

8-2013

Influences of Music Genre and Components on Food Perception and Acceptance

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INFLUENCES OF MUSIC GENRE AND COMPONENTS
ON FOOD PERCEPTION AND ACCEPTANCE

INFLUENCES OF MUSIC GENRE AND COMPONENTS ON FOOD PERCEPTION AND ACCEPTANCE

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science in Food Science

by

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University of Iowa
Bachelor of Science in Biology, 2011

August 2013
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ABSTRACT

Managers of consumer goods companies (i.e., restaurants, grocery stores, and bars) have the potential to effectively utilize environmental factors to stimulate desired consumer behaviors. Background music has been identified as one of the most readily manipulated and influential elements to which a shopper or consumer may be exposed to in a service setting. Nevertheless, little is known about the effect of background sound on food perception and acceptance. This research sought whether background music genre and musical components can alter food perception and acceptance, but also to determine how the effect can vary as a function of food type (i.e., emotional vs. non-emotional) and source of music editor (i.e., single vs. multiple). In Experiment 1, single and multiple editors transposed the traditional music piece, “Air on the G String,” into four genres: classical, rock, hip-hop, and jazz. The same music piece was edited into contrasting ends of musical components of tempo, pitch, and volume for Experiment 2. According to a preliminary survey centering on the association between food and emotion, milk chocolate (emotional), and bell pepper (non-emotional) were selected as food stimuli for both experiments. Following consumption, participants rated flavor intensity, flavor pleasantness, texture liking, and overall liking using 15-cm line scales. In Experiment 1, participants liked food stimuli significantly more with the jazz stimulus as opposed to the hip-hop stimulus. Ratings of flavor pleasantness and overall impression for food stimuli only differed between the single editor genres. In Experiment 2, participants liked bell pepper flavor and texture significantly more with the fast tempo versus the slow tempo stimulus. Ratings of chocolate texture and bell pepper overall impression significantly heightened in the low pitch condition. In the loud volume condition, participants’ evaluated flavor pleasantness, texture impression, and overall impression of chocolate significantly higher in comparison to the quiet and silent

conditions. In summary, the present thesis presents new empirical evidence that music genre, components, and editor, along with food type can modulate food perception and acceptance. Furthermore, our findings assist food service industries in creating the most appropriate atmosphere by explaining observed consumer behaviors induced by musical stimuli.

ACKNOWLEDGEMENTS

It would not have been possible to complete this master's thesis without the help and support of the kind people around me, to only some of whom it is possible to give particular mention here.

Above all, I would like to extend thanks to my encouraging and amazing family. To my loving parents for supporting me financially, emotionally, and mentally the last 23 years, but mainly for the past two convoluted years. To my witty best friend, my sister, for always instilling a sense of peace and contentment with every given situation. I am so lucky to have y'all for taking the weight off of my shoulders; I cannot wait to return the favor. I sincerely thank you for your continuous unequivocal support, for which my mere expression of thanks does not suffice. To Aimee, for being my roommate, partner in crime, my real-life Hannah, and most of all, my best friend. Without your friendship I would have ended up back in the Midwest. Thank you for lending an ear for complaining, a shoulder for crying, arms for hugging, knowledge for advice, but most of all thank you for your presence for motivation, encouragement, and allowing me to pull through those endless all nighters. I wouldn't have wanted to do it with anyone else.

I would like to express the deepest appreciation to my thesis advisor, Assistant Professor, Dr. Han-Seok Seo, for his intellectual guidance in sensory and statistical analysis, but also for his continuous and convincing determination and dedication in regard to research and teaching. Without his guidance and persistent help the completion of this thesis would not have been possible.

I also would like to express my sincere thanks to my committee members: Dr. Jean-François Meullenet and Dr. Robert Harrington, whose guidance, knowledge, and support have been invaluable. In addition, I extend my thanks to the staff and fellow graduate students at the

Department of Food Science and the Sensory & Consumer Research Center. I appreciate your assistance in the numerous chocolate bars we had to break, bell peppers we had to cut, and cups we had to code; the consumer tests would have been a disaster without y'all.

To my fellow graduate students and classmates whom I have bonded with in the last two years, please know that your friendship, jokes, and study sessions have been instrumental in my completion.

Last, but by no means least, I thank my friends back home in the Midwest for their support and encouragement from hours away. Most importantly, thank you for your understanding in my lack of communication, the numerous texts I have not responded to, ample phone calls I have not returned, and weeks I have been MIA. Y'all have been in my thoughts and I will make it up to each and every one of you with the completion of this thesis.

For my errors or inadequacies that may remain in this work, of course, the responsibility is entirely my own.

DEDICATION

This master's thesis is dedicated to my beloved family for supporting me throughout my life, but mainly for the endless encouragement in my education, even when my aspirations changed and my path became foggy. Thank you, Mom and Dad, for providing me an opportunity to pack up and move down south to pursue my M.S. degree. I love you.

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CHAPTER 1 – INTRODUCTION

Of the multitude of stimuli that make up an environment of a service setting, music is inexpensive and easy to control (Caldwell & Hibbert, 2002). People still sit down and listen deliberately to music, but in the present day there is an increasing number of daily activities that people do while listening to music such as driving, eating, reading, socializing, cleaning, etc. (North & Hargreaves, 1998). Atmospherics such as music composed of various genres, tempos, volumes, and pitch that make up an environment have a greater influence on a product than the product itself (Milliman, 1986). Therefore, it is important to understand the behavioral responses arising from effects on informational processing (Kellaris & Mantel, 1994), mood (Alpert & Alpert, 1990), and emotional changes (Anand & Holbrook, 1985).

Music pieces are categorized into genres, however the classification is ambiguous and forever changing due to the disappearance, emergence, and variation of such compositions. For this particular research, the definition of ‘genre’ is “a style or category of music” (Oxford University Press, 2010). Given that genres of music can be classified into four dimensions based on emotional descriptors (Rentfrow & Gosling, 2003), classical, jazz, rock, and hip-hop were selected for this research. Based on previous findings, the four genres can be placed into three groups: 1) classical and jazz stimuli, 2) hip-hop stimulus, and 3) rock stimulus (Rentfrow & Gosling, 2003; Zenter et al., 2008). Although two identical music pieces are placed in an identical genre, when arranged by two different editors, listeners often exhibit different emotional responses (Hailstone et al., 2009). To account for this variation the four genres were edited and played by either a single editor or multiple commercial editors, which determined whether genre effects on food perception and acceptance can be dynamic as a function of music editor. In addition, music pieces arranged by a single editor tend to alleviate emotional variations

that may be elicited by multiple editors, allowing for emphasis to be placed solely on genre effects.

Music pieces are made up of components, three of which are focused on in the following studies: tempo, pitch, and volume. Tempo, defined as beats per minute, is also ambiguous in terms of a range, regardless, a music pieces' tempo is known to effect a listener's arousal, appeal, and behavioral intention toward the piece (Kellaris & Kent, 1991). An emotional response can also be induced by the pitch of a musical piece, which is defined as the relative lowness or highness of a noise (Bruner, 1990), so as the pitch rises or falls a listener's emotion grows or diminishes (Gundlach, 1935). Songs played at an optimum volume induce positive responses such as repeat purchases, because similar to the other components, volume, the magnitude of a musical composition, influences emotions and behaviors (Novak et al., 2010).

An additional aim was to determine how the effect of background music on sensory perception and acceptance can vary as a function of food type: emotional *vs.* non-emotional. People tend to consume sweet and fatty foods to alleviate stress (Gibson, 2006), in addition to this and other such findings, it is suggested that consumers rely on particular foods to mediate emotions.

The research for this master's thesis is divided into two publications based on the sequential and complementary nature of the studies. The second study was designed and carried out after completion of the first, based on the results presented. Both studies focused on background music influences on food perception and acceptance, differing in the music structural characteristic under investigation.

Considering the aforementioned, the first objective of the present study was to determine whether background music genre can alter food perception and acceptance, but also to determine

how the effect can vary as a function of the type of food (emotional *vs.* non-emotional) and source of music editor (single *vs.* multiple). Based on previous findings and other empirical evidence it would be expected that between the three genre groups, different emotions would be induced, resulting in variation in sensory perception and acceptance for food stimuli. Given that perceptions and liking for certain foods is influenced by emotional status, it is hypothesized that the impact of music genre on food stimuli will be more pronounced in emotional foods. In addition, the perceptions and acceptance for the food stimuli would be more transparent between genres arranged by a single editor as opposed to those arranged by multiple editors. The second objective, similar to the first, sought to determine whether background music components such as tempo, pitch, and volume influenced food perception and acceptance in addition to determine whether the effect varied as a function of food type (emotional *vs.* non-emotional). By using music pieces with varying music components, eliciting differing emotional impacts, it is anticipated that food perception and acceptance will differ. The same hypothesis seen in objective one, regarding food type is expected for objective two, meaning the impact of music component on food stimuli will be more pronounced in emotional foods.

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CHAPTER 2 – REVIEW OF LITERATURE

1. The senses of hearing, taste, and smell

The human senses are important to survival and quality of life as the hedonic responses that result rely on the chemosensory inputs binding to receptors, because of this the central nervous system, limbic system, and the brain are all involved (Hadley et al., 2004). Among the human tasks that require the joint use of multiple sensory systems, food evaluation is probably one of the most multisensory as both gustatory and olfactory take part in forming flavor perceptions (Auvray & Spence, 2008; Rozin, 1982; Stevenson, 2009). A gustatory experience is shaped by the mouth, but also influenced by the ears (Sweetow & Tate, 2000).

