The Sound of Saturation

"(How) does listening to intensely pleasurable music influence consumption-related reward-seeking behavior?"

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ABSTRACT

The aim of this study was to investigate whether the satisfied feeling generated by listening to intensely pleasurable music can work on a general level, diminishing the desire for other types of reward such as food. 120 students and employees of the University of Twente participated in an experiment in which the effect of three different music conditions (no music, neutral music and intensely pleasurable music) on the desire for other rewards and on actual eating behavior was measured.

Present study was not able to find support for the main hypothesis that listening to intensely pleasurable 'chill inducing' music diminishes the desire for other types of reward. Negative correlations found between musically induced chills and the desire for other rewards (M&M's and drinks) did not remain significant when the thirst of the participants and the time between their last meal and the experiment were used as covariates.

Interpretations for the lack of results are discussed, including the possibilities that (a) the manipulation of the intensely pleasurable music was not strong enough, (b) participants were too distracted by the questionnaires to focus on the music or provided snacks, (c) some measurements took place before chills had actually occurred, (d) the measure of chills was not sensitive enough, given that chills were assessed by the participants' estimate of chill intensity, without physiological or neurological measurements.

Previous studies do indicate that the subject is worth further investigation. For future research it is recommended to combine physiological and/or neurological measurements with behavioral research, allowing for more accurate investigation of the subject.

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1. INTRODUCTION

1.1 MOTIVE

When visiting Italy, you will be likely to enjoy the concept of 'aperitivo'. Literally, aperitivo is a pre-meal drink (often combined with a snack) meant to stimulate your appetite. Although it is meant to stimulate your appetite, enjoying it too much may spoil your dinner altogether by giving you enough fulfillment before dinner has even started. A survey by Wadhwa, Shiv & Nowlis (2008) showed that this principle is what many marketers using samples to stimulate consumer interest are afraid of. The survey showed that 81% of the responding experts on food sampling thought that sampling a bit of food or beverage that tastes good would decrease hunger or thirst in an individual and thus decrease subsequent consumption of food or drink.

Research by Wadhwa et al. shows that apart from food samples, other 'non gustatory' samples can be used as well to influence the desire for more food or other types of reward. Their research shows that activating the reward system with a cue in one domain (e.g. a nice fragrance), can influence reward seeking behavior in different domains (e.g. food). This 'general motivation theory' by Wadhwa et al. states that when you present people with a cue high in incentive value the reward system is activated, instigating a generalized motivational state, which causes them to seek anything rewarding.

An example of a non-gustatory cue that is able to activate the reward system is music. Sometimes a musical piece can make you experience such intense feelings that listening to it can give you physical reactions, like *chills* or shivers down the spine. Listening to such intensely pleasurable and moving music can strongly stimulate the reward system in the brain (Blood & Zatorre, 2001; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011), a brain region known to be active in response to other euphoria-inducing stimuli such as sex, drugs and food. Recent research by Salimpoor et al. (2011) shows that listening to music that gives us chills can increase the production of dopamine with 21%, and research by Wise et al. (1995) shows that an increased dopamine level can suppress the appetite and need for other rewarding stimuli of rats.

If intensely pleasurable music can strongly increase the production of dopamine and activate the reward system, and activity in this brain region can induce behavioral indices of satiety with rats, then what effect does listening to intensely pleasurable music have on human reward-seeking behavior? Could it be possible that listening to pleasurable music can stimulate the appetite, but enjoying it 'too much' might fulfill you to such an extent that it can satiate you and diminish your desire for other types of rewards (e.g. food), following an inverted U curve, just like an aperitivo?

Would this musically-induced satiation work on the same general level as motivation, leading to '**general satiation**'?

Very little is known about the possibility of a 'general satiation' system, which is why this research will focus on the main research question:

"(How) does listening to intensely pleasurable music influence consumption-related reward-seeking behavior?"

1.2 RELEVANCE

This research aims to broaden the knowledge on the influence of a musically activated reward system on human (consumption-related) reward-seeking behavior. A body of research has shown that music can strongly activate the reward system, and an activated reward system can influence human behavior, but until now the focus in behavioral research has been on 'just' pleasurable music. Little is known about the possibility of extremely pleasurable music to 'satiate' people and the question if this musical satiation can lead to satiation in other domains as well. Demonstrating the possibility of an abstract cue such as music to satiate people to such an extent that the need for other types of reward diminishes would be a very interesting starting point for future research.

Because this research focuses on extremely pleasurable, chill-inducing music, and musical preference is highly individual, it is difficult to find ways to practically apply results of this research in everyday life. However, the notion that abstract cues could satiate consumers to such an extent that the desire for other types of reward diminishes could be a very interesting base for more commercially interesting applications.

1.3 STRUCTURE

Based on the literature discussed in the theoretical framework, several hypotheses on the influence of listening to intensely pleasurable music on consumption-related reward-seeking behavior will be formulated in chapter two. The methods with which these hypotheses are tested during this experimental research will be discussed in chapter three. The results of this research will be presented in chapter four, leading to a conclusion and discussion in chapter five.

2. THEORETICAL FRAMEWORK

In this theoretical framework, the main theories and studies on which current research is inspired will be discussed. Paragraph 2.1 will explain the theory of *reverse alliesthesia* and *general motivation.* Paragraph 2.2 discusses the features that instigate chills in music, and paragraph 2.3 describes that listening to such chill-inducing music can activate the reward system. Based on the theories mentioned in this chapter, hypotheses will be formulated in paragraph 2.4.

2.1 REVERSE ALLIESTHESIA

As described in the introduction (paragraph 1.1), many marketers using samples to stimulate consumer interest are afraid that sampling a bit of food or beverage that tastes good could decrease hunger and thirst in the consumer, leading to a decreased subsequent consumption of food or drinks. However, the marketers' expectations go against an emerging body of work on *alliesthesia.* Research by Rolls, Rolls and Rowe (1983) showed that for hungry people, the pleasantness of the sight of food decreased by eating to satiety, while for thirsty people the pleasantness of the sight of water decreased by drinking to satiety. In other words, an increase in a physiological drive state (e.g. thirst) enhances the liking (incentive value) of a consumption cue, such as water (Wadhwa et al., 2008). Research suggests that this might work the other way around as well, encountering stimuli high in incentive value could intensify motivational states and thus enhance the desire to engage in subsequent consumption-related behaviors (Berridge, 2000). This is a phenomenon termed *reverse alliesthesia* by Wadhwa et al. (2008). It suggests that drinking a small quantity of a beverage that tastes good will enhance thirst and thereby increase the desire for a beverage.

Based on prior research on reverse alliesthesia, Wadhwa et al. (2008) distinguish three levels of specificity in hypotheses on reverse alliesthesia. These three levels are; *Cue-specific effects, Drive-specific effects* and *General motivational effects.*

Hypotheses *on cue-specific effects* of reverse alliesthesia suggest that the specific cue restricts the ensuing motivational effects without spilling over to a broader array of rewarding options. According to this cue-specific hypothesis drinking a small amount of Fanta would enhance the desire to consume more Fanta, but not another beverage (e.g. Coca-Cola) or a food item.

The second level of specificity distinguished by Wadhwa et al. is the level of *drive-specific effects*. Hypotheses based on this level of specificity operate on a broader level of specificity than the cue-specific hypothesis, by suggesting that consuming a sample of tasty food would enhance hunger and

thereby the desire for any food, but not a beverage. According to this hypothesis drinking a small amount of a nice beverage would increase the desirability of this beverage, but also of any other beverage. It would not increase the desirability of food or for instance a nice massage.

In the third level, the *General motivation hypothesis* on alliesthesia proposes that when you present people with a consumption cue high in incentive value, a generalized motivational state is activated, which causes them to seek anything rewarding. This hypothesis suggests tasting a small amount of something tasty like chocolate will not only increase your desire for more chocolate or any other food item, but also result in a desire for anything rewarding (e.g. a nice massage).

To clarify, these three different levels-of-specificity hypotheses are illustrated in the following figure:

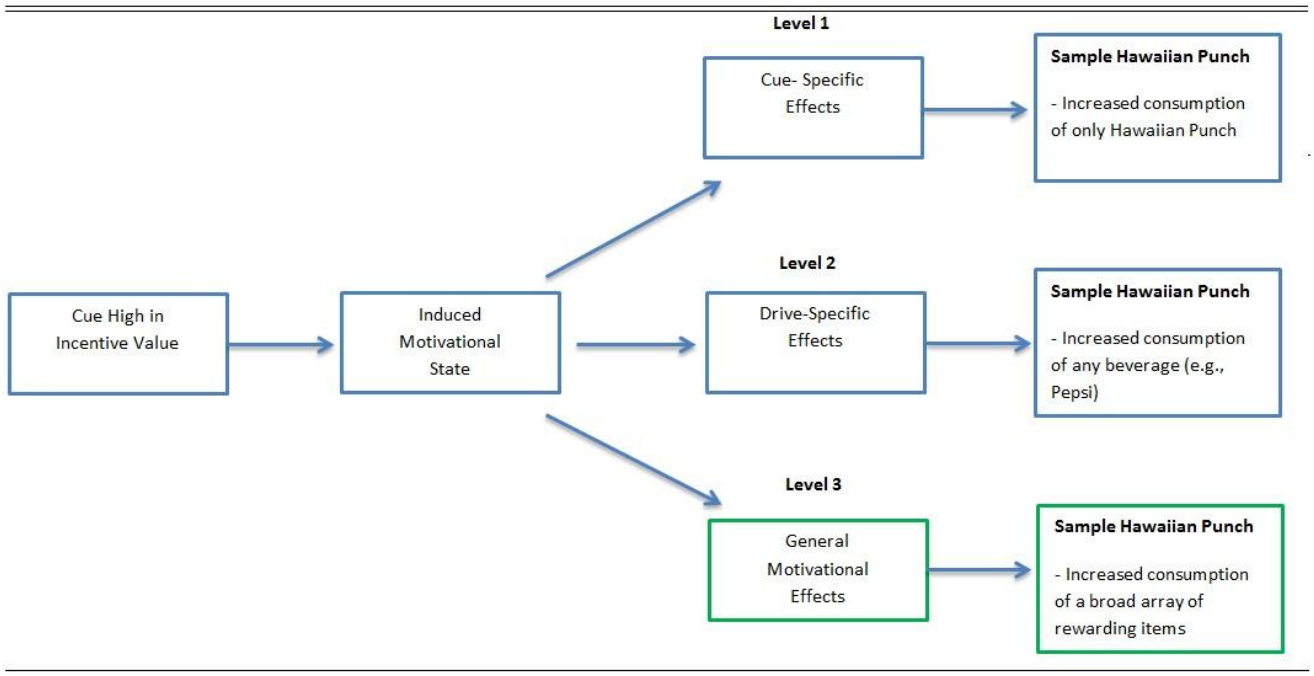

Figure 1: Cue-Specific, Drive-Specific, and General Motivation Hypotheses. Wadhwa, Shiv & Nowlis (2008).

