

# Sweets in my beat, sugar for my money?

*The effects of high-pitched background music on consumers' choice of sweet food products.*

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## Preface

To be honest, I'm quite tired. It actually feels like I ran a marathon mentally. I put all my effort in to my thesis (and maybe a bit of chocolate..) to make sure that the result will be good. And this is the result. Science, stress, sweat and a lot of time, all beautifully wrapped up into the thesis that lies in front of you. I actually got fascinated by the influencing ability of environmental variables on our behaviour. This interest actually emerged from the course 'Consumer experience of the service environment' that was part of my Master program. I further developed the idea for this thesis with my supervisor and the result lies in front of you.

The greatest part I had to do myself of course, but I am also very thankful to my supervisor who helped me when I got stuck and who stayed calm and friendly when I called her for the umpteenth time 😊. Because of her enthusiasm for the field of study, it was nice to have her as my supervisor. I also want to thank my second supervisor for giving me tips to improve my thesis.

I also want to thank several other people who helped me and who sometimes had to live with the stressed maniac inside of me. Special thanks go to my mother and my faddy (Fake daddy 😊) who always calmed me down when needed and who always belief in me. I also want to thank my cutie pie (i.e. 'the boyfriend') for listening to my concerns, for hugging me when needed and for just having faith in me. This last point also applies to my parents and to Aura, my sweet and really good friend. I want to thank Ernst as well for helping me with the html code issues that arose while inserting the music fragments in the survey. All other people I did not mention and who supported me during my graduation period, thanks so much!

Loves,

Merel

**OBJECTIVE:** In this study the effect of musical pitch on sweet food cravings and food choice is explored. It is known that females are more sensitive to high-frequency sounds than males. Females also extremely like and crave sweet foods that contain much fat, like pastries and cake. Therefore, it is explored if females choose more sweet food products than males when exposed to high-pitched music. It is also argued that people who have a high food craving trait are more sensitive to sweet food cravings and therefore choose more sweet food items than people with a low food craving trait when exposed to high-pitched music. Females are expected to score higher on this trait.

**DESIGN & METHODS:** A 3 (Music: low-pitched music vs. high-pitched music vs. no music) x2 (low food craving trait vs. high food craving trait) between-subjects design is used here (N=212). Results of males and females were also compared. Participants completed an online survey in the Starbucks store at the University of Twente. In the music conditions a part of the questions had to be filled in while listening to high- or low-pitched music.

**RESULTS:** No main effects of music condition on the level of sweet food cravings and the amount of sweet food items chosen were found. Although the effects of music were expected to be more pronounced for females, no gender differences were found. Participants with a high craving trait indeed had higher sweet food cravings and did also choose more sweet food items than participants with a low food craving trait. However, this was not dependent on the music condition where they were in. No significant gender difference was found for food craving trait.

**CONCLUSION:** Several factors can trigger food cravings, however musical pitch did not appear to be one of them in this study. The procedure of the study could however have negatively affected the results, therefore future research is needed. Food cravings are a common phenomenon and contribute to people's eating behaviour and therefore indirectly to people's health. More future research is needed to identify environmental factors that affect food cravings and food choice. Findings might be useful for health education purposes and for restaurants. They should however be used with keeping the consumer's health in mind.

**KEYWORDS:** Food cravings, servicescape, music, pitch, food choice

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# 1. Introduction

The physical environment of a service organization (the servicescape) includes various elements like color, music, scent, layout and design in the environment. This physical environment is able to influence behaviours and create an image. This is especially the case for businesses like retail stores, hotels and restaurants (Bitner, 1992). An example of a relevant environment is the coffee company Starbucks. There are more than 24,000 Starbucks stores spread over 70 countries (Starbucks Coffee Company, 2016a). On their website they make clear that the customer can expect more than only coffee when visiting a Starbucks store: *“We’re not just passionate purveyors of coffee, but everything else that goes with a full and rewarding coffeehouse experience. We also offer a selection of premium teas, fine pastries and other delectable treats to please the taste buds. And the music you hear in store is chosen for its artistry and appeal.”* (Starbucks Coffee Company, 2016b). Starbucks thus wants to offer the customer a full experience when he or she visits the shop. An experience influences more than one of our senses (Hoch, 2002). Marketeers for example address the auditory sense and use sound in many consumer domains. Sound is used to communicate but also to persuade the consumer. As an auditory cue, music too is used in marketing (Meyers-Levy, Bublitz & Peracchio, 2010). Music is also used in service settings or servicescapes. It is a useful tool in marketing because behavioural and affective responses in consumers can be triggered by use of music in a marketing-related context like these servicescapes (Bruner, 1990). Music can be considered as one of the main ambient conditions in a service environment and therefore it also has the attention of marketeers (Kubacki & Croft, 2004).

However, these cues like music do not only address the auditory sense. The incoming information can influence the perception in the other senses as well (Zampini & Spence, 2005). This is because our world consists for the greatest part of objects and events that are multisensory (Driver & Spence, 2000). As a consequence, when any of our senses receive information, this information can influence the perception in the other senses as well (Zampini & Spence, 2005). For example, music is able to influence how people experience food and drinks.

Regarding the experience of food and drinks, the sense of hearing is most often overlooked by researchers. However, what we hear can be of great importance for our experience of food and drinks. Many effects of auditory cues have been mentioned in this area. What we hear can for example influence the perceived taste of the food, the amount of money spent, but also what food we purchase (Spence & Shankar, 2010). Many studies consider the effects of music on our behaviour (o.a. Oakes, 2000; North, Shilcock & Hargreaves, 2003; North, Hargreaves & McKendrick, 1999).

An example of such a study is the one that explored the influence of country-related music on product choice. Consumers buy more German wine when German background music is playing and they buy more French wine when French background music is playing (North et al., 1999).

Many studies in this area explore the effect of musical variables, such as musical genre, pitch, volume and tempo (Kubacki & Croft, 2004). Bruner (1990) listed the findings of various studies in this area among which also pitch-related findings. These reported studies on pitch focused especially on mood-related findings like perceived happiness. However, musical pitch can also be linked to the perceived taste of food. Basic tastes are associated with relative pitch. For example, lower-pitched notes are associated with bitter and umami tastes. However, sweet and sour tastes are associated with high-pitched notes (Crisinel & Spence, 2010a). Most research in this area has focused on the effect of musical pitch on taste associations and flavour perception. The latter means how a person experiences a particular flavour. The taste association means that a musical element (like pitch) is associated with a particular flavour. This is an example of a crossmodal correspondence. However, the effect of crossmodal correspondences, like the one of audition (pitch) and flavour, on choice behaviour did not get sufficient attention (Knöferle & Spence, 2012). Although research mentioned that high-pitched sounds are associated with sweet taste, it has not been explored if high-pitched music affects the choice of sweet food products. In this study the ability of musical pitch to affect food choice is explored. The general research question is:

### **How does music affect the choice of food products?**

The research context is the Starbucks store environment. Although Starbucks' main product is coffee, they also sell food products like pastries and sandwiches (Starbucks Coffee Company, 2016c). According to Van den Bogert, Operations lead manager at Albron Starbucks (personal communication, July 5, 2016), Starbucks offers these products to provide the customer with a better service based on their needs. The offer of these products however is also a nice opportunity to enhance profits. Because a coffee can naturally lead to pastry, these products are good to offer at a coffee store like Starbucks (Makens & Bowen, 1996). Of course Starbucks wants to make large profits and therefore it is preferred that customers purchase additional items besides their coffee. This is where the practical relevance for the company comes into play. If high-pitched sounds indeed positively influence the choice of sweet food products, this could help Starbucks to increase their sales of sweet food products, and thus their profits. These results could eventually also provide the scientific world with a scientifically supported link between high-pitched sounds and the choice of sweet food products. However, this link should not only be used to enlarge profits of sweet food

products. From a social perspective it is for health reasons not desirable that consumers enlarge their intake of sweet food products. All around the globe overweight and obesity is increasing and no country managed to reverse their obese epidemic (Roberto, Swinburn, Hawkes, Huang, Costa, Ash, Zwicker, Cowley & Brownell, 2015). When compared to other European countries the Netherlands has a relatively lower rate of obesity and overweightness (Blokstra, Vissink, Venmans, Holleman, Van der Schouw & Smit, 2011). However, this rate is increasing (Gast, Frenken, Van Leest, Wendel-Vos & Bemelmans, 2007). In Western society food is available in large amounts. In this case food intake is mostly motivated by the rewarding value of food and not because of physical hunger (Berridge, 2004). This rewarding value of food is made more salient because of the convenience, availability and the relatively low cost of tasty foods in most Western societies (Davis, Patte, Levitan, Reid, Tweet & Curtis, 2007). These obesogenic environments consist of various factors that promote obesity (Swinburn, Egger & Raza, 1999). If it turns out that the high-pitched music indeed promotes the choice of sweet food products, this factor could contribute to this obesogenic environment as well. However, the ultimate objective of this study is to find out more about the role music could play in the food choice process. This again can be used to make people more aware of environmental factors that contribute to their eating behaviour. These and other practical implications will be discussed in the discussion part.



## 2. Theoretical framework and research

Who has not been tempted by the scent of freshly baked bread or by the sight of a chocolate cake?

Having the feeling to consume the desirable food immediately?

The experience of food cravings is relatively common among people according to various studies (Lafay, Thomas, Mennen, Charles, Eschwege & Borys, 2001; Weingarten & Elston, 1991; Yanovski, 2003). According to Baker, Morse and Sherman (1986) cravings are motivational states that could either be physiological or psychological and that promote substance-seeking and ingestive behaviours. This is usually towards drugs or foods. A more specified definition is given by Weingarten & Elston (1991, p. 167) who define a food craving as '*an intense desire to eat a specific food*'. According to Weingarten and Elston (1991) 97% of female and 68% of men in a college population reported that they have experienced food cravings.

Various studies have shown that people tend to crave particular foods like sweets, carbohydrates and high-fat foods (e.g. Christensen & Pettijohn, 2001; Gendall, Joyce & Sullivan, 1997; Pelchat, 1997). Ahmed, Guillem & Vandeale (2013) even found strong evidence that these liked hyper palatable foods, especially those high in sugar, can induce craving and reward that could be compared with addictive drugs. People's initial preference for sweetness or sweet foods (Birch, 1999) has an evolutionary explanation. In the past, food was scarce and sweet foods were safe sources of energy and nutrients, so people developed a preference for them (Beidler, 1982 in Keskitalo, Knaapila, Kallela, Palotie, Wessman, Sammalisto, Peltonen, Tuorila & Perola (2007). However, there is no synonymy between food pleasantness and craving (Pelchat, Johnson, Chan, Valdez & Ragland, 2004). Food cravings are however closely associated with liking because of the foods that are craved the most are highly palatable. Besides liking the food, hunger is also not a precondition for food cravings to occur, however it may make them more likely to occur (Pelchat, et al., 2004). When food cravings are experienced, the likelihood of these cravings to result in eating is high (Hill & Heaton-Brown, 1994).

In Western society food is available in large amounts. In this case food intake is mostly motivated by the rewarding value of food and not because of physical hunger (Berridge, 1996, 2004). According to Jansen (1998) and Weingarten & Elston (1990), cues that signal food intake, such as the food's smell, sight or taste, may act as a conditioned stimuli. These in turn can trigger a response like a food craving. In our society we are often presented with various food cues, such as food images and the smell of food that can trigger these cravings. Besides these food cues, the physical environment may

also play an important role when it comes to food cravings and eventually food choice. The effects of this physical environment on consumers in service settings has been widely recognized in the marketing field (Bitner, 1992). In the next section these ‘*atmospherics*’, or physical design and décor elements, will be further discussed.

## 2.1 Atmospherics in the service environment

In many texts the effects of physical design and decor elements (atmospherics) are mentioned (Bitner, 1992). In general, the physical environment is able to influence behaviours and create an image. This is especially the case for service businesses like hotels, restaurants, bank services, retail stores and hospitals. Because the customer consumes the service in the physical environment, this environment may have a strong impact on the perceptions of the service experience of the customer. The service environment, or servicescape, consists of several environmental dimensions (Bitner, 1992). One of these dimensions, the ambient conditions, will be addressed in the next section.