1.1. The sense of hearing

An auditory environment can be nonverbal, one where physical noises dominate, or verbal, one where words and semantics dominate (Belojevic et al., 2003). Regardless of type, sounds arise from objects and events of all kinds signifying safety, danger, interest, etc., which are vital to human function at both cognitive and emotional levels (Belojevic et al., 2003; Fay, 2009). Sound characteristics like volume, tempo, and duration in an environment collectively make up an auditory scene. The human auditory system has the capacity to grasp the auditory scene by determining the collection of individual sources of sounds, source location, human orientation to the sound, overall human location, and events occurring nearby (Belojevic et al., 2003; Fay, 2009). For example, the sound of waves hitting the shore tells the listener the size of the body of water, state of the weather, and composition of the beach or shore (Fay, 2009). Auditory source segregation is the process of sorting simultaneous and successive acoustic components into individual sources and then linking those sources to a specific occurrence, which allows humans to hear out specific musical instruments in a musical piece (Fay, 2009).

The lack of hearing poses a serious threat to the safety and health of an individual as the environmental sounds whether nonverbal or verbal cannot be collected or interpreted (Belojevic et al., 2003). Hereby, providing highly destructive and negative experiences causing frustration, irritation, and inefficiency to an individual (Belojevic et. al., 2003).

Any kind of sound can be considered a noise, but any noise without a steady pitch sound is considered a transient sound meaning it is a changing sound or appearing and disappearing (Beament, 2001). All sounds pass the human ear at a speed of 330 meters per second and can only be heard at the time it passes the ear (Beament, 2001). The human ear is sensitive to transient patterns and therefore recognizes sounds of this kind such as speech and natural noises (Beament, 2001). Due to this selectivity most sounds are not made of a steady pitch rather they are transient, because they are meant to be heard whether it is for safety, communication, or pleasure (Beament, 2001). In terms of communication, humans use the sense of hearing to obtain information through remembering. In the human auditory system, by remembering the sensation produced when a single word is received it becomes recognizable, eventually remembering a series of words (Beament, 2001). The same mechanism is used to recognize music pieces by identifying an unsteady pitch (Beament, 2001). This becomes an automatic process and provides a continuous memory of words and music formed by succession of musically pitched sounds.

It has been said that present day humans inherit the same auditory machinery from those dating back several million years ago, which still remains similar to the brains of our animal relatives (Beament, 2001). But how does this auditory machinery, such as the automatic system of the ear and brain detect presence of noise, size of the noise, and the direction the noise is coming from in order to produce reactions for survival (Beament, 2001)?

The human auditory system consists of two ears, the vestibulocochlear nerve, and the central auditory nervous system consisting of centers in the brain and the pathways in the brainstem (Maroonroge et al., 1986). Each ear is divided into three parts: the outer ear, middle ear, and inner ear. The pinna, containing the ear canal entrance, and the ear canal itself make up the outer ear, which is separated from the middle ear by the eardrum (Maroonroge et al., 1986). The eardrum receives sound waves from and is protected by the ear canal (Maroonroge, 1986). Within the middle ear are the ossicle bones, which transfer sound energy to the inner ear, based on pressure and muscle responses (Maroonroge et al., 1986). Contractions by these muscles reduce the sound level to shield the inner ear from harmful noises (Maroonroge et al., 1986). Housing the two sensory organs of balance and hearing, the vestibule, semicircular canals, and the cochlea, the inner ear is the most complex part (Maroonroge et al., 1986). The organ of hearing, also known as the organ of corti, is made up of sensory cells and is located in the cochlea (Maroonroge et al., 1986). The vestibulocochleaer nerve connects the organ of corti and organ of balance to the brain by way of auditory nerve and vestibular nerve, which are responsible for carrying information from sensory cells to the brain and back to the other cells of the nervous system (Maroonroge et al., 1986). As sounds are transmitted through the outer and middle ear the organ of corti sends mechanical vibrations to the inner ear from which they are converted into neural impulses sent through the auditory nerve to the brainstem, eventually to the brain (Maroonroge et al., 1986).

The central auditory nervous system (CANS), a subsystem of the central nervous system (CNS), consists of neural structures and connections within the brain that converts neural impulses into auditory sensation coming from the vestibulocochlear nerve (Maroonroge et al., 1986). The neurons travel through the brainstem, synapse with the nuclei, and are aided by the

inferior colliculi, eventually arriving at the thalamus (Maroonroge et al., 1986). The thalamus, located above the midbrain, directs the sensory information (except for smell) to the cerebrum, specifically, Heschl's gyrus, located in the forebrain. The cerebrum is divided into two cerebral hemispheres, from which are divided into four lobes: planning and initiating motor actions in the frontal lobe, auditory and receptive language processing in the temporal lobe, reception of somatic sensory data in the parietal lobe, and visual processing in the occipital lobe (Lockwood et al., 1999). From there the information is transmitted to other auditory association areas within the brain (Lockwood et al., 1999). For example, the outermost layer of the cerebrum containing six neural layers, the auditory cortex, receives information from the thalamus based on the function (Maroonroge et al., 1986). The cortex is the last stage of the hearing process, which is responsible for the occurrence of sensations (Beament, 2001). Through the linkages all information entering the brain provides a perception of the surrounding environment along with an emotional state from that image (Beament, 2001).

1.2. The sense of taste

The sense of taste is in charge of evaluating the nutritious content of food consumed, overall pleasure of the meal, and preventing the ingestion of toxic substances (Chandrashekar et al., 2006). Although a vast spectrum of entities can be assigned flavors, there are only four tastes; sweet identifies energy-rich nutrients, salt detects proper dietary electrolyte balance, and sour and bitter warn against a potentially hazardous substance (Chandrashekar et al., 2006; Hadley et al., 2004). A fifth taste is sometimes referred to as umami, identifying savory substances through concentrations of MSG and aspartate (Hadley et al., 2004). It was believed that the tongue was made up of a taste map portraying which parts of the tongue could identify which of the five

tastes (Hadley et al., 2004). However, recent data has revealed that responsiveness to the five basic tastes is present in all areas of the tongue, allowing multiple tastes to be appreciated separately and simultaneously (Chandrashekar et al., 2006; Hadley et al., 2004).

As one consumes foodstuff, saliva transports the taste molecules to the papillae, housing taste buds, and contained within the buds are approximately one hundred taste receptor cells (Hadley et al., 2004). Gustatory processing begins when the chemical substance binds to a taste receptor cell (Hadley et al., 2004). Papillae, and therefore taste receptor cells, are distributed throughout the tongue, palate, larynx, pharynx, and epiglottis (Carleton et al., 2011). The model of taste detection is continually being debated as results have varied. However, the recent prevailing model suggests that detection for sweet, bitter, and umami, although expressed through different subsets of G-protein-coupled receptors (GPCRs), all signal through a common pathway to transform tastant recognition into cell activation (Chandrashekar et al., 2006). Through knockout experiments the salty and sour tastes remained impaired suggesting that the pathway for these tastes was independent of the other tastes (Chandrashekar et al., 2006). Instead of GPCRs, salt and sour tastes are detected through ion channels (Chandrashekar et al., 2006). In addition, it is suggested that no single fiber responds to one taste quality, although some are quite selective meaning they respond “best” to a particular stimulus and others are more broadly tuned, moreover the selectivity can be modified or changed depending on factors such as hormones, glucose, and temperature (Carleton et al., 2011; Cowart et al., 1997). According to this process of selection, it would be expected that taste receptor cells express different families of receptors and recognition would result from interpreting collective activity from various broadly tuned taste receptor cells (Carleton et al., 2011).

The occurring action potentials trigger the release of neurotransmitters, which produce synaptic potentials in the dendrites of the sensory nerves and action potentials in nerve fibers (Cowart et al., 1997). These gustatory nerve fibers transmit a neural code of the taste quality through axons to the neurons of the brain stem (Cowart et al., 1997). From there axons travel to the tail of the brain stem which is responsible for eating reflex behaviors like gagging, licking, or lateral tongue movement (Cowart et al., 1997). Axons also ascend to the neocortex, which is responsible for identifying taste qualities and aversions (Cowart et al., 1997). A large group of axons ends in the limbic system, where affective responses to tastes are made. When convergent gustatory, somatosensory, visual, and olfactory inputs are received a multisensory response is created (Carleton et al., 2011).

Recent studies using functional magnetic resonance imaging (fMRI) showed that the gustatory cortex activation patterns are specific to the five tastes with some overlap, carrying information for the stimulus, but also for the pleasantness of the tastant (Carleton et al., 2011). The pleasantness of the gustatory stimuli is through an affective response, indicating the level of liking (positive or negative) based on a hedonic scale value (Carleton et al., 2011). Typically, bitter and sour tastants are unpleasant, whereas sweet and salty are pleasant, but this is apt to change with concentration (Carleton et al., 2011). Taste stimuli with similar hedonic values have shown activation in similar regions, which is not true for stimuli with different hedonic scores (Carleton et al., 2011).

The phenomenon of sensory specific satiety is seen with gustatory stimuli. This occurs when a particular food is eaten to satiety and becomes less rewarding without changing the makeup of the food (Carleton et al., 2011). For example, if a salty stimulus is exposed for a prolonged amount of time the stimulation will decrease with further exposure to salt substances

(Hadley et al., 2004). This reveals that throughout the gustatory pathway the selectivity of a neuron may change based on the internal state, leading to the assumption that post-ingestion effects may alter taste responses throughout the brain (Carleton et al., 2011). A common taste dysfunction observed is called phantogeusia where neural damage, oral infection, or certain medications may cause a persistent unpleasant taste sensation in the mouth (Coward et al., 1997).

Taste perception varies according to context, and is significantly extended by other inputs such as olfactory, visual, and somatosensory as well as prior experiences, satiety, and hunger (Coward et al., 1997). By combining and comparing across taste qualities in addition to utilizing information from other sensory systems, a final perception is orchestrated in the brain.