Although the different studies on which the general-motivation hypothesis is based focus solely on gustatory cues, research by Wadhwa et al. demonstrates that the effects can extend to nongustatory cues as well. Their experimental research showed that respondents who sampled an appetitive fragrance (Febreze) subsequently drank significantly more Pepsi than respondents who sampled an aversive (ammonia) or neutral (water) fragrance. This general-motivation hypothesis based on nongustatory cues is supported by Van den Bergh, Dewitte & Warlop (2008). Their research showed that men who have been exposed to pictures featuring sexy women (sexual cue) show a higher preference for immediately available rewards over larger and delayed monetary rewards than men who have been exposed to pictures of landscapes. A second experiment showed that men have a

higher preference for immediately available monetary rewards after fondling a bra than after touching a t-shirt.

As mentioned in paragraph 1.1, music is also a non-gustatory cue which is able to strongly activate the reward system (Blood & Zatorre, 2001; Salimpoor et al., 2011). The next paragraph will focus on the musical features that are associated with strong emotions and even physical reactions in listeners, followed by a paragraph on the possibilities of such intensely pleasurable music to activate the reward system.

2.2 MUSIC AND CHILLS

It is generally agreed that people tend to make associations between music and emotion and can experience a broad range of emotions while listening to it (Balkwill & Thompson, 1999; Juslin & Västfjäll, 2008; Robazza, Macaluso & D'Urso, 1994). Some musical pieces can even make you experience such intense, euphoric responses, that listening to it can give you *chills*; apparent physiological manifestations of an emotional response.

The so-called chill is described as a sudden, arousing reaction that is accompanied by goose bumps, shivers, or tingles in the spine. It is generally felt in the upper spine, neck, shoulders, and scalp and is occasionally accompanied by a lump in the throat, weeping, sighing, or a palpitation (Guhn, Hamm & Zentner, 2007).

Though personal experiences and culture play a big role in individual reactions to music, research shows that certain features of music are consistently associated with inducing strong emotions and chills in listeners. An experiment by Sloboda (1991) showed that 18 out of the 20 tear-triggering passages identified by participants contained an *appoggiatura,* which usually is a dissonant melodic note 'leaning' on a strong beat and resolving on a weak beat (Crutchfield, 1989). The dissonance with the melody generates a tension in the listener, which is resolved when the music returns to the anticipated melody. Listeners often experience chills at these moments of resolution. When a melody contains several appoggiaturas next to each other, this generates an even stronger reaction, by creating a cycle of tension and release. Guhn et al. (2007) found that the chill-inducing passages in their study also shared some features. They abruptly went from soft to loud, and included a sudden entrance of a new instrument or harmony. They often involved an expansion of the frequencies played, and all the passages contained unexpected deviations in the harmony or melody.

An example of a well-known song containing these chill-inducing features is the song “Someone like you”, sung by Adele. The song begins with a soft, repetitive pattern. Adele keeps the notes within a narrow frequency range. When the chorus enters, Adele’s voice jumps up an octave, and she belts out notes with increasing volume. The harmony shifts, and the lyrics become more dramatic. The song also contains many ornamental notes similar to appoggiaturas. During the chorus, Adele creates mini rollercoasters of tension and resolution by slightly modulating her pitch at the end of long notes, right before the accompaniment goes to a new harmony (Doucleff, 2012). These surprises in volume, timbre and harmonic pattern, and the moments of resolution after the appoggiaturas make this song likely to tingle the spine and give you chills.

2.3 MUSIC AND THE REWARD SYSTEM

Blood and Zatorre (2001) have studied this physical response to intensely pleasurable music, and have discovered that subjective reports of chills were accompanied by changes in heart rate, electromyogram, and respiration. Their research also shows that listening to such intensely pleasurable music can increase and decrease cerebral blood flow in brain regions thought to be involved in reward/motivation, emotion, and arousal. These brain regions include ventral striatum, midbrain, amygdala, orbitofrontal cortex and ventral medial prefrontal cortex, and are known to be active in response to other euphoria-inducing stimuli such as food and sex. So although music does not seem to have an obvious intrinsic biological or survival value, the recruitment of circuitry in brain structures involved in pleasure and reward links music with biologically relevant, survival-related stimuli.

Recent research by Salimpoor et al. (2011) shows that listening to intensely pleasurable music strongly stimulates the reward-system in the brain. Listening to music that gives us chills or ‘shivers down the spine’ can increase the production of dopamine with 21%, which makes it almost as powerful as one of the strongest known dopamine-boosters; cocaine. Cocaine is a drug of abuse which suppresses the appetite, and research with rats (Wise et al., 1995) shows that this is due to the increased dopamine level. The self-administration of drugs in rats correlates strongly with activity increases in the ventral striatum as well as behavioral indices of satiety.

Apart from cocaine, both food and sexual activity have been shown to increase dopamine activity in the ventral striatum (Salimpoor et al., 2011). The pleasant experience of eating chocolate has been found to correlate with dopamine activity in the midbrain and orbitofrontal cortex (Small, Zatorre,

Dagher, Evans, & Jones-Gotman, 2001), brain regions that are also stimulated by listening to intensely pleasurable music (Blood & Zatorre, 2001; Salimpoor et al., 2011).

If listening to intensely pleasurable music can strongly stimulate the reward-system in the brain and activate cerebral blood flow in the ventral striatum, and activity in this brain region can induce behavioral indices of satiety with rats, this could suggest that listening to intensely pleasurable music could also induce satiated behavior with humans. This idea is reinforced by research by Briers, Pandelaere, Dewitte & Warlop (2006) who suggest that satiation in one domain can also affect appetitive responses in a different domain. They demonstrated that monetary satiation (deprivation) leads to less (more) food intake; respondents ate more M&M's in the high-desire-for-money condition (deprivation) than the low-desire-for-money condition (satiation). Neural evidence suggests that the same dopaminergic reward circuitry of the brain is activated for a wide variety of reinforcers (Camerer, Loewenstein, & Prelec, 2005).

Based on the mentioned literature, for current research an inverted U curve is expected to explain the relationship between pleasurable music and the desire for other types of reward. Listening to pleasurable music can stimulate the appetite by activating the reward system, but the satisfaction of listening to *intensely* pleasurable -chill inducing- music can influence appetitive responses in other domains as well, leading to general satiation and diminishing the desire for other types of reward. This expected inverted U curve is illustrated in figure 2.

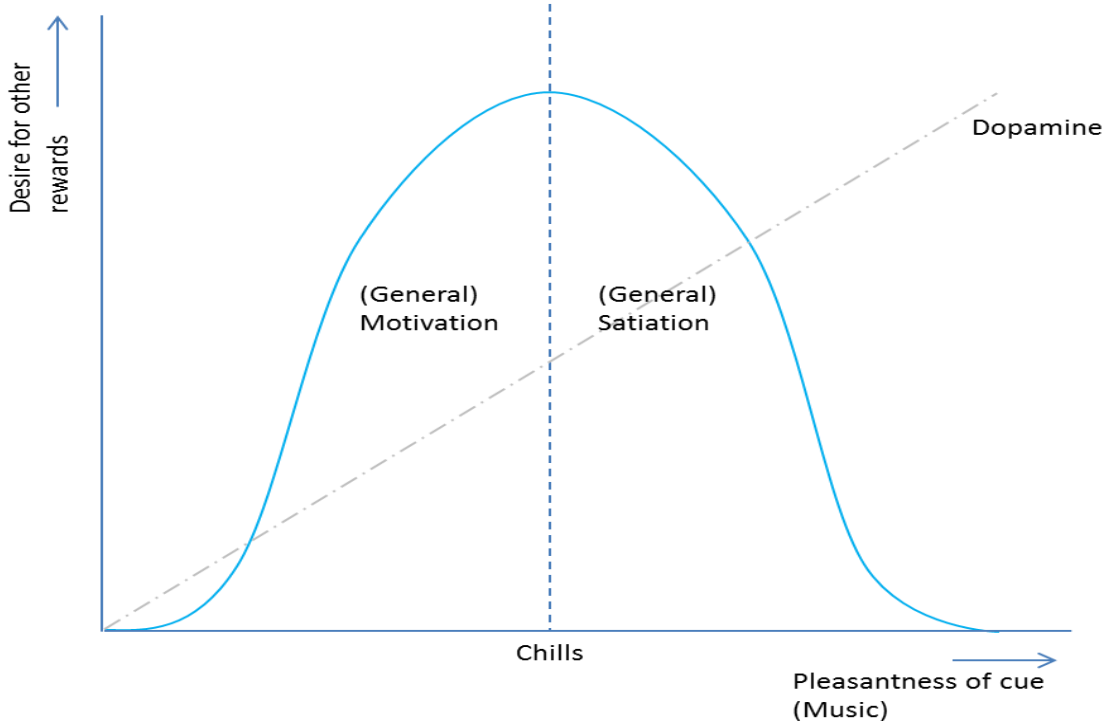

Figure 2: Inverted U-curve relationship between pleasantness of cue and desire for other rewards

* It should be noted that the release of dopamine in the reward-related brain regions is not as constant as the line in this figure might imply. Although dopamine activity increases as emotional experiences get more pleasurable and intense, it specifically increases moments before (anticipation) and during the 'chill-moments' in music, creating peaks (Salimpoor et al., 2011).