### 2.1.1 Ambient conditions in the servicescape

As stated by Bitner (1992, p. 62), “*Perceptions of the servicescape lead to certain emotions, beliefs and physiological sensations which in turn influence behaviors*”. These behaviours are affected by the internal response to the environment. This response and the subsequent behaviour can be influenced by several dimensions of the servicescape. One dimension consists of the ambient conditions. Important factors here are for example odour, noise, temperature and music. These ambient conditions affect the five senses. An example is the influence of music in restaurants and supermarkets. The pace of shopping, length of stay and amount of money spent could all be affected by the tempo of the music (Milliman, 1982, 1986). Another example is the influence of music familiarity on perceived shopping time. People believed that they have shopped for a longer time when the music was familiar to them, however the actual shopping time was longer when exposed to less familiar music (Yalch & Spangenberg, 2000). Music as well as lighting, temperature, noise and colour can also influence employee performance and job satisfaction (Bitner, 1992). In short, music has been researched frequently (Kubacki & Croft, 2004). As mentioned earlier, it is able of triggering consumers’ affective and behavioural responses when used in a marketing-related context (Bruner, 1990). Therefore this ambient condition and its effects will be further explored in the next section.

### 2.1.2 Music in the servicescape

Bitner (1992) introduced the servicescape typology and framework. This model explores the domain of non-verbal communication in service environments and how this non-verbal communication can affect the emotional, physiological and cognitive responses of employees and customers. Bitner

(1992, p. 58) defines the servicescape as *“the built environment, that is the man-made, physical surroundings”*. Music is just one element in this environment, however it has been studied frequently as already mentioned (Kubacki & Croft, 2004). Oakes (2000) extended the servicescape framework of Bitner (1992) by introducing the musicscape. Instead of focusing on all physical elements in service environments, this framework only focuses on music and on consumer behaviour. In these studies, one musical variable is often manipulated, such as volume, pitch, musical genre or tempo (Kubacki & Croft, 2004). Studies in this area showed several effects of music on consumer behaviour. An example of the influence of music on consumer behaviour is the positive effect of classical background music on the purchase of more expensive wines. Participants bought more expensive wines when classical music was playing than when top-40 music was playing (Areni & Kim, 1993). Another example is the positive effect of fast tempo music on diner eating speed in a restaurant (Roballey, McGreevy, Rongo, Schwantes, Steger, Wininger & Gardner, 1985). Besides diner eating speed, music is able to influence various factors in restaurants. The amount of spending can for example be influenced by the musical style. Customers spend more when classical music is playing in the background of a restaurant than when pop music is playing or when there is no music playing in the background (North et al., 2003). The customer could also be affected by the music’s pitch. This musical aspect is important here because it appeared to be linked to taste. This will be elaborated more thoroughly in the next paragraph.

### 2.1.3 Taste and musical pitch

Holt-Hansen (1968) was probably the first researcher who explored the correspondence between taste and pitch of a sound. He studied the harmony between the taste of two kinds of beer and the pitch of a tone. He found that different pitch ranges were ascribed to both drinks (Holt-Hansen, 1968). However, his study did not take into account specific tastes and their association to pitch. Crisinel and Spence elaborated on these findings by conducting several studies in the area of these crossmodal associations. In these studies they documented the existence of an association between relative pitch and the basic tastes (Crisinel & Spence, 2009; 2010a; 2010b). They found that sweet and sour tastes were associated with high-pitched notes and that bitter and umami tastes were associated with low-pitched notes. Salty tastes were associated with a medium pitch (Crisinel & Spence, 2010a). The association between high pitch and sweet tastes is especially of interest here because it could be linked to food cravings. Because food cravings are mostly preceded by thinking about the particular food (Hill, 2007) and people associate high pitched sounds with sweet tastes, this could make them think about sweet foods. This in turn could trigger a food craving for sweet foods. This assumption is also supported by the fact that people particularly crave foods like sweets,

carbohydrates and high-fat foods (e.g. Christensen & Pettijohn, 2001; Gendall, et al. ; Pelchat, 1997) and that especially foods high in sugar can induce strong food cravings (Ahmed et al., 2013).

The high-pitched music is expected to work as a prime for sweet food cravings here. Although food cravings do not always result in eating, the likelihood was found to be high (Hill & Heaton-Brown, 1994). These findings result in the first hypotheses:

**H1a: Participants who are exposed to high-pitched music experience a higher level of sweet food cravings (State) than participants who are not exposed to any music and participants who are exposed to low-pitched music.**

**H1b: Participants who are exposed to high-pitched music choose more sweet food products than participants who are not exposed to any music and participants who are exposed to low-pitched music.**

In the first hypothesis food cravings are assessed as a response to a specific situation, which means they are assessed as a state. Food cravings could also be assessed as a trait, which will be discussed in the next section

## 2.2 Sensitivity for food cravings

### 2.2.1 Food cravings as a trait

As already mentioned, food cravings could also be measured as a psychological trait of an individual instead of in a specific situation (Cepeda-Benito, Gleaves, Williams & Erath, 2000). To report in a consistent way about this trait, it is indicated with 'food craving trait' from now on. People that possess this trait and therefore score high on the Food Cravings Questionnaire-Trait, are expected to be more sensitive to food cravings in general and thus also to sweet food cravings. Besides this, these high food cravers are expected to be more reactive to food-related cues. First, the reactivity to cues in the environment that may trigger a food craving was an incorporated dimension in the Food Craving Questionnaire-Trait. Because of this, it is reasonable to expect participants with a high craving trait to be more sensitive for cues that are associated with food (like the high-pitched music) than participants with a low craving trait. Second, former studies found high food cravers to be more reactive to food-related cues than low food cravers. In these studies this was found for high versus low chocolate cravers (Rodríguez, Fernández, Cepeda-Benito & Vila, 2005 ; Smeets, Roefs & Jansen, 2009). Rodriguez et al. (2005) found high chocolate cravers to report higher state cravings than low chocolate cravers in response to chocolate cues (images of chocolate). The musical pitch is here

considered as food-related cue and is expected to positively affect sweet food cravings of participants with a high craving trait. Because of the high likelihood of cravings resulting in eating (Hill & Heaton-Brown, 1994), these people are also expected to choose more sweet food products. This leads to two hypotheses:

**H2a: Participants with a high food craving trait experience a higher level of sweet food cravings (State) than participants with a low craving trait when exposed to high-pitched music.**

**H2b: : Participants with a high food craving trait choose more sweet food products than participants with a low craving trait when exposed to high-pitched music.**

Besides this food craving trait, gender may also play a role when it comes to food cravings. This will be explained in the following section.

### 2.2.2 Food craving and gender

Food cravings are a common phenomenon among both males and females, especially among females. Women show a higher level of food cravings than men (Weingarten & Elston, 1991). Because of this women could show more food cravings in our study, however, there are more arguments for women's higher level of food cravings, especially for cravings for sweet food items.

First, women extremely like or crave foods that are sweet and high in fat, such as cakes, pastries, candies and ice cream (Drewnowski, 1995). Cepeda-Benito, Fernandez & Moreno (2003) found that women reported significantly more cravings for sweets and chocolate than men. Previously, it was mentioned that high-pitched notes are associated with a sweet taste (Crisinel & Spence, 2010a). Because especially women like the sweet, high fat foods, it could be that these high-pitched notes trigger women's sweet food cravings which could result in the intake of more sweet food products than when men are exposed to these high-pitched sounds. Besides this, audition may also support this assumption.

Audition is important concerning the correspondence between taste and pitch. For the association to be made it is important that people actually perceive the notes that are associated with certain tastes. Therefore, for the sweet taste to be associated with the high-pitched notes, these notes have to be perceived. In perceiving sounds there are several differences between the auditory systems of males and females. Females score higher on several auditory aspects such as hearing sensitivity and susceptibility to noise exposure at high frequencies (McFadden, 1998). Corso (1959) was one of the

first researchers that mentioned that adult females have a more sensitive hearing at high frequencies than adult males (Sax, 2010). This finding was replicated in various other studies (e.g. Chung, Mason, Gannon and Wilson, 1983; Royster, Royster and Thomas, 1980; Dreisbach, Kramer, Cobos & Cowart, 2007). Besides this, the aging process of the auditory system is also different for both sexes. Studies of middle-aged and elderly persons show that males have more high-frequency hearing loss than females (Cruickhanks, Wiley, Tweed, Klein, Klein, Mares-Perlman & Nondahl, 1998). Taken together it could be said that females are more sensitive than males in hearing high-frequency sounds. This factor could also explain the moderation of the factor gender, that moderates between the high-pitched music on one side and the food cravings and the choice of sweet food products on the other side.

Females are here expected to have higher sweet food cravings than males and to therefore choose more sweet food products. Assumptions especially apply to the high-pitched music condition and less to the other music conditions because high-pitch is linked to sweet taste and women particularly like sweet food items. Their superior high-frequency hearing supports this assumption. For this reason sweet food cravings and the amount of sweet food products chosen are expected to be higher for females than for males in the high-pitched music condition. This results in the following hypothesis:

**H3: The effects of music on sweet food cravings (State) and food choice are more pronounced for females than for males.**

This hypothesis concerns the state food cravings. However, gender may also play a role in the sensitivity for trait food cravings. This will be further explained in the next section.

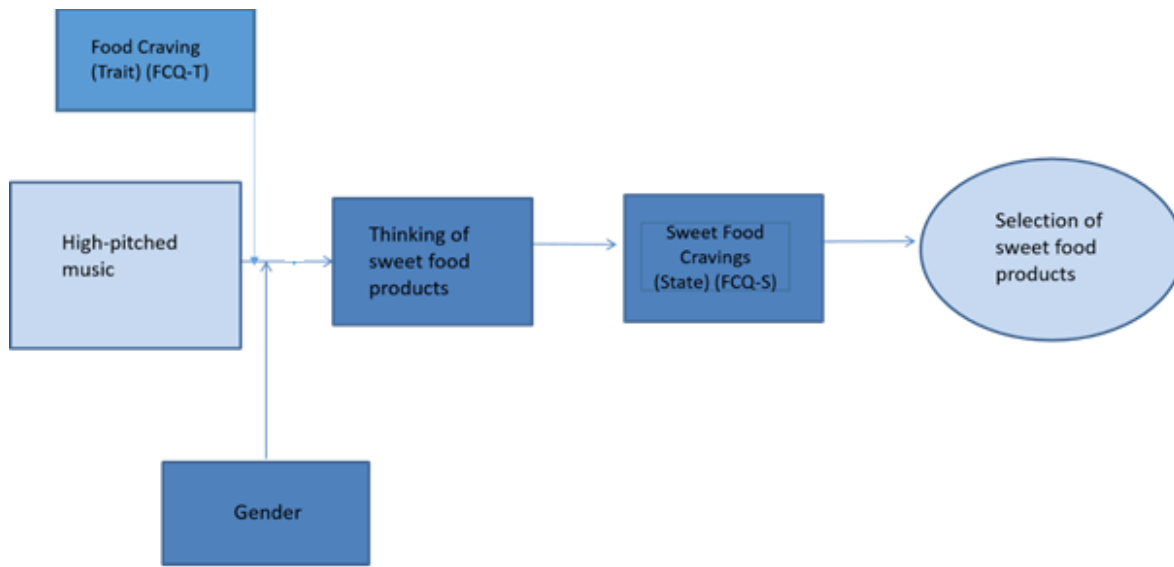
### 2.2.3 Gender and the food craving trait

When it comes to the prevalence of food cravings, gender plays an important role. When the Food Craving Questionnaire-Trait (FCQ-T) is considered for example, Cepeda-Benito et al. (2003) found women to score significantly higher than men on this scale. They actually did not find a significant difference between males and females in the reported cravings on the Food Craving Questionnaire-State (FCQ-S). Because it is expected that females have a higher food craving trait than males, a higher sensitivity for sweet food cravings is expected for females. Because of the high likelihood of food cravings resulting in eating (Hill & Heaton-Brown, 1994), females are also expected to choose more sweet food products. This results in the following hypotheses:

**H4a: Females are more sensitive to sweet food cravings (state) than males.**

**H4b: Females chose more sweet food products than males. .**

Now that all the hypotheses have been addressed, a conceptual research model can be created. This model is shown in Figure 1.



*Figure 1: Conceptual research model*

It is relevant to test the former hypotheses because results could provide science with a well-established link between high-pitched sounds and the choice of sweet food products. Besides this, more evidence will be gained about if there is a difference between how both males and females are affected by this. More evidence will be also gained about the role of the craving trait in the whole process. In practice the findings could provide companies that sell sweet food products with useful information for increasing their profits. The consumer's health however, should also be kept in mind when using the findings. This will all be discussed later. Before the hypotheses can be explored, the used methods have to be addressed. This will be done in the next chapter.

### 3. Methods

In this section the research design and the methods will be discussed. The first part addresses the pretest that was conducted. Thereafter, the design and the stimulus materials are described. A description of the measures, the procedure and the participants will follow. Finally, the analysis of the data is discussed.