1.3. The sense of smell

The sense of smell is not only important to the well-being of an individual, but also economically as sales of scented products make up an annual market of over \$25 billion in the United States alone (Keller et al., 2004). Human sense of smell is feeble compared to many animals, but it is still capable of detecting odorants at concentrations as low as 1 part per 10 million, which provides information on the air we breathe, food we eat, and dangers that surround us (Hadley et al., 2004). Detecting odors from the oral cavity and pharynx is termed retro nasal olfaction, which occurs when odorant molecules pass into the nose by movement from the tongue and pharynx during chewing and swallowing (Hadley et al., 2004). The perceptions created depend on peripheral detection and central cortical processing (Keller et al., 2004), which occur when odorant molecules in the air are inhaled and bind to receptors (Hadley et al., 2004). Detection is influenced by absorption, solubility, and reactivity of the odorant molecules (Hadley et al., 2004). Airflow direction, velocity, and volume are all factors that

influence the stimulation created by odorant molecules; sniffing increases the turbulence in airflow allowing greater delivery of air to the epithelium in turn activating the olfactory system for incoming stimulation (Hadley et al., 2004). Odor perceptions are highly influenced by memories, experiences, and input from other sensory sources such as visual (Keller et al., 2004), but odor memory in humans is significantly longer than visual memory (Hadley et al., 2004). Interpretations of odors vary among individuals as one's previous experiences differ (Hadley et al., 2004). For example, a specific odor perceived during an unpleasant experience is capable of producing a powerful response in the future (Hadley et al., 2004).

The human olfactory system consists of several million olfactory sensory neurons in the sensory epithelium (Keller et al., 2004) of the nasal cavity and olfactory bulb (Hadley et al., 2004). The nasal cavity contains 10-20 million receptor neurons and each neuron expresses one of 350 possible odorant receptor genes, which gives the neuron a specific sensitivity to the scent of odor molecules that will bind and activate the specific odorant receptor (Keller et al., 2004). The affinity and specificity is seen in both the receptor and the odor molecule; an odor may activate only a single receptor or many different receptors based on the odors' chemical properties (Hadley et al., 2004) and a receptor may be activated by only one odor molecule or recognize many (Keller et al., 2004). As humans age a decrease in olfaction is attributed to the proportion of receptors being replaced by non-olfactory epithelium (Hadley et al., 2004). However, a decrease in intensity of odors also occurs with prolonged exposure to the odor, also known as adaptation (Hadley et al., 2004).

The olfactory system is unique in that it is closely associated with the central nervous system (Keller et al., 2004), however very little is known about the mechanism that guides central olfactory processing (Keller et al., 2004). Contained within the nasal cavity, nasal

conchae direct air toward the upper posterior region where the olfactory epithelium lies (Vokshoor & McGregor, 2011). Olfactory vesicles arise from the 100 million epithelial olfactory receptor cells and contain cilia, which serve as sites of stimulus transduction (Vokshoor & McGregor, 2011). At the base of the anterior nasal septum, the vomeronasal organ unconsciously detects external chemical signals called pheromones, which are believed to mediate endocrine, psychological, and autonomic responses (Vokshoor & McGregor, 2011). The posterior nasal cavity is stimulated by the trigeminal nerve to detect toxic stimuli (Vokshoor & McGregor, 2011); trigeminal branches play a role in nasal reflexes like sneezing or holding breath when these toxic odors are inhaled (Hadley et al., 2004). Once the olfactory receptor cells are affected by an odor stimulus the axons travel to the outermost glomerular layer of the olfactory bulb to relay information to mitral cells, the second-order neurons (Vokshoor & McGregor, 2011). The olfactory bulb is composed of five layers – glomerular, external plexiform, mitral cell, internal plexiform, and granule cell – which have distinct synaptic specializations (Vokshoor & McGregor, 2011). Mitral cell axons from the olfactory bulb emerge to form the olfactory tract, directly leading to the olfactory cortex (Hadley et al., 2004; Vokshoor & McGregor, 2011), which is unique to the olfactory system because other sensory systems go through the thalamus before the cortex (Hadley et al., 2004). Once third-order neurons in the olfactory cortex are contacted, projections are sent to the nuclei of the thalamus (Vokshoor & McGregor, 2011), but also to the hypothalamus and hippocampus (Hadley et al., 2004). Connection with the thalamus is believed to be responsible for conscious odor perception and the hippocampus links olfactory input with areas of the brain associated with learning and behavior, which may explain why memories are evoked by odors (Hadley et al., 2004).

Olfactory dysfunction is dangerous since danger related odors such as smoke, spoiled foods, and toxins are no longer detected (Vokshoor & McGregor, 2011). As many as 2 million people in the United States experience some degree of dysfunction that may have occurred by head trauma, upper respiratory infections, tumors, and exposure to toxic chemicals or infections (Vokshoor & McGregor, 2011). The type of loss is classified by degree such as: absence (anosmia), decreased (hyposmia), or distortion (dysomia) (Vokshoor & McGregor, 2011).

2. Influence of auditory cues on the flavor perception

Investigating auditory cues and the effects they have on flavor perception has been fairly researched. The perception influences stem from more than just external cues. Internal cues, such as food-like biting sounds (Zampini & Spence, 2004) or sounds from mastication (Christensen & Vickers, 1981) can also pose an enhancing or diminishing effect on flavor perceptions and the degree of liking. The presence of auditory cues varying in pitch, tempo, or volume can have differing influences on both flavor perception and flavor liking.

2.1. Associations between auditory and flavor cues

It has been shown that an environment possessing a high pitch stimulus enhances the flavor perception of both sweet and sour attributes (Crisinel & Spence, 2010a; Mesz et al., 2011). Conversely when an environment presents a low pitch stimulus the perceptions of bitter and salt are enhanced (Crisinel & Spence, 2010a). Not only were perceptions enhanced, but also the association between sweet and sour perception with a high pitch stimulus was higher than the association between sweet and sour perception with a low pitch stimulus. The same is true for salt and bitter perception with a low pitch stimulus versus a high pitch stimulus (Crisinel &

Spence, 2010b). Crisinel and Spence (2010b) took their study even further by having subjects' pair bitter foods (i.e., coffee, beer, and dark chocolate) and sour foods (i.e., lime, lemon juice, and vinegar) with low and high pitch sounds. The results showed that the participants automatically paired the bitter foods with low pitch sounds and the sour foods with high pitch sounds (Crisinel & Spence, 2010a). In a study involving volume and flavor perceptions the authors found that when participants were presented with a loud background noise while consuming either salty or sweet foods the recorded perceptions varied (Woods et al., 2011). In the presence of loud noise the participants perceived the sweet items to have a higher intensity compared to detected salt perception in the salty items (Ferber & Cabanac, 1987). In addition, the participant's degree of liking was higher for the sweet samples versus the salty samples in a loud condition (Ferber & Cabanac, 1987). The authors claimed this effect was seen because loud noises increase stress, which triggers a sugar craving (Ferber & Cabanac, 1987).

2.2. Role of congruency in the cross-modal integration between auditory and flavor cues

As subjects consumed beer in the presence of a harmonized pitch their overall perception and liking was heightened (Holt-Hansen, 1976). A recent study used two music samples, one that was congruent to bitter foods and another that was congruent to sweet foods. While consuming toffee in the presence of the music samples the bitter soundtrack elicited a more intense bitter taste, whereas the sweet soundtrack elicited a more intense sweet taste (Crisinel et al., 2012a). Woods et al. (2011) used sound stimuli (i.e., loud, quiet, and silent white noise) with varying flavors of rice cakes. When consumed in differing volumes the perceived crunchiness varied. When consumed in the louder environment the subject perceived enhanced crunchiness compared to that of the quiet or silent condition (Woods et al., 2011). In much older studies it

has been determined that the amplitude of the mastication is directly related to the crispiness and therefore the quality, which in turn depicts the pleasantness (Zampini & Spence, 2004).

Meaning when mastication is loud the crispiness is perceived as high and possessing a good quality, therefore the overall food product would be perceived as pleasant. Many studies have shown that in addition to influenced pleasantness the hedonic ratings of liking for the product are also influenced when the subject produces enhanced sounds from chewing (Spence & Shankar, 2010). Zampini and Spence (2004) believe that when the background noise arises from the same source as the food being consumed the perception ratings are enhanced (Woods et al., 2011). A study was done to investigate the impact of the sound of bacon sizzling and chicken's clucking while participants consumed bacon and egg flavored ice cream. In the presence of the bacon sizzling sound, participants rated the bacon intensity and flavor higher in comparison to the presence of the clucking sound, even though all ice cream samples contained the same composition (Spence & Shankar, 2010).

When participants consumed beer in the presence of a changed or off pitch their positive perception diminished; subjects claimed the beer was weak, thin, watery, and bitter (Holt-Hansen, 1976). Contrary to Crisinel and Spence' results suggesting that bitter and salty tastes were associated with low pitch stimuli, a different study eluded that there does not seem to be an association between these food and pitch stimuli (Crisinel & Spence, 2010b). In a different study, when subjects were exposed to loud, quiet, and silent conditions of white noise and consumed both salty and sweet snack items the flavor perceptions were less intense in the loud condition (Woods et al., 2011). An explanation for this is that contrast effects may extend cross-modally, so that when a loud background cue is heard it decreases the intensity of the flavor or taste perception (van Wassenhove et al., 2008). When subjects consumed a soft pretzel in the

presence of loud noise or silence their perception of moisture was decreased in the loud condition compared to that of the silence (Masuda et al., 2008). While participants were exposed to loud, quiet, or silent conditions of white noise they were asked to consume various flavors of rice cakes. These sound stimuli were not related to crunchy or crispy biting sounds, but the authors found that the perception of crispiness was heightened in the loud condition as opposed to the quiet condition (Woods et al., 2011).

