various real life contexts [4]–[6], then it could be assumed that it also has the same effect in a digital game environment. Therefore the different musical styles should cause differences in the amount that subjects are willing to spend on in-game items.

2.3.3 Hypothesis 3

In previous experiments [4]–[6] classical music consistently had a major effect on the spending behavior of subjects , regardless whether it fit in its environment or not. Therefore it could be assumed that classic music will also have a major impact on spending behavior in games. As such, I expect classical music to cause the most difference (in a positive direction) in the maximum amount that subjects are willing to spend on in-game items.

3 Conceptual model

To visualise the assumed causal relationships between the core concepts of this research project a conceptual model was constructed (see Figure 1), it was constructed following the guidelines of *Designing a Research Project (Second Edition)* [13]. The model was designed to help with formulating assumed relationships between the various important concepts and objects relevant to this project and to help narrow down the research scope and find boundaries, choosing which aspects to examine and which to discard. The model's most important elements are the independent and dependent variables as this is what the entire project is centered around: does a change in the independent variable create a change in the dependent variable?

The core concepts/variables are modeled as rectangles, the relationships take the form of arrows. Positive relationships (if an X value moves in a certain direction, then the Y value moves in the same direction) are indicated by a '+' sign . Negative relationships (if an X value moves in a certain direction, then the Y value moves in the exact opposite direction), though not present in this model, would be indicated by a '-' sign. In reality directions and relations are a bit more abstract and directions often do not translate as easily as 'high X value means high Y value', since they might be values of completely different types.

Certain relationships have an 'x' sign, this indicates that the related elements have no effect on each other, meaning the X value is unrelated to the Y value. One could assume then, that if the effect is zero that there is no relation between these elements. While that may be true for the variables themselves (they do not change based on each other's value), the core concepts could still be related to each other and visualizing them as relationships thus still aids with showing their relevance to the other concepts, regardless of if they affect values.

Elements marked in red in Figure 1 are concepts that were initially considered but ended up being omitted from the final setup, these will be elaborated on in section 3.4 *(elements outside of scope)*.

Please note that everything in the model is an assumption based on the literature and hypotheses mentioned earlier in this paper. The model is only there to aid with structuring and designing this research project and experiment.

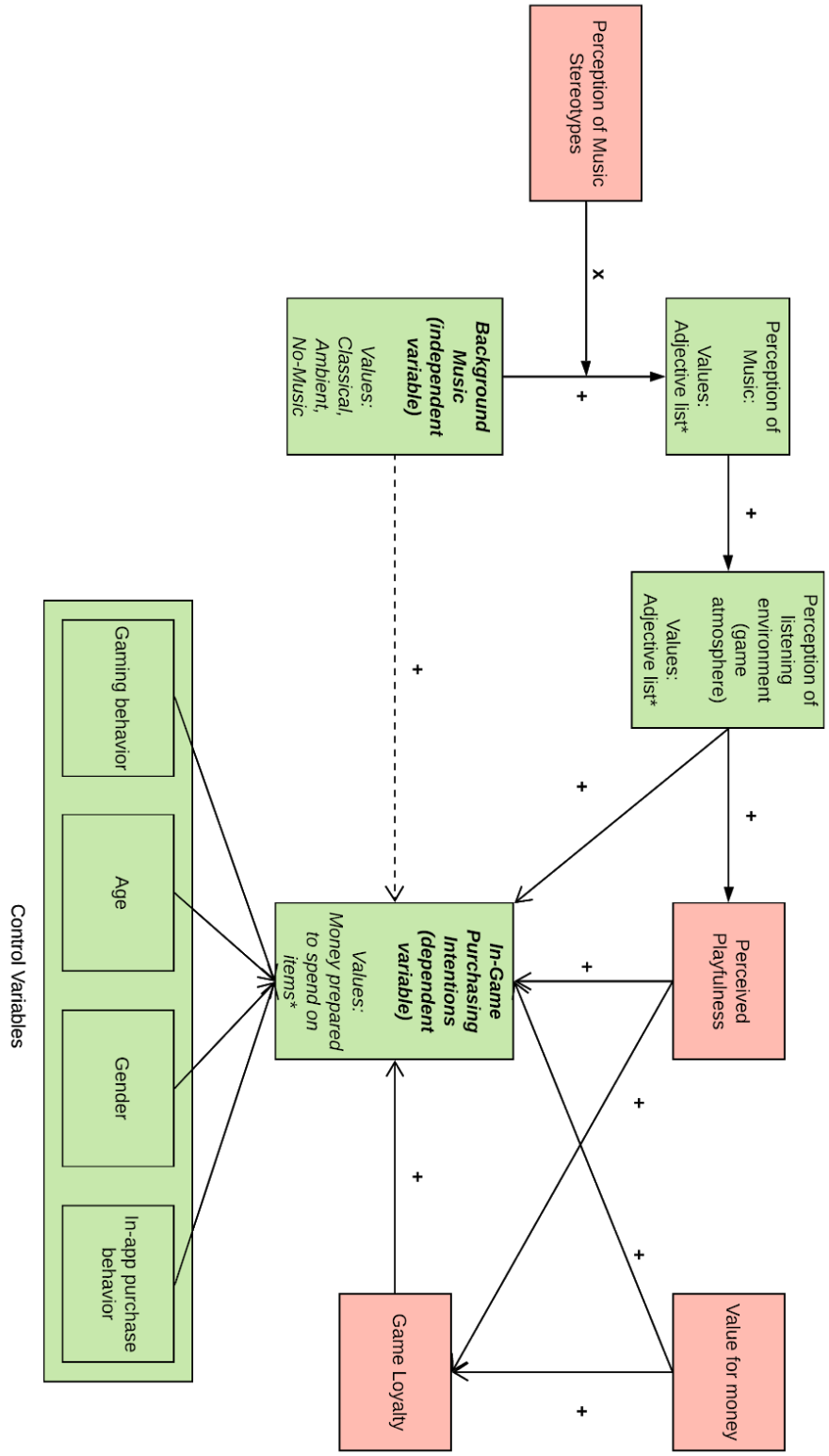


Figure 1. Conceptual model.

3.1 Independent variable: background music

The independent variable, *background music,* plays a fundamental part in this research as it is part of the main question, 'does a change in background music have an influence on buying intentions and game atmosphere?'. The variable background music takes three values, each corresponding to their respective test-group: classical music, ambient music and no music.

I assume the background music has a positive influence on the perception of music. Meaning that when classical music is playing in the background, the perception of music will possess characteristics of classical music. Or that when ambient music is playing, the way the participants perceive the music will possess characteristics of ambient music.

I also assume that the background music has a positive influence on the in-game purchasing behavior. Meaning that music playing results in higher purchasing intentions than no music playing.

3.2 Dependent variable: in-game purchasing intentions

The dependent variable, *in-game purchasing intentions,* also plays a fundamental part in this research, as the goal is to discover what the influence of the dependent variable is on it as well as the influence of the various other variables on it. This variable is measured in the amount of money people are willing to spend on a set of proposed items. An in depth explanation on these items and how they were conceived can be found in the method section further on in this paper.

3.3 Other variables

3.3.1 Perception of music

The variable *perception of music* is formed by a series of characteristics, which are: Active, Exciting, Majestic, Festive, Enjoyable, Beautiful, Comfortable, Peaceful, Sleepy, Insignificant, Desolate, Boring, Unstimulating, Depressing, Ugly, Disgusting, Frustrating, Harsh, Frightening, Hectic, Forceful. These adjectives were derived from previous research by Russel and Pratt on the affective quality attributed to environments [14], [15], which was also the inspiration for the adjectives selected in the Cafeteria experiment by North and Hargreaves [6]. The characteristics take the form of 0 (definitely does not possess this characteristic) to 10 (definitely does possess this characteristic).

I assume that the perception of music has a positive influence on the perception of the listening environment (atmosphere). Meaning that if the music is perceived as very festive, then the listening environment is also perceived as very festive.

3.3.2 Perception of listening environment (game atmosphere)

The variable *perception of the listening environment* is how the game atmosphere is perceived. The perception is constructed using the same series of characteristics as those for the perception of music, they are also measured on the exact same scale of 0 to 10.

I assume that the perception of the listening environment (game atmosphere) has a positive influence on the in-game purchasing behavior. Meaning that the different atmospheres influence how much participants are willing to spend on in-game items.

3.3.3 Control variables

Various control variables were selected to allow for contextualizing the results in the end, determining potential outliers or drawing extra conclusions. Due to not knowing exactly how the variables will be used afterwards, the direction of the relationships is also difficult and unnecessary to predict. Therefore, the directionalities are not displayed in the model for these variables. The control variables included questions to assert the prior experience participants had with games (how much they play games on a daily basis, how long they have been gaming for) and microtransactions (they have spent real money on in-game items before and if so, how often). More standard questions such as age and gender were also asked.