#### 3.1. Pretest

A pretest was conducted to be sure that participants associated the selected music fragments with specific tastes and that the music was experienced as high-pitched or low-pitched. This test was conducted at the University of Twente in the area comprised of both the Educafé and the Starbucks Café. The researcher took place at a table there and random people were invited to take part. Participants listened using their headphones to five music fragments that all lasted thirty seconds. The pretest consisted of two different music conditions. In condition 1 participants listened to five high-pitched music fragments and in condition 2 participants listened to five low-pitched music fragments. Besides the pitch of the music, the used instruments could also affect the taste association. High-pitched piano music is associated with the sweet taste of sucrose and brass instruments are associated with sour and bitter tastes (Crisinel & Spence, 2010a). This information also influenced the selection of songs. Several songs were selected that contain piano or piano-like sounds and also a low-pitched brass music song was selected. The music fragments that were used for the pretest are displayed in Table 1.

*Table 1: Used music fragments*

	Condition 1: high-pitched music	Condition 2: Low-pitched music
1	Air balloon – Lilly Allen	Not the only one – Sam Smith
2	Rather be – Clean bandit ft. Jess Glyne	Rehab – Amy Winehouse
3	Fuck you – Lilly Allen	Lime tree arbour – Nick Cave & The bad seeds
4	Happy (high-pitched version) – Pharrel Williams	The Black Pearl – Low Brass Ensemble
5	Loving you – Minnie Riperton	Vic and Ray – Mark Knopfler



After each music fragment, participants had to fill out a short online questionnaire, which consisted of the same questions for each song. Each music fragment had to be rated on its degree of sweetness and its degree of bitterness. The results are displayed in Table 2. Because round shapes are associated with sweetness and angular shapes with bitterness (Spence & Ngo, 2012), participants also had to rate the song as more round or more angular. Besides this, people also tend to map sharper-sounding words like ‘takete’ to bitterness and more round-sounding words like ‘maluma’ to sweetness (Ngo, Misra & Spence, 2011 ). This association was also tested in the questionnaire. These results are displayed in Table 3. Participants also had to rate the pleasantness of the songs and the height of pitch.

*Table 2: Degree of sweetness and bitterness of songs in two conditions*

Condition 1: High-pitch		Sweetness <sup>a</sup>		Bitterness <sup>b</sup>		Condition 2: low-pitch		Sweetness <sup>a</sup>		Bitterness <sup>b</sup>	
Song		Mean	SD	Mean	SD	Song		Mean	SD	Mean	SD
1		7.40	2.17	2.13	1.06	1		5.82	2.22	3.24	2.14
2		6.20	1.94	3.13	2.07	2		5.41	1.81	3.76	1.72
3		6.33	1.59	3.73	2.25	3		5.06	2.02	4.24	2.22
4		5.13	3.16	4.53	2.23	4		4.53	1.88	4.18	1.94
5		9.07	1.10	2.00	1.81	5		4.88	1.50	5.00	2.15

*A: Ten-point Semantic Differential (Helemaal niet zoet/heel erg zoet)*

*B: Ten point Semantic Differential (Helemaal niet bitter/heel erg bitter)*

In condition 1 song 5 was definitely rated as the most sweet and the least bitter. This song was also rated as the song that is the most round and the most ‘maluma’, which is in line with the preceding results. Concerning condition 2 it was less obvious which song had to be chosen. When both the results in Table 2 as the results in Table 3 were taken into account, song 4 was the most in line with the expectations based on the literature. At first glance, there was a tendency to choose song 4 based on these results. Although the results of the pretest did not differ dramatically between these two songs. No song of condition 2 stood out in terms of its rated bitterness, sweetness and the word and shape associations. Only the ratings of the shapes and words that were most associated with the two songs were more in line with the literature for song 4. What was more, is that song 5 was

considered to be more appropriate in the Starbucks environment than song 4. This is why song 5 was chosen.

*Table 3: Associations of songs*

Condition 1: high-pitch		Rond/hoekig <sup>a</sup>		Maluma/ takete <sup>b</sup>		Condition 2: low pitch		Rond/hoekig <sup>a</sup>		Maluma/takete <sup>b</sup>	
song		Mean	SD	Mean	SD	Song		Mean	SD	Mean	SD
1		2.53	1.06	2.33	.90	1		2.06	1.09	2.12	.70
2		2.80	.94	2.87	1.25	2		2.65	1.17	2.71	1.16
3		3.13	.99	3.47	1.36	3		1.82	1.02	2.47	1.07
4		4.07	1.10	3.93	1.03	4		3.06	1.14	3.53	.87
5		1.40	.51	1.47	.64	5		1.76	.56	2.06	.75

*A: Five-point Semantic Differential (rond/hoekig)*

*B: Five-point Semantic Differential (maluma/takete)*

The pleasantness and the height of pitch of the discussed songs is displayed in Table 4. Concerning the pleasantness of the songs the chosen songs were rated differently, however the difference was not very large. The height of pitch of song 5 in condition 1 did meet the former expectations. In condition 2, song 5 was experienced as more low-pitched compared to song 4, which supports the choice for song 5. Both songs were not rated as high-pitched.

*Table 4: Pleasantness and height of pitch of chosen songs*

Song	Pleasantness <sup>a</sup>		Height of pitch <sup>b</sup>	
	Mean	SD	Mean	SD
5 (condition 1)	4.20	.78	4.07	.80
4 (condition 2)	3.41	1.12	2.53	1.38
5 (condition 2)	3.82	.81	1.59	.71

*A: Five-point Semantic Differential (Onaangenaam/aangenaam)*

*B: Five-point Semantic Differential (Laag/hoog)*

According to the discussed literature, we expected the high-pitched songs to be rated as sweet, not bitter and high-pitched. On the contrary, the low-pitched songs were expected to be rated as bitter,

not sweet and low-pitched. For the high-pitched songs stronger associations were expected with round shapes and with the word 'maluma'. For the low-pitched songs this was expected to be the other way around. In condition 1, song 5, 'loving you' by Minnie Riperton, was most in line with the literature. In condition 2, song 4 was most in line with the literature. However, in the end song 5, 'Vic and Ray' by Mark Knopfler, was chosen. This was because the results did not differ dramatically between the two songs and song 5 matched better to the atmosphere of Starbucks.

## 3.2 Main study

### 3.2.1 Design and stimulus materials

The used design of the main study is a 3 (Music: low-pitched music vs. high-pitched music vs. no music) x 2 (Food Craving trait: high vs. low) between-subjects design in which gender was taken into account as well. The stimulus materials consisted of two different music fragments which have been selected on the basis of the pretest. The high-pitched music fragment was the song 'loving you' by Minnie Riperton. The low-pitched music fragment was 'Vic and Ray' by Mark Knopfler. These fragments were repeated until the participant finished the questions that had to be answered while listening to the music fragment.

### 3.2.2 Measures

An online-survey was used as a research instrument. In total the survey consisted of 66 items in the music conditions and 63 items in the no-music condition. In the following paragraphs an overview of the constructs, variables and items is given.

First, the constructs food craving trait and sweet food cravings (state) are discussed. Other measurements are discussed later.

#### 3.2.2.1 Food craving trait

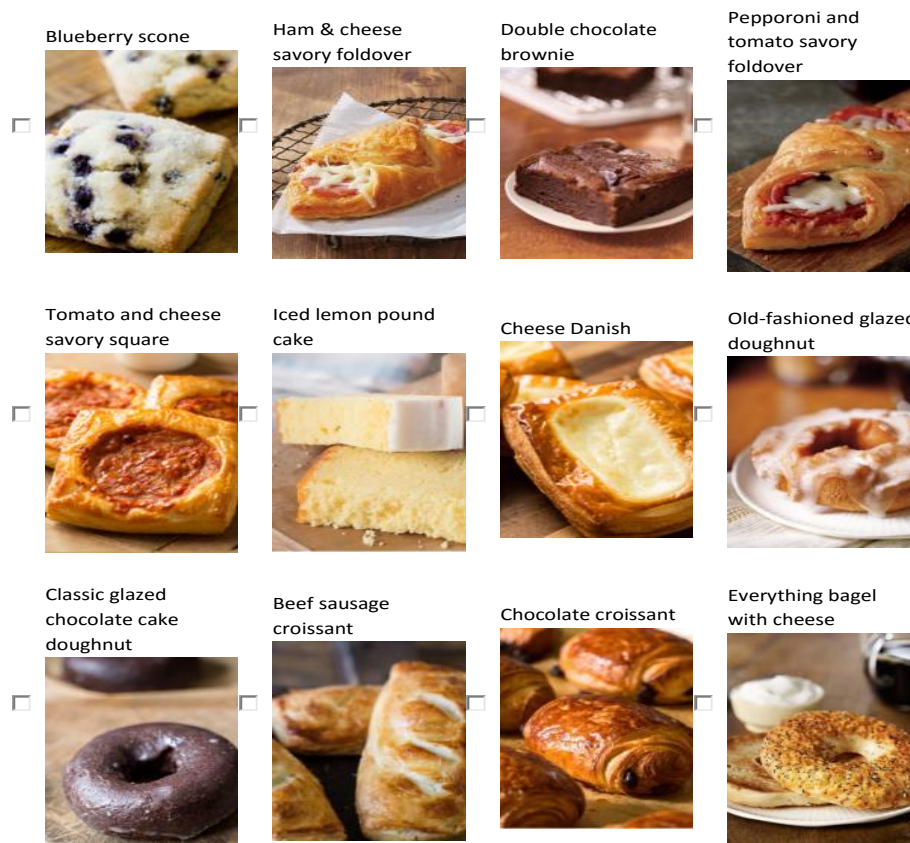
The Food Cravings Questionnaire-Trait-Reduced (Meule, Hermann & Kübler, 2014) that consists of 15 items was used to measure the trait food cravings. This is a shortened version of the Food Cravings Questionnaire-Trait of Cepeda-Benito et al. (2000). The items were measured on a 6-point scale ranging from 'never' to 'always'. An example of an item was "When I crave something, I know I won't be able to stop eating once I start". Because the questionnaire had already been validated thoroughly, the reliability was high. The Chronbach's Alpha value and the number of items are both shown in Table 5. The variable 'mean food craving trait' was calculated by creating composite scores of the 15 items. Composite scores were created by calculating the average scale score of participants.

### *3.2.2.2 Sweet food cravings (state)*

The Food Craving Questionnaire State (FCQ-S) was also used in the survey. This scale consists of 15 items that were measured on a 5-point Likert scale which ranged from 'strongly disagree' to 'strongly agree'. In eight of the fifteen items a type of food where the craving is directed to could be inserted. In these blanks 'one or more sweet foods' was filled in so the cravings toward sweet food items could be measured. An example of an item here was "Eating one or more sweet foods would make things seem just perfect" (Cepeda-Benito et al, 2000). Because of the former validation of the questionnaire, the reliability was high. The Chronbach's Alpha value and the number of items are again shown in Table 5. The variable 'mean sweet food cravings (state)' was calculated by creating composite scores of the 15 items. Composite scores were again created by calculating the average scale score of participants.

### *3.2.2.3 Food choice*

Food choice was measured by letting participants choose between 12 food items of which 6 savoury and 6 sweet. Participants had to choose the item(s) they preferred at the moment. They could choose as many food items as they wanted but they had to choose at least one food item. In Figure 2 these items are shown. For food choice two new variables were created by calculating the total scores for both the chosen sweet food items and for the chosen savoury food items. The new variables were called 'total sweet choice' and 'total savoury choice'.



*Figure 2: Items food choice*

#### *3.2.2.4 Word and shape associations food items*

All food items also had to be rated on two different scales in the survey. The items had to be rated on a word scale that ranged from ‘maluma’ to ‘takete’ and as well on a scale that ranged from a round shape to an angular shape. Both scales are shown in Figure 3. The scales were derived from the analog labelled line scales used in studies of Spence & Gallace (2011) and Ngo, Misra & Spence (2011). The scale was slightly changed. Numbers from 0 to 10 were added to facilitate later analysis and instead of a crayon marking the midpoint of the line, a bar was used. Four different composite scores were created out of the shape and word association items. The word association items for the sweet foods were calculated into the composite variable ‘mean word association sweet items’ and the word association items for the savoury foods were calculated into the composite variable ‘mean word association savoury items’. Composite scores were created by calculating the average scale score of participants.

The same was done for the shape association items for both the sweet and the savoury food items. Before these composite variables were created, the inter-item reliability was checked. The Cronbach’s Alpha scores for these variables are shown in Table 5.