Blood & Zatorre (2001) found that ratings of pleasantness and emotional intensity tended to be higher than chills intensity, suggesting that pleasantness and emotional intensity must reach a certain level before chills are experienced.

Although a body of research has focused on the left half of this inverted U, examining the effects of pleasurable abstract cues on general motivation (e.g. Berridge, 2000; Van den Bergh et al., 2008; Wadhwa et al., 2008), very little is known about the right half and the possibilities of intensely pleasurable abstract cues to induce satiation in other domains as well. This is why current research will focus on exploring possible general satiation effects caused by an intensely pleasurable abstract cue; chill-inducing music.

2.4 HYPOTHESES AND RESEARCH MODEL

This research will focus specifically on intensely pleasurable, chill-inducing music. Therefore it is expected that results will differ from results obtained in the mentioned research on reversed alliesthesia and general motivation. It is expected that just as general motivation, **general satiation** can occur when the presented cue is intensely pleasurable. For this study it is therefore hypothesized that the chill inducing music used in this research will activate the reward system of the participants in such a way that they will feel generally satiated, which will result in participants showing a lessened need for other types of reward, leading to the following main hypothesis:

H1*: Listening to intensely pleasurable, chill-inducing music diminishes the desire for other types of reward.*

(*A shift is made here between the main hypothesis and sub hypotheses. The main hypothesis refers to the primary objectives of the study. The sub hypotheses will be either accepted or rejected based on statistical analysis, and will lead to a conclusion whether to accept or reject the main hypothesis stated.)*

One way to measure consumption-related reward-seeking behavior is to make participants choose between a small but direct or a larger but delayed reward. This type of choice is sometimes difficult

because it involves trading off costs and benefits occurring at different times (Green & Myerson, 2004). Based on research on reverse alliesthesia by Wadhwa et al. (2008), it could be hypothesized that a musically induced increase in motivation instigates generalized impatience in intertemporal choice, caused by a greater urgency to consume anything rewarding. This hypothesis is supported by research by Van den Bergh et al. (2008), which showed that exposure to sexy cues leads to more impatience in intertemporal choice between monetary rewards. For current research it is hypothesized that the intensely pleasurable music satiates the subjects to such an extent that they will feel a lesser need for instant reward, and will choose a larger but delayed reward as a result. Research by Dholakia, Gopinath, and Bagozzi (2006) shows that satiation leads to an enhanced capacity of delaying gratification, resulting in more patience. Because this research uses music that is expected to be so pleasurable that it is able to lead to *general satiation* in the participants, it is hypothesized that:

H1a*: Listening to intensely pleasurable, chill inducing music instigates patience in intertemporal choice.*

In the experiment of Wadhwa et al. (2008) on the effects of sampling on consumption-related reward-seeking behavior, half of the 85 participants sampled a tasty Hawaiian punch, the other half of the participants (in the cue-absent condition) did not sample anything. Next, each participant was given a checklist which contained six food items and four different sizes of the sampled drink. Each participant was asked to make a choice of the food items and the size of the drink he or she desired to consume. The pattern of results found in this experiment is not only consistent with research on reverse alliesthesia, but also with the general motivation hypothesis discussed earlier. Not only was the size of the drink participants selected larger in the consumption-cue-present condition than in the consumption-cue-absent condition, the number of food items chosen was also higher in the consumption-cue-present condition than in the consumption-cue-absent condition. Previously mentioned studies by Wadhwa et al. (2008) and Van den Bergh et al. (2008) show that these general motivation effects can extend to nongustatory cues as well. If we assume that just as general motivation, general satiation can occur when the presented cue (music) is intensely pleasurable, the mentioned research technique would be expected to lead to opposite results. This expectation is summarized in the following sub hypotheses:

H1b: ***The more musically induced chills participants experience, the fewer food items they will select to consume from a checklist.***

H1c: ***The more musically induced chills participants experience, the fewer drinks they will select to consume from a checklist.***

The next step is to find out if 'musical satiation' is able to not only influence choice behavior, but actual eating behavior as well. Research by Briers et al. (2006) has shown that satiation in one domain can affect appetitive responses in a different domain by demonstrating that respondents ate more M&M's in the high-desire-for-money condition (deprivation) than the low-desire-for-money condition (satiation). Highlighting the role of a general satiation mechanism, this research proposes that satiation in the musical domain (measured by chills) can influence appetitive responses, decreasing the amount of M&M's eaten by participants.

H1d: ***The more musically induced chills participants experience, the fewer M&M's they will consume during the subsequent task.***

It is desirable to highlight the role of the reward system in this experiment and show that possible music effects occur to changed motivational states in the reward system, as opposed to for example just a musically induced positive mood. To evince the role of the reward-system in a behavioral research experiment without the ability to provide physiological or neurological proof, Van den Bergh et al. (2008) compared consumption- and choice behavior between subjects with low and high scores on sensitivity to reward during their research. Sensitivity to rewarding stimuli can vary strongly from one person to the next (Torrubia, Ávila, Moltó & Caseras (2001). Individuals with a high sensitivity to reward show a greater tendency to respond to rewards, leading to an increased motivation to engage in reward-seeking behaviors. Van den Bergh et al. used the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPRQ) (Torrubia et al., 2001) to measure the different levels of sensitivity to reward with their participants. This is a 48-item yes-no response item questionnaire containing two scales: Sensitivity to Punishment (SP) and Sensitivity to Reward (SR). Several theorists have argued that two general motivational systems underlie behavior. 1: The behavioral approach system (BAS), which is believed to regulate appetitive motives, in which the goal is to move toward something desired. 2: The behavioral avoidance (or inhibition) system (BIS). This system regulates aversive motives, in which the goal is to avoid something unpleasant. The two scales of the SPSRQ consist of items assessing BIS and BAS functioning, respectively.

The correlation between scores on this scale and the experimental outcomes demonstrated that individuals with a sensitive reward system were more susceptible to the effect of sexual cues on

choice- and consumption behavior. The extent to which participants were sensitive to reward moderated the effect of the sexual cues used in their experiment.

For this research, it is hypothesized that participants with a highly sensitive behavioral approach system will be affected to a greater extent by musical cues.

H2: ***Sensitivity to reward enhances the negative relationship between musically induced chills and consumption-related reward-seeking behavior.***

Wadhwa et al. (2008) also wanted to highlight the role of the reward system in their experiment on the general motivational effects of different types of cues, but they used a different approach. A manipulation technique was used in which they gave half of their subjects a small unexpected gift during their experiment. The results show that subjects who sampled tasty milk chocolate (high-incentive-value) subsequently consumed significantly more Pepsi than subjects who sampled soy chocolate (low-incentive-value). But this effect was attenuated when subjects were given an unexpected dollar bill after the consumption-cue manipulation but before the subsequent tasks. For this research, in light of the reverse alliesthesia theory, this would suggest that satiating the (musically) induced motivational state before the subsequent consumption task (with an unexpected reward) should attenuate consumption effects caused by an induced reward-seeking general motivational state.

H3: ***An unexpected gift attenuates the effects of music on reward-seeking behavior.***

This research is not aiming to find more evidence for the existence of a general motivation system, but tries to find possible proof for the existence of a 'general satiation system' which can be triggered by listening to intensely pleasurable music. However, if the intensely pleasurable music does not generally satiate participants during this research, using the surprise present technique by Wadhwa et al. (2008) can give insight in other motivational effects that can occur.

Blood and Zatorre (2011) selected musicians for their research on responses to intensely pleasurable music, based on the premise that this population is more likely to experience strong emotional responses to music. However, research by Robazza et al. (1994) showed that experts in music and nonexperts ascribed similar emotions to pieces of music. Grewe, Kopiez, & Altenmüller (2009a) also found that chills are independent of age, gender and music education. In contrast with these findings, research by Nusbaum and Silvia (2011) suggests that individual differences on aspects of musical engagement can, to an extent, predict whether a person is likely to experience chills.

Openness to experience turned out to be the most significant predictor of variance in chills, but several markers of people's experience and engagement with music in everyday life mediated the openness's effects. In current research, it is hypothesized that:

H4: ***The effect of listening to intensely pleasurable music on chills is positively moderated by musicality.***

The main hypotheses that are based on the literature mentioned above, and which will be tested during this research are summarized in the following model, figure 3:

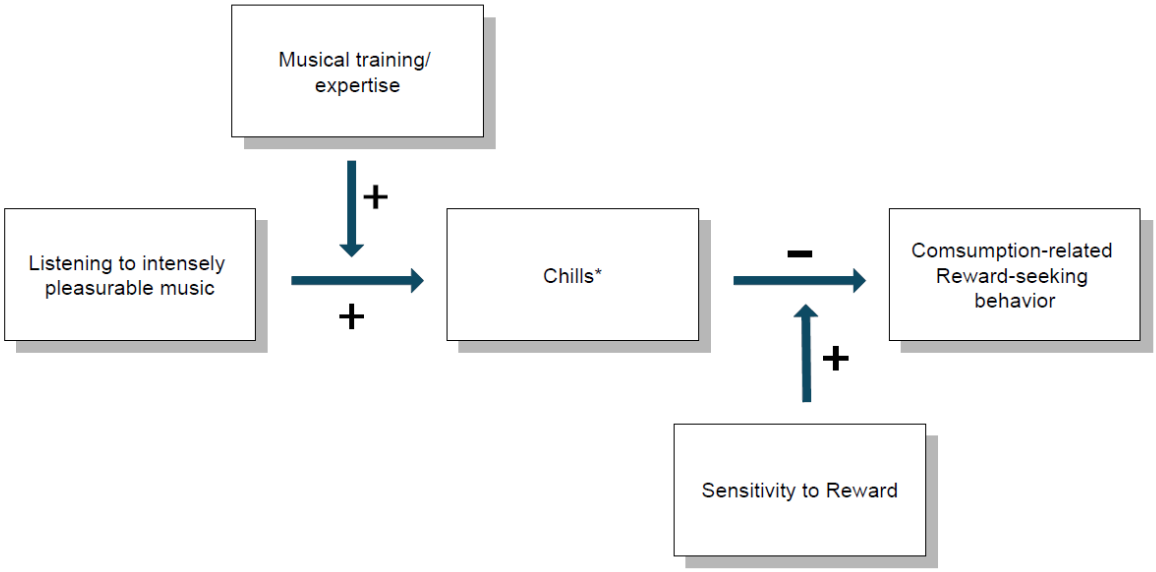

Figure 3: Hypothesis model

* Based on mentioned literature, the assumption is made that musically induced chills are accompanied by activation in the reward system. Because this assumption is not tested during this research, the activated reward system is not mentioned in this model.