3.4 Elements outside of scope

In the conceptual model there are a few concepts marked in red, these are variables that are related but were excluded from this research project due to various reasons.

3.4.1 Perception of music stereotypes

The cafeteria experiment from North and Hargreaves proposed the *perception of music stereotypes* as intervening variable between the background music and the perception of music. This was to see if the atmosphere was influenced by the actual background music playing as opposed to the perceived stereotypes of the background music genres.

In this project this would have been measured using the same list of adjectives as the one for perception of music and listening environment. Due to this list being very long however, the questionnaire would take a considerable extra amount of time for participants to complete, if I were to test the perception of music stereotypes. The questionnaire was already fairly long, and I feared that including this would scare away participants from completing it therefore I decided to cut this element from the experiment, and thus from this project.

Discarding this element was not as impactful luckily, as the results from the cafeteria experiment showed that the atmosphere is mostly influenced by the played background music and not by the stereotypes associated with them [6]. Therefore it is very possible that this is the case here as well, meaning the stereotypes would have no effect on this experiment. Though to be sure of this, this of course would have to be researched.

On top of that, even if the stereotypes *did* influence the perception of the music in this case, it does not make as much of a difference to me as I set out to see what the influence is of playing background music on the in-game atmosphere and purchasing intentions. This means that even if the stereotypes are what cause a difference in the dependent variable they are themselves still triggered by the background music playing and therefore fundamentally the dependent variable is nevertheless influenced by the background music.

3.4.2 Perceived playfulness

Perceived playfulness is a variable that according to Hsiao and Chen has a positive influence on the purchasing intentions and game loyalty of users [12].

Implementing this into the questionnaire would add onto the already long list of questions, which I was hesitant to do as to not scare off participants from completing it. This element also had a lot of relations with other omitted concepts, meaning that even when implemented it would not provide as much insight, seeing as other relevant and related elements are not tested. Due to all that I decided to omit this element from this research project.

3.4.3 Value for money

Another element Hsiao and Chen suggest has an influence on in-game purchasing intentions and on game loyalty is the perceived *value for money* [12]. This consists of two sub-elements: good price and reward.

The better the price and the better the reward obtained (subjective to participants, of course) the higher the value for money is.

This was omitted from this research since for this experiment participants name their own price on the in-game items, eliminating the possibility for the items to be fairly priced since they have no price to begin with.

3.4.4 Game loyalty

Hsiao and Chen also suggest *game loyalty* as a relevant variable, proposing that the more loyal a user is to a game, the more likely they are to spend on in-game items. This variable has a positive influence on in-game purchasing intentions.

However since this experiment does not focus on an established game, but on a short one specially designed for this project that players will not be in contact with for more than a couple of minutes it is impossible to establish a loyal group of players. Therefore this element was omitted from this research.

4 Research questions

To help answer the main research question (*is background music in video games able to influence players' purchasing intentions therein as well as their perception of the atmosphere?*) and provide structure for this research project, three research questions were formulated, of which some are subdivided into smaller questions. These questions are answered throughout the various sections of this research paper. Section 4 raises these questions and elaborates on them.

4.1 RQ1: What are the variables?

"What aspects are relevant and how do they relate?"

Sub questions:

1. What aspects can be derived from literature? (RQ1.1)
2. What aspects are relevant for this research? (RQ1.2)
3. How do I define those aspects? (RQ1.3)

This research question has, by this point, already been answered in the sections leading up to here (sections 1 through 3).

4.2 RQ2: What are the results when those variables are tested in the experiment?

"What was the participant behavior?"

Research question 2 will be answered upon finishing section 6, *results*.

4.3 RQ3: What conclusion can be drawn between the variables and the results?

"Does background music in video games have an influence on the in-game atmosphere and on in-game purchasing intentions?''

Sub questions include the answers to the hypotheses:

1. *Do different musical styles give rise to differences in the perceived characteristics (atmosphere) of the game?* (RQ3.1)
2. *Do different musical styles cause differences in the maximum amount that subjects are willing to spend on in-game items?* (RQ3.2)
3. *Does classical music have a bigger influence on the willingness to spend than the other conditions?* (RQ3.3)

Research question 3 will be answered upon finishing section 7, *discussion*.

5 Method

Section 5 elaborates on the methods employed and the experiment conducted for this research project to answer the main research question (*Is background music in video games able to influence players' purchasing intentions therein as well as their perception of the atmosphere?*) and the hypothesis research subquestions (RQ3.1 through RQ3.3). The methods used here are heavily based on the cafetaria experiment [4] (and to a certain degree on other related experiments), borrowed elements have however been modified to be applicable in a digital video game setting. The conducted experiment was set up completely digitally and online, this made it easier to acquire participants, as participating was made very accessible. The experiment was divided into two parts: participants first got to play a short game, where the background music was altered depending on their test-group. After this, they were asked to conduct a short questionnaire. The time to complete the experiment was somewhere between 10 to 20 minutes. This section will continue to elaborate on the participants that took part in the experiment as well as the materials and design used to set up the experiment.

5.1 Participants

The designed experiment was put online on the twelfth of May 2020, and ran till the first of June 2020. During this time the experiment was shared online on multiple forums and websites, as well as shared in close personal circles. It was available to anyone with a computer or Tablet with a physically connected keyboard (this is due to game constraints). In this time 102 participants completed the experiment, each participant was randomly assigned to one of the three groups upon starting the experiment. Due to this randomization the groups were not divided completely equally, but instead ended up in a division of: 27 (26%) in the control group, 57 (56%) in the classical music group and 18 (18%) in the ambient music group. The randomization was done through a simple JavaScript function, attached in Appendix 1. It is unknown to me how it caused such an unbalanced division. An information sheet was put online to give transparency to the participants as to how their data was used, a copy of this sheet can be found in Appendix 2. All participants gave consent to use their data according to this sheet.

5.2 Materials and design

5.2.1 Game

The game was designed with a couple of goals in mind. Firstly, it had to be simple to pick-up and play, offering easy to learn mechanics to be accessible for a wide group of players. It was also necessary to provide short play-sessions, meaning the player should be able to experience and have fun in the game in short bursts of a few minutes. This is especially important as it helps reduce the time it takes for subjects to participate in the experiment, reducing the odds of them getting bored or annoyed and quitting the experiment before it is completed. Secondly, the game had to be charming and believable, giving off the feeling of being an actual game that one could find on a mobile phone, instead of being a simple one-off game designed purely for an experiment. Thirdly, the game had to be designed in such a way that in-game purchases could be implemented, meaning there had to be room for customization or itemization options. The game had to be optimized well enough to run smoothly for all participants, as to not influence test results with participants having gameplay issues due to bad framerate or bugs. And on top of that, the game had to be easy and quick to develop to be able to meet deadlines.

Various concepts were designed, but also quickly discarded as they did not meet some of the aforementioned requirements. The first concept was a casual arcade type racing game, akin to the Mario Kart series. This fit the criteria of being enjoyable in short bursts, easy to pick up and play and believable, but proved to be too complicated to develop due to various reasons. Firstly, as a result of the game being played in a 3D perspective, designing and implementing character and level designs would have taken up a significantly larger amount of time due to them requiring extensive modeling, texturing and animating. Secondly, building an engaging yet fair racing experience (easy to pick up while still challenging) is extremely difficult. Requiring a meticulous balance of well programmed AI competitors and a well laid out track, both things which take up a considerable amount of time to craft. The second concept was a 2D side-scrolling platformer, where the player simply has to go from A to B, while avoiding obstacles along the way. This concept was easier to develop due to it being played from a 2D perspective (eliminating the need for 3D models), but still required intricate level design in order to be both easy to pick up but still challenging and fun enough to be engaging. Something which simply would have taken up too much time to build and develop.

The final concept, a 2D endless-runner type game was chosen as the definitive concept for this experiment. Endless runners, as described by Momoda in [16], are a popular type of action game with an infinite linear design, meaning there is no definite end (other than a game over) nor are there breakpoints or pauses. It can be seen as one continuous level, that is procedurally generated, often starting easy and gradually becoming more difficult as the player gets further. The objective in these types of games is to survive as long as possible, avoiding obstacles along the way. Often featuring very easy controls which can be narrowed down to only two buttons for moving the character along a defined axis (left-right or up-down) .