Table 5: Reliability of constructs

Construct	Cronbach's alpha	Number of items	Items removed
Food craving (trait) <sup>a</sup>	.92	15	0
Sweet food cravings (State) <sup>b</sup>	.90	15	0
Average word association sweet items	.87	6	0
Average word associations savoury items	.81	6	0
Average shape association sweet items	.83	6	0
Average shape association savoury items	.82	6	0

a. Six-point Likert scale (1=Never/6=Always)

b. Five-point Likert scale (1=Strongly disagree/5= Strongly agree)

### 3.2.3 Procedure

Participants were recruited at the Starbucks café at the University of Twente by simply asking random visitors to take part. The store manager of Starbucks was first asked for permission before collecting participants at the Starbucks store. Participants were told that the study was about consumers and the Starbucks menu and that they were asked to fill out an online survey. This survey was constructed using Qualtrics Survey Software. The participant was provided with headphones because it could be that he or she would hear a music fragment during the study. Participants first had to read the introduction which also contained an informed consent. The participant could only continue filling out the survey if he or she agreed with this informed consent. If the participant agreed, he or she was automatically assigned to one of the three music conditions and the survey started. If the participant did not agree, he or she was sent to the end of the survey. However, all participants agreed.

At first, participants were asked when they last ate and how they would rate their degree of hunger. The questions of the Food Cravings Questionnaire-Trait-Reduced (Meule, Hermann & Kübler, 2014) followed. When these questions were completed, the participant was informed that he or she was going to listen to a sound fragment to test if the audio worked correctly. After this fragment, the participant was asked what animal he or she heard in the fragment. This question and the sound fragment were not included in the no-music condition. When finished, the participant was informed that on the next page background music of the Starbucks atmosphere would start. An instruction to not turn off the music followed. This was because it functioned as a part of the Starbucks atmosphere. Of course, this information and the music fragment were again not included in the no-music condition. On the following page, a Youtube video showing a still image of a Starbucks store was shown and one of the two music fragments was continually repeated. In the no-music condition only this still image was shown and participants were asked to be aware of the Starbucks environment where they found themselves in. On this page a collection of questions had to be answered (with or without one of the music fragments). These questions made up the largest part of the survey. At first, participants were shown a collection of food items of Starbucks where they had to choose from. After they made their choice, the same items had to be rated on the word association and the shape association scales. The last questions that had to be answered while listening to the music (if participants were in the music conditions), were the ones of the Food Craving Questionnaire-State (FCQ-S) (Cepeda-Benito et al, 2000). When completed, several demographic questions followed. Participants had to indicate their gender, their age and their occupation. Thereafter two questions about the music followed for participants in the music conditions. Last, participants had to indicate



how often they visited a Starbucks store. Last, participants could fill in their email address to have a chance to win a Starbucks giftset. The winning participant was contacted later.

On average it took a participant about 10 minutes to fill out the survey. If the participant did not understand a word when filling in the survey, the researcher gave an explanation of that word. However, the researcher did not give her opinion and did also not try to influence the participant. When finished, the participant was thanked for the participation.

### 3.2.4 Participants

#### 3.2.4.1 General description

The target group consisted of consumers. In fact we are all consumers. In general, all kinds of people can purchase a coffee at Starbucks. Because men and women are compared in this research, there were two approximately equal groups of participants needed. Therefore each music condition had to contain a more or less equal number of participants of each gender. As can be derived from Table 5, this was accomplished. The food craving trait of participants was measured by the Food Craving Questionnaire-Trait (FCQ-T). A new variable was made, craving trait category, to distinguish participants with a high food craving trait and participants with a low food craving trait. This was done by conducting a median split for the mean scores of participants on the FCQ-T. A new variable was made using the command 'recode into different variables' to distinguish these groups that were separated by the median.

*Table 5: Distribution of gender and age among the music conditions*

		Music condition 1: high-pitched music	Music condition 2: low-pitched music	Music condition 3: no music	Total
Gender	Male	38	37	36	111
	Female	33	33	35	101
	Total	71	70	71	212
Craving trait	High	31	35	40	106
	Low	40	35	31	106
	Total	71	70	71	212
Age	16≥25	52	50	51	153
	26≥35	14	11	14	39
	36≥45	4	9	2	15

46>	1	0	4	5
Total	71	70	71	212

*Table 6: frequency of Starbucks visit*

Gender	Frequency of Starbucks visit		
	Never	Sometimes	Often
Male	36	54	21
Female	8	70	23

Participants were 212 people who found themselves in the Starbucks area at the University of Twente. This could either be students, employees or visitors. Table 5 shows that participants were approximately equally distributed among the three music conditions. Also males and females were approximately equally distributed among these music conditions. Of the participants, 111 (52,4%) were male and 101 (47,6%) were female. The ages of the participants ranged from 16 to 59 years ( $M=24,95$ ,  $SD=7,45$ ). Concerning the age of the participants, Table 5 shows that more than half of the participants were between 16 and 26 years old (72,2%). Only a small amount of participants was older than 46 years. Because of the performed median split, the numbers of participants with a high or a low craving trait were equal. Their distribution among the music conditions was approximately equal. As shown by Table 6, females visited Starbucks stores more often than men.

*Table 7: Degree of hunger of participants*

Degree of hunger <sup>a</sup>		Gender			
		Male		Female	
Music condition	Food craving (trait)	M	SD	M	SD
2: Low-pitched music	Low	1.76	.77	1.43	.65
	High	1.50	.63	1.84	.89
3: No music	Low	2.00	.77	1.62	.87
	High	1.61	.78	1.64	.79

*a: 10-point semantic differential (0='Not hungry at all'/10='Very hungry')*

#### *3.2.4.2 Degree of hunger*

The participants were also asked to indicate their degree of hunger at the moment. This question was asked before the music manipulation. The means and standard deviations can be found in Table 7. It was important to know the participants' degree of hunger because it could influence the level of food cravings and the amount of chosen food items. Eventual significant effects found, could wrongly

be attributed to the music condition. Because of this, possible significant differences in degree of hunger between the three music conditions were explored. No significant differences were found here. However, other interesting effects of degree of hunger were found. A significant main effect of degree of hunger on the level of sweet food cravings experienced [ $F(2,185)=18,09$ ,  $p=.000$ , partial eta squared= .164] was found. The post-hoc test showed that participants that were not hungry differed significantly from participants that were hungry ( $p=.000$ ). Hungry participants had higher sweet food cravings ( $M=2.53$ ,  $SD=.65$ ) than participants that were not hungry ( $M=1.96$ ,  $SD=.61$ ). The not hungry participants also significantly differed from the somewhat hungry participants ( $p=.001$ ). Somewhat hungry participants had higher sweet food cravings ( $M=2.32$ ,  $SD=.63$ ) than not hungry participants ( $M=1.96$ ,  $SD=.61$ ). However, the higher sweet food cravings that were found for the more hungry participants turned out not to affect the amount of sweet food items chosen. What was actually found is a significant main effect of participants' degree of hunger on the amount of savoury food items chosen [ $F(2,185)=5,09$ ,  $p=.007$ , partial eta squared = .052]. The post hoc test using Bonferroni test showed that the significant difference in total savoury food choice was found between participants that were not hungry and participants that were hungry ( $p=.020$ ). Hungry participants chose significantly more savoury food items ( $M=1.43$ ,  $SD=1.25$ ) than participants that were not hungry ( $M=.82$ ,  $SD=1.09$ ). This is an interesting finding that will return in the discussion part.

### 3.2.5 Analyses

The data were analysed using the statistical program SPSS. It was explored if significant differences existed between several groups in terms of the dependent variables. This was done by first conducting a Multivariate analysis of variance to check which independent variables significantly differed in terms of the dependent variables. These variables were further investigated by conducting several factorial between groups analyses of variance (ANOVA's). The results of the analyses are discussed in the results chapter.

## 4. Results

In this chapter the results of the conducted study will be discussed. First, the overall results are covered and thereafter differences between various groups will be discussed. These differences are discussed for each dependent variable.

### 4.1 Overall results

All participants in the two music conditions indicated that they have heard the music fragment well. The music fragments were rated on a scale that ranged from 0 (very annoying) to 10 (very pleasant). The high-pitched music fragment ( $M=5,42$ ,  $SD=2,38$ ) and the low-pitched music fragment ( $M=5,57$ ,  $SD=2,11$ ) both had an average rating. The participants in the music conditions also showed that they heard the sound fragment well because all participants gave the right answer to the corresponding question. What is more, all participants in the music conditions confirmed that they could hear the music fragment well in the survey. Before the data will be analysed thoroughly, the overall results are depicted in Table 9. Table 9 shows the means and standard deviations in all music conditions and among the two craving trait levels. This table shows several differences on the dependent variables between music conditions and the food craving groups. However, to inspect these differences more thoroughly, there is need for further analysis.

To check the assumptions, a multivariate analysis of variance (MANOVA) was conducted first ( $N=212$ ). Three-way factorial between groups analyses of variance (ANOVA's) were used for the follow-up analysis ( $N=212$ ). There were three dependent variables, that is total sweet choice, total savoury choice and level of sweet food cravings (state). The moderating variables were gender and food craving trait (high food craving trait vs. low food craving trait). The music condition was the independent variable. There were three music conditions in total: (1) participants listened to high-pitched music, (2) participants listened to low-pitched music and (3) participants did not listen to any music.

Table 9: Overall results

		Total Sweet choice		Total savoury choice		Food craving (state, directed to sweet food items) <sup>a</sup>	
Music condition	Food craving (trait)	M	SD	M	SD	M	SD
1: high-pitched music	High	2.19	1.70	1.06	1.41	2.64	.59
	Low	1.38	.98	1.33	1.53	1.99	.69

	Total	1.73	1.39	1.21	1.47	2.27	.72
2: Low pitched music	High	1.60	.88	.80	.93	2.37	.58
	Low	1.06	.97	1.03	1.12	1.93	.59
	Total	1.33	.96	.91	1.03	2.15	.63
3: No music	High	1.93	1.35	.98	1.19	2.30	.63
	Low	1.29	1.30	.97	1.05	1.88	.57
	Total	1.65	1.35	.97	1.12	2.11	.64

*A: 5-point Likert scale (Strongly disagree/strongly agree)*

## 4.2 Differences between groups

### 4.2.1 Multivariate analysis of variance (MANOVA)

To get an overall view of the present main effects and interaction effects in the study, a multivariate analysis of variance (MANOVA) was performed (N=212). The used dependent variables were level of sweet food cravings and number of sweet food items chosen. Independent variables were music condition, food craving trait and gender. A significant main effect of music condition on the combined dependent variables was found [ $F(4,398)=2.49$ ,  $p=.043$ , partial eta squared=.042]. The analysis also showed a significant main effect of food craving trait on the combined dependent variables [ $F(2,199)=19.77$ ,  $p=.00$ , partial eta squared=.166]. Although there was no main effect of gender on the combined dependent variables, a significant interaction effect between gender, food craving trait and music condition on the combined dependent variables was found [ $F(4,398)=2.53$ ,  $p=.040$ , partial eta squared=.025]. For this reason gender was still taken into account in the follow-up analyses. Factorial between groups analyses of variance (ANOVA's) were used to explore the effects of music condition, gender and food craving trait on the dependent variables. These variables will be discussed in the following paragraphs.

### 4.2.2 Level of sweet food cravings (state)

A three-way factorial between groups analysis of variance (ANOVA) was used to investigate effects of music condition, craving trait and gender on the level of sweet food cravings (N=212). A significant main effect of music condition on the level of sweet food cravings [ $F(2,200)=3.24$ ,  $p=.041$ , partial eta squared=.031] was found. However, the Post-hoc test using the Bonferroni test showed that none of the music conditions differed significantly from the other for the level of sweet food cravings. There was done a last significance check to explore the found main effect of music condition on level of sweet food cravings experienced. This was done by conducting a one-way between groups analysis of variance. This last check showed that there was no significant main effect of music condition on the level of sweet food cravings [ $F(2,209)=1.10$ ,  $p=.335$ ]. Although there are differences in the level of

sweet food cravings between the music conditions shown in Table 9, these differences are minimal. Figure 2 makes this even more clear. The fact that no significant main effect of music condition on the level of sweet food cravings was found, could be due to the procedure of the study. A further elaboration will follow in the discussion. Besides the music condition, the food craving trait was also expected to be of influence. However, first there was checked if males and females differed in the possession of this trait. This is because females were assumed to have a higher food craving trait than males. However, no difference between males [ $F(2,108)=1,67$ ,  $p=.194$ ] and females [ $F(2,98)=1,26$ ,  $p=.289$ ] for this trait was found. A positive effect of food craving trait on the level of sweet food cravings was assumed. Tested was if the possession of a high or low food craving trait would affect the level of sweet food cravings. To do this, participants were divided into two categories for the analysis: participants with a high food craving trait and participants with a low food craving trait. A significant main effect of this food craving trait was indeed found on the level of sweet food cravings [ $F(1,200)=33,06$ ,  $p=.000$ , partial eta squared=.142]. Participants with a high food craving trait reported a higher level of sweet food cravings ( $M=2,42$ ,  $SD=.61$ ) than participants with a low food craving trait ( $M=1,94$ ,  $SD=.62$ ).