The next chapter will describe the different methods that were used to test the hypotheses.

3. METHOD

This chapter about the methods used during the experiment will start with a description of the experimental design in paragraph 3.1. Next, the procedure (paragraph 3.2) and the participants (paragraph 3.3) will be discussed. In paragraph 3.4 the used stimuli and instruments will be explained. In paragraph 3.2, abbreviations of the hypotheses (H1, H2 etc.) stated in paragraph 2.4 can be found throughout the text, to indicate which hypotheses were tested during the different stages of the experiment.

3.1 DESIGN

The experiment used a 3x2 between-subjects design, with music-condition (chills music versus neutral versus no music) and gift (gift versus no gift) as the manipulated factors. This lead to the following six research conditions:

No music – No gift	No music – Gift
Neutral music – No gift	Neutral music – Gift
Chills music – No gift	Chills music - Gift

Participants were randomly assigned across the six different conditions.

3.2 PROCEDURE

When the participant entered the room, he or she was told that he/she could start the music that was selected for him/her (either the highly pleasurable or the neutral music) by pressing the 'start' button, after which he/she could start reading the instructions. In the condition without music the participant could start reading the instructions right away. The instructions for the experiment (which can be found in the appendices) started with a welcoming text which told the subject that the gift that had been arranged for their participation hadn't arrived yet. That is why they were asked to choose between a substitute gift (a single cookie) that they could receive right away, or the package with 6 cookies, which they could collect the next day.

This method was used to examine the influence of listening to (intensely pleasurable) music on reward related choice-behavior. It shows if the participants choose a small but direct reward, or a larger but delayed reward **(H1a)**.

After the participant had chosen the type of reward he or she desired, he/she was asked to complete the next two small assignments before the song that was playing finished (or in the no-music condition; within a few minutes). First the participant was asked to use a few words to describe the feelings that the music which was still playing evoked for him or her. This task created a situation in which participants were busy with something that is not directly related to the research question, but still kept them focused on the music. In the no-music condition, participants were simply asked to briefly describe their feelings.

Next, the participant was asked to look at a fictional menu (see appendix) and indicate which food-items and drinks he/she would choose if he/she was allowed to consume anything on the menu immediately after the experiment had finished. This method was used to give insight on the possible influence of the different music conditions on the type and amount of food and drinks desired by the subject **(H1b&H1c)**. All the items on the menu were of a similar price-category, to prevent the subjects from just choosing the most expensive/luxurious items on the menu.

After the participant had finished these two tasks, he or she was taken to a different desk, where he/she was asked to fill out the SR-questionnaire **(H2)** and a questionnaire based on the 'musical training', 'self-reported musical perception and production abilities' and 'emotion' constructs of the Goldsmith Musical Sophistication Index **(H4)**. On this desk the subject was also presented with a bowl of M&M's. The number of M&M's in the bowl were counted before the subject entered the room and again after the subject had completed the questionnaire, to calculate the amount of M&M's eaten. The time spend on the questionnaire was also taken into account, to measure the amount of M&M's eaten per minute. This method was used to examine the influence of the different music-conditions on actual eating behavior **(H1D)**.

To obtain insight in the motivational or satiating effects of the cued music, half of the subjects received a small unexpected gift **(H3)** before they were asked to fill out the Sensitivity to Reward and musicality questionnaires.

After the participant had completed both of the questionnaires, he/she was asked to indicate on a 7-point Likert scale to which extent he/she had enjoyed the music that was played. Another 7-point Likert scale was used as an indication of the amount of musically induced chills the participant had experienced during the research. This information was used to find out if there are differences in the amount of 'satisfaction' the subjects obtained from the music, and to examine if the different degrees of satisfaction correlate with the experimental outcomes. Next, the participant was asked if

he or she noticed anything special during the experiment, and if he or she had any idea what the research might be about.

Finally, the last question examined the degree of satiation of the subject before he or she entered the experiment. This was measured using a 7-point Likert scale, on which the subject indicated the amount of hunger and thirst he or she experienced right before the experiment started. Participants were also asked to write down what time it was when they had their last meal. This information was used to measure the amount of time (in minutes) between the participant's last meal and the experiment. The outcomes of these questions were later used as covariates during the analysis of the possible correlation between the experimental conditions and the choice- and consumption behavior.

3.3 PARTICIPANTS

Participants were 120 students and employees of the University of Twente, recruited through posted advertisements and face-to-face recruitment. Of the 120 participants, 79 (65.8%) were male and 41 (34.2%) were female. Their ages ranged from 18 to 61 years (M = 24; SD = 7.52). The subjects were told that the study was about musicality, that it would take about 15 minutes, and that they would receive a small gift as an acknowledgement for their participation. When subjects were interested in participating, they were asked to write down their email-address in one of the available time-slots in the research-schedule. All participants received an email with a reminder. In addition, the participants were asked if they could name an extremely pleasurable piece of music which consistently gave them chills when they listened to it. This made it possible to download the selected music for the chills-condition in advance of the experimental research.

3.4 STIMULI AND INSTRUMENTS

MUSIC

Three different music conditions were used in this experiment; extremely pleasurable/chills music, neutral music, and no music. In the chills music condition, music was played which had been selected by the participant as a piece of music that elicits intensely pleasurable emotional responses, and 'shivers down the spine'. Participant-selected music is the most reliable way to induce intense emotional responses, because music preference is highly individual (Rentfrow &Gosling, 2003).

Apart from the control condition without music, a 'neutral' music condition was included in the experiment. This was desirable because numerous researchers have found that in general, listening to music while eating is related to increases in people's food intake (Bellisle & Dalix, 2000; Stroebele & de Castro, 2006). This can be caused by musically induced distraction, offsetting cognitive restraint, a stable disposition to limit food intake. Comparing the results from the intensely pleasurable music condition to the results from the neutral music condition can possibly prove that results found in the first condition are not simply caused by distraction or other factors such as an increased positive mood that cause 'regular' music to instigate increased meal intake. Because this research focuses on the difference between influence of 'just' pleasurable stimuli and influence of intensely pleasurable stimuli, it is not necessary to include a condition with unpleasant music.

For the control (neutral) music condition, the classical piece '*maid with the flaxen hair*' by composer Claude Debussy was selected. This piece was selected because it was expected that participants would generally find the music beautiful, but the composition does not include the chill-inducing features described by Guhn et al. (2007). Results from the pretest showed that participants indeed found the music beautiful, but it did not elicit strong emotional responses or chills. These results are supported by a manipulation check described in paragraph 4.1, which shows that the piece scored high on beauty, but low on chills.

THE SENSITIVITY TO REWARD QUESTIONNAIRE

A 'Sensitivity to Reward' questionnaire (Appendix 1) containing 24 yes-no items was used to assess the individual differences of the participants in the sensitivity of their motivational systems. This questionnaire is based on the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) by Torrubia et al. (2001), which assesses the earlier described BIS and BAS functioning. Test results by Torrubia et al. (2001) show that both scales are independent, and since sensitivity to reward is of much greater interest to this study than the sensitivity to punishment, only the sensitivity to reward will be measured. The possible correlation between scores on this scale and the experimental outcomes might demonstrate that individuals with a sensitive reward system are more susceptible to the effect of music cues on choice- and consumption behavior. This would highlight the role of the reward system in this experiment.

GOLDSMITH'S MUSICALITY SOPHISTICATION INDEX

(Self-reported) musicality of the subjects was measured using a questionnaire based on **Goldsmith's Musical Sophistication Index** (Gold-MSI) (Müllensiefen, Gingras, Stewart & Musil, 2011), which is a psychometric tool for the measurement of musical attitudes, behaviors, and skills. The original test

comprises a self-report questionnaire as well as a suite of music-psychological test batteries testing for different musical skills. The Gold-MSI questionnaire consists of 70 items testing seven different factors of musicality which are summarized in the following table, arising from a pilot survey with 488 participants:

Table 1: Summary of the dimensions measured by the Gold-MSI. Müllensiefen, Gingras, Stewart & Musil (2011)

Number	Short Name	Interpretation	Cronbach's alpha	Number of items
1	Importance	Importance of music in everyday life	.914	15
2	Perception & Production	Self-reported musical perception and production abilities	.731	16
3	Musical training	Life history of formal musical training	.922	9
4	Emotion	Importance of music for psychological (esp. emotional) functions	.816	8
5	Body	Music and associated bodily movement	.826	7
6	Creativity	Musical creativity and ability to join into musical activities with others	.861	9
7	Openness	Attendance of cultural music events/openness to new music	.693	6

Not all seven factors of this musicality index are equally relevant to this research, but the Gold-MSI was deliberately constructed to comprise largely independent factors as measured by distinct subscales. The musicality questionnaire used in this experiment (Appendix 1) examined the self-reported musical perception and production abilities (factor 2), the amount of musical training the participant has received (factor 3) as well as the frequency and intensity of emotions and 'chills' the participant experiences (factor 4) while listening to music. Items from the Gold-MSI measuring these factors were combined to form a 33-item musicality questionnaire. A summary of the different musicality factors and their reliability as measured in current research can be found in table 2. 'Total musicality score' represents the sum of the three measured factors.

Table 2: Summary of the musicality factors and their reliability as measured in current research

Construct	Cronbach's Alpha	# Items	Discarded Items	Measurement
Emotions	0.763	8	0	7-point likert scale
Musical training	0.905	9	0	7-point likert scale
Perception & production	0.890	16	0	7-point likert scale
Total musicality score	0.931	33	0	7-point likert scale

Data obtained with this musicality questionnaire was used to examine a possible relation between musicality/musical training and the amount and intensity of musically induced emotions and chills. The possible correlation between scores on this questionnaire and the experimental outcomes could also demonstrate that musically trained subjects are more susceptible to the effect of music cues on consumption-related reward-seeking behavior.