The endless runner game for this experiment was given an underwater theme and given an overall cute cartoony aesthetic. This was done to glue the experience together and give the game an identity, instead of being an obvious experiment. The player plays as a whale character, moving it up and down along three rows, while avoiding the spiny pufferfish obstacles that occupy those same rows. The game scrolls horizontally with columns of two obstacles approaching the player (moving from the right edge of the screen to the left). These columns appear with a fixed interval, starting slow but quickly speeding up to their maximum speed. Each column has a space for the player to safely move through. The player starts with three HP, short for health points. One HP is lost when colliding with an obstacle, these points slowly regenerate but if the player runs out of HP their run is over and they have to restart. Users received three minutes of play time, during which they got infinite attempts to try and beat the highscore. Once the timer had run out and they hit the game-over screen they were redirected to a simple page with an overview of their highscore and a button leading them to the questionnaire. The main menu was designed to be simplistic, as not draw away from its functionality or distract users, featuring only a short instruction text, a play button and a volume slider. The end-screen with the button redirecting the user to the questionnaire was designed in a similar simplistic fashion. For screenshots of the game, see Appendix 3.

This concept fit all the criteria. The game was easy to pick up and play due to its simple control scheme (up/down) and easy objective (avoid obstacles). It was also very fit for short play sessions due to how little time each specific run/attempt takes. An important benefit of this concept was that due to its simplicity it was very easy to program. This freed up a lot of time which could then be spent on the quality of the individual assets and code, which made it easy to provide a sense of charm and flesh out the game (instead of it coming across as a barebones functional experiment) and allowed for good code optimization making the game run smoothly even on weaker systems.

This concept was brought to life using the Unity Game Engine [17], and built for HTML5 for easy online deployment, making the game accessible through the user's browser instead of having to download something. A major help with the development of the game was YouTube user 'Blackthornprod' [18], who's tutorials provided a solid starting point with developing in the Unity Engine. The game then was hosted on my own domain *http://sfspithorst.me* through GitHub Pages [19].

5.2.2 Music

Three variations of the game were developed for each condition. The first variant, made for the control group, contained only in-game audio effects (for example when colliding with an enemy), with no music playing in the background. The other two variants contained the same exact in-game audio effects, but additionally (depending on the group) contained a specially prepared playlists with music playing in the background. The music played at a normalized constant volume and at a lower level than the sound effects, to keep them audible and prevent the music from becoming obnoxious.

In a similar fashion to the cafeteria and restaurant experiments the classical music playlist was composed of songs from Handel's Water Music Suite (see Appendix 4). This suite was chosen partially because it had been used in relevant experiments such as the cafeteria and restaurant ones conducted by North e.a. [5], [6]. Aside from that, this suite to me felt best suited for the game after comparing various classical songs (both used in other experiments and unused ones). Certain other pieces completely broke immersion or did simply not suit the theme of the game as much as Handel's Water Suite in my opinion (though this is of course strictly subjective). The playlist for the ambient test group contained songs from various artists all from the *AMG Records* ambient music label [9] (see Appendix 4). These songs were selected to all feature similar sonic tonalities and tempo. The playlists in the classical and ambient music group games were randomised upon each playthrough, meaning each user experienced songs in a different order, but from the same selection.

5.2.3 Questionnaire

The questionnaire consisted of three sections with a special fourth section only for the classical and ambient music groups. The first section assessed buying intentions for in-game items. The in-game items were designed to fill three types, these types are based on items commonly found in mobile games: Utility- , Cosmetic- and Hybrid items. All the items and their descriptions, as shown to subjects in the questionnaire can be found in Appendix 5. The items were graphically designed to be in line with the game visuals.

Utility items serve a gameplay purpose, they have the ability to change how mechanics work, give extra health or provide the player with extra abilities for example. Four of these were designed for this experiment: a red heart granting the player one extra health point on a run, a purple heart granting the player the ability to continue where they left off upon a game-over, a bundle of three red hearts and a bundle of three purple hearts. These hearts are consumed on use, meaning they can only be used *once* to activate their respective ability.

Cosmetic items serve no gameplay purpose, but change how aspects of the game look, like the protagonist character for example. Three of these were designed for this experiment: an angel costume, a devil costume and a fancy costume.

Hybrid items do both, they change visual aspects of the game while providing a change in gameplay. For example, giving the ability to play as a different character who both looks and behaves differently to the main one. Three of these were designed for this experiment: a killer whale with the in-game ability to move faster, a swordfish with the in-game ability to take an extra hit and a pink dolphin with the in-game ability to see a few spaces ahead.

Subjects were asked to pick a currency and then asked what they were willing to spend on the items starting with Cosmetic items, followed by Hybrid items and finishing with Utility items, in the following order: Fancy costume, Angel costume, Devil costume, Killer Whale, Swordfish, Dolphin, Red Heart, Red Heart Bundle, Purple Heart, Purple Heart Bundle.

In the second section subjects were asked to rate the game based on how much it possessed certain adjectives on a scale of 0 (the game definitely *did not* possess this characteristic) to 10 (the game definitely *did* possess this characteristic). The adjectives were: Active, Exciting, Majestic, Festive, Enjoyable, Beautiful, Comfortable, Peaceful, Sleepy, Sleepy, Insignificant, Desolate, Boring, Unstimulating, Depressing, Ugly, Disgusting, Frustrating, Harsh, Frightening, Hectic, Forceful.

Participants in one of the two music test groups where then also asked to fill in a third section where they were asked to rate the background music they heard based on the same adjectives, on a scale of 0 (the background music definitely *did not* possess this characteristic) to 10 (the background music definitely *did* possess this characteristic).

In the final section, general questions were asked. Some to make sure the user responses are valid (such as ‘Was your sound enabled during the experience?’ and ‘Did you understand the game?’) and others to provide a context to the results and offer depth, insight or possible explanations for potential results, these are elaborated on in section 6 and 7. The complete question list for this section can be found in Appendix 6.

On top of this, when the user is redirected to the questionnaire the high-score is also sent with it. The questionnaire was built and conducted through TypeForm [10].

6 Results

Section 6 elaborates on how the data from the questionnaire was handled and cleaned, as well as the various tests used to analyze the data in order to answer the hypothesis research questions (RQ3.1 through RQ3.3) as well as the main research question: *Is background music in video games able to influence players' purchasing intentions therein as well as their perception of the atmosphere?* The influence of the control variables on the data is also analyzed in this section.

6.1 Outliers and data handling

There were 102 questionnaire entries, of which 27 in the control group, 57 in the classical music group and 18 in the ambient music group. Out of these only entries using Euros (the majority), GB Pounds or US Dollars were kept. The reasoning behind is that other currencies either contained too small datasets (of 1 entry per currency for example) or they were too different in value (and less stable) in comparison to the chosen western currencies (the kenyan shilling for example). The remaining dataset contained 27 control group entries, 51 classical music entries and 17 ambient music entries, this distribution is shown in Table 1. Of these, 2 were using GBP and 6 were using USD as their currency, these were converted to Euros using the monthly average rate from XE [20] which at the time were 1 USD to 0,88 EUR and 1 GBP to 1,12 EUR. The data was analysed using IBM SPSS Statistics [21].

Table 1

Distribution of groups

Characteristic	No Music	Classical	ambient
Frequency	27	51	17
Percent	28,4	53,7	17,9
Cumulative %	28,4	82,1	100

6.2 Perceived characteristics of the game

A MANOVA was carried out to investigate differences between the two musical styles and the no music group on the subjects ratings of the game characteristics. The result was nonsignificant, $F(42, 144) = 1{,}138$, $p = 0{,}283$; Wilk's $\Lambda = 0.564$. The result of the univariate tests and Tukey HSD tests are presented in Table 2, these indicated that there were *no* significant differences between the conditions except for the peaceful characteristic, which is significant at alpha = 0,05 level. For ease of viewing, every *p* value marked in red is non-significant at the level alpha = 0,05.