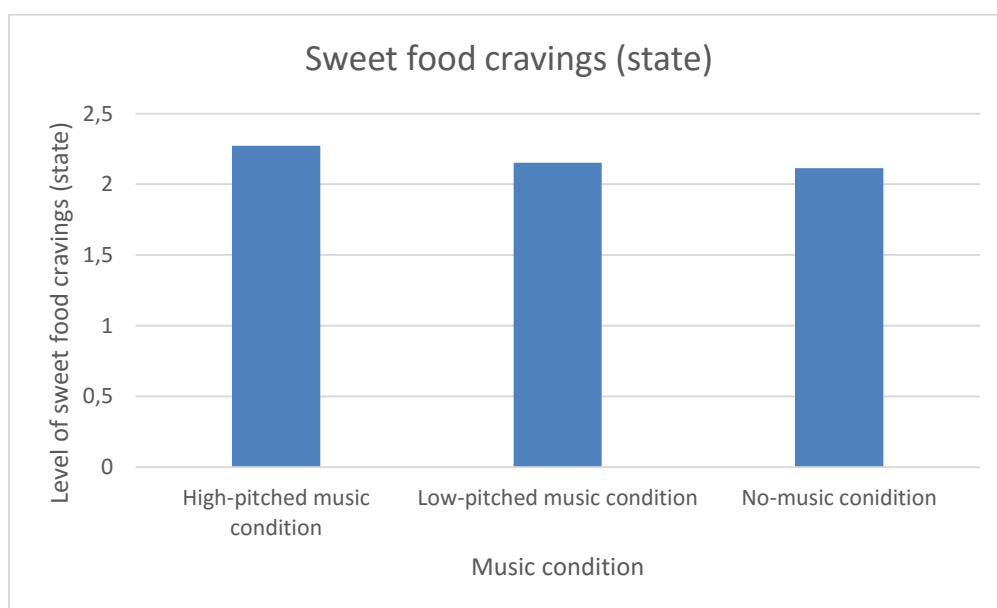


Figure 2: Level of sweet food cravings (state)

#### 4.2.3 Choice of sweet food items

A three-way factorial between groups analysis of variance (ANOVA) was used to investigate effects of music condition, food craving trait and gender on the choice of sweet food items ( $N=212$ ). A main effect of music condition on the choice of sweet food items was expected. The results of the ANOVA showed a marginally significant effect of music condition in terms of the choice of sweet food items [ $F(2,200)= 2,54$ ,  $p=.082$ ; partial eta squared= .025] The Post-hoc test using the Bonferroni test

however showed that none of the music conditions significantly differed from the other in the number of sweet food items chosen. A one-way between groups analysis of variance confirmed that there was no significant main effect of music condition on the number of sweet items chosen [ $F(2,209)=2,04, p=.133$ ]. However, Table 9 shows existing differences in the number of sweet food items chosen between the music conditions. These differences are visualized in Figure 3. Figure 3 suggests that there is a main effect of music condition on the number of sweet food items chosen, although it is not significant. This could as well be due to the procedure of the study. This will be discussed more in depth in the discussion part. Assumed was as well that a high food craving trait would have a positive effect on the choice of sweet food products. A significant main effect of the food craving trait on the choice of sweet food items [ $F(1,200)=16,08, p=.000$ , partial eta squared = .074] was indeed found. Participants with a high food craving trait chose more sweet food products ( $M=1,90, SD=1,34$ ) than participants with a low food craving trait ( $M=1,25, SD=1,08$ ). Despite of the scarce main effects found so far, an interaction effect was found. The found interaction effect was between music condition, gender and food craving trait in terms of total sweet choice [ $F(2,200)=4.03, p=.019$ , partial eta squared = .039]. As shown in Table 11 (see appendix), the highest mean value was found in the high-pitched music condition ( $M=2,64, SD=1,60$ ). This indicates that males with a high food craving trait who were exposed to high-pitched music, chose the most sweet food items. The interaction is illustrated in Figure 4 .

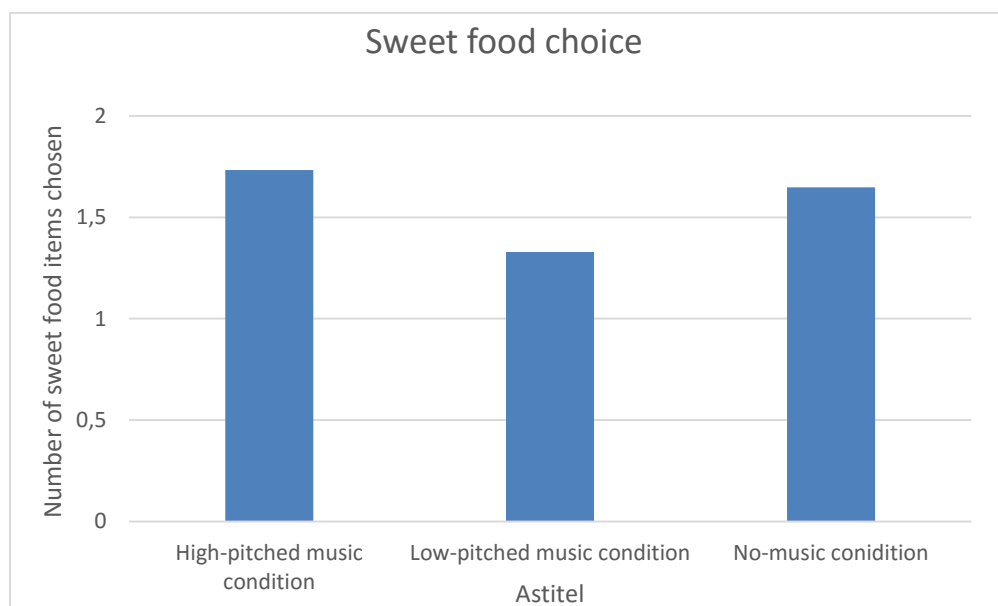


Figure 3: Sweet food cravings among music conditions

#### 4.2.4 Choice of savoury food items

A three-way factorial between groups analysis of variance (ANOVA) was conducted to explore the effects of music condition, gender and food craving trait on the choice of savoury items . No

significant main effects of the independent variables on the number of savoury items chosen were found. An interesting main effect of degree of hunger on this variable was however found earlier (see method section). No interaction effects for the number of savoury food items chosen were found.

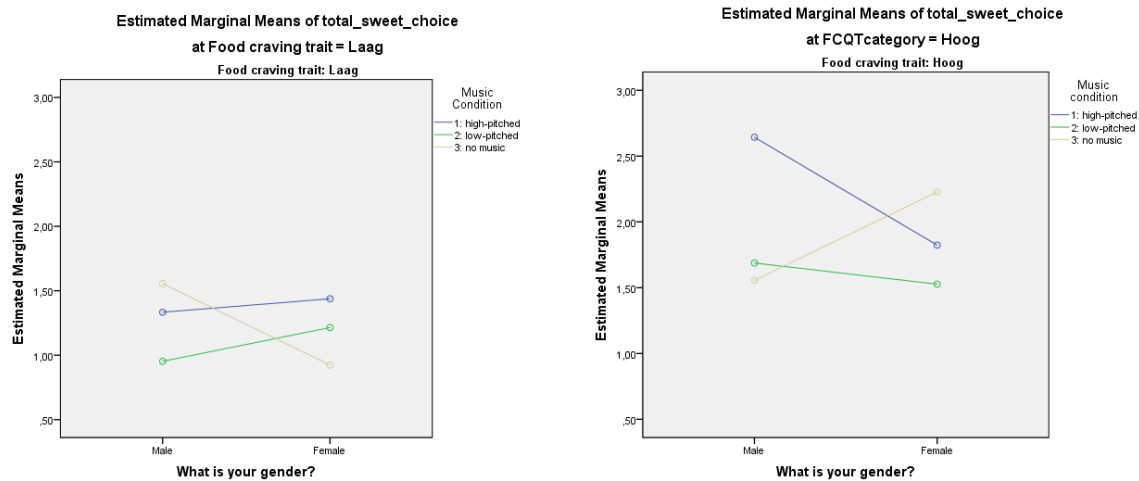


Figure 4: Interaction effects for food craving trait categories

#### 4.2.5 Food items and word and shape associations

Expectations from literature were checked for the shapes and words that were most associated with food items. Expected was that sweet food items would be associated more with round-sounding words like 'maluma' (Ngo et al., 2011) and round shapes (Spence & Ngo, 2012) than the savoury food items. Savoury items were expected to be associated more with sharper sounding words like 'takete' (Ngo et al., 2011) and more angular shapes (Spence & Ngo, 2012). Table 10 shows the means and standard deviations of the shape and word associations for both the sweet and savoury food items.

Table 10: Word and shape associations food items

	High-pitched music condition		Low-pitched music condition		No-music condition	
	M	SD	M	SD	SD	M
Word association sweet food items <sup>a</sup>	4.31	2.06	4.47	1.85	4.31	1.74
Word association savoury food items <sup>a</sup>	5.37	1.90	5.33	1.67	5.66	1.39



Shape association sweet food items <sup>b</sup>	3.62	1.78	4.14	1.68	3.77	1.54
Shape association savoury food items <sup>b</sup>	6.20	1.46	5.70	1.68	6.14	1.37

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*a. Ten-point Semantic differential (0=Maluma/10=Takele)*

*b. Ten-point Semantic differential (0=Round shape/10= Angular shape)*

Table 10 does not show much difference in the mean ratings of the shape and word associations among the three music conditions. This effect of music condition, but also the effect of food craving trait and gender on the word and shape associations of the food items was further explored. Results are discussed in the next section.

#### 4.2.6 Word and shape associations

The effect of music condition, food craving trait and gender on the word and shape associations of the food items was explored by conducting a three-way factorial between groups analysis of variance (ANOVA) (N=212). A marginally significant main effect of music condition on the shape association of sweet food items [ $F(2,200)=2.38$ ,  $p=.095$ , partial eta squared= .023] was found. However, when checking with a one-way between groups analysis of variance, no marginally significant effect was found. The numbers in Table 10 suggests a main effect of music condition on the shape association of sweet food items, however it was not significant. Also no significant main effects for food craving trait or gender on the shape association of sweet food items were found. A marginally significant main effect of music condition on the shape association for savoury food items [ $F(2,200)=2.98$ ,  $p=.053$ , partial eta squared=.029] was however found. However, when a one-way between groups analysis of variance (ANOVA) was conducted, no marginally significant effect of music condition was found here. Also no significant main effect of gender and food craving trait on the shape association of savoury food items was found. No significant main effects of music condition, gender and food craving trait on the word associations of savoury food items and word associations of sweet food items were found. However, a significant interaction effect between gender, craving trait and music condition in terms of shape association of sweet food items [ $F(2,200)=3.55$ ,  $p=.031$ , partial eta squared= .034] was found. The lowest mean value was found in the no-music condition ( $M=3.12$ ,  $SD=1.02$ ). This indicates that females with a low craving trait who were not exposed to any music, associated sweet food items the most with round shapes. Males with a high food craving trait that were exposed to low-pitched music associated sweet food items the least with round shapes ( $M=5.01$ ,  $SD=1.87$ ). This information is displayed in Table 12 (see appendix). The interaction effect is illustrated in Figure 5. For the shape association of savoury food items there was also found an

interaction effect between the former three variables [ $F(2,200)=4.01$ ,  $p=.020$ , partial eta squared=.039]. This indicated that females with a low craving trait that were not exposed to any music, associated savoury food items the least with round shapes and thus the most with angular shapes ( $M=6,60$ ,  $SD=.95$ ). This information is displayed in Table 13 (see appendix) and the interaction is illustrated in Figure 6.