To measure the effect of music on actual eating/consumption behavior, participants were provided with a bowl of M&M's while they filled out the sensitivity to reward-questionnaire and the musicality questionnaire.

4. RESULTS

In this chapter the results of the empirical research will be discussed, starting with the results of the manipulation check in paragraph 4.1. In paragraph 4.2 the results of the analyses used to test the hypotheses will be addressed.

4.1 MANIPULATION CHECK

To find out if the experimental manipulation of the cued music produced the desired chills effect, a manipulation check was carried out first. During the experiment, participants were asked to indicate on a 7-point Likert scale the extent to which they had experienced chills while listening to the music that was played. Table 3 shows the results of this manipulation check.

Table 3: manipulation check music; standard deviations music vs. experienced chills

Music condition	Score chills	Std. Deviation	N
Neutral music	1,80	1,14	40
Chills music	3,95	1,81	40

Note: 1= no chills, 7 = strong chills

Table 3 shows that participants in the chills music condition indeed experienced more chills than the participants in the neutral music condition, F (1, 78) = 40.444, $p < 0.001$. Participants in the 'chills condition' scored 2.15 points higher on the scale which asked them to indicate the amount of chills they had experienced than participants in the 'neutral music condition'.

Participants were also asked to indicate on a 7-point Likert scale how beautiful they thought the music was that had been played during the experiment. Table 4 shows the results.

Table 4: manipulation check music; standard deviations music vs. beauty value

Music condition	Beauty value	Std. Deviation	N
Neutral music	5,00	0,961	40
Chills music	6,78	0,480	40

Note: 1= not beautiful, 7 = very beautiful

This table shows that although the neutral music generally did not elicit many chills (table 3), participants did find the music fairly beautiful (F (1, 78) = 109.282, p < 0.001). This indicates that the 'neutral music' was well chosen; it possibly induced a positive mood for participants, without eliciting chills.

Based on the results of the manipulation check, it can be assumed that the experimental manipulation of music successfully induced more chills in the 'chills condition' than in the 'neutral music condition', and that the music for the 'neutral music condition' was well selected.

4.2 RESULTS

EFFECT OF MUSICAL CHILLS ON CHOICE AND DESIRE FOR OTHER TYPES OF REWARD

To check the first main hypothesis ***'Listening to intensely pleasurable, chill-inducing music diminishes the desire for other types of reward',*** a Chi-squared test was conducted to measure the influence of the three different music conditions on the participants' choice for type of reward. The results of this test are summarized in table 5:

Table 5: Chi-squared: model summary (music condition & choice for type of reward)

Music condition	No cookie	One cookie	Package of 6 cookies	Total
No music	25.0%	55.0%	20.0%	100.0%
Neutral music	40.0%	42.5%	17.5%	100.0%
Chills music	42.5%	37.5%	20.0%	100.0%
Total	35.8%	45.0%	19.2%	100.0%

At first sight it seems participants in the two music conditions chose the 'no cookie' option more often than participants in the no music condition. However, further analysis shows that the effect of music conditions on choice for type of reward is insignificant ($\chi 2$ (4) = 3.53, p = .473), which means that hypothesis **H1a*: 'Listening to intensely pleasurable, chill inducing music instigates patience in intertemporal choice'*** is rejected.

A one way ANOVA with music conditions as fixed factor and amount of food items selected on fictional menu as dependent factor was conducted to test variance between the experimental groups regarding the participants' desired amount of food. No significant between-group variance was

found (F (2,117) = .245, p = .783). A Pearson product-moment correlation coefficient was computed to assess the relationship between the amount of chills participants had experienced (as indicated on a 7-point Likert scale) and the amount of food items they indicated to desire on a fictional menu-card. No significant correlation was found between the amount of chills and the amount of food items selected on the menu card (r = -.072, n = 80, p = .264), rejecting hypothesis **H1b:** ***The more musically induced chills participants experience, the fewer food items they will select to consume from a checklist.*** Analysis does show a negative correlation between the amount of chills experienced and the amount of drinks selected from the menu card, r = -.190, n = 80, p < .05. This appears to indicate that chills correlate with a lessened desire for drinks, supporting hypothesis **H1c**; ***the more musically induced chills participants experience, the fewer drinks they will select to consume from a checklist.***

Another Pearson product-moment correlation coefficient was computed to assess the relationship between the amount of chills participants had experienced during the research, and the amount of M&M's they had eaten per minute during the second part of the experiment. The amount of M&M's per minute were used as a variable instead of the total amount of M&M's, because there was a fair amount of variance in the time it took participants to finish the questionnaires in the second part of the experiment (mean = 10.98, SD = 3.718). There is a small but significant negative correlation between the two variables, r = -.197, n = 80, p < .05. The amount of chills participants experienced during the research were correlated with a decrease in the amount of M&M's they ate per minute during the research. This negative correlation seems to support hypothesis **H1d;** ***the more musically induced chills participants experience, the fewer M&M's they will consume during the subsequent task.***

MODERATION EFFECT OF SENSITIVITY TO REWARD

Next, a multiple regression model was tested to investigate whether the association between the amount of chills and the amount of M&M's eaten per minute was moderated by the sensitivity to reward of the participants. After centering the amount of chills and the sensitivity to reward score and computing the chills-sensitivity to reward interaction term, the two predictors and the interaction were entered into a simultaneous regression model. Results show that sensitivity to reward did not moderate the effects of chills on the amount of M&M's eaten per minute r^2 = .005, F (1, 76) = .401, p = .528.

Another multiple regression model was computed to investigate possible moderation effects of sensitivity to reward on the relationship between the amount of chills and the amount of drinks

selected on the fictional menu. The computed chill-sensitivity to reward interaction term was entered into a simultaneous regression model with the two predictors. Results show that the effect of musical chills on the amount of drinks selected on the menu was not moderated by sensitivity to reward $r^2 = .003$, $F(1, 76) = .221$, $p = .528$.

Given these results, hypothesis **H2**; ***Sensitivity to reward enhances the negative relationship between musically induced chills and consumption-related reward-seeking behavior*** is not supported in this research. Sensitivity to reward on itself does correlate significantly with the amount of food ($r = .271$, $n = 120$, $p < .005$) and drinks ($r = .207$, $n = 120$, $p < .02$) selected from the fictional menu card. Participants scoring high on sensitivity to reward chose more drinks and food items from the menu than participants scoring low on sensitivity to reward.

MODERATION EFFECT OF UNEXPECTED GIFT

As mentioned before, a negative correlation was found between the amount of chills experienced by participants and the amount of M&M's eaten per minute during the second part of the experiment ($r = -.197$, $n = 80$, $p < .05$). Hypothesis 3 suggests that this effect of music on reward-seeking behavior will be attenuated by an unexpected gift. To test this hypothesis, a multiple regression model was tested to investigate whether the unexpected gift handed out to half of the participants moderated the association between the amount of chills and the amount of M&M's eaten per minute. No significant moderation effects of the unexpected gift on the relation between chills and M&M's eaten per minute was found ($r^2 = .008$, $F(1, 76) = .689$, $p = .409$). **H3: *'An unexpected gift attenuates the effects of music on reward-seeking behavior'*** will therefore be rejected.

MODERATION EFFECT OF MUSICALITY

The manipulation check shows that participants in the chills music condition experienced significantly more chills ($M = 3.95$, $SD = 1.14$) than participants in the neutral music condition ($M = 3.95$, $SD = 1.81$), $F(1, 78) = 40.444$, $p < .001$. A multiple regression model was tested to investigate whether the association between the different music conditions and the amount of chills experienced during the research was moderated by the musicality of the participants. After altering the music conditions into indicator variables, centering the musicality score and computing the music condition - musicality term, the two predictors and the interaction were entered into a simultaneous regression model. Results show that musicality did not moderate the effects of the different music conditions on the experienced amount of chills $r^2 = .005$, $F(1, 76) = .517$, $p = .474$, rejecting **H4: *The effect of listening to intensely pleasurable music on chills is positively moderated by musicality.***

A significant positive correlation was found however between musicality (measured by the total score on the musicality questionnaire) and the amount of chills experienced during the research, r = .271, n = 80, p = < .01, indicating that participants scoring high on musicality did experience more chills than participants with a lower score on the musicality questionnaire.

HUNGER AND THIRST AS COVARIATES

On the last page of the questionnaire, participants were asked how hungry and thirsty they were right before they participated in the experiment, and how much time had elapsed between their last meal and the start of the experiment. The data obtained with these questions was used to further investigate the relationship between the amount of chills experienced by the participants, the amount of M&M's eaten per minute and the amount of drinks selected from the fictional menu.

A Pearson correlation test showed a negative correlation between the amount of chills experienced and the amount of drinks selected from the menu (r = -.190, n = 80, p < .05). An ANCOVA was conducted with amount of chills as fixed factor, amount of drinks selected as dependent variable, and the participant's thirst as a covariate. This analysis of covariance shows that the effect of chills on the amount of drinks selected is no longer significant when the thirst of the participants is taken into account, F (6, 72) = 1.374, p = .237. This means that **H1c**; ***the more musically induced chills participants experience, the fewer drinks they will select to consume from a checklist*** has to be rejected.

Another ANCOVA was conducted to further investigate the found relation between the amount of chills experienced and the amount of M&M's eaten per minute, with chills as fixed factor, M&M's eaten per minute as dependent variable, and amount of time between the last meal and the start of the research as covariate. Analysis shows that the found correlation between chills and amount of M&M's is no longer significant when the time between the last meal and the experiment is used as a covariate (F (6, 72) = .796, p = .576. This means that **H1d; *the more musically induced chills participants experience, the fewer M&M's they will consume during the subsequent task*** is also rejected.

5. DISCUSSION

This chapter will state the major findings of the study and explain their meaning. Results and used techniques will be compared with other studies from the field, highlighting the differences and similarities (paragraph 5.1). Limitations of the research which might have influenced the outcomes are discussed in paragraph 5.2. The chapter will conclude with suggestions for future research in paragraph 5.3.