Table 2

Univariate tests and Tukey HSDs on the effects of music on perceived characteristics of the game

	M					
Characteristic	No Music	Classical	Ambient	*F*	*Sig.* *test of in-between subject*	*Sig.* *Tukey HSD*
Exciting	6,44	5,69	5,76	1,778	,175	,259
Unstimulating	3,74	3,61	2,94	,709	,495	,421
Forceful	4,78	3,69	3,53	2,249	,111	,142
Hectic	5,67	5,96	4,71	1,431	,244	,208
Beautiful	4,81	5,18	5,65	,583	,560	,455
Majestic	4,26	4,06	4,35	,086	,918	,928
Boring	4,26	4,59	3,59	,931	,398	,360
Disgusting	,48	,65	,47	,193	,825	,882
Enjoyable	6,33	6,53	6,65	,135	,874	,849
Harsh	3,93	3,67	2,71	1,080	,344	,257
Peaceful	3,44	4,06	5,29	2,299	,106	,050
Insignificant	5,11	4,94	3,76	1,581	,211	,160
Depressing	1,74	1,82	1,41	,227	,797	,776
Sleepy	2,26	2,51	3,29	,860	,426	,330
Comfortable	4,48	4,76	5,35	,906	,408	,298
Festive	4,67	4,12	3,53	1,338	,267	,173
Frustrating	5,78	5,67	4,76	,927	,399	,344
Desolate	3,59	2,65	3,00	1,507	,227	,301
Ugly	2,44	2,37	2,53	,034	,966	,964
Frightening	1,48	1,16	1,65	,617	,542	,579
Active	6,33	6,65	6,06	,574	,565	,565
For all cases df = 2						

A series of Pearson product-moment correlations were then conducted to measure the correlation between responses to the game atmosphere and responses to the background music characteristics. Almost all characteristics were significantly correlated, with *r* values ranging from 0,268 to 0,706. See Table 3 for all the correlations. The only four non-correlated characteristics were ‘exciting’, ‘unstimulating’, ‘harsh’ and (ironically) ‘insignificant’. Indicating that participants' responses to the game background music are closely related to their responses to the game atmosphere. Note, for all cases where the significance is reported as ,000 the actual value is somewhere under 0.0005.

Table 3

Product-moment correlations between responses to the game atmosphere and responses to the background music characteristics

Characteristic	Pearson Correlation (r-value)	*Sig.* (2-tailed)
Exciting	,183	,135
Unstimulating	,216	,077
Forceful*	,366	,002
Hectic*	,382	,001
Beautiful*	,354	,003
Majestic**	,293	,015
Boring**	,282	,020
Disgusting*	,706	,000
Enjoyable**	,268	,027
Harsh	-,035	,780
Peaceful*	,417	,000
Insignificant	,218	,074
Depressing*	,373	,002
Sleepy*	,508	,000
Comfortable*	,611	,000
Festive*	,555	,000
Frustrating*	,335	,005
Desolate*	,454	,000
Ugly*	,397	,001
Frightening**	,288	,017
Active*	,440	,000

* statistically significant at the 0,05 level
** statistically significant at the 0,01 level

Participants' responses to the game on the 21 characteristic adjective scales were researched using a principal component factor analysis. Every component with an eigenvalue bigger than 1 was extracted and rotated using varimax. The results are shown in Table 4.

Table 4

Factor analysis of responses to game characteristics: rotated components
Values with loading values of over 30% been highlighted

Characteristic	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Exciting	-,231	,199	**,497**	-,335	,008	**,485**
Unstimulating	**,417**	-,174	-,442	,088	,072	-,556
Forceful	-,007	**,068**	-,056	-,084	**,846**	,187
Hectic	-,234	,058	**,475**	**,598**	,219	-,005
Beautiful	-,304	**,746**	**,323**	,000	,171	,062
Majestic	-,215	**,680**	,284	,152	,173	,071
Boring	**,686**	-,102	-,314	,108	,030	-,331
Disgusting	,173	-,123	-,213	**,818**	-,011	,101
Enjoyable	-,500	**,395**	,223	-,003	,019	,297
Harsh	,052	,020	,224	,284	**,640**	-,070
Peaceful	-,015	**,830**	-,201	-,183	-,027	,021
Insignificant	**,798**	-,150	,103	-,034	-,016	-,143
Depressing	**,417**	-,229	-,100	**,658**	,210	,041
Sleepy	**,616**	,252	-,442	,122	-,185	,182
Comfortable	-,041	**,801**	-,053	-,162	-,117	,133
Festive	,083	**,517**	**,620**	-,154	-,101	-,004
Frustrating	**,539**	-,074	,257	,204	**,477**	,080
Desolate	**,603**	-,078	-,246	,154	,246	,187

Ugly	**,586**	-,428	-,062	**,339**	-,111	,210
Frightening	,094	,066	-,046	,212	,184	**,757**
Active	-,143	-,033	**,769**	-,014	,178	,082
Eigenvalue	3,399	3,214	2,468	2,027	1,708	1,539
% of Variance	16,184	15,303	11,753	9,655	8,134	7,329
Cumulative %	16,184	31,487	43,240	52,895	61,028	68,357
Rotation converged in 22 iterations						

A series of ANOVAs and Tukey HSDs was conducted using the derived factor scores, the results (shown in Table 5) indicate no significant difference between the factor scores across the three musical conditions.

Table 5

ANOVAs and Tukey HSDs on the effects of the background music on the various factors

	M					
Factor	No Music	Classical	Ambient	*F*	*Sig.* $_{ANOVA}$	*Sig.* $_{Tukey\ HSD}$
1	,1336486	-,0028705	-,2036538	,589	,557	,450
2	-,1445591	,0015393	,2249761	,708	,495	,384
3	,1179486	,0898719	-,4569458	2,225	,114	,096
4	-,2001998	,1285857	-,0677929	1,002	,371	,465
5	,2923639	-,0641981	-,2717484	1,924	,152	,106
6	,1204474	-,1892820	,3765473	2,383	,098	,102
For all cases df = 2						

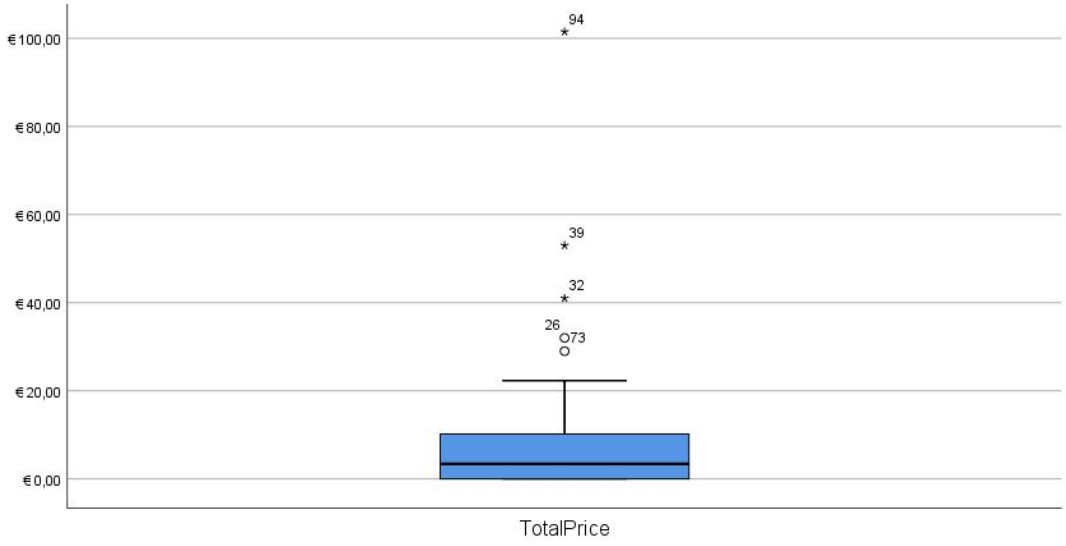
6.3 Purchase intentions

A new 'total price' variable was introduced to aid with analyzing the purchase intention results. This variable is the sum of all the individual prices a participant was willing to spend on the 10 in-game items. Before doing tests on the purchase intentions outliers were found in the total price variable. This resulted in 5 extreme values (see Table 6).

Table 6

Total price stem and leaf plot

Frequency	Stem	Leaf
58	0	00000000000000000000000000000000011111 22222223333334444444
13	0	5566778899999
10	1	0011233344
8	1	55566688
1	2	2
5 *extremes*	>=29	



Stem width: 10

Each leaf: 1 case

A MANOVA was carried out to investigate the differences between the three conditions on the prices they were willing to spend on the ten in-game items. The result of this was nonsignificant, F (20, 156) = 0,701, p = 0.821; Wilk's Λ = 0.842. Further analysis through univariate tests and Tukey HSDs showed that no items yielded a significant F ratio, the results are displayed in Table 7. This indicates that the music condition did not have an influence on the amount participants were willing to spend in-game .