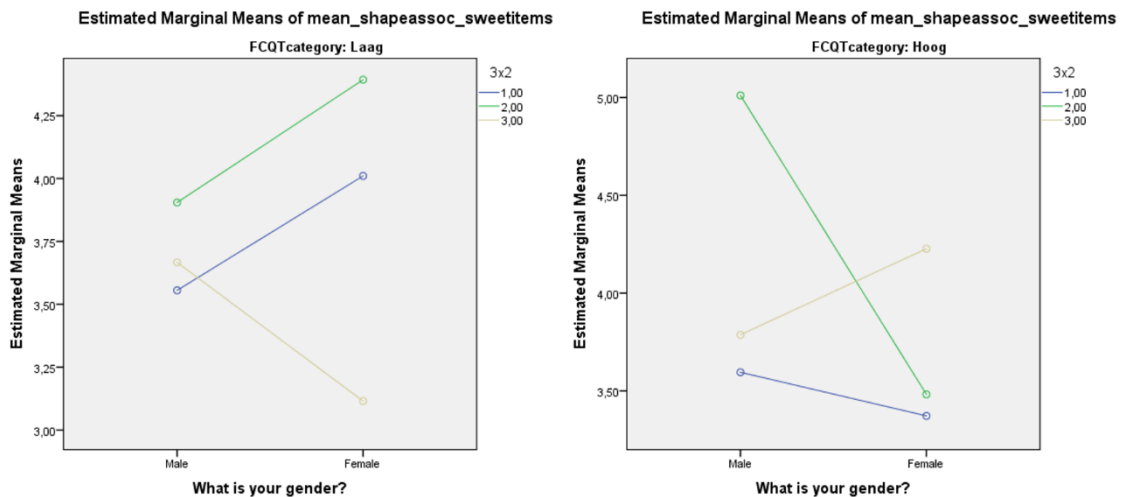


Figure 5: Interaction plots for shape association sweet food items

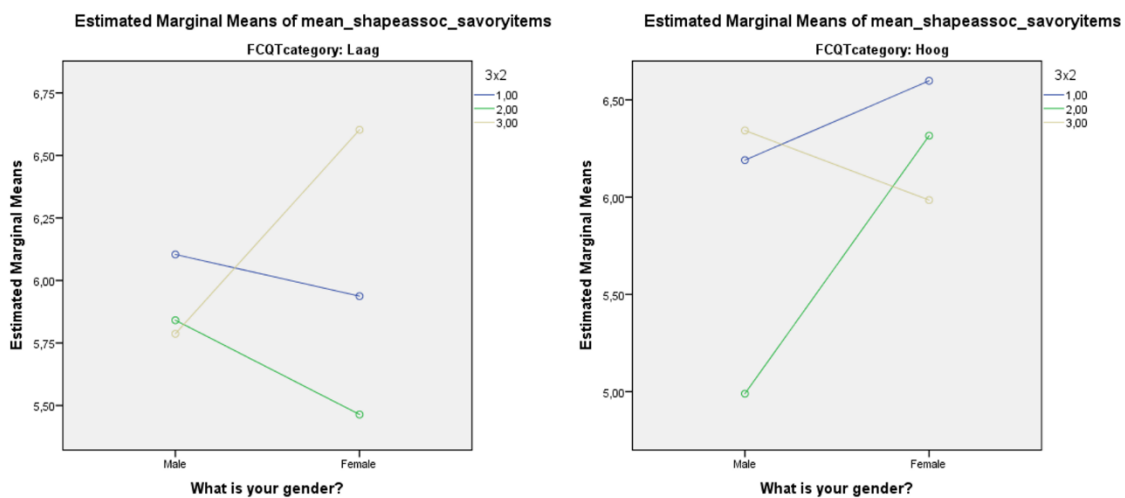


Figure 6: Interaction plots for shape association savoury food items

## 5. Conclusion and discussion

The objective of this study was to explore the effect of musical pitch on food cravings and food choice, especially towards sweet food items.

The influencing abilities of environmental elements like music clearly emerged from the literature. Especially music turned out to be an important influencer in a marketing context. Various musical variables turned out to affect consumers in many ways. The length of stay and the amount of money spent could for example be affected by the music's tempo (Milliman, 1982, 1986). Besides this, the pitch of the music could also be of influence. The music's relative pitch could namely be associated with the basic tastes (Crisinel & Spence, 2009, 2010a, 2010b). Especially the association between high-pitch and sweet tastes was interesting in the chosen Starbucks context because of the various sweet food items they offer. People also tend to crave foods like sweets, carbohydrates and high-fat foods (a.o. Christensen & Pettijohn, 2001; Gendall et al., 1997; Pelchat, 1997). Based on the literature, high-pitched music was expected to trigger sweet food cravings and result in the choice of sweet food products. Assumed was that participants, when exposed to high-pitched music, would have higher sweet food cravings and choose more sweet food items than participants that are exposed to low-pitched music or no music. The findings will be discussed to see if the former assumptions hold. First, a short overview of the main findings is given.

Musical pitch did not seem to positively affect the level of sweet food cravings and the number of sweet food items chosen in this study. These effects were expected to be more pronounced for females, however, no gender differences were found. It was actually found that participants with a high food craving trait had a higher level of sweet food cravings and chose more sweet food products. This was however not dependent of the music condition were participants were in. Last, females and males did not differ significantly on the food craving trait. These main findings and the hypotheses will now be discussed more thoroughly.

The first hypothesis assumed a difference in level of sweet food cravings and in the number of chosen sweet food items between the three music conditions. According to the literature, a food craving is mostly preceded by thinking of the particular food item (Hill, 2007) and people associate high-pitched sounds with sweet taste (Crisinel & Spence, 2010a). It was expected that the high-pitched music would work as some kind of prime for sweet food cravings which in turn could trigger the choice of sweet food items. However, no significant difference in sweet food cravings and number of sweet food items chosen was found when the music conditions were compared. Maybe the assumed process did not really work in the study. However, this could also be due to other influencing factors.

An important factor could be the procedure of the study. Participants first had to fill out the questions that measured the food craving trait before they got to hear the music and had to answer the food choice and sweet food cravings questions. These food craving trait measures might have primed the participant's awareness that the study was about food and food cravings. This could have negatively affected the priming process, which is normally unconscious. Participants' degree of hunger might also have played a role.

A great deal of participants completed the survey around lunchtime and half of participants indicated that they ate less than an hour ago. This might explain why more than half of the participants indicated that they were not hungry when filling out the survey.

The degree of hunger turned out to affect the sweet food cravings experienced. Participants that were not hungry had significantly less food cravings towards sweet items than somewhat hungry and hungry participants. This is in line with the finding that hunger is not a precondition for food cravings to occur, but can make the occurrence of these cravings more likely (Pelchat et al., 2004).

The degree of hunger actually turned out not to influence the amount of sweet food items chosen.

So a higher degree of hunger resulted in higher sweet food cravings but this did not result in the choice of more sweet food items. This is again in line with research of Hill & Heaton-Brown (2004) who stated that food cravings do not always have to result in eating despite the high likelihood.

What was found actually, is that a higher degree of hunger resulted in the choice of more savoury food items. It could be that participants experienced savoury food cravings. It might be that the food craving questions reminded participants of their savoury food cravings. This could have resulted in the choice of these food items.

For the second hypothesis was assumed that a high food craving trait resulted in a higher level of sweet food cravings and more sweet food items chosen when participants were exposed to high-pitched music. This second hypothesis could only be partly confirmed. It was indeed the case that participants with a high craving trait had significantly higher sweet food cravings and chose significantly more sweet food products than participants with a low craving trait. This corresponds with the initial reason why Cepeda-Benito et al. (2000) eventually developed the Food Craving Questionnaire-Trait. The questions that measured this food craving trait also contained questions that measured the responsiveness to some food cues. Food cravings namely can be triggered by exposure to stimuli associated with the desired substance like the sight or smell of desirable foods (Weingarten & Elston, 1990). Because of this, it is reasonable to expect participants with a high craving trait to be more sensitive for cues that are associated with food (like the high-pitched music) than participants with a low craving trait. This assumption is supported by several studies that show high food cravers to be more reactive to food-related cues than low food cravers (Rodríguez,

Fernández, Cepeda-Benito & Vila, 2005 ; Smeets, Roefs & Jansen, 2009). However, this was not found in the current study. Overall participants with a high food craving trait had significantly higher sweet food cravings and also chose more sweet food products, but this did not depend on the music condition where they were in. Regardless whether participants with a high food craving trait were exposed to high-pitched, low-pitched, or no music at all, they had higher sweet food cravings and chose more sweet food items than participants with a low food craving trait. This is not entirely in contradiction with previous literature. This is because in the relevant studies of Weingarten & Elston (1990) and Cepeda-Benito (2000) none of the mentioned food cues that could trigger a food craving concerned auditory cues. Cues like seeing someone eating and the sight and smell of the food were mentioned in the studies. It could be that auditory cues are less effective for triggering food cravings than the mentioned cues like the smell of the food. What might also have played a role here, is the music that was continually playing during a large part of the survey. It could be that participants filled in the related questions quicker than normal because they eagerly wanted to leave the page because of the music. The music might have unconsciously rushed them. This might influenced the way participants filled out the questions.

Hypothesis three assumed that the effects of music on sweet food cravings and food choice are more pronounced for females than for males. Compared to the other music conditions, in the high-pitched music condition participants' sweet food cravings and amount of sweet food items chosen were expected to be the highest. In this music condition females were expected to have higher sweet food cravings and therefore choose more sweet food items than males. This hypothesis was not confirmed in the study. Females did not differ significantly from men in the level of sweet food cravings and the number of sweet items chosen when they were exposed to high-pitched music. This is in contradiction with the finding that women show a higher level of food cravings than men (Weingarten & Elston, 1991). Women's sensitive hearing on high frequencies (McFadden, 1998) and their preference for sweet and high-fat foods (Drewnowski, 1995) did not seem to result in higher sweet food cravings and more chosen sweet food items when compared to men. In fact, the interaction effect between gender, craving trait and music condition showed that men with a high food craving trait who were exposed to high-pitched music, chose the most sweet food items.

However, the music that was continually playing could also have played a role here. Although participants not really rated the music as being very annoying, it could unconsciously have rushed participants. This could have led participants to fill out the related questions in a hurry, while in the participants in the no-music condition could undisturbedly fill out the survey without being rushed by the music. This might have resulted in less sincere results for the participants in the music conditions.

The fourth hypothesis assumed females to have a higher food craving trait and to be therefore more sensitive to sweet food cravings than males. This was expected to result in the choice of more sweet food products than males. This hypothesis could be rejected as a whole. First, females did not have a significantly higher food craving trait than men, there was no significant difference found between the two. Females also did not have higher reported sweet food cravings than men and they also did not choose significantly more sweet food items than men did. This is in contradiction with findings of Cepeda-Benito et al. (2003) who found women to score significantly higher on the Food Craving Questionnaire-Trait than men. The participants in this study were all Spanish students and consisted for 75% of women. It could be that nationality plays a role here and that Spanish women have a higher food craving trait than Dutch women. What also could play a role, is the male-female ratio in their study. There are far more females that took part than males. It might be the case that the men that took part, scored mostly below the average. It could be that the males would have had a score that is more comparable with the female score when gender would have been more evenly distributed, like in the current study. No other studies that explored this gender difference in terms of food craving trait have been found to compare the results with. For this reason additional research has to be done to explore if there is a difference between males and females in the possession of the food craving trait. More suggestions for future research will be presented in the next section. However, study limitations will be discussed first.

## 5.1 Limitations

Already many factors that may have threatened the internal validity of the study were mentioned. A main limitation which was mentioned, is the procedure or the sequence of the survey. Before participants were exposed to the music they had to fill out questions that measured the food craving trait. These questions might have primed participants and made them aware that the study was about food and food cravings. This might explain why the manipulation did not work in the current study. Other factors that might have threatened the general validity of the study could be mentioned as well. A factor that might affected the internal validity, is the participant's personal taste preference. The preference for the sweet taste of food differs between people. This preference could also have played a role in the choice of food items. Considering the external validity, it is important to keep in mind that the results could not be generalized to all consumers. The age of most participants ranged from 16 years to 25 years. They made up 72% of the whole research sample. For this reason results cannot be generalized to consumers of all ages, like the older ones. Another limitation here is the fact that participants were only collected in Enschede, in the eastern part of the Netherlands. For this reason results cannot be generalized to other regions of the country. Another point is the educational level of participants. By far the most participants were studying at a

University. This educational level is not representative for the whole Dutch population and results thus can not be generalized to the whole population.

## **6. Practical recommendations and Implications for future research.**

The prevalence of overweight and obesity is increasing around the world (Roberto, Swinburn, Hawkes, Huang, Costa, Ash, Zwicker, Cowley & Brownell, 2015) in the obesogenic environment where we live in. Food cravings are part of this problem because they can trigger the intake of high-palatable foods (Ahmed et al., 2013) even when a person is not hungry (Pelchat et al., 2004). Especially for health reasons it is important to know what triggers food cravings. Musical pitch however is not one of these triggers according to the results of this study. Although the music was not of influence in this study, the customer's degree of hunger was. There was a positive effect of the degree of hunger on the total savoury food items chosen. This argues for a permanent offer of savory snacks in coffee stores besides sweet food products. When hungry customers enter the store, they can satisfy their cravings, whether they are savoury or sweet. Thus stores always have to make sure that they have a varied assortment of snacks as well for the savoury as for the sweet food cravers. Besides the assortment, the target group for the food items should also be varied. It is important that sweet items are not mainly marketed to women because they are not the only ones with sweet tooth. Results actually showed that men with a high food craving trait who were exposed to high-pitched music, chose the most sweet food items.