3. Influence of background music on food perception and eating behavior

From multiple studies and sources there is evidence that any one of the structural components whether it is tempo, pitch, or volume of background music may affect customers in the consumer or retail environment, adding to or detracting from the pleasantness of a stimulus (Herrington, 1996; Herrington & Capella, 1994; Novak et. al., 2010). However, some studies have looked further and suggest that the style of music is likely to have more of a significant effect on a consumer's perceptions and choices (Bruner, 1990). Additionally, the level of persuasion is enhanced when the music sample is appropriate for the context that it is presented in (MacInnis & Park, 1991).

3.1. Influences of background music on food perception

Atmospherics can be adjusted through lighting, layout, sounds, colors, and temperature, and may stimulate perceptual and emotional responses in consumers, affecting their behavior (Kotler, 1973), willingness to buy (Baker et al., 1992), mood (Bruner, 1990), and cognition (Herrington, 1996). Of the many environmental stimuli a shopper may encounter, background music has been identified as one of the most readily manipulated and influential elements

(Milliman, 1982, 1986). Additionally, emotional context of a musical composition can impact a listener's mood, which in turn may alter their behavior (Bruner, 1990; Gardner, 1985).

Customers enjoy shopping while listening to background music because it produces a sense of belonging and appreciation from the storeowners and employees (Linsen, 1975), along with feelings of relaxation (Keenan & Boisi, 1989). Managers of stores also saw the effects of background music on their customers, claiming that customers expressed positive moods and purchased more (Burleson, 1979). However, behavior differs according to the type of music played. For instance, shoppers may spend more time and money when the music "fits" with the product of purchase (Areni & Kim, 1993), closely matches the musical tastes of shoppers (Yalch & Spangenberg, 1993), or is perceived as appropriate for the setting (Herrington, 1996; Wilson, 2003).

3.1.1. Effects of music hedonicity

A consumer's level of liking for a particular music sample influences their evaluation on the object being consumed or evaluated (Murray et al., 1992; Park & Young, 1986). For instance, in a study conducted by Gorn (1982), subjects evaluated products more favorable when listening to liked music as compared to disliked. In a larger study, held in a university cafeteria, music samples of pop, classical, easy listening, and no music were presented to consumers. Participants perceived the cafeteria environment as upscale and were prepared to spend higher amounts of money in the presence of classical music in comparison to the other three conditions (North and Hargreaves, 1998). Similarly, music samples that were liked increased the participants' willingness to return and willingness to interact with others (North & Hargreaves, 1996). For those environments rated as peaceful or pleasant there tends to be a positive relationship between

the arousal level and the overall enjoyment levels. Faster music elicited higher levels of arousal leading to a positive relationship with customer satisfaction (Caldwell & Hibbert, 2002).

3.1.2. Effects of music genre

In the previously mentioned cafeteria study, with respect to genres, classical was associated with being upscale, less upbeat, dignified, and elegant whereas pop music was more upbeat, assertive, aggressive, and less peaceful (North & Hargreaves, 1998). A study carried out in a restaurant found significant differences among genres for atmospheric characteristics. Jazz music presented the most differences such as: perceived as the most invigorating, associated with highest willingness to pay, correlated with responses of customer service, and elicited feelings of happiness, fun, and fresh (Wilson, 2003), but once again classical music was considered upscale and sophisticated and pop was correlated with perceived service and feelings of excitement (Wilson, 2003).

Additionally, classical music tends to have a positive effect on spending and willingness to pay. In one study consumers purchased more expensive wine and more of it in the presence of classical music as opposed to Top 40 music (Areni & Kim, 1993). When classical music was played in a cafeteria, consumers expressed a higher willingness to pay for 14 items in comparison to easy listening or no music at all (North & Hargreaves, 1998). In a restaurant setting, patrons spent significantly more money when classical music was playing compared to pop or no music at all (North et al., 2003).

Perceptions of time have also been altered in the presence of music, whether they are passively exposed to it during consumption or actively listening to it in an experimental setting (Caldwell & Hibbert, 2002). While shopping, younger shoppers estimated their shopping time to

be shorter in the presence of Top 40 music as opposed to other background music, but the reverse was seen for older shoppers (Yalch & Spangenberg, 1990, 1993). Also investigating the effects on duration, along with the amount of money spent in a restaurant, a study showed that in the presence of classical music sales were lower than with popular music (Wilson, 2003). Classical music differed significantly from all other music samples in terms of appropriateness, as it was the least appropriate for the restaurant, showing a positive relationship between the perception of the restaurant and the perception of music played in that restaurant (Wilson, 2003). Interactions were also seen between style of music, perception of atmosphere, and alcohol consumption. For instance, in the presence of jazz music, atmospheric ratings and willingness to interact increased with the amount of alcohol consumed (Wilson, 2003). In the presence of classical music, greater amount of customers left from 8 p.m. to 10 p.m. in the evening, leaving fewer customers present in the restaurant after 11 p.m. (Wilson, 2003). Alcohol consumption, and therefore sales, decreased when classical music was played in the background (Wilson, 2003). Similarly, when music composed of lyrics regarding drinking were played in a bar participants ended up spending more time and more money at the establishment in comparison to a bar that was playing Top 40 music or “cartoon” music (Jacob, 2006). These investigations suggest that the type of music effects how long patrons remain in restaurants or bars.

Classical conditioning can be used to explain these effects of music on consumer evaluations, thus consumer liking of a product was dependent on whether it was presented with a liked or disliked music sample, transferring their positive feelings for the music to the product (Gorn, 1982; North and Hargreaves, 1996).

3.1.3. Effects of music volume

As seen in studies, the volume of the background music can influence shopping and dining pace (Smith & Curnow, 1966). In the presence of lower volumes, patrons shop and eat at a more leisurely pace than in the presence of higher volumes (Milliman, 1982, 1986; Smith and Curnow, 1966). As the volume of the surrounding music increases, a consumer within that environment tends to increase their rate of chewing (Smith & Curnow, 1966). The level of arousal in a music sample also affects behavioral activity; higher levels of arousal are associated with increased rates of activity and decreased amount of time spent on an activity (Caldwell & Hibbert, 2002; Novak et al., 2010; Smith & Curnow, 1966).

In a university restaurant, patrons were exposed to three music volumes, (i.e., soft, comfortable, and comfortable but slightly loud) and asked to evaluate several behavioral responses. In the presence of soft and comfortable music patrons were more likely to stay at the restaurant longer than planned as opposed to the comfortable but slightly loud condition (Novak et al., 2010). This may be due to an increase in pleasure, as a result of being able to communicate more with their tablemates in softer music (Novak et al., 2010). In addition, under the comfortable condition patrons were more likely to spend more money than they had planned compared to the comfortable, but slightly loud (Novak et al., 2010). The same volume effect was seen with the amount of time spent in grocery stores; when exposed to a louder volume shoppers spent less time in the store (Smith & Curnow, 1966). Furthermore, while shopping if the volume of background music in the store was not within the considered zone of tolerance, patrons were dissatisfied (Beverlan et al., 2006).

3.1.4. Effects of music tempo

In a few studies differing perceptual effects were seen due to altering the music tempo. When exposed to slower tempo music (60 bpm) patrons perceived the environment to be more peaceful compared to faster tempo music (80 bpm), furthermore patrons evaluated the presence of background music more peaceful than no music at all (North et al., 2000). Individuals also judged the duration of fast tempo music to be longer than slow tempo; similarly loud music is perceived as longer than quiet (Kellaris & Altsech, 1992; Kellaris & Kent, 1992).

Altering the tempo of background music has also had behavioral effects on consumers, for instance, customers eating at a restaurant with slow tempo background music ate the same amount of food as those eating in the presence of fast tempo, but drank more alcoholic beverages, which can be attributed to slower tempo music being more soothing and therefore creating a more relaxing environment (Milliman, 1986). Individuals also adjust their chewing behavior voluntarily or involuntarily according to the music tempo, so as the tempo increases their chews per minute also increase and vice versa (Milliman, 1982). Consistently, Milliman (1982, 1986) showed that slower music (< 72bpm) made traffic flow slower in stores and increased sales volume by 38% compared to faster tempo music (> 94bpm).

Similarly, music tempo influenced the speed of alcoholic beverage consumption at a bar; fast tempo led to faster consumption and slow tempo led to slower consumption (McElrea & Standing, 1992). The music tempo also influenced alcohol consumption at a restaurant affecting the average dollar amount spent on alcoholic beverages. While slow tempo music was playing restaurant goers spent, on average, 40% more on alcohol or consumed three more drinks per person than in the fast tempo condition, whereas the average dollar amount spent on food showed no significance between the two music conditions (Milliman, 1986). However, dissimilar

affects were seen in a few different studies. In one such study there were no affects seen with patrons in a supermarket due to tempo of the background music (Herrington, 1996), but in another study higher spending was seen in both food and beverage purchases for those that rated the music stimulus as enjoyable (Caldwell & Hibbert, 2002). This contradicts Milliman (1986), which suggests tempo only influences the dollar amount spent on drinks but not food. In cases as such, one of the more relevant issues is to distinguish music samples liked by consumer segments that frequent the restaurant (Caldwell & Hibbert, 2002). Although music tempo and preference were significantly related to time spent in the restaurant or other service environments several authors agree that musical preference is a more likely explanation for the association between music and behavior, but research design could also be a key influence (Caldwell & Hibbert, 2002; Herrington, 1996).