Table 7

Univariate tests and Tukey HSDs on the effects of music on purchasing intentions

	M					
Item	No Music	Classical	Ambient	*F*	*Sig.* *test of in-between subject*	*Sig.* *Tukey HSD*
Fancy Costume	€ 0.31	€ 0.40	€ 0.49	,588	,558	,472
Angel Costume	€ 0.26	€ 0.29	€ 0.42	,532	,589	,515
Devil Costume	€ 0.30	€ 0.30	€ 0.42	,365	,695	,676
Killer Whale Character	€ 0.44	€ 0.62	€ 0.64	,557	,575	,616
Swordfish Character	€ 0.45	€ 0.66	€ 0.83	1,129	,328	,242
Dolphin Character	€ 0.43	€ 0.64	€ 0.78	1,249	,292	,228
Red Heart	€ 0.40	€ 0.29	€ 0.29	,494	,612	,692
Pack of three red hearts	€ 0.65	€ 0.57	€ 0.65	,075	,928	,955
Purple Heart	€ 0.57	€ 0.46	€ 0.53	,210	,811	,852
Pack of three purple hearts	€ 0.94	€ 0.82	€ 1.09	,261	,771	,755
Total	€ 4.74	€ 5.05	€ 6.14	,299	,742	,681
For all cases df = 2						

In Table 7 it appears as if for the Fancy Costume, Angel Costume, Devil Costume, Killer Whale Character, Swordfish Character, Dolphin Character and Total price the mean willingness to spend was higher for the music conditions than for the no-music test group. Therefore another test was done to specifically test the differences between music and no-music, with no regard for the differences between the two music types, the results of this can be found in Table 8. Though the same items appeared to have a higher mean for the music condition, the results were not found to be significant.

Table 8

Anova on the effects of both music groups combined vs no music on purchasing intentions

	M			
Item	No Music	Music	*F*	*Sig.*
Fancy Costume	€ 0.31	€ 0.42	,888	,349
Angel Costume	€ 0.26	€ 0.32	,283	,596
Devil Costume	€ 0.30	€ 0.33	,043	,837
Killer Whale Character	€ 0.44	€ 0.62	1112	,295
Swordfish Character	€ 0.45	€ 0.70	1732	,192
Dolphin Character	€ 0.43	€ 0.68	2112	,150
Red Heart	€ 0.40	€ 0.29	,996	,321
Pack of three red hearts	€ 0.65	€ 0.59	,069	,793
Purple Heart	€ 0.57	€ 0.48	,321	,573
Pack of three purple hearts	€ 0.94	€ 0.89	,030	,863
Total	€ 4.74	€ 5.32	,187	,667
For all cases df = 1				

Since the music condition showed no indication of affecting buying intentions, various MANOVAs were conducted on the effect of the control variables on the willingness to spend. The results of this are shown in Table 9 and indicate that the age and amount of money participants have spent before on games had a significant effect on the amount they were willing to spend on the items in this experiment.

Table 9

MANOVAs on the effect of the control variables on the willingness to spend on the ten individual items

Effect	Wilks' Lambda	Hypothesis df	Error df	*F*	*Sig.*
Average Playtime[a]	,381	40000	157323	1141	,280
Money Spent Before[b]	,114	30000	121019	4432	,000*
Gaming Experience[c]	,389	50000	190353	,875	,706
Gender[d]	,574	30000	121019	,839	,704
Age[e]	,002	230000	401593	1656	,000*
Location[f]	,852	30000	241362	,452	,994
Currency[g]	,876	20000	166000	,568	,930

* statistically significant at the 0,01 level
a The daily average time spent gaming by participants
b Whether or not participants have spent real money on in-game items before in their life
c How long participants have been gaming for
d Gender of participant
e Age of participant
f Geographical region of participant
g Currency used to answer questionnaire responses

The control variables with significant effects were further analyzed with univariate tests and Turkey HSDs. For the 'money spent before' variable (Table 10) there were five univariate items that yielded a significant *F* ratio, at the alpha level of 0,01. Each of these items indicated that the average price that participants were willing to spend per item was higher based on how much they had spent on games before. The total (sum of willingness to spend on all the individual items per participant) also yielded a significant *F* ratio at the same alpha level indicating that the total price participants were willing to spend was also higher based on how much they had spent in other games prior to participating in this experiment.

For the 'age' variable (Table 11) there were two univariate items that yielded a significant *F* ratio at the alpha level of 0,05 and two that yielded a significant *F* ratio at the alpha level of 0,01. The total also yielded a significant *F* ratio at the alpha level of 0,05. .Each of these items indicated that the average price participants were willing to spend per item (as well as the total price) was highest for people aged 31 through 40, followed by people aged 11 through 20, then by people aged 21 through 30 with people over 41 spending the least.

Interesting here is that both the *age* and *money spent before* control variables shared almost the same pool of univariate items that they had a significant effect on. *Both* control variables had a significant influence on what participants were willing to spend on the *Angel Costume* and all three *Character* items (Dolphin, Killer Whale, Swordfish), they both also affected the total price participants were willing to spend. The only difference between the items that both control variables had an effect on, is that the *money spent before* variable also influenced what participants were willing to spend on a *pack of three red hearts,* whereas the *age* variable did not.

Table 10

Univariate tests and Tukey HSDs on the effects of having spent on in-game items beforehand on the willingness to spend

	M Spent before:						
Item	Never	Once	Occasio -nally	Often	*F*	*Sig.* *test of in-between subject*	*Sig.* *Tukey HSD*
Fancy Costume	€ 0.31	€ 0.57	€ 0.46	€ 1.00	1,802	,153	,129
Angel Costume	€ 0.24	€ 0.44	€ 0.27	€ 1.50	5,062	,003*	,000*
Devil Costume	€ 0.26	€ 0.35	€ 0.44	€ 1.00	1,834	,147	,058
Killer Whale Character	€ 0.39	€ 0.62	€ 0.99	€ 2.50	8,357	,000*	,000*
Swordfish Character	€ 0.51	€ 0.61	€ 0.84	€ 2.50	4,620	,005*	,000*
Dolphin Character	€ 0.48	€ 0.61	€ 0.90	€ 2.00	3,836	,013**	,003*
Red Heart	€ 0.35	€ 0.22	€ 0.22	€ 1.00	1,635	,187	,040
Pack of three red hearts	€ 0.60	€ 0.47	€ 0.52	€ 2.50	3,363	,022**	,001*
Purple Heart	€ 0.48	€ 0.39	€ 0.58	€ 1.50	1,587	,198	,033
Pack of three purple hearts	€ 0.86	€ 0.69	€ 1.16	€ 1.50	,465	,707	,707
Total	€ 4.48	€ 4.97	€ 6.40	€ 16.95	3,505	,019**	,001*

For all cases df = 3

* statistically significant at the 0,01 level

** statistically significant at the 0,05 level

Table 11

Univariate tests and Tukey HSDs on the effects of age on the willingness to spend

	M Age						
Item	11-20	21-30	31-40	41+	*F*	*Sig.* *test of in-between subject*	*Sig.* *Tukey HSD*
Fancy Costume	€ 0.32	€ 0.38	€ 0.83	€ 0.50	,906	,442	,246
Angel Costume	€ 0.42	€ 0.26	€ 0.83	€ 0.08	2,558	,060	,012**
Devil Costume	€ 0.38	€ 0.30	€ 0.67	€ 0.11	1,199	,315	,126
Killer Whale Character	€ 0.67	€ 0.50	€ 1.66	€ 0.20	3,303	,024**	,001*
Swordfish Character	€ 0.77	€ 0.56	€ 1.66	€ 0.19	3,092	,031**	,002*
Dolphin Character	€ 0.78	€ 0.56	€ 1.33	€ 0.20	2,400	,073	,016**
Red Heart	€ 0.43	€ 0.26	€ 0.53	€ 0.16	1,239	,301	,391
Pack of three red hearts	€ 0.77	€ 0.58	€ 0.78	€ 0.19	1,077	,363	,519
Purple Heart	€ 0.55	€ 0.50	€ 0.70	€ 0.21	,721	,542	,478
Pack of three purple hearts	€ 0.94	€ 0.93	€ 1.57	€ 0.24	1,179	,322	,166
Total	€ 6.03	€ 4.83	€ 10.58	€ 2.06	2,172	,097	,016**

For all cases df = 3

* statistically significant at the 0,01 level

** statistically significant at the 0,05 level

By concluding this section the third research question *(what are the results when those variables are tested?)* has been answered.

7 Discussion

This section explores the analyzed results from the previous section in order to draw various conclusions and to finally answer the main research question and the hypothesis research questions. Various explanations for the results are given and finally the limitations of this research as well as opportunities for future research projects are discussed.

7.1 Game atmosphere

The results reported in Table 2 provide no evidence that differences in background music (including no music) have an influence on how the participants perceived the game atmosphere. However, the results reported in Table 3 do indicate that the way participants perceived the background music heavily correlated with the way they perceived the game atmosphere, as their responses to the background music adjective scales were significantly correlated to the adjective scales for the game atmosphere. So while the different styles played might not directly influence the way users perceive the game atmosphere, their perception of the background music itself did indicate to be parallel to the way they perceived the game atmosphere.