5.1 CONCLUSION

This research did not manage to find support for the main hypothesis that musically induced chills lead to a lessened desire for other types of reward. Analysis of variance between the three music groups (no music, neutral music, chills music) shows that the different music conditions did not have any statistically significant influence on the measured consumption-related reward-seeking behaviors. This seems to imply that either the music did not satiate participants during the research, or musically induced satisfaction does not work on a general level.

The notion that no correlations were found between the three music conditions and the measured reward-seeking behaviors might indicate that the manipulation of the music for the three conditions was not successful or strong enough. Although participants in the chills music condition scored 2.15 points higher on the scale which asked them to indicate the amount of chills they had experienced than participants in the neutral music condition (F (1, 78) = 40.444, $p < 0.001$), a mean score of 3.95 on a chill indication scale of 1 to 7 is not very high. Possible explanations for this mediocre score will be discussed in the next paragraph.

Although the research design and methods used in this experiment are to a large extent inspired by the techniques used by Wadhwa et al. (2008), current research did not manage to achieve the same kind of results. The biggest difference between their research and current research is that Wadhwa et al. focused on general motivation, as opposed to the general satiation this research was aiming to find. One can assume that it is less difficult to motivate rather than satiate people with (abstract) cues. Furthermore, most of the cues used in their experiment to activate the reward-system were samples of drinks (punch) or food (chocolate), which are less abstract cues than music.

Another difference between the experiment of Wadhwa et al. and current research is the task during which participants were provided with food. While Wadhwa et al. measured the amount of food and drinks consumed by participants while watching a documentary, current research measured the amount of M&M's eaten by the participants while filling out questionnaires. Watching a

documentary is a more passive activity than filling out questionnaires. Participants of current research might have been (too) focused on (finishing) the questionnaire, keeping them from eating M&M's. In contrast to the research of Wadhwa et al. where participants had no influence on the duration of the experiment because every participant was asked to watch the same documentary, participants in current research might have been eager to finish the questionnaire quickly so the experiment would take less time. A focus on (finishing) the questionnaires in combination with possible dietary restraints (which will be discussed in the next paragraph) might explain why only 31 out of 120 participants ate M&M's during current research, making it difficult to make valid analyses of the eating behavior.

The technique used in this research to test the effects of listening to intensely pleasurable music on intertemporal choice behavior – choosing between a small but direct reward or a bigger but delayed reward – was based on research by Van den Bergh, Dewitte & Warlop (2008). Their research shows that exposure to 'sexy cues' (e.g. bikini photos and bras) leads to more impatience in intertemporal choice between monetary rewards. The music conditions or experienced chills in this research however, did not have any influence on intertemporal choice. A difference between the experimental designs might explain why. Van den Bergh et al. confronted their participants with the sexy cues before they engaged in a subsequent delay discounting task (sequentially), while current research measured the choice behavior while the music was playing (simultaneously). Research has shown that musically induced chills tend to occur at very specific moments in the musical piece (Blood & Zatorre, 2001; Sloboda, 1991). Participants of current research were asked to make a choice in type of reward right after the music started playing. This could mean that the participants had not experienced chills yet, and the reward system had not been activated or satiated yet at the moment of intertemporal choice. This is a possible limitation of the manipulation which will be discussed in the next paragraph.

Current research was not able to find evidence in support of a general satiation system activated by abstract cues. Briers et al. (2006) were one of the very few able to demonstrate that satiation in one domain (monetary satiation) can affect appetitive responses in a different domain (M&M's). Although their research shows similarities with current research, an evolutionary explanation can be used to explain their results. It is proposed that people's desire for money is an adaption of their desire for food. Music has no (known) evolutionary value, which could explain why musical satiation does not affect appetitive responses.

As mentioned before, very little is known about the possibility of abstract cues to instigate general satiation. Although there are some indications that satiation can work on a general level as well,

literature on general motivation is much more abundant. As current study explores a new field of research, it is possible that the assumptions based on previous theories and literature are incorrect and that music cannot satiate a person and diminish the desire for other types of reward. It is also important to note that chills are physiological *markers* of intense autonomic nervous system (ANS) arousal, which is believed to underlie peak pleasure during music listening (Grewe, Kopiez & Altenmuller, 2009b; Rickard, 2004). As such, chills are byproducts and not a cause of emotional responses. It is therefore important to clarify that although chills index peak emotional responses, the specific experience of chills is not always necessary to result in neural activity in the reward system (Salimpoor et al., 2011).

The lack of results might also be contributed to by the limitations of current research, which will be discussed in the next paragraph.

5.2 LIMITATIONS

No physiological or neurological measurements took place during current research. This makes it difficult to measure the extent to which participants experienced chills. Previous research on musically induced chills used physiological measures or fMRI scans to measure the activity in the reward system. Due to the design and procedure of current behavioral experiment such measurements were not an option, and analyses were based on the self-report of experienced chills, which might not be very accurate.

This limitation coheres with the previously mentioned specificity of chill-moments in musical pieces. Often chills occur during a very specific measure or chord. During a behavioral experiment, the impossibility of physiological or neurological measurements makes it difficult to capture these specific moments and examine the relation between these exact chill moments and actual behavior.

Furthermore, the controlled setting in which the research took place might have influenced and attenuated the intensity of the experienced chills and emotions. Completing the questionnaires while listening to the music might also have caused distraction, making it difficult to fully focus on the music.

Also, possible dietary restraints were not taken into account during current research. Although participants were randomly assigned across the three different music conditions, such restraints might account to some extent for the lack of results. Cognitive restraint is known to be a stable disposition to limit food intake (Bellisle & Dalix, 2000).

Analysis of covariance showed that the found correlations between musically induced chills and the desire for other rewards (M&M's and drinks) were no longer significant when the thirst of the participants and the time between the last meal and the experiment were taken into account. Current research design did not allow for control of these hunger and thirst variables, but it seems logical that a participant who just had lunch will experience less desire for food than a participant who has not eaten yet. To minimize the influence of the time of the day on the research results participants in all three conditions were equally distributed across the different time slots, but a suggestion for a research design allowing for more control is described in the next paragraph.

5.3 RECOMMENDATIONS

SUGGESTIONS FOR FUTURE RESEARCH

Although current research was not able to provide evidence supporting the theory of a general satiation system which can be activated by music, previously mentioned studies indicate that it is a theory worth further investigation. For future research, it is suggested to compose an experimental design in which it is possible to combine physiological or neurological measurements with behavioral research. This would make it possible to 'capture' the specific chill moments, allowing for more accurate investigation of the effects. As a pretest, fMRI scans can be used to investigate whether the reward system of the participants is indeed activated, at which specific moments, and how long this activation lasts.

It is not recommended to ask participants to fill out questionnaires while listening to the intensely pleasurable music, because this might distract them and diminish the emotional and physiological impact of the music. Instead, it is advised to first prime the chill-inducing music and then measure subsequent reward-seeking behavior. It is also recommended to give participants a less cognitively demanding task when measuring their consumption, e.g. watching a movie.

Furthermore, scales or questionnaires developed to assess the strength of potential attitudes affecting food intake could be included to examine possible dietary restraints of the participants. Including these measured restraints in the analyses of the obtained data could lead to more complete and accurate results.

Another method to minimize the influence of possible dietary restraints or between-subject variances regarding hunger or eating behavior is to let each subject participate in once-weekly laboratory lunch tests under three different music conditions. For condition one, the meal can be

ingested ad libitum without any music playing. This condition can serve as the control condition, the baseline. For condition two participants listen to a neutral piece of music during the meal. For condition three, participants listen to self-selected intensely pleasurable and chill-inducing music during the lunch. Within-subjects analysis of variance can minimize the influence of the difference in eating habits or dietary restraints between subjects. The fact that the experiment takes time during lunch and on a fixed time can decrease the influence of the degree of hunger of the participants by trying to equalize the amount of hunger to the best of ability, although it is impossible to completely control this variable.

SUGGESTIONS FOR PRACTICAL APPLICATIONS

Music is an environmental factor that is frequently used and adapted to create specific ambiences and stimulate different kinds of consumer behavior because it is relatively cheap and time-saving to adjust compared to other environmental factors. Although music is well-known for its ability to influence consumer behavior, current research focuses specifically on chill-inducing music, which is highly personal. This makes it difficult to use 'chill-inducing' music in retail, advertisement or restaurant settings; there are no known musical pieces that generally induce chills in anyone who listens to it.

Vermeulen, Hartmann & Welling (2011) did conduct an experiment in which they used chill-inducing music as background music for advertisements. Results showed that advertisement attitudes improved when a brand name was shown synchronously (vs. asynchronously) to chill-inducing elements in melancholic music. In addition, participants who experienced chills reported more positive ad attitudes. This sounds promising, but it must be stressed out that the chill-inducing music was selected on a pretest in which 17 participants listed pieces of music evoking chills. The musical selection that stood out most – the last chorus in Whitney Houston's "I will always love you"- still evoked (self-reported) chills for only 30% of the participants, showing again that it is very difficult to find musical pieces that generally induce chills.

A more personal setting in which chill-inducing music can be used is the therapeutic setting. Precisely the personal character of this type of music makes it very suitable for therapeutic sessions aiming at forming and reinforcing the patient's identity; people can identify themselves with certain musical pieces. This type of music can also be used to help patients regulate their emotions, when the music and accompanying emotions are presented at a level of balance. Associations can be created

between intensely pleasurable music and traumatic experiences, to enable patients to process these experiences.

Although the personal character of chills-music makes it difficult to use in restaurants or retail settings, the notion that abstract cues are able to activate the reward system to such an extent that the desire for other types of reward diminishes could of course be a very interesting starting point for more commercially interesting applications. An example of a recently developed product in this line of thought is the world's first slimming fragrance 'Prends-moi'. This perfume is said to contain ingredients which release B-endorphins present in the skin, transmitting a 'pleasure message' through the brain which triggers a sensation of wellbeing and an increase in contentment, reducing the need to overeat (Hazell, 2012).

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APPENDIX 1 – QUESTIONNAIRE IN DUTCH

Beste deelnemer,

Via Ravensbergen heb ik een bedankje weten te regelen voor je deelname aan het onderzoek, namelijk een familiepak luxe gevulde koeken. Helaas heb ik deze verpakkingen nog niet binnen. Ik wil je daarom graag vragen op dit formulier aan te geven of je nog even wilt wachten op je beloning (vanaf morgen kun je de koeken bij mij op komen halen), of dat je voor een vervangende beloning kiest; 1 gevulde koek, die ik je nu al wel mee kan geven.