Roballey et al. (1985) tested Milliman's hypotheses that eating speed would decrease with slow tempo music (Milliman, 1982, 1986). Although there was an increase in number of bites per minute from no music to slow tempo to fast tempo, there was not a significant decrease in bites per minute in the presence of slow tempo music (Roballey et al., 1985). This may be due to an arousal effect, thus an increase in tempo results in increased productivity for noncomplex tasks (Mrudula, 1974), or due to the effect of improving efficiency, morale, safety, and increasing productivity or satisfaction in customers (Mussulman, 1974).

In addition, Roballey et al. (1985) examined Milliman's suggestion that when slow music was presented restaurant patrons ate at a more leisurely pace and took more time to eat meals before leaving (Milliman, 1982, 1986). In the presence of fast tempo music, eating speeds were significantly higher compared to slow tempo music and no music conditions, but there were no significant differences in the total time it took to complete a meal (Roballey et al., 1985).

Regardless of the music tempo there were no differences in whether patrons left before being seated, which may suggest that background music contributes to an approach environment (Milliman, 1986). In the case that tempo did contribute, patrons may exhibit either avoidance behavior by leaving the environment or approach behavior by remaining in the environment after a certain waiting period.

Another hypothesis test was that music would affect behavior without subjects' awareness (Roballey et al., 1985). After conducting the experiment no significant differences in subjects' awareness of background music were found (Roballey et al., 1985). However, when random customers were selected and asked outside of the store whether or not they recalled the music, there were no significant variations in awareness between the slow and fast tempo conditions (Milliman, 1982).

4. Musical components

Music is composed of many components including harmony, melody, instruments, tempo, pitch, volume, and lyrics giving it a musical texture (Bruner, 1990; Pachet & Cazaly, 2000). Collectively, these elements make up a soundscape, which is any aural field of interest with musical compositions (Schaefer, 1994, 1996). Places, environments, and specifically soundscapes, composed of atmospherics such as brightness, size, shape, volume, tempo, pitch, scent, freshness, softness, smoothness, and temperature have a greater influence on a product than the product itself (Milliman, 1986). In such cases where the emphasis is placed on the sound attributes in the environment it is important to understand not only the musical elements, but also the effects stemming from such stimuli. The various behavioral responses arise from the effects music poses on informational processing (Kellaris & Mantel, 1994), emotional and physiological

changes (Anand & Holbrook, 1985), mood (Alpert & Alpert, 1990), and classical conditioning (Gorn, 1982; North & Hargreaves, 1996). For example, in low involvement decisions, since mood influences cognitive processes, those in a positive mood state evaluate objects or events of interest as more favorable (Alpert & Alpert, 1990; Isen & Shalke, 1982). Although the genre is an important environmental characteristic, it is not responsible for the emotional impact, but rather the parts that make up the song in the genre are the driving forces (Pachet & Cazaly, 2000).

4.1. Genre

Musical genres are numerous, emerging, evolving, disappearing, and vary widely by popularity and longevity, making boundary work difficult (Lamont & Molnar, 2002). Several descriptions of ‘genre’ have surfaced from various researchers and studies. For instance, genre can be identified as a set of music pieces that share a distinctive musical language (van der Merwe, 1989), a system of orientations, expectations, and conventions that bind together an industry, performers, critics, and fans in making what they identify as a distinctive sort of music (Lena & Peterson, 2008), or an expression that governs artists’ work, their peer groups, and the audiences for their work (Becker, 1982; Bourdieu, 1993). Due to the various interpretations and ambiguous boundaries, a universal consensus on a definition for music ‘genre’ is lacking (Scaringella, Zoia, & Mlynek, 2006), but it can be defined as “a style or category of music” (Oxford University Press, 2010). To assist consumers in finding music selections, retailers produced a hierarchical structure of four levels: global music category (classical, jazz, rock, etc.), specific subcategories (classical > concertos or rock > hard rock), alphabetical ordering of artists’ name, and then album name (Pachet & Cazaly, 2000). The hierarchical links can stem

from connections of: genealogy (evolution), geography, aggregation, repetition, historical periods, or by specific subgenres (Pachet & Cazaly, 2000). However, this system does not omit all inconsistencies as artists produce music titles, which may belong to different musical categories within a given album (Pachet & Cazaly, 2000).

Some music forms like rock-n-roll become very popular and last over a long period of time, others are very popular but die quickly like disco (Brewster & Broughton, 2000), and some like polka thrive over many decades without becoming widely popular (Shepherd et al., 2005). From previous studies, some common genres are classical, pop, easy listening, and jazz (North & Hargreaves, 1998). Although boundaries are ambiguous genres have some unique characteristics to help categorize. Music pieces of high complexity and sophistication, written in a score to identify rhythm, pitch, and coordination tend to fit into the classical genre (Grout, 1973). Classical music is composed mainly of orchestra families such as strings, woodwinds, brass, and percussion to arrange pieces like concertos, operas, and symphonies (Grout, 1973). Phrasing, harmonization, modulation, and texture are common characteristics of classical music that can typically be detected by the human ear (Grout, 1973). Blue notes, call-and-response, improvisation, polyrhythm, syncopation, and the swing note of ragtime are all unique components of music pieces in the jazz genre, which contains many subgenres including New Orleans Dixieland, big band style swing, bebop, jazz fusions, and cool jazz (Borneman, 1969). Typically the instruments used to produce jazz music are those of brass, reeds, and some drums (Borneman, 1969). Genre of rock music containing subgenres of soft rock, heavy metal, hard rock, progressive rock, and punk rock is typically identified by the blues-based, fast, danceable, and catchy sound (Keightley, 2001). The quartet of guitarist, lead singer, bass guitarist, and drummer that is commonly found in rock music supply the three cords, strong, insistent back

beat, and catchy melody, unique to the rock genre (Keightley, 2001). The hip-hop genre is one of the easier ones to identify due to its' stylized rhythm capable of including rapping, which is chanting rhyming speech (Crossley, 2005). Other stylistic elements that have made hip-hop flourish in the recent decades may include, MCing, scratching, break dancing, beatboxing, and graffiti writing (Crossley, 2005).

Music acts on the nervous system like a key on a lock by activating a pathway of reactions. Brain processes begin, altering the mood state and linked emotional reaction, resulting in a visible behavioral response (Bruner, 1990; Clynes & Nettheim, 1982; Gardner, 1985; Herrington, 1996). When investigating effects of emotional context of a musical composition, results showed happy music produced happier moods, whereas sad music produced higher purchase intentions, suggesting that varying music structure can evoke different moods and purchase intentions (Alpert & Alpert, 1986, 1988). For instance, during a cognitive task in the presence of a “stimulating” music sample, participants mean emotionality was elevated, whereas in the presence of a “sedating” music sample or control, group means decreased (Smith and Morris, 1976). Another study found that genres made of complex harmonies evoked feelings of agitation and sadness rather than feelings of serenity and happiness resulting from a simple harmony (Cooke, 1962; Zettl, 1973). The texture of a musical stimulus contributes to the observed behavioral response based on the makeup of instruments. For instance, brass songs are associated with triumphant emotions, woodwinds with mournful, pianos with brilliant, and strings with glad (Gundlach, 1935). However, this systematic pathway is susceptible to change as musical preferences vary with music structural characteristics (Kellaris, 1992), music complexity (Burke & Gridley, 1990), listener's age (Yalch & Spangenberg, 1993), musical knowledge

(Vanderark & Ely, 1993), cultural background (Wright, 1975), and music familiarity (Davies, 1991).

4.2. Tempo

Descriptors like speed and time help define tempo, one of many musical texture attributes. Proportional to the speed of music or noise, tempo, can be defined as the beats per minute (bpm) or rate at which a rhythm progresses (Milliman, 1986; Webster & Weir, 2005; Wilson, 2003). Since individual differences like age and other demographic characteristics dictate an acceptable tempo range, defining the boundaries of fast and slow is difficult (Milliman, 1986). In fact the ambiguity may go as far as masking true effects of any given tempo (Caldwell & Hibbert, 2002). Even with thorough research a discrepancy still stands as one classifies 72 bpm or less as slow tempo music and 92 bpm or more as fast tempo (Milliman, 1986), whereas another considers 60-65 bpm to be slow tempo music and 90 bpm or more as fast tempo (Milliman, 1986). In fact, Milliman (1982) used slow tempo music with an average of 60 bpm and fast tempo music with an average of 108 bpm. An additional study utilized a favorable tempo range of 70-110 bpm (Bruner, 1990). Researchers claim that tempo varies with context, which is accounted for when the wider spread range is used (Dowling & Harwood, 1986; Fraisse, 1982; Holbrook & Anand, 1988). In general, studies show that tempo influences perceptions of music's appeal, arousal, and behavioral intentions toward the music (Kellaris & Kent, 1991). Consistencies throughout studies show that fast tempo music elicits happy and pleasant emotions, whereas slow tempo music elicits tranquil, sentimental, and solemn emotions (Hevner, 1937). Fast tempo music is also known to evoke exhilarating or joyous feelings (Hevner, 1937). An association can be made between tempo and arousal through evidence that

faster tempos may elicit higher emotional responses, leading to higher arousal levels (Anand & Holbrook, 1985). According to Caldwell and Hibbert (2002), listeners prefer music with more arousing structural elements, in this case, faster tempo.

4.3. Pitch

The music structural component, pitch, is the relative lowness or highness of a given noise measured in hertz, as it is based on the frequency of vibration and the size of the vibrating object (Bruner, 1990). Therefore, high pitch is a result of smaller objects vibrating faster and slow pitch is a result of larger objects vibrating slower (Bruner, 1990). A sequence of notes over a period of time throughout a song is referred to as a melody, which can be arranged using the central note, scale, and chord, collectively known as the music key (Bruner, 1990). Pitch and melody are positively correlated, as the melody ascends, the pitch heightens; conversely, as the melody descends so does the pitch (Bruner, 1990). There are also two scales, major and minor, composed of a series of notes that go in either ascending or descending pitch, beginning and ending with the same note (Bruner, 1990).