The results reported in Table 4 show what groups of characteristics (named factors) had the most variance across replies, and therefore the most impact on the perception of the game atmosphere. These factors might be interpreted as following:

1. The first factor might be interpreted as ‘unstimulating characteristics’, as all characteristics with a loading of over 30% for the first factor are unstimulating: ‘unstimulating’, ‘boring’, ‘insignificant’,
2. The second factor might be interpreted as ‘positive characteristics’, as all characteristics with a loading of over 30% for the second factor are positively associated ones: ‘forceful’, ‘beautiful’, ‘majestic’, ‘peaceful’, ‘comfortable’ and ‘festive’.
3. The third factor might be interpreted as ‘energetic/active characteristics’, as all characteristics with a loading of over 30% for the third factor might be associated with high energy upbeat activities: ‘exciting’, ‘hectic’, ‘beautiful’, ‘festive’ and ‘active’.
4. The fourth factor might be interpreted as ‘negative characteristics’, as all characteristics with a loading of over 30% for the fourth factor are negatively associated ones: ‘hectic’, ‘disgusting’, ‘depressing’ and ‘ugly’.
5. The fifth factor might be interpreted as ‘discouraging characteristics’, as all characteristics with a loading of over 30% for the fifth factor might be seen as discouraging: ‘forceful’, ‘harsh’ and ‘frustrating’
6. The final and sixth factor has only two characteristics with loading values of over 30%, being ‘exciting’ and ‘frightening’ so it might simply be interpreted as a combination of the two.

The results reported in Table 5 however unfortunately provide no evidence that the various musical conditions in this experiment had any influence on these six factors.

7.2 Purchasing intentions

The three music conditions, based on the results reported in Table 7, provided no evidence of having an influence on the amount of money that participants were willing to spend on the 10 in-game items. Table 8 also showed that between music in general and no music there was no significant difference in the willingness to spend.

Despite the independent variable of this research (the background music condition) not having a significant influence on the purchasing intentions, two control variables did prove to have a significant influence, as reported in Table 9. These being the amount of times participants had spent money on in-game items in other games before and their age. The results reported in Table 10 provided evidence that for the majority of the in-game items the participants were willing to spend significantly more if they had already spent money on in-game items for other games. For all of the significant cases it was true that the more times participants had spent money in other games, the higher the amount they were willing to spend in this game. The results reported in Table 11 provided evidence of another influence on the intention to spend, namely the age of the participants. For each of the significant cases the same age groups were consistently willing to spend more (or less). With the age group of 31-40 intending to spend the most, followed by participants of age 11-20, then by participants of 21-30 years old and finally, people of over 41 always intending to spend the least.

It is interesting that among the set univariate items that the two control variables did have an influence on, they shared mostly the same ones. Perhaps even more interesting is that the pool of items that both of the control variables had an influence on included *all* of the character items. These character items were hybrid items, providing both cosmetic changes as well as gameplay bonuses. A possible explanation for why both control variables had an significant influence on all what participants were willing to spend on the character items is that these items offered more to the player than what other items provided (functionality *and* aesthetics instead of only one of the two). Suppose the two control variables have a certain influence on the intention to spend on functionality and a certain influence on the intention to spend on aesthetics, then by the character items combining both functionality and aesthetics they effectively combine the effects of the two as well, multiplying the influence.

This explanation however is purely a theory, further research on the differences between *functional* and *aesthetic* items could be interesting to explore this explanation. What stands however, is that both control variables *did* have a significant influence on the intentions to spend on a part of the items as well as on the total price participants were willing to spend.

7.3 Results summarized

Differences in background music did not seem to give rise to the purchasing intentions of participants in this specific digital context. Different background music types also did not indicate to have any significant effect on differences between how the game was perceived. The perception of the background music itself however did heavily correlate to the perception of the game atmosphere.

The perception of the game was heavily influenced by six factors, unstimulating-, positive-, energetic/active-, negative-, discouraging- and exciting/frightening characteristics.

The purchasing intentions, while not influenced by the background music, were affected by participant's age (31-40 year olds intended to spend the most) and their past spending behavior on in-game microtransactions (the more times they spent on other games in the past, the higher their intention was to spend money here).

7.4 Main research question and hypothesis research questions answered

Though it might have already become clear by this point what the outcome is of the hypotheses and the main research question, it is still useful to clearly and concretely name and answer them.

7.4.1 Hypothesis question 1 (RQ3.1)

Do different musical styles give rise to differences in the perceived characteristics (atmosphere) of the game?

No, there is no evidence that hypothesis 1 is true.

7.4.2 Hypothesis question 2 (RQ3.2)

Do different musical styles cause differences in the maximum amount that subjects are willing to spend on in-game items?

No, there is no evidence that hypothesis 2 is true.

7.4.3 Hypothesis question 3 (RQ3.3)

Does classical music have a bigger influence on the willingness to spend than the other conditions?

No, there is no evidence that hypothesis 3 is true.

7.4.4 Main research question

Is background music in video games able to influence players' purchasing intentions therein as well as their perception of the atmosphere?

No, there is no evidence that the background music in video games had any influence on the players' purchasing intention. A correlation between the perception of atmosphere and

background music was found, but between the music genres/conditions no significant difference was found on the game atmosphere perception.

At this point the final research question *(what conclusion can be drawn between the variables and the results?)* has been answered, meaning all research questions have been answered.

7.5 Limitations and future studies

The results from this experiment differ from what might be expected from the related experiments conducted in physical environments where the playing of different types of music was shown to have an influence on both the perceived atmosphere of the environment as the buying behavior [4]–[6]. One explanation for this might be the inherent difference between digital and real environments. Or perhaps, the differences come down to the nature of the environment, where the real world experiments were conducted in places where spending money is a primary goal (stores, restaurants and cafeteria) while this experiment was conducted in an environment where spending money is very common, but only a secondary goal as the main goal is simply playing the game.

Another possibility is that background music in games actually does have the ability to influence game atmosphere perception and in-game purchasing behavior, but that this experiment with this specific setup and under these specific circumstances failed to demonstrate any significance in the results. This could for example be a consequence of the relatively small scale of the experiment (±100 participants) or the uneven distribution across them. Or, perhaps the fact that this experiment was conducted internationally without any specifically targeted regional demographic, meant that cultural or economic differences across countries influenced the results more than music influenced them. Geographical regions were analyzed as control variables in this research with no significant influence on the results, however this was only on a regional level (with the final results being from Southern America, Northern America, Western Europe and Eastern Europe) with no regard for specific countries or even cities, towns and municipalities, so it is impossible to actually determine whether or not cultural or economic differences influenced the final results.

Another interesting theory which could explain why there was no significant difference found in what people were willing to pay, is the relative worth of money across different ages. Meaning, that 1 euro (for example) is worth more to a 10 year old than to a 30 year old person. This could mean that if both those 10 and 30 year old participants were willing to spend 1 euro on the same item, then technically they were intending to spend the same but the younger person was willing to spend something worth more. The finding that different age groups had varying purchasing intentions could potentially support this explanation. As a concept the relative worth of money is very intriguing to me, and research on this could (regardless of context) be very interesting.

Besides the differences across participants, differences in the setup itself could have also affected the results, leading to the current results. Each individual choice made while constructing this experiment could have been influential to the point where the variance across test conditions became irrelevant. Big choices like the game type, mechanics and visuals, or smaller choices such as the phrasing of questionnaire questions could have all had such an influence. Perhaps the music in the playlists, despite being carefully selected, had too many differences, so much that it effectively was not a test of two music genres, but a test of various songs that each influenced participants differently.

Another big influence could have been the volume at which participants played the game. Biswas et al. [22] found that the volume at which background music is played has a significant influence on participants buying behavior. In their research project they found that participants, when exposed to low volume background music, chose healthier food options to a greater extent than when exposed to it at a high volume. This shows that a difference in volume can have a significant impact on buying behavior. And while the difference between 'healthy' or 'unhealthy' items does not apply here, it could still very well be the case that the volume level had an effect on the results from the experiment conducted in this research project. After all, participants did have control over their own audio levels (either through the in-game volume slider or by manually adjusting their speaker/headphone volume) and thus participated in the experiment with varying volume levels. This influence could be eliminated by conducting this experiment in a controlled environment with the music playing at a set level. It might however also be interesting to test the effect of game audio volume in general on in-game purchasing behavior.

Another possible, yet unlikely explanation is that participants were not completely honest while filling in the questionnaire, saying that they had audio enabled during the experiment when in reality they did not.