( ) Pak koeken *( ) 1 koek* *( ) Ik hoef geen koek(en)*

Beste deelnemer,

Op de volgende pagina tref je 2 opdrachtjes aan, waarvan het de bedoeling is dat je ze beiden hebt afgerond voordat de muziek is afgelopen. Als de muziek is afgelopen of als je (eerder) klaar bent met de opdrachtjes, mag je de pen neerleggen en een seintje geven aan de proefleidster, waarna je kunt beginnen aan het tweede deel van het onderzoek. Met eventuele vragen kun je ook bij de proefleidster terecht.

Succes!

Omschrijf in een paar woorden de gevoelens die deze muziek bij jou opwekt

…….

…….

…….

…….

…….

Onder deze tekst staat een fictieve menukaart weergegeven. Probeer op deze menukaart door middel van kruisjes zo precies mogelijk aan te geven welk eten en /of drinken je uit zou kiezen wanneer je alles wat op de kaart staat direct na het onderzoek gratis zou mogen consumeren. Geef bij de drankjes ook de gewenste grootte van het drankje aan door een S, M, of L te omcirkelen. Je mag meerdere dingen aankruisen.

( )	**Koffie**	**S /M / L**	**( )**	**Broodje kaas**	**Aantal: ……**
( )	**Thee**	**S /M / L**	**( )**	**Broodje ham**	**Aantal: ……**
( )	**Water**	**S /M / L**	**( )**	**Broodje gezond**	**Aantal: ……**
( )	**Melk**	**S /M / L**	**( )**	**Broodje jam**	**Aantal: ……**
( )	**Frisdrank**	**S /M / L**	**( )**	**Broodje hagelslag**	**Aantal: ……**
( )	**Jus d'orange**	**S /M / L**	**( )**	**Broodje pindakaas**	**Aantal: ……**

( )	**Muffin**	**( )**	**Soep**
( )	**Zakje chips**	**( )**	**Yoghurt/kwark**
( )	**Pakje koekjes**		
( )	**Zak dropjes**		

Geef een seintje aan de proefleidster wanneer je klaar bent met de opdrachten op deze pagina

Deel 2

Omcirkel het antwoord dat het meest op jou van toepassing is			
1	Motiveert de verwachting dat je geld zal krijgen je sterk om dingen te doen?	**Ja**	**Nee**
2	Motiveert de mogelijkheid tot waardering (van collega's, medestudenten, vrienden of familie) je vaak om te handelen?	**Ja**	**Nee**
3	Ontmoet je vaak mensen die je fysiek aantrekkelijk vindt?	**Ja**	**Nee**
4	Houd je ervan om drugs te nemen omdat ze je plezier verschaffen?	**Ja**	**Nee**
5	Doe je vaak dingen om geprezen te worden?	**Ja**	**Nee**
6	Houd je ervan om in het middelpunt van de belangstelling te staan tijdens feestjes of sociale evenementen?	**Ja**	**Nee**
7	Spendeer je veel tijd aan het verwerven van een goed imago?	**Ja**	**Nee**
8	Is het voor jou noodzakelijk dat mensen constant hun affectie voor jou tonen?	**Ja**	**Nee**
9	Als je in een groep bent, probeer je dan je mening zodanig te vormen dat het de slimste of grappigste is?	**Ja**	**Nee**
10	Maak je vaak van de gelegenheid gebruik om personen te versieren die je aantrekkelijk vindt?	**Ja**	**Nee**
11	Deed je als kind veel dingen om andermans goedkeuring te krijgen?	**Ja**	**Nee**
12	Zet de mogelijkheid tot stijging op de sociale ladder je aan tot actie, zelfs als dit zou inhouden dat je niet fair speelt?	**Ja**	**Nee**
13	Geef je de voorkeur aan activiteiten die onmiddellijke winst opleveren?	**Ja**	**Nee**
14	Vind je het vaak moeilijk om de verleiding te weerstaan om verboden dingen te doen?	**Ja**	**Nee**
15	Houd je van concurreren en doe je er graag alles aan om te winnen?	**Ja**	**Nee**
16	Vind je het gemakkelijk om smaken en geuren te associëren met plezierige gebeurtenissen?	**Ja**	**Nee**
17	Zijn er veel objecten en gewaarwordingen die je herinneren aan plezierige gebeurtenissen?	**Ja**	**Nee**
18	Wanneer je begint te spelen op een spelautomaat (bv gokautomaat), vind je het dan moeilijk om te stoppen met spelen?	**Ja**	**Nee**
19	Doe je soms dingen omwille van een snelle opbrengst?	**Ja**	**Nee**
20	Dwaalt je aandacht gemakkelijk af van je werk als er een aantrekkelijke, onbekende persoon aanwezig is?	**Ja**	**Nee**
21	Ben je in die mate geïnteresseerd in geld dat je er risico's (bv. riskante jobs) voor zou nemen?	**Ja**	**Nee**
22	Houd je ervan om competitieve aspecten toe te voegen in al je activiteiten?	**Ja**	**Nee**
23	Zou je graag een persoon zijn met sociale macht?	**Ja**	**Nee**
24	Hou je ervan om je fysieke bekwaamheid te tonen, zelfs als dit gevaar zou inhouden?	**Ja**	**Nee**

Omcirkel per stelling de antwoordcategorie die het meest op jou van toepassing is:	**1. Helemaal mee oneens**	**2. Sterk mee oneens**	**3. Mee oneens**	**4. Neutraal**	**5. Mee eens**	**6. Sterk mee eens**	**7. Helemaal mee eens**
1. Soms kies ik muziek uit die mij kippenvel kan bezorgen.	1	2	3	4	5	6	7
2. Als ik twee tonen hoor die achter elkaar gespeeld worden, vind ik het moeilijk om te bepalen welke van de twee hoger is.	1	2	3	4	5	6	7
3. Muziekstukken roepen zelden emoties bij me op.	1	2	3	4	5	6	7
4. Ik vind het moeilijk om met het ritme mee te tikken wanneer ik muziek luister.	1	2	3	4	5	6	7
5. Ik ontvang nooit complimenten over mijn talent als muzikant/zanger(es).	1	2	3	4	5	6	7
6. Ik kan beoordelen of iemand een goede zanger(es) is of niet.	1	2	3	4	5	6	7
7. Ik kies vaak bepaalde muziek uit om mezelf te motiveren of prikkelen.	1	2	3	4	5	6	7
8. Ik ben in staat te herkennen wat er speciaal is aan een muziekstuk.	1	2	3	4	5	6	7
9. Ik zou het moeilijk vinden om het verschil te horen tussen het geluid van een fluit en een clarinet.	1	2	3	4	5	6	7
10. Het vermogen om muziek te kunnen spelen is een zeer waardevolle vaardigheid.	1	2	3	4	5	6	7

Omcirkel per stelling de antwoordcategorie die het meest op jou van toepassing is:	**1. Helemaal mee oneens**	**2. Sterk mee oneens**	**3. Mee oneens**	**4. Neutraal**	**5. Mee eens**	**6. Sterk mee eens**	**7. Helemaal mee eens**
11. Ik vind het moeilijk om een bekend lied te herkennen wanneer het op een andere manier of door een andere artiest gespeeld wordt.	1	2	3	4	5	6	7
12. Ik ben in staat om te praten over de emoties die een muziekstuk bij mij oproept.	1	2	3	4	5	6	7
13. Ik kan horen wanneer mensen uit de maat zingen of spelen.	1	2	3	4	5	6	7
14. Ik vind het moeilijk om onderscheid te maken tussen verschillende muziekgenres.	1	2	3	4	5	6	7
15. Ik kan geen noten/bladmuziek lezen.	1	2	3	4	5	6	7
16. Als ik een muziekstuk hoor, kan ik normaal gesproken het genre herkennen.	1	2	3	4	5	6	7
17. Ik vind het moeilijk om foutjes te ontdekken in de uitvoering van een muzieknummer, zelfs als ik het nummer ken.	1	2	3	4	5	6	7
18. Muziek kan herinneringen bij mij oproepen aan mensen en plaatsen uit het verleden.	1	2	3	4	5	6	7
19. Als ik zing, heb ik geen idee of ik vals zing of niet.	1	2	3	4	5	6	7
20. Ik beschouw mijzelf niet als een muzikant.	1	2	3	4	5	6	7

Omcirkel per stelling de antwoordcategorie die het meest op jou van toepassing is:	**1. Helemaal mee oneens**	**2. Sterk mee oneens**	**3. Mee oneens**	**4. Neutraal**	**5. Mee eens**	**6. Sterk mee eens**	**7. Helemaal mee eens**
21. Ik ben in staat om twee uitvoeringen of versies van hetzelfde muziekstuk te vergelijken en de verschillen te bespreken.	1	2	3	4	5	6	7
22. Meestal weet ik het wanneer ik een nummer voor de eerste keer hoor.	1	2	3	4	5	6	7
23. Ik kan horen wanneer mensen valse noten zingen of spelen.	1	2	3	4	5	6	7
24. Muziek kan mij rillingen over mijn rug of kippenvel bezorgen.	1	2	3	4	5	6	7
25. Als ik in groepsverband in de maat van de muziek moet meeklappen vind ik dat moeilijk, en moet ik het voorbeeld van andere mensen volgen.	1	2	3	4	5	6	7
26. Ik geloof niet dat muziek een belangrijke rol speelt bij het bepalen van de sfeer van een gelegenheid.	1	2	3	4	5	6	7
27. Wanneer ik muziek luister, vind ik het moeilijk om te horen of een noot in een andere toonsoort dan de vorige staat.	1	2	3	4	5	6	7

Omcirkel per stelling de antwoordcategorie die op jou van toepassing is:

28. Ik heb gedurende **0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 of meer** jaar regelmatig/dagelijks geoefend op een muziekinstrument (inclusief zang).

29. Op het hoogtepunt van mijn muzikale interesse, oefende ik **0 / 0.5 / 1 / 1.5 / 2 / 3-4 / 5 of meer** uur per dag op mijn primaire instrument (inclusief zang)

30. Ik heb gedurende **0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 of meer** jaar gespeeld of gezongen in een groep, band, koor of orkest.