Frequency, which is measured in hertz, is directly proportional to the pitch. Therefore, a sound with a high frequency will have a high pitch and a sound with a low frequency will have a low pitch (Haskel & Sygoda, 1996). Humans are unable to hear sounds at all frequencies, rather healthy individuals have a hearing range of 20 to 20,000 Hz (Haskel & Sygoda, 1996). A human's heartbeat is typically registered at a frequency of 1 or 2 Hz, which is too low for a human ear to detect (Cutnell & Johnson, 1998). On the opposite end, sonar sounds produced by dolphins exceed the human pitch range (Cutnell & Johnson, 1998).

As the pitch of a song rises or falls the intensity of a listener's emotions grow or diminish, respectively. Thus far, there is a strong association between pitch and perceived happiness; a high pitch music stimulus comes across as more exciting or happy in comparison to a low pitch music stimulus, which is perceived as sad (Gundlach, 1935; Hevner 1937; Rigg 1940; Watson 1942). Similarly, songs arranged in higher keys and major modes elicit happier, more animated, and positive feelings compared to those in lower keys and minor modes (Cooke, 1962; Zettl, 1973). Consistent results were seen in two other studies as well, in that stimuli presented in major modes created dynamic positive expressions that were happy, bright, and playful as opposed to plaintive, angry, or mysterious expressions produced from stimuli in a minor mode (Hevner, 1935; Scherer & Oshinsky, 1977).

4.4. Volume

A dynamic property of noise or music that interprets the magnitude of a perceived note, sound, tone, or musical composition is commonly known as the volume (Novak et al., 2010). Volume is measured in decibels (dB), a unit capable of quantifying sound levels relative to a 0 dB reference in order to compare with a typical threshold of perception for a human ear (Novak et al., 2010). Because the human ear has a large dynamic range and a high tolerance for sound intensity decibels are expressed in logarithmic units. Human hearing is not equally sensitive across all sound frequencies, being less sensitive at low frequencies than at high frequencies (Novak et al., 2010). In order to correct for this a-weighted system is built into a sound level meter providing adjusted measurements (dBa), expressed using the relative loudness perceived by the human ear (Kryter, 1994).

The softest sound a person can hear with normal hearing is at 0 dBa/dB, which is used as the point of reference (Novak et al., 2010). From a past study an average range of adjusted noise levels was recorded as 50.5 dBa to 90 dBa. The soundscape of an environment is dynamic dependent on music volumes, but also the volumes of ambient noise created by patron conversations, which increases with the number of patrons (Korn, 1954; Novak et al., 2010; Webster & Klumpp, 1962). To compensate for the background music volume, an involuntary response known as the Lombard effect is elicited, which is an increase in vocal effort (Korn, 1954; Webster & Klumpp, 1962). Taking this effect into consideration further research determined a preferred range of background noise plus music levels to be 59.6 dBa to 64.4 dBa, insinuating that restaurant owners should use this range as a target to optimize pleasure and overall satisfaction in restaurants (Novak et al., 2010). Additionally, the highest levels of pleasure were observed in the presence of 62 dBa to 67 dBa sound levels (Novak et al., 2010).

Similar to other musical components, volume can affect a listener's emotions and behavior. In a study when sounds were played at an optimum level there were significant effects on pleasure eliciting a continuum of effects (Novak et al., 2010). Participants were in a pleasurable mood, eliciting a positive response, causing repeat customer intentions and overall satisfaction (Novak et al., 2010). Although optimum volume levels show effects, both quiet and loud volumes do as well. Cooke (1962) shows that under louder volumes feelings of liveliness, energy, and/or agitation are experienced in comparison to peaceful, gentle, and dreamy feelings in a quieter environment. From a marketers perspective volume may pose implications for targeting particular consumers. For example, Kellaris and Rice (1993) found that females responded more positively to music at lower volumes than males. The influences seen from volume on emotion and behavior can potentially be explained by Mehrabian and Russel's

approach and avoidance behavior model. Focusing on volume as the environmental stimulus, emotions and behavior are influenced; in turn triggering a particular behavioral response of either staying or leaving the environment of interest, known as approach or avoidance behaviors, respectively (Novak et al., 2010).

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**CHAPTER 3 – BACKGROUND MUSIC GENRE CAN MODULATE FLAVOR
PLEASANTNESS AND OVERALL IMPRESSION OF FOOD STIMULI**

ABSTRACT

Although we frequently consume foods with background music, relatively little is known about influences of background music on food acceptance. This study aimed to determine whether background music genre can alter food perception and acceptance, but also to determine how the effect of background music can vary as a function of type of food (i.e., emotional versus non-emotional foods) and source of music editor (i.e., single versus multiple editors). The traditional music piece (“Air on the G string”) was edited into four genres: classical, jazz, hip-hop, and rock, by either a single editor or multiple editors. Milk chocolate and bell pepper were selected as the emotional and non-emotional foods, respectively, based on preliminary survey results. Ninety-nine participants were assigned to Group SE (receiving four music genres arranged by a single editor) or Group ME (receiving four music genres arranged by multiple editors). Following consumption, participants were asked to rate flavor intensity, flavor pleasantness, texture impression, and overall impression of chocolate and bell peppers in the presence of the four musical stimuli. There were no significant effects of music genre on ratings of flavor intensity, flavor pleasantness, and texture impression for food stimuli. However, participants liked food stimuli significantly more while listening to the jazz stimulus than the hip-hop stimulus. Further, the influence of background music on overall impression was present in the emotional food (i.e., chocolate), but not in the non-emotional food (i.e., bell peppers). In addition, ratings of flavor pleasantness and overall impression for food stimuli differed between music genres arranged by a single editor (Group SE), but not between those by multiple editors (Group ME). In conclusion, our findings provide new empirical evidence that background music genre can alter flavor pleasantness and overall impression of food stimuli. Furthermore, the

influence of music genre on food acceptance can vary as a function of the type of food served and the source of music editor.

1. Introduction

Think about the last time you stepped foot in a restaurant or bar. Do you remember what type of background sounds filled the atmosphere? It is apparent that people often consume foods and beverages in the presence of background sound, in addition to sounds produced by mastication or drinking. Nevertheless, little attention has been paid to the influence of background sound on sensory perception and acceptance of foods.

The Mehrabian-Russel (MR) model (Mehrabian & Russel, 1974) proposes that individuals respond emotionally to environmental stimuli such as background music, leading to an approach-avoidance behavior to the stimuli. Approach behaviors include a willingness to move towards, stay in, perform well in, and return to the environmental stimuli, whereas avoidance behaviors are opposing (Donovan & Rossiter, 1982). In service environments, approach-avoidance behaviors are also seen in spending behavior, shopping time, and evaluations of environment and service experience (Donovan & Rossiter, 1982; Herrington & Capella, 1996). In fact, previous research has shown that background sounds, whether it is music or noise, affect what is consumed or purchased (Areni & Kim, 1993; North, Hargreaves, & McKendrick, 1997), the amount consumed (Caldwell & Hibbert, 1999; Gueguen, Guellec, & Jacob, 2004), the consumption rate (Milliman, 1986), the dollar amount spent (Jacob, 2006; Milliman, 1986), and the sensory perception and pleasantness (Seo & Hummel, 2011; Seo, Gudziol, Hähner, & Hummel, 2011; Seo, Hähner, Gudziol, Scheibe, & Hummel, 2012; Spence, Shankar, & Blumenthal, 2009; Stafford, Fernandes, & Agobiani, 2012; Woods et al., 2011; for reviews see Spence & Shankar, 2010; Spence, 2012). For example, it has been shown that fast tempo sounds cause consumers to eat at a faster rate (i.e., more bites per minute) than slow tempo sounds (Milliman, 1986). Fast tempo music also leads patrons to spend more money in a

restaurant than slow tempo music (Caldwell & Hibbert, 2002). In addition, loud noises decrease perceived intensities of taste stimuli in foods when compared to quiet noises (Woods et al., 2011; but also see Stafford et al., 2012). Altogether, previous studies highlight the impacts of specific musical components such as tempo, pitch, timbre, loudness, and complexity on consumers' eating and shopping behavior.