Further research would have to be conducted to eliminate or elaborate on the various explanations and speculations, or to potentially find new theories. Further research could not only explain the results of this experiment, but also aim to focus on some of the aspects that were left out of this research. For example, as it stands there is a heavy correlation between the music perception and the game atmosphere perception. It is not known however if these two variables influence each other or if the correlation is the result of another currently unknown dependent variable, further research could clear this up. If they are directly related, then (and this is only speculation) the way a participant perceives the music could then directly influence and translate to how they perceive the game atmosphere, or maybe it is the other way around and the way the game atmosphere is perceived translates to the perception of the background music characteristics. In this case the perception of one would overpower the other, but perhaps their influence on each other is more nuanced and instead of one dominating the other, they both influence each other and balance each other out. Meaning that attributes from both the music and

the game are evened out to create a single shared perception. Another theory regarding the (cor)relation between the two elements is that subjects have difficulty distinguishing with the affective qualities across the game and music on a perceptual level, leading them to give the same or similar responses on the characteristics of both the game atmosphere and the music.

Additional research could also assess how the perception of the musical stereotypes relates to the other elements from this research. It would be interesting to see if participants' behavior is influenced directly by the music they heard, or by the stereotypes they associated with that music. This was tested in the cafeteria experiment [6] with results suggesting that the atmosphere was more closely correlated to the music played itself than to the stereotypes suggested.

The divide between paying and non-paying users therefore could be an interesting subject to conduct further research on. Hsiao and Chen [12] found that players who had already paid for items in their experiment game (a real, previously existing game) had different spending behavior in *that same game* than those who did not. My research similarly found that players who had already paid for items in *a different game* had different spending behavior in my experiment game than those who did not. Further research could also engage in finding out how Hsiao and Chen's other variables (which were omitted from this research) relate to those of this research such as playfulness, value for money and loyalty [12].

In the meantime, however, there are some obvious practical applications of the findings in this research. For example, the knowledge on the effect of age on the participants' buying intentions could help with determining a target demographic for a game in order to maximize profits. On top of that, knowing that participants who have spent in one game are more likely to spend on another game might imply that as a developer, building a loyal player base can aid with increasing revenue - as participants that spend money in one of your games, are more like to spend money on another one of your games as well. The discovery that participants' perception of the game correlates heavily with their perception of the music could, assuming they influence each other, be used while developing games to have more control over how players will perceive your game. At this point however, it is unknown how these variables are influenced other than that they are significantly correlated, so further research would be required to determine a successful use of this knowledge.

As it stands now, this research has demonstrated that music and atmosphere are correlated, but no evidence was found of the various musical styles having an influence on the perception of the game or purchasing intentions. Age and past microtransaction behavior however did prove to be influential to how much participants were intending to spend.

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9 Appendix

9.1 Appendix 1: Randomisation JavaScript Function

```
<script>
       var sites=['http://www.sfspithorst.me/V1.3/var0/index.html',
       'http://www.sfspithorst.me/V1.3/var1/index.html',
       'http://www.sfspithorst.me/V1.3/var2/index.html'
       ];

function openUrl(){
    var i = Math.round(Math.random()*(sites.length-1));
    window.location.href=sites[i];
    return false;
}
</script>
   <p class="text-center"><a class="btn btn-primary btn-lg"
href='javascript:openUrl()' role="button">Play the game!</a> </p>
```

9.2 Appendix 2: Research Participant Information Sheet

RESEARCH PARTICIPANT INFORMATION SHEET

Influence of audio on video games

Samuel Spithorst
University of Utrecht
Version date: May 12, 2020

What is the purpose of this study?
To research the effects of audio in video games on users.

What will I do if I choose to be in this study and how long will it take?
The study consists of a short period of gameplay (3 minutes), followed by a short questionnaire (approximately 5-15 minutes).

Will information about me and my participation be kept confidential?
Your responses will be kept strictly confidential, and digital data will be stored in secure computer files. Any publications based on this research will not include your name or any other individual information by which you could be identified. The project's research records may be reviewed by departments at Utrecht University responsible for regulatory and research oversight.

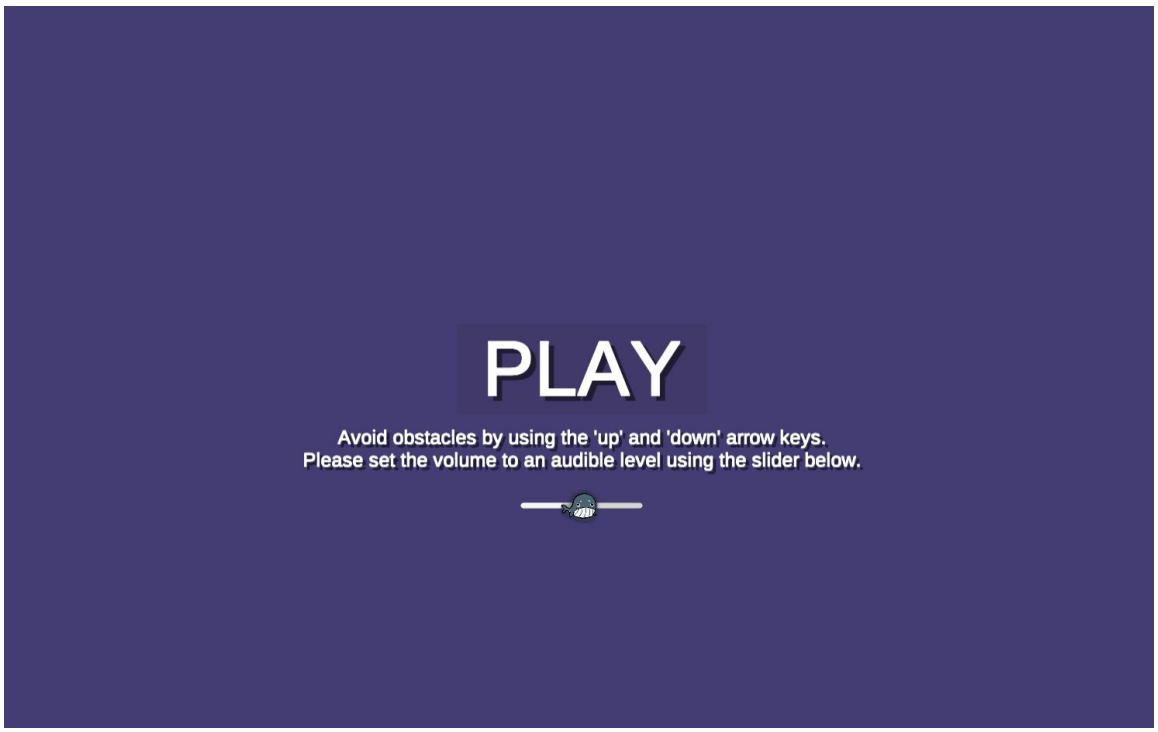
What are my rights if I take part in this study?
Your participation in this study is voluntary. You will not be paid for your participation. You may choose not to participate or, if you agree to participate, you can withdraw your participation at any time without being penalized.

Who can I contact if I have questions about the study?
If you have questions, comments or concerns about this research project, you can talk to one of the researchers. Please contact s.f.spithorst@students.uu.nl

If you have questions about your rights while taking part in the study or have concerns about the treatment of research participants, please write to: s.f.spithorst@students.uu.nl or contact the research supervisor p.vankranenburg@uu.nl