31. Ik heb gedurende **0 / 0.5 / 1 / 2 / 3 / 4-6 / 7 of meer** jaar les gehad in muziek theorie.

32. Ik heb gedurende mijn leven **0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 of meer** jaar les gehad op een muziekinstrument (inclusief zang/stem)

33. Ik kan **0 / 1 / 2 / 3 / 4 / 5 / 6 of meer** instrumenten bespelen

Geef op de volgende schaal aan hoe mooi je de muziek vond die je aan het begin van dit onderzoek geluisterd hebt, waarbij **1** staat voor: Helemaal niet mooi, en **7** voor: Heel erg mooi.

Helemaal niet mooi 1 2 3 4 5 6 7 Heel erg mooi

Heb je tijdens het luisteren naar deze muziek kippenvel ervaren?

Helemaal niet 1 2 3 4 5 6 7 Heel sterk

Is je iets vreemds opgevallen tijdens dit onderzoek, of heb je een idee waar dit onderzoek over gaat?

……

……

……

……

……

……

Wat is je geslacht? ……

Wat is je leeftijd? ……

Hoe veel trek had je vlak voordat het onderzoek begon?

Helemaal geen trek 1 2 3 4 5 6 7 Heel veel trek

Hoeveel dorst had je vlak voordat het onderzoek begon?

Helemaal geen dorst 1 2 3 4 5 6 7 Heel veel dorst

Hoe laat heb je ongeveer voor het laatst iets gegeten? Vul het tijdstip in: ……

Hartelijk bedankt voor je deelname aan dit onderzoek!

APPENDIX 2 - QUESTIONNAIRE IN ENGLISH:

Dear respondent,

Thank you for participating in this experiment! Ravensbergen has helped me with arranging a gift to thank you for your participation, by giving me boxes of luxury cookies to hand out. Unfortunately I haven't received the cookies yet, so I would like to ask you to specify if you would like to wait for this gift (you can collect them here tomorrow), or if you would like to receive just one cookie, which I can give you directly after the experiment.
( ) Box of 6 cookies ( ) One cookie ( ) I don't want a cookie/cookies

On the next page you will find 2 assignments, which I would like you to finish before the end of the song. When the music stops you may put your pen down and call the experimenter, so you can continue with the second part of the study. If you have any questions you may also call the experimenter.

Good luck!

Subjects in the 'no music'-condition received a slightly different instruction, in which the last paragraph read:

On the next page you will find 2 assignments. Try not to spend too much time on them. When you have finished the assignments you may call the experimenter, so you can continue with the second part of the study. If you have any questions you may also call the experimenter.

Good luck!

Shortly describe the feelings you experience when listening to this music:

……

……

……

……

……

Underneath this text a fictional menu is presented. Please try to indicate – by filling in the boxes - which foods and beverages you would choose if you could consume them for free immediately after the experiment. Please indicate the desirable size of the beverages by marking S, M, or L.

You are allowed to choose multiple items.

( )	Coffee	S / M / L	( )	Cheese sandwich	Amount:
( )	Tea	S / M / L	( )	Ham sandwich	Amount:
( )	Water	S / M / L	( )	Salad sandwich	Amount:
( )	Milk	S / M / L	( )	Jam sandwich	Amount:
( )	Soda	S / M / L	( )	Peanut butter sandwich	Amount:
( )	Orange Juice	S / M / L	( )	Chocolate sprinkles sandwich	Amount:

( )	Muffin	( )	Soup
( )	Bag of potato chips	( )	Yoghurt
( )	Pack of cookies		
( )	Bag of licorice candy		

Please give a sign to the researcher when you are finished with the questions on this page.

Please circle the most appropriate answer			
1	Does the good prospect of obtaining money motivate you strongly to do some things?	Yes	No
2	Are you frequently encouraged to act by the possibility of being valued in your work, in your studies, with your friends or with your family?	Yes	No
3	Do you often meet people that you find physically attractive?	Yes	No
4	Do you like to take some drugs because of the pleasure you get from them?	Yes	No
5	Do you often do things to be praised?	Yes	No
6	Do you like being the center of attention at a party of social meeting?	Yes	No
7	Do you spend a lot of your time on obtaining a good image?	Yes	No
8	Do you need people to show their affection for you all the time?	Yes	No
9	When you are in a group, do you try to make your opinions the most intelligent of the funniest?	Yes	No
10	Do you often take the opportunity to pick up people you find attractive?	Yes	No
11	As a child, did you do a lot of things to get people's approval?	Yes	No
12	Does the possibility of social advancement move you to action, even if this involves not playing fair?	Yes	No
13	Do you generally give preference to those activities that imply an immediate gain?	Yes	No
14	Do you often have trouble resisting the temptation of doing forbidden things?	Yes	No
15	Do you like to compete and do everything you can to win?	Yes	No
16	Is it easy for you to associate tastes and smells to very pleasant events?	Yes	No
17	Are there a large number of objects or sensations that remind you of pleasant events?	Yes	No
18	When you start to play with a slot machine, is it often difficult for you to stop?	Yes	No
19	Do you sometimes do things for quick gains?	Yes	No
20	Does your attention easily stray from your work in the presence of an attractive stranger?	Yes	No
21	Are you interested in money to the point of being able to do risky jobs?	Yes	No
22	Do you like to put competitive ingredients in all of your activities?	Yes	No
23	Would you like to be a socially powerful person?	Yes	No
24	Do you like displaying your physical abilities even though this may involve danger?	Yes	No

Please circle the most appropriate category:	**1. Completely Disagree**	**2. Strongly Disagree**	**3. Disagree**	**4. Neither Agree nor Disagree**	**5. Agree**	**6. Strongly Agree**	**7. Completely Agree**
1. I sometimes choose music that can trigger shivers down my spine.	1	2	3	4	5	6	7
2. If I hear two tones played one after another I have trouble judging which of them is higher.	1	2	3	4	5	6	7
3. Pieces of music rarely evoke emotions for me.	1	2	3	4	5	6	7
4. I have trouble tapping along to the beat when I listen to a song.	1	2	3	4	5	6	7
5. I have never been complimented for my talents as a musical performer.	1	2	3	4	5	6	7
6. I am able to judge whether someone is a good singer or not.	1	2	3	4	5	6	7
7. I often pick certain music to motivate or excite me.	1	2	3	4	5	6	7
8. I am able to identify what is special about a given musical piece.	1	2	3	4	5	6	7
9. I would find it difficult to tell the difference between the sound of a flute and a clarinet.	1	2	3	4	5	6	7
10. The ability to play music is a very valuable skill.	1	2	3	4	5	6	7
11. I have trouble recognizing a familiar song when played in a different way or by a different performer.	1	2	3	4	5	6	7

Please circle the most appropriate category:	**1. Completely Disagree**	**2. Strongly Disagree**	**3. Disagree**	**4. Neither Agree nor Disagree**	**5. Agree**	**6. Strongly Agree**	**7. Completely Agree**
12. I am able to talk about the emotions that a piece of music evokes for me.	1	2	3	4	5	6	7
13. I can tell when people sing or play out of time with the beat.	1	2	3	4	5	6	7
14. I have difficulties in distinguishing between musical genres.	1	2	3	4	5	6	7
15. I can't read a musical score.	1	2	3	4	5	6	7
16. When I hear a music piece I can usually identify its genre.	1	2	3	4	5	6	7
17. I find it difficult to spot mistakes in a performance of a song even if I know the tune.	1	2	3	4	5	6	7
18. Music can evoke my memories of past people and places.	1	2	3	4	5	6	7
19. When I sing, I have no idea whether I'm in tune or not.	1	2	3	4	5	6	7
20. I would not consider myself a musician.	1	2	3	4	5	6	7
21. I can compare and discuss differences between two performances or versions of the same piece of music.	1	2	3	4	5	6	7

Please circle the most appropriate category:	**1. Completely Disagree**	**2. Strongly Disagree**	**3. Disagree**	**4. Neither Agree nor Disagree**	**5. Agree**	**6. Strongly Agree**	**7. Completely Agree**
22. I usually know when I'm hearing a song for the first time.	1	2	3	4	5	6	7
23. I can tell when people sing or play out of tune.	1	2	3	4	5	6	7
24. Music can trigger shivers down my spine.	1	2	3	4	5	6	7
25. If I have to clap along to music in a group situation I find it difficult and have to follow other people's lead.	1	2	3	4	5	6	7
26. I don't think that music is very important for setting the atmosphere of an occasion.	1	2	3	4	5	6	7
27. When I listen to music, I have a hard time hearing whether one note is a different pitch to the next.	1	2	3	4	5	6	7

Please circle the most appropriate category:

28. I engaged in regular, daily practice of a musical instrument (including voice) for **0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 or more** years**.**

29. At the peak of my musical interest, I practiced **0 / 0.5 / 1 / 1.5 / 2 / 3-4 / 5 or more** hours per day on my primary instrument.

30. I have played or sung in a group, band, choir or orchestra for **0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 or more** years.

31. I have had formal training in music theory for **0 / 0.5 / 1 / 2 / 3 / 4-6 / 7 or more** years

32. I have had **0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 or more** years of formal training on a musical instrument (including voice) during my lifetime.

33. I can play **0 / 1 / 2 / 3 / 4 / 5 / 6 or more** musical instruments

Please indicate in the next scale to what extent you appreciated the music you listened to at the start of this research, **1** indicates: no appreciation, **7** indicates: great appreciation.

No appreciation 1 2 3 4 5 6 7 Great appreciation

Did you experience chills while you listened to the music?

No chills 1 2 3 4 5 6 7 Strong chills

During this research, did you notice anything odd? Do you have a clue on the subject of this research?

.....
.....
.....
.....
.....

What is your sex? .....
What is your age? .....

How was your appetite just before starting this experiment?

No appetite 1 2 3 4 5 6 7 Great appetite

How thirsty were you just before starting this experiment?

Not thirsty 1 2 3 4 5 6 7 Very thirsty

At what time did you last eat something? Please fill in the time: . . h . . m

Thank you for your participation!