The current study focuses on the impact of music genre on food perception and acceptance. Due to ambiguous boundaries there has not been universal consensus on a definition for music "genre" (Scaringella, Zoia, & Mlynek, 2006), but it can be characterized as "a style or category of art" (Oxford University Press, 2008). Given that musical components such as pitch, tempo, timbre, and complexity are different between music genres, we would expect that musically evoked emotions vary between music genres. In fact, fast tempo and major mode elicit happiness, whereas slow tempo and minor mode induce sadness (Peretz, Gagnon, & Bourchard, 1998). Further, Rentfrow and Gosling (2003) classified 14 different genres of music into four dimensions. For example, the "reflective and complex" dimension included blues, classical, jazz, and folk music pieces and the "intense and rebellious" dimension contained rock, alternative, and heavy metal pieces. In addition, country, sound tracks, religious, and pop music pieces were placed into the "upbeat and conventional" dimension, whereas rap/hip-hop, soul/funk, and electronica/dance music pieces were attributed to the "energetic and rhythmic" dimension. Similarly, Zentner, Gandjean, and Scherer (2008) demonstrated that classical and jazz music listeners commonly experience the "complex/reflective" emotion (e.g., tender longing, amazement, spirituality, and peacefulness), whereas techno and Latin American music listeners often experience the "energetic" emotion (e.g., activation). In addition, the "rebellious" emotion (e.g., revolt and anger) was more common in the listeners of pop/rock music. Likewise, the

variations between genres in the music-elicited emotions may lead to an approach-avoidance behavior (Mehrabian & Russel, 1974), resulting in the difference in food perception and acceptance between genres of background music. In fact, it has been reported that emotions affect sensory perception, pleasantness, and food choice (Gibson, 2006; Nakagawa, Mizuma, & Inui, 1996; Pollatos et al., 2007; Seo & Hummel, 2011). For example, in an unpleasant emotional state, odor stimuli are perceived less pleasant and/or more intense (Pollatos et al., 2007; Seo & Hummel, 2011). Therefore, combining the evidence that 1) music-elicited emotions are different between music genres (Rentfrow & Gosling, 2003; Zentner, Gandjean, & Scherer, 2008) and 2) emotions affect sensory perception, pleasantness, and food choice (Gibson, 2006; Nakagawa et al., 1996; Pollatos et al., 2007; Seo & Hummel, 2011), the present study was designed to examine effects of music genre on sensory perception and impression for food stimuli by presenting four music genres: classical, jazz, hip-hop, and rock. Based on previous findings of musically evoked emotions (Rentfrow & Gosling, 2003; Zentner et al., 2008), the four music genres used in the current study can be grouped into three groups: 1) classical and jazz stimuli, 2) hip-hop stimulus, and 3) rock stimulus. Therefore, it would be expected that three music groups elicit different emotions, leading to variation in sensory perception and impression for food stimuli.

People tend to consume sweet and fatty foods to alleviate stress (Gibson, 2006). Also, emotional eating shows a significant correlation with the consumption of energy dense and sweet foods, but not with the consumption of vegetables and fruits (Konttinen, Männistö, Sarlio-Lähteenkorva, Silventoinen, & Haukkala, 2010). These findings mean that certain foods (e.g., “emotional foods”) seem more suitable to mediate emotions. Therefore, an additional aim was to answer how the effect of background music on sensory perception and impression can vary

between emotional and non-emotional foods. On the basis of the two ideas: 1) music-elicited emotions play an important role in modulating the effect of music genre on food perception and acceptance and 2) sensory perception and liking for certain foods such as chocolate are more influenced by emotional status, we hypothesized that the impact of music genre on sensory perception and impression for food stimuli would be more pronounced in emotional foods such as chocolate than in non-emotional foods such as bell peppers.

Even though two different playlists perform an identical music piece, listeners often show different emotional responses to their performances. In addition, music pieces arranged by two different editors do not elicit the same emotion although both music pieces are placed into an identical genre of music. In fact, earlier studies have illustrated that identical music pieces can be altered through editing mechanisms, which may lead to differences in musically evoked emotion (Hailstone, Omar, Henley, Frost, Kenward, & Warren, 2009; Livingstone, Muhlberger, Brown, & Thompson, 2010). To focus on the influence of music genre on food perception and acceptance, four music genres were transformed from a traditional music piece (“Air on the G string”), lessening potential influences of music familiarity and preference (Davies, 1991; Fontaine & Schwalm, 1979; Gorn, 1982; Russell, 1987). In addition, the four music genres were edited and played by either a single or multiple music editors, allowing us to determine whether the effect of music genre on sensory perception and impression for food stimuli can be dynamic as a function of source of music editor (i.e., single editor versus multiple editors). Music pieces arranged by a single editor/performer can minimize emotional variations that may be elicited by multiple editors/performers, allowing the emphasis to be placed on the impact of music genre on food perception and acceptance. Therefore, it would be expected that the difference in sensory

perception and impression for food stimuli is more obvious between four music genres arranged by a single editor/performer than between those arranged by multiple editors/performers.

As mentioned above, the overall purpose of this study is to determine whether background music genres can influence sensory perception and impression for foods consumed simultaneously, in addition to determining the influences as a function of type of food (i.e., emotional versus non-emotional foods) and source of music editor (i.e., a single versus multiple editors/performers). Currently, atmospheric characteristics such as background music commonly go overlooked and underappreciated. This study will provide foodservice professionals and business owners with valuable and concise explanations as to how their consumers will behave in a given background music filled environment.

2. Materials and methods

2.1. Participants

A total of 99 healthy volunteers (53 females and 46 males) with an age range from 18 to 30 years [mean age \pm standard deviation (SD) = 21 ± 3 years] took part in this experiment. In this study, Western musical pieces (see below) were presented to all participants. To control participants' familiarity with the music samples, only North American people were considered for this study. Prior to the experiment, all participants reported no clinical history of major diseases including diabetes, cancer, cardiovascular diseases, and renal diseases. They also reported no smelling, tasting, or hearing impairments. All participants proved to have no impairments in gustatory and auditory function based on results of the following tests: "taste spray" test (Burghart Instruments, Wedel, Germany; for details see Vennemann et al., 2008) and "tuning fork" test (Doyle et al., 1984), respectively. Based on order of their appearance,

participants were assigned to Groups SE (25 females and 23 males; mean age of 21 years) or ME (28 females and 23 males; mean age of 21 years). Music samples presented differed between the two groups (see below). The two groups were not significantly different in either participants' mean age ($t_{97} = -0.78, P = 0.44$) or sex ratio ($\chi^2 = 0.08, P = 0.84$). All participants were informed thoroughly about the experimental procedure and provided informed written consent before participation.

2.2. Musical stimuli

As an auditory cue, the traditional music piece: “Air on the G string” (an adaptation by August Wilhelmj of the Air, the second movement in the Orchestral Suite No. 3 in D major, BWV 1068, composed by Johann Sebastian Bach) was arranged into four different genres: classical, hip-hop, jazz, and rock. Musical editing was performed by an individual editor/playlist and also by multiple editors/playlists. Specifically, an individual editor/playlist arranged the traditional music (Air on the G string) into four different genres using digital audio workstations: the GarageBand '11 (version 6.0.5., Apple Inc., Cupertino, CA) and the Finale (version 2011b.r2, MakeMusic, Inc., Eden Prairie, MN). The music pieces arranged by multiple editors/playlists were commercially available except for the hip-hop stimulus. The musical components, key and tempo, of the pieces used in this study, are shown in Table 3.1. To minimize occurrence of first-order-carry-over effect (Macfie, Bratchell, Greenhoff, & Vallis, 1989), a second music piece (Mozart, 12 Variations in C, K.265) was used as a warm-up sample prior to onset of the main experiment. Plemmons and Resurreccion (1998) reported that a warm-up sample increased reliability of ratings in sensory testing. Using a sound editor program (Power Sound Editor Free, ver. 6.9.6., PowerSE Co., Ltd.), all musical stimuli were edited to last

five minutes and were administered through headphones (Model MDR-W08L, Sony, Tokyo, Japan) at a volume of 75dB.

Table 3.1.
Key and tempo of musical stimuli used in genre study

	Music genre			
	Classical	Jazz	Hip-hop	Rock
Musical stimuli arranged by a single editor/performer				
Key	D Major	D Major	D Major	D Major
Tempo	82 bpm	102 bpm	100 bpm	100 bpm
Musical stimuli arranged by multiple editors/performers				
Key	D Major	D Major	D Major	D Major
Tempo	40 bpm	80 bpm	72 bpm	90 bpm

2.3. Food stimuli and presentation

The food stimuli used in this study were selected based on a preliminary survey associated with “emotional foods.” A total of 150 volunteers (92 females and 58 males) with an age range from 18 to 76 years (mean age \pm SD = 38 \pm 15 years) participated in the survey (Appendix 1.1). Participants selected foods they consume when their mood or emotion is altered from a predetermined list of 29 frequently consumed foods. Foods having the highest and lowest selections were chosen for the experiment. From the results (Appendix 1.2), chocolate ($N = 92$) and bell pepper ($N = 3$) were chosen as the emotional and non-emotional foods, respectively.

With this being considered, milk chocolate (The Hershey Co., Hershey, PA) and red bell peppers (Wal-Mart Distributor, Fayetteville, AR) were selected. These food stimuli were purchased from the local supermarket one day before the experiment. The chocolate was stored at room temperature and prior to serving it was broken into bite size pieces (3.5 x 2.0 x 0.5 cm).

Bell peppers were stored in a refrigerator (4 °C) and taken out one hour prior to evaluation in order to reach room temperature, then sliced into small pieces (3.5 x 3.0 x 0.5 cm).

2.4. Procedure

A constant experimental setting, including ambient temperature (20 °C), was maintained throughout the entire experiment. Data collection was obtained using a computerized sensory data acquisition system, Compusense[®] five (Release 4.6-SP3, Compusense Inc., Guelph, ON, Canada). Participants were seated in individual sensory booths on a chair 70 cm from a computer monitor. They were instructed to place headphones snugly on their ears. Once participants were logged into the computer system, they were asked to rate their overall mood and hunger level using two 15-cm line scales ranging from 0 (extremely unpleasant; extremely hungry) to 15 (extremely pleasant; extremely full), respectively.

At once, all participants were administered a warm-up musical stimulus. Subsequently, 45 s after initial music presentation, a piece of bell pepper (3.5 x 3.0 x 0.5 cm) placed in a soufflé cup with a three-digit code was presented. After consuming the food and musical stimuli simultaneously, participants were asked to rate flavor intensity and pleasantness on two 15-cm line scales ranging from 0 (extremely weak; extremely unpleasant) to 15 (extremely strong; extremely pleasant), respectively. Then, using two 15-cm line scales ranging from 0 (extremely dislike) to 15 (extremely like), participants were asked to rate the food sample in terms of texture impression and overall impression.