9.3 Appendix 3: Experiment Game Screenshots

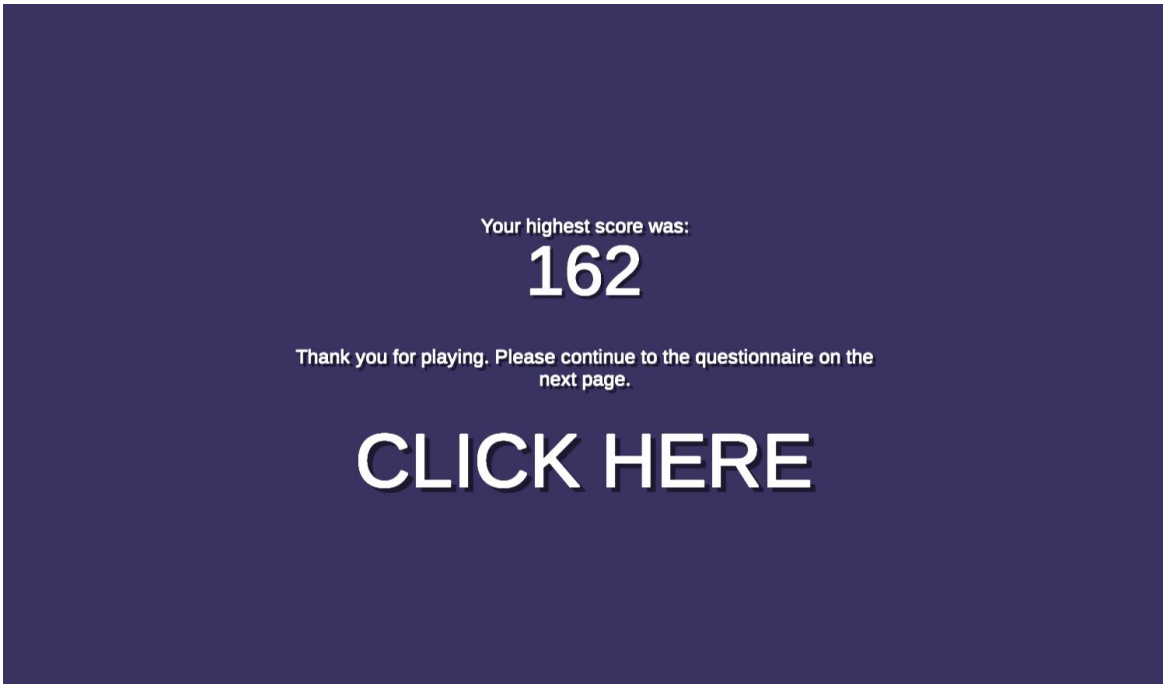
9.3.1 Main menu screen:



9.3.2 Gameplay:

9.3.3 Running out of Health Points (with time remaining):

9.3.4 The end screen (Running out of Health Points with time no time remaining):



9.4 Appendix 4: Music Selection

9.4.1 Classical music playlist:

Water Music Suite No. 1 in F Major, Water Music Suite No. 2 in D Major and Water Music Suite No. 3 in G Major. All three from the *'Georg Friedrich Händel: Music for the Royal Fireworks • Water Music'* album. [23]

9.4.2 Ambient music playlist:

Random Forest - Awakening [24], Swoof - Waves [25], Tony Anderson - Immanuel [26] and We Are All Astronauts - Ether [27].

9.5 Appendix 5: Items in Questionnaire

9.5.1 Utility Items shown in questionnaire:

9.5.2 Cosmetic Items shown in questionnaire:

9.5.3 Hybrid Items shown in questionnaire:

9.6 Appendix 6: Questionnaire Questions

Thank you for playing! You will now be asked a series of questions. This will take somewhere between 5-15 minutes.

By the way, great job on your highscore of: [highscore from game]!

1. First things first: Item pricing

We have made a selection of the finest in-game purchases. For each one of these you will be asked to give a fair price, please be as precise as possible!

a. **Before we start, please let us know what currency you would like to use:**
   This provides a context for the following answers.
   i. USD
   ii. CAD
   iii. YEN
   iv. EUR
   v. GBP

b. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Fancy Costume Item]
   i. Open text field

c. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Angel Costume Item]
   i. Open text field

d. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Devil Costume Item]
   i. Open text field

e. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Killer Whale Item]
   i. Open text field

f. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Swordfish Item]
   i. Open text field

g. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Dolphin Item]

   i. Open text field

h. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Red Heart Item]
   i. Open text field

i. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of 3 Red Hearts Item]
   i. Open text field

j. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of Purple Heart Item]
   i. Open text field

k. **How much would you be prepared to spend on the displayed in-game item? In [answer from 1a].**
   [image of 3 Purple Hearts Item]
   i. Open text field

l. **Great job! You made it through the first section! We're not quite there yet, but the following sections shouldn't take long - hang in there!**

2. **Game Characteristics**

   You will be shown a list of adjectives, please rate the game based on how much it possessed the following characteristics. Using a scale from 0 (the game definitely *did not* possess this characteristic) to 10 (the game definitely *did* possess this characteristic). This might seem like a long list at first, but you should be able to breeze through them. Just fill in your first thought and continue, don't overthink these and save yourself some precious time!

   a. **Exciting**
      Did the game possess this characteristic?
      i. Scale from 0 (definite no) to 10 (definite yes)

   b. **Unstimulating**
      Did the game possess this characteristic?
      i. Scale from 0 (definite no) to 10 (definite yes)

   c. **Forceful**
      Did the game possess this characteristic?
      i. Scale from 0 (definite no) to 10 (definite yes)

   d. **Hectic**
      Did the game possess this characteristic?
      i. Scale from 0 (definite no) to 10 (definite yes)

e. Beautiful

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

f. Majestic

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

g. Boring

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

h. Disgusting

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

i. Enjoyable

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

j. Harsh

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

k. Peaceful

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

l. Insignificant

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

m. Depressing

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

n. Sleepy

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

o. Comfortable

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

p. Festive

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

q. Frustrating

Did the game possess this characteristic?

   i. Scale from 0 (definite no) to 10 (definite yes)

r. **Desolate**

   Did the game possess this characteristic?

   i. Scale from 0 (definite no) to 10 (definite yes)

s. **Ugly**

   Did the game possess this characteristic?

   i. Scale from 0 (definite no) to 10 (definite yes)

t. **Frightening**

   Did the game possess this characteristic?

   i. Scale from 0 (definite no) to 10 (definite yes)

u. **Active**

   Did the game possess this characteristic?

   i. Scale from 0 (definite no) to 10 (definite yes)

v. **We're almost finished, hang in there!**

3. **Music Characteristics [only for test groups *with* music, the no music group did not get section]**

   You will be shown a list of adjectives, please rate the in-game background music you heard based on how much it possessed the following characteristics. Using a scale from 0 (the background music definitely *did not* possess this characteristic) to 10 (the background music definitely *did* possess this characteristic). The same applies here! No need to overthink, just fill in your first thoughts.

   a. **Beautiful**

      Did the game possess this characteristic?

      i. Scale from 0 (definite no) to 10 (definite yes)

   b. **Majestic**

      Did the game possess this characteristic?

      i. Scale from 0 (definite no) to 10 (definite yes)

   c. **Forceful**

      Did the game possess this characteristic?

      i. Scale from 0 (definite no) to 10 (definite yes)

   d. **Boring**

      Did the game possess this characteristic?

      i. Scale from 0 (definite no) to 10 (definite yes)

   e. **Exciting**

      Did the game possess this characteristic?

      i. Scale from 0 (definite no) to 10 (definite yes)

   f. **Unstimulating**

      Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

g. **Harsh**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

h. **Disgusting**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

i. **Hectic**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

j. **Peaceful**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

k. **Comfortable**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

l. **Insignificant**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

m. **Enjoyable**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

n. **Sleepy**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

o. **Desolate**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

p. **Depressing**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

q. **Frightening**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

r. **Ugly**

Did the game possess this characteristic?

i. Scale from 0 (definite no) to 10 (definite yes)

s. **Festive**
   Did the game possess this characteristic?
   i. Scale from 0 (definite no) to 10 (definite yes)

t. **Active**
   Did the game possess this characteristic?
   i. Scale from 0 (definite no) to 10 (definite yes)

u. **Frustrating**
   Did the game possess this characteristic?
   i. Scale from 0 (definite no) to 10 (definite yes)

v. **We're almost finished, hang in there!**

4. **Bonus Round**
   These are a final set of very brief questions that will help us make sense of the final data!
   a. **Was your game audio turned on and audible, with nothing else playing simultaneously?**
      i. Yes
      ii. No
   b. **What do you classify as?**
      i. Male
      ii. Female
      iii. Other
      iv. Would rather not say
   c. **How old are you?**
      i. Open field
   d. **Where are you located?**
      i. Asia
      ii. Northern America
      iii. Southern America
      iv. Western Europe
      v. Eastern Europe
      vi. Oceania
   e. **Did you have any problems with (understanding) the game?**
      i. Yes
      ii. No → redirects to extra question:
         1. **What did you have problems with?**
            a. Open field
   f. **How much experience do you have with (mobile) gaming?**
      i. Less than half a year
      ii. 0.5 - 1 year

iii. 1 - 3 years
iv. 3 - 5 years
v. 5 - 7 years
vi. More than 7 years

g. How much do you play (mobile) games, on average, each day?

i. Less than half an hour
ii. 0.5 - 1 hour
iii. 1 - 2 hours
iv. 2 - 4 hours
v. More than 4 hours

h. Have you ever spent money on in-game items? Microtransactions, Downloadable Content, Etc.

i. No, never
ii. Yes, once
iii. Yes, occasionally
iv. Yes, often

i. If you want to receive an update with the final result of this research you can fill in your email. Otherwise leave it blank and continue. (Do not close the survey!)

i. Open field

That's all! Thank you so much for participating! Feel free to share the experiment with friends, by linking to this page: http://sfspithorst.me