More research should be done about this topic in the future. Future research should explore what environmental factors could trigger food cravings. Other musical variables should also be studied. The effect of these musical variables should be explored in different ways without continually repeating the same piece of music. This is to avoid participants from being annoyed or hushed by the music but also to contribute to the truthfulness of the study. In real stores the same music fragment would not be played all over again. The research instrument chosen could also contribute to the experienced truthfulness of the study for the participant. This also applies to studies of other environmental triggers for food cravings that should be done. A simulation study would be useful in exploring the effect of various environmental variables here. When done well, it could contribute to a truthful store experience of the participant. This would make results more generalizable to a real life context. In future research virtual reality glasses could for example be used for an optimal experience of the studied environment.

Findings could be useful in practice. Environmental factors that trigger food cravings might be relevant for health education purposes and for restaurants and coffee stores like Starbucks. Both parties can use the findings to make policy or environmental adjustments which can contribute to a healthier society. Findings could also be used for commercial reasons by restaurants and cafés to increase profits. However, the consumer's health should also be kept in mind. Consumers can be made more aware of the factors that trigger food cravings and food choice. This information again can be used in their decision-making. It would be ideal if restaurants and the health education sector would work together on a healthier society and use the findings with this aim in mind.

In general, there can be concluded that musical pitch was not found to be a trigger of sweet food cravings and the choice of sweet food products. However, more research should be conducted in this area because the procedure of the study might have affected the results. Before conducting these studies, the best way to incorporate the musical manipulation should be pretested thoroughly. In future studies participants' taste preferences should be included as well. Hopefully more knowledge about how food cravings and food choice can be triggered will be gained by further exploring the subject. This knowledge again can be used for commercial purposes but also to contribute to a healthier society.



## 7. Literature list

Ahmed, S. H., Guillem, K., & Vandaele, Y. (2013). Sugar addiction: pushing the drug-sugar analogy to the limit. *Current Opinion in Clinical Nutrition & Metabolic Care*, 16(4), 434-439.

Areni, C. S., & Kim, D. (1993). The influence of background music on shopping behavior: classical versus top-forty music in a wine store. *Advances in consumer research*, 20(1), 336-340.

Baker, T. B., Morse, E., & Sherman, J. E. (1986). The motivation to use drugs: a psychobiological analysis of urges. In *Nebraska symposium on motivation*. 34, 1986, 257-323.

Berridge, K. C. (1996). Food reward: brain substrates of wanting and liking. *Neuroscience & Biobehavioral Reviews*, 20(1), 1-25.

Berridge, K. C. (2004). Motivation concepts in behavioral neuroscience. *Physiology and Behavior*, 81(2), 179–209

Birch, L. L. (1999). Development of food preferences. *Annual review of nutrition*, 19(1), 41-62.

Bitner, M. J. (1992). Servicescapes: the impact of physical surroundings on customers and employees. *The Journal of Marketing*, 56 (2), 57-71.

Blokstra A., Vissink., Venmans L.MA.J., Holleman P., Van der Schouw Y.T., Smit HA (2011). Nederland door de maat genomen, 2009-2010. Monitoring van risicofactoren in de algemene bevolking. Retrieved at January 14th, via: <http://www.rivm.nl/bibliotheek/rapporten/260152001.pdf>

Bruner, G. C. (1990). Music, mood, and marketing. *the Journal of marketing*, 54 (4), 94-104.

Cepeda-Benito, A., Gleaves, D. H., Williams, T. L., & Erath, S. A. (2000). The development and validation of the state and trait food-cravings questionnaires. *Behavior Therapy*, 31(1), 151-173.

Cepeda-Benito, A., Fernandez, M. C., & Moreno, S. (2003). Relationship of gender and eating disorder symptoms to reported cravings for food: construct validation of state and trait craving questionnaires in Spanish. *Appetite*, 40(1), 47-54.

Christensen, L., & Pettijohn, L. (2001). Mood and carbohydrate cravings. *Appetite*, 36(2), 137-145.

Chung, D. Y., Mason, K., Gannon, R. P., & Willson, G. N. (1983). The ear effect as a function of age and hearing loss. *The Journal of the Acoustical Society of America*, 73(4), 1277-1282.

Corso, J. F. (1959). Age and sex differences in pure-tone thresholds. *Journal of the Acoustical Society of America*, 31 (4), 498-507.

Crisinel, A. S., & Spence, C. (2009). Implicit association between basic tastes and pitch. *Neuroscience letters*, 464(1), 39-42.

Crisinel, A.-S., & Spence, C. (2010 a). As bitter as a trombone: Synesthetic correspondences in non-synesthetes between tastes and flavors and musical instruments and notes. *Attention, Perception, and Psychophysics*, 72 (7), 1994–2002.

Crisinel, A. S., & Spence, C. (2010 b). A sweet sound? Food names reveal implicit associations between taste and pitch. *Perception*, 39(3), 417-425.

Cruickshanks, K. J., Wiley, T. L., Tweed, T. S., Klein, B. E., Klein, R., Mares-Perlman, J. A., & Nondahl, D. M. (1998). Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin the epidemiology of hearing loss study. *American Journal of Epidemiology*, 148(9), 879-886.

Davis, C., Patte, K., Levitan, R., Reid, C., Tweed, S., & Curtis, C. (2007). From motivation to behaviour: a model of reward sensitivity, overeating, and food preferences in the risk profile for obesity. *Appetite*, 48(1), 12-19.

Dreisbach, L. E., Kramer, S. J., Cobos, S., & Cowart, K. (2007). Racial and gender effects on pure-tone thresholds and distortion-product otoacoustic emissions (DPOAEs) in normal-hearing young adults. *International journal of audiology*, 46(8), 419-426.

Drewnowski, A. (1995). Metabolic determinants of binge eating. *Addictive behaviors*, 20(6), 733-745.

Driver, J., & Spence, C. (2000). Multisensory perception: beyond modularity and convergence. *Current Biology*, 10(20), R731-R735.

Gast GC, Frenken FJ, van Leest LA, Wendel-Vos GC, Bemelmans WJ. (2007) Intra-national variation in trends in overweight and leisure time physical activities in The Netherlands since 1980: stratification according to sex, age and urbanisation degree. *International journal of obesity*, 31(5),15–20.

Gendall, K. A., Joyce, P. R., & Sullivan, P. F. (1997). Impact of definition on prevalence of food cravings in a random sample of young women. *Appetite*,28(1), 63-72.

Hill, A. J. (2007). The psychology of food craving. *Proceedings of the Nutrition Society*, 66(02), 277-285.

- Hill, A. J., & Heaton-Brown, L. (1994). The experience of food craving: A prospective investigation in healthy women. *Journal of Psychosomatic Research*, 38(8), 801-814.
- Hoch, S. J. (2002). Product experience is seductive. *Journal of Consumer Research*, 29(3), 448-454.
- Holt-Hansen, K. (1968). Taste and pitch. *Perceptual and Motor Skills*, 27, 59–68
- Jansen, A. (1998). A learning model of binge eating: cue reactivity and cue exposure. *Behaviour research and therapy*, 36(3), 257-272.
- Keskitalo et al. (2007). Sweet taste preferences are partly genetically determined: identification of a trait locus on chromosome 16. *The American journal of clinical nutrition*, 86(1), 55-63.
- Knöferle, K., & Spence, C. (2012). Crossmodal correspondences between sounds and tastes. *Psychonomic bulletin & review*, 19, 992-1006. .
- Kubacki, K., & Croft, R. (2004). Mass marketing, music, and morality. *Journal of Marketing Management*, 20 (5-6), 577-590.
- Lafay, L., Thomas, F., Mennen, L., Charles, M. A., Eschwege, E., & Borys, J. M. (2001). Gender differences in the relation between food cravings and mood in an adult community: Results from the Fleurbaix Laventie Ville Sante study. *International Journal of Eating Disorders*, 29(2), 195-204.
- Makens, J. C., & Bowen, J. T. (1996). Increasing restaurant profits with product merchandising. *The Cornell Hotel and Restaurant Administration Quarterly*, 37(1), 72-79.
- McFadden, D. (1998). Sex differences in the auditory system, *Developmental Neuropsychology*, 14 (2/3), 261-298.
- Meule, A., Hermann, T., & Kübler, A. (2014). A short version of the Food Cravings Questionnaire—Trait: the FCQ-T-reduced. *Frontiers in psychology*, 5(190), 1-10.
- Meyers-Levy, J., Bublitz, M. J., & Peracchio, L. A. (2010). The sound of the marketplace: the role of audition in marketing. In A. Krishna (Eds.), *Sensory marketing: Research on the sensuality of products*, (pp. 137-156) (1<sup>st</sup> edition). Hove, East Sussex: Routledge.
- Milliman, R. E. (1982). Using background music to affect the behavior of supermarket shoppers. *The journal of Marketing*, 46(3), 86-91.

- Milliman, R. E. (1986). The influence of background music on the behavior of restaurant patrons. *Journal of consumer research*, 13(2), 286-289.
- North, A.C., Hargreaves, D.J., & McKendrick, J. (1999). The effect of music on in-store wine selections. *Journal of Applied Psychology*, 84 (2), 271-276.
- North, A. C., Shilcock, A., & Hargreaves, D. J. (2003). The effect of musical style on restaurant customers' spending. *Environment and Behavior*, 35(5), 712-718.
- Ngo, M. K., Misra, R., & Spence, C. (2011). Assessing the shapes and speech sounds that people associate with chocolate samples varying in cocoa content. *Food quality and preference*, 22(6), 567-572.
- Oakes, S. (2000), "The influence of the musicscape within service environments". *Journal of Services Marketing*, 14 (7) 539 – 556.
- Pelchat, M. L. (1997). Food cravings in young and elderly adults. *Appetite*, 28(2), 103-113.
- Pelchat, M. L., Johnson, A., Chan, R., Valdez, J., & Ragland, J. D. (2004). Images of desire: food-craving activation during fMRI. *Neuroimage*, 23(4), 1486-1493.
- Roballey, T.C., McGreevy, C., Rongo, R.R., Schwantes, M.L., Steger, P.J., Wininger, M.A. and Gardner, E.B. (1985), "The effect of music on eating behaviour". *Bulletin of the Psychonomic Society*, 23 (3), 221-222.
- Roberto, Swinburn, Hawkes, Huang, Costa, Ashe, Zwicker, Cawley & Brownell, K. D. (2015). Patchy progress on obesity prevention: emerging examples, entrenched barriers, and new thinking. *The Lancet*, 385(9985), 2400-2409.
- Rodríguez, S., Fernández, M. C., Cepeda-Benito, A., & Vila, J. (2005). Subjective and physiological reactivity to chocolate images in high and low chocolate cravers. *Biological Psychology*, 70(1), 9-18.
- Royster, L. H., Royster, J. D., & Thomas, W. G. (1980). Representative hearing levels by race and sex in North Carolina industry. *The Journal of the Acoustical Society of America*, 68(2), 551-566.
- Sax, L. (2010). Sex differences in hearing implications for best practice in the classroom. *Advances in Gender and Education*, 2, 13-21.
- Smeets, E., Roefs, A., & Jansen, A. (2009). Experimentally induced chocolate craving leads to an attentional bias in increased distraction but not in speeded detection. *Appetite*, 53(3), 370-375.

Spence, C., & Gallace, A. (2011). Tasting shapes and words. *Food Quality and Preference*, 22(3), 290-295.

Spence, C., & Ngo, M. K. (2012). Assessing the shape symbolism of the taste, flavour, and texture of foods and beverages. *Flavour*, 1(1), 12.

Spence, C., & Shankar, M. U. (2010). The influence of auditory cues on the perception of, and responses to, food and drink. *Journal of Sensory Studies*, 25(3), 406-430.

Starbucks Coffee Company (2016a). Starbucks Company profile. Retrieved at June 15<sup>th</sup>, via: <http://www.starbucks.com/about-us/company-information/starbucks-company-profile>

Starbucks Coffee Company (2016b). *Company information*. Retrieved June 6<sup>th</sup> 2016, from: <http://www.starbucks.com/about-us/company-information>

Starbucks Coffee Company (2016c). *Starbucks menu*. Retrieved June 6<sup>th</sup> 2016, from: <http://www.starbucks.com/menu>

Swinburn, B., Egger, G., & Raza, F. (1999). Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Preventive medicine*, 29(6), 563-570.

Weingarten, H., & Elston, D. (1990). The phenomenology of food cravings. *Appetite*, 15(3), 231-246.

Weingarten, H. P., & Elston, D. (1991). Food cravings in a college population. *Appetite*, 17(3), 167-175.

Yalch, R. F., & Spangenberg, E. R. (2000). The effects of music in a retail setting on real and perceived shopping times. *Journal of business Research*, 49(2), 139-147.

Yanovski, S. (2003). Sugar and fat: cravings and aversions. *The Journal of nutrition*, 133(3), 835S-837S. Zampini, M., & Spence, C. (2005). Modifying the multisensory perception of a carbonated beverage using auditory cues. *Food Quality and Preference*, 16(7), 632-641.

## 8. Appendix

### 8.1 Tables interaction effects

Table 10: Interaction effect for total sweet food choice

Total sweet choice		Gender			
		Male		Female	
Music condition	Food craving (trait)	M	SD	M	SD
1: high-pitched music	Low	1.33	.96	1.44	1.03
	High	2.64	1.60	1.82	1.74
2: high pitched music	Low	.95	1.07	1.21	.80
	High	1.69	.87	1.53	.90
3: No music	Low	1.56	1.50	.92	.86
	High	1.56	1.46	2.23	1.19

Table 12: Interaction effect for shape associations\* sweet food items

		Gender			
		Male		Female	
Music condition	Food craving (trait)	M	SD	M	SD
1: high-pitched music	Low	3.56	1.88	4.01	1.83
	High	3.60	1.56	3.37	1.86
2: high pitched music	Low	3.90	1.61	4.39	1.81
	High	5.01	1.87	3.48	1.21
3: No music	Low	3.67	1.59	3.12	1.02
	High	3.79	1.64	4.23	1.60

\*Ten-point Semantic differential (0=Round shape/10= Angular shape)

Table 13: Interaction effect for shape association\* savoury food items

Savoury shape association		Gender			
		Male		Female	
Music condition	Food craving (trait)	M	SD	M	SD
1: high-pitched music	Low	6.10	1.28	5.94	1.84
	High	6.19	1.04	6.598	1.64
2: high pitched music	Low	5.84	1.73	5.46	1.91

3: No music	High	4.99	1.60	6.32	1.36
	Low	5.79	1.37	6.603	.95
	High	6.34	1.58	5.98	1.37

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*\*Ten-point Semantic differential (0=Round shape/10= Angular shape)*

## 8.2 Questionnaire

Dear participant,

Thank you for participating in this study. It will only take less than 10 minutes of your time. In this study you will have to answer several questions first. After this, you will get to hear a sound fragment and a music fragment, therefore it is important that your speakers are turned on. So please make sure that the sound system of your device works well. After the sound fragments another number of questions have to be completed.

Participation in this study is voluntary and anonymous. The data will be kept confidential and only combined results will be reported not individual ones. There are no risks or inconveniences involved in this study and at every moment it is possible to stop. Beforehand there could not be given more information about the purpose of the study because it could possibly influence the results. Participants are compensated by having a chance of winning a Starbucks gift set when they leave their email address at the end of the survey.

If you have any questions or remarks, you can always contact the researcher at [m.quekel@student.utwente.nl](mailto:m.quekel@student.utwente.nl)

Did you read the information above and do you agree?

- ☐ Yes
- ☐ No

When was the last time you did eat?

- ☐ Less than 1 hour ago
- ☐ Between 1 and 2 hours ago
- ☐ More than 2 hours ago

How would you rate your degree of hunger at the moment on a scale from 1 to 10 (1 represents 'not hungry at all' and 10 represents 'very hungry')



	'Not hungry at all'					'Very hungry'					
	0	1	2	3	4	5	6	7	8	9	10
Degree of hunger at the moment											

Please indicate for each of the following statements how frequently it would be true for you **in general**.

	Never	Rarely	Sometimes	Often	Usually	Always
When I crave something, I know I won't be able to stop eating once I start.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I eat what I'm craving I often lose control and eat too much.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food cravings invariably make me think of ways to get what I want to eat .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel like I have food on my mind all the time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find myself preoccupied with food.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whenever I have cravings, I find myself making plans to eat.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I crave foods when I feel bored, angry or sad.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Never	Rarely	Sometimes	Often	Usually	Always
I have no will power to resist my food crave.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Once I start eating, I have trouble stopping.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can't stop thinking about eating no matter how hard I try.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I give in to a food craving, all control is lost.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whenever I have food craving, I keep on thinking about eating until I actually eat the food.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I am craving something, thoughts of eating it consume me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My emotions often make me want to eat.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is hard for me to resist the temptation to eat appetizing foods that are in my reach.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

To make sure that the music fragment that follows after this question could be heard well, a test fragment is played. You get to hear a random sound and you have to answer the question about the audio test fragment.

\* This text was not included in the no music condition

What animal did you hear in the preceding fragment?

☐ Tiger

☐ Dog

☐ Bird

\* This question was not included in the no music condition

Now that we made sure that your audio works correctly, the music can be played. You find yourself in the Starbucks store as you already noticed. The music that will start at the next page just functions as background music. This is one element of the Starbucks atmosphere. **Please do not stop the music video** because it is important for the perceived total atmosphere. Just start answering the questions below while the music keeps playing.

\*In the no music condition this text was replaced by the following text:

You find yourself in the Starbucks store as you already noticed. Please be aware of the current Starbucks environment and try to answer the following questions in full awareness of this environment. On the following page is an image of a Starbucks store displayed to stress this environment.

You find yourself at the moment in a Starbucks store. Below you see a collection of items from the Starbucks menu. It is comprised of various sweet snacks and various savoury snacks. If you were about to choose right now, which items of the **total** menu below would you prefer? You can choose as many items as you wish.

\* The two versions of the questionnaire each had a different order of the food items

Blueberry scone



Ham & cheese  
savory foldover



Double chocolate  
brownie



Pepporoni and  
tomato savory  
foldover



Tomato and cheese  
savory square



Iced lemon pound  
cake



Cheese Danish



Old-fashioned glazed  
doughnut



Classic glazed  
chocolate cake  
doughnut



Beef sausage  
croissant



Chocolate croissant



Everything bagel  
with cheese



Below the same savoury and sweet Starbucks items are displayed again. Please mark the point

that you think best matches the food item on this scale. If the flavour better matches the word on the left of the page mark a point to the left of centre, whereas if the flavour better matches the word on the right of the page mark a point to the right of the centre. These words are made-up words, just mark the point that best matches the food item according to you. You can drag the bar back-and-forth to the point which you think best matches with the food item.

\* The two versions of the questionnaire each had a different order of the food items

	Maluma					Takete					
	0	1	2	3	4	5	6	7	8	9	10
Blueberry scone											
											

Please mark again the point that you think best matches the food item on this scale.

Maluma

Takete

0 1 2 3 4 5 6 7 8 9 10

Tomato and cheese  
savory square



Please mark again the point that you think best matches the food item on this scale.

Maluma

Takete

0 1 2 3 4 5 6 7 8 9 10

Classic glazed chocolate  
cake doughnut



Please mark again the point that you think best matches the food item on this scale.

	Maluma					Takete					
	0	1	2	3	4	5	6	7	8	9	10
Ham and cheese savory foldover 											

Please mark again the point that you think best matches the food item on this scale.

Maluma

Takete

0 1 2 3 4 5 6 7 8 9 10

Iced lemon pound cake



Please mark again the point that you think best matches the food item on this scale.

Maluma

Takete

0 1 2 3 4 5 6 7 8 9 10

Beef sausage croissant







Please mark again the point that you think best matches the food item on this scale.

	Maluma					Takete					
	0	1	2	3	4	5	6	7	8	9	10
Double chocolate brownie											
											

Please mark again the point that you think best matches the food item on this scale.

	Maluma					Takete					
	0	1	2	3	4	5	6	7	8	9	10
Cheese danish											
											

Please mark again the point that you think best matches the food item on this scale.

	Maluma					Takete					
	0	1	2	3	4	5	6	7	8	9	10
Chocolate croissant											
											

Please mark again the point that you think best matches the food item on this scale.

	Maluma					Takete					
	0	1	2	3	4	5	6	7	8	9	10
Pepporoni and tomato savory foldover											

Maluma

Takete

0 1 2 3 4 5 6 7 8 9 10



Please mark again the point that you think best matches the food item on this scale.

Maluma


Takete

0 1 2 3 4 5 6 7 8 9 10

Old-fashioned glazed  
doughnut



Please mark again the point that you think best matches the food item on this scale.

	Maluma					Takete					
	0	1	2	3	4	5	6	7	8	9	10
Everything bagel with cheese 											

Below the same savoury and sweet Starbucks items are displayed again. Please mark the point that you think best matches the food item on this scale. If the flavour better matches the shape on the left of the page mark a point to the left of centre, whereas if the flavour better matches the shape on the right of the page mark a point to the right of the centre. You can drag the bar back-and-forth to the point which you think best matches with the food item.

\* The two versions of the questionnaire each had a different order of the food items



0 1 2 3 4 5 6 7 8 9 10

Blueberry scone



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Tomato and cheese  
savory square

--	--	--	--	--	--	--	--	--	--	--



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Classic glazed chocolate  
cake doughnut



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Ham and cheese savory  
foldover



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Iced lemon pound cake



--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Beef sausage croissant



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Double chocolate brownie

--	--	--	--	--	--	--	--	--	--





0 1 2 3 4 5 6 7 8 9 10



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



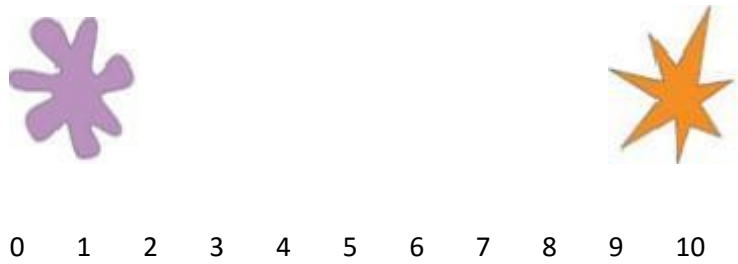
0 1 2 3 4 5 6 7 8 9 10

Cheese danish



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.

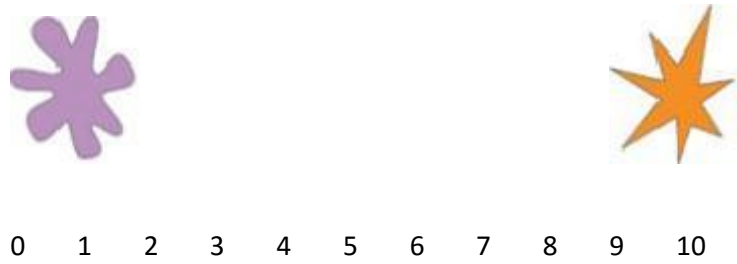


Chocolate croissant



--	--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



Pepporoni and tomato  
savory foldover

--	--	--	--	--	--	--	--	--	--	--



0 1 2 3 4 5 6 7 8 9 10



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Old-fashioned glazed  
doughnut



--	--	--	--	--	--	--	--	--	--	--

Please mark again the point that you think best matches the food item on this scale.



0 1 2 3 4 5 6 7 8 9 10

Everything bagel with cheese



--	--	--	--	--	--	--	--	--	--	--	--

Please indicate in what extent you do agree or disagree with the following statements **right now, at this very moment.**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I have an intense desire to eat one or more sweet foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm craving one or more sweet foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have an urge for one or more sweet foods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating one or more sweet foods would make things seem just perfect	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
If I were to eat what I'm craving, I'm sure my mood would improve	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eating one or more sweet foods would feel wonderful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I had one or more sweet foods, I could not stop eating it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My desire to eat one or more sweet foods seems overpowering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know I'm going to keep on thinking about one or more sweet foods until I actually have it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am hungry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I ate right now, my stomach would'nt feel as empty.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel weak because of not eating.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I ate something, I would'nt feel so sluggish and lethargic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Satisfying my craving would make me feel less grouchy and irritable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would feel more alert if I could satisfy my craving.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What is your gender?

- ☐ Male
- ☐ Female

What is your age?

What is your occupation?

- ☐ Student
- ☐ Working
- ☐ Other:

What do you study?

\*when student was chosen

Overall, I could hear the music fragment well (not to be confused with the test sound fragment)

- ☐ yes
- ☐ no

\* This question was not included in the no music condition

What did you think of the music fragment (not to be confused with the sound fragment)? Can you rate the music fragment on the following scale? The 0 represents 'very annoying' and the 10 represents 'very pleasant'.

	Very annoying		Very pleasant								
	0	1	2	3	4	5	6	7	8	9	10
Music fragment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

\* This question was not included in the no music condition

How often do you visit a Starbucks café?

Never

☐

Sometimes

☐

Often

☐