After a 60 s break, all participants were presented with eight pairs of musical and food stimuli (i.e., four music genres x two food stimuli) in a sequential monadic fashion according to the Williams Latin Square design (Williams, 1949). The musical stimuli presented varied

between the two groups of participants; the four musical stimuli arranged by a single editor/performer were presented to Group SE and those arranged by multiple editors/performers (e.g., commercial pieces) were presented to Group ME. Forty-five seconds after the onset of music presentation, either chocolate or bell pepper in a soufflé cup with a three-digit code was presented. After consuming food stimuli in the presence of musical stimuli, participants were asked to rate flavor intensity and pleasantness using two 15-cm line scales ranging from 0 (extremely weak; extremely unpleasant) to 15 (extremely strong; extremely pleasant), respectively. Participants were also asked to rate the food sample in terms of texture impression and overall impression on two 15-cm line scales ranging from 0 (dislike extremely) to 15 (like extremely). Next, all participants were asked to assess their familiarity of the music sample using a 15-cm line scale ranging from 0 (extremely unfamiliar) to 15 (extremely familiar). Using two 9-point category scales ranging from 1 (extremely unpleasant; extremely non-stimulating) to 9 (extremely pleasant; extremely stimulating) participants assessed pleasantness and stimulation of the presented musical stimulus, respectively. The time interval between stimuli presentations was approximately 60 s. During the break, spring water was provided for palate cleansing in silence. Participants were instructed to refrain from removing their headphones until the entire experiment was completed.

2.5. Data analysis

Data analysis was conducted using SPSS 21.0 for WindowsTM (IBM SPSS Inc., Chicago, IL, U.S.A.). The Shapiro-Wilk Normality test (Shapiro & Wilk, 1965) concluded that the null hypothesis stating the data came from a normally distributed population was rejected for ratings

of flavor intensity, flavor pleasantness, texture impression, and overall impression for the food stimuli ($P < 0.05$). Therefore, non-parametric statistical methods were executed for data analysis.

To test whether ratings for sensory perceptions and impressions of identical stimuli (i.e., bell peppers with traditional music) were significantly different between Groups SE and ME, the nonparametric Mann-Whitney U -tests were used. When determining whether these perceptions and impressions were altered as a function of musical stimuli, the non-parametric Friedman test (Friedman, 1937) was performed. When the Friedman test indicated a statistical significance, the Wilcoxon signed-rank test was used for further analysis of individual paired comparisons. In addition, the Friedman test determined whether musical stimuli ratings for familiarity, pleasantness, and stimulation differed between the four musical genres. Finally, non-parametric Spearman correlation analysis was conducted to examine relationships for individual ratings of musical and food stimuli.

3. Results

Comparison between Groups SE and ME in participants' ratings for warm-up stimuli

Initially, all participants from Groups SE and ME were asked to evaluate sensory perceptions and impressions of bell peppers in the presence of the traditional music piece (Mozart, 12 Variations in C, K.265). This task was designed not only to minimize first-order-carry-over effect (Macfie et al., 1989; Plemmons & Resurreccion, 1988), but also to verify that ratings for sensory perceptions and impressions of certain stimuli (i.e., bell peppers with traditional music) between Groups SE and ME lack significant differences.

Mann-Whitney U -tests showed that participants' ratings for overall mood ($U = 987.50$, $P = 0.10$) and hunger level ($U = 1216.50$, $P = 0.96$) were not significantly different between

Groups SE and ME. Flavor intensity ratings ($U = 1148.00$, $P = 0.60$) along with ratings for flavor pleasantness ($U = 1217.50$, $P = 0.96$), texture impression ($U = 1085.50$, $P = 0.33$), and overall impression ($U = 1206.00$, $P = 0.90$) of bell peppers in the presence of traditional music were not significantly different between Groups SE and ME. Ratings for music pleasantness ($U = 1038.00$, $P = 0.18$) and music stimulation ($U = 1151.50$, $P = 0.61$) showed no significant differences between Groups SE and ME. However, Group SE (mean \pm SD = 11.61 ± 3.62) showed significantly higher ratings for music familiarity than Group ME (9.64 ± 2.73) ($U = 987.50$, $P = 0.02$).

Background music-elicited sensory perception and impression

To examine overall influence of background music genre on sensory perception and impression of food stimuli, we combined data of Groups SE and ME. There were no significant effects of music genre on ratings of flavor intensity ($\chi^2 = 0.53$, $df = 3$, $P = 0.91$), flavor pleasantness ($\chi^2 = 3.32$, $df = 3$, $P = 0.35$), and texture impression ($\chi^2 = 2.63$, $df = 3$, $P = 0.45$). However, ratings of overall impression for food stimuli significantly differed across four musical stimuli ($\chi^2 = 8.34$, $df = 3$, $P = 0.04$). Specifically, participants liked food stimuli significantly more in the presence of the jazz stimulus than in the presence of the hip-hop stimulus ($P = 0.02$).

Comparison between emotional and non-emotional foods in the background music-elicited sensory perception and impression

Chocolate

As shown in Figure 3.1 there were no significant effects of music genre on the ratings of flavor intensity ($\chi^2 = 1.42$, $df = 3$, $P = 0.70$), flavor pleasantness ($\chi^2 = 1.42$, $df = 3$, $P = 0.70$), and

texture impression ($\chi^2 = 4.87$, $df = 3$, $P = 0.18$). However, Figure 3.1 shows that overall impression of food stimuli was significantly different between musical stimuli ($\chi^2 = 9.61$, $df = 3$, $P = 0.02$). That is, chocolate was rated more pleasant with the jazz stimulus than with the hip-hop ($P = 0.02$) and the rock stimuli ($P < 0.01$).

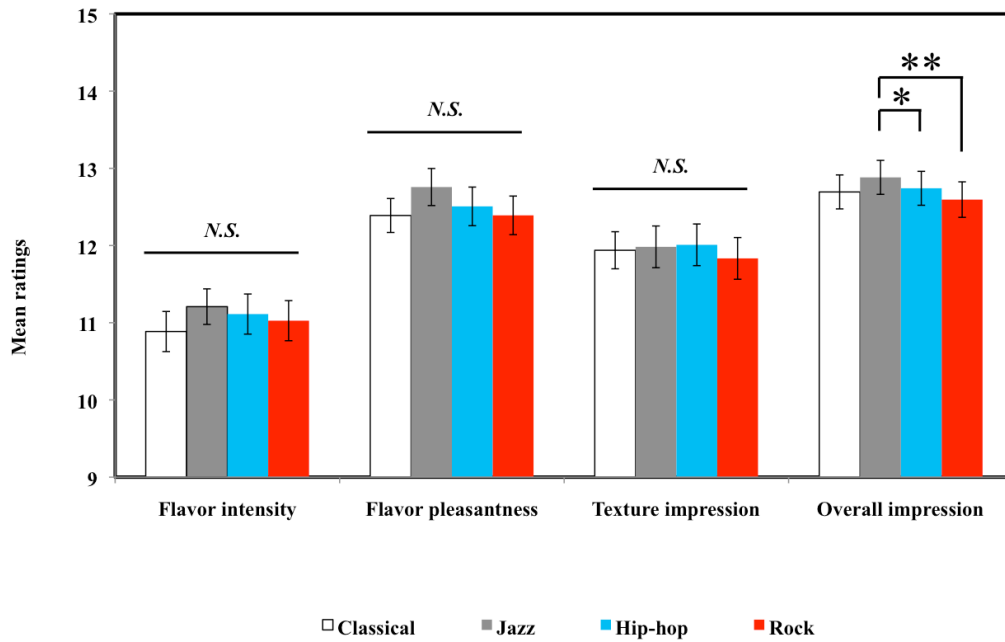


Figure 3.1. Mean ratings of flavor intensity, flavor pleasantness, texture impression, and overall impression for chocolate across the four musical stimuli. The *N.S.* indicates no significance at $P < 0.05$. * and ** indicate significance at $P < 0.05$ and $P < 0.01$, respectively. Error bars represent the standard errors of the means.

Bell peppers

Table 3.2 presents mean ratings of flavor intensity, flavor pleasantness, texture impression, and overall impression for bell peppers as a function of music genre. As viewed in Table 3.2 across four musical stimuli, there was no significant difference in ratings of flavor intensity ($\chi^2 = 0.53$, $df = 3$, $P = 0.91$), flavor pleasantness ($\chi^2 = 1.58$, $df = 3$, $P = 0.67$), texture impression ($\chi^2 = 2.39$, $df = 3$, $P = 0.50$), or overall impression ($\chi^2 = 6.00$, $df = 3$, $P = 0.11$) of bell peppers.

Table 3.2.

Mean ratings (\pm standard deviation) of flavor intensity, flavor pleasantness, texture impression, and overall impression for bell peppers across the four musical stimuli.

	Music genre			
	Classical	Jazz	Hip-hop	Rock
Flavor intensity	9.52 (\pm 3.31)	9.11 (\pm 3.31)	9.28 (\pm 3.47)	9.24 (\pm 3.51)
Flavor pleasantness	8.38 (\pm 3.60)	8.27 (\pm 3.30)	7.91 (\pm 3.64)	8.10 (\pm 3.46)
Texture impression	9.18 (\pm 3.30)	9.20 (\pm 3.31)	8.78 (\pm 3.37)	9.08 (\pm 3.31)
Overall impression	8.84 (\pm 3.25)	8.44 (\pm 3.39)	8.19 (\pm 3.59)	8.53 (\pm 3.26)

Comparison between musical stimuli arranged by a single and multiple editors/performers in background music-elicited sensory perception and impression

Single editor/performer

Flavor intensity ratings of food stimuli were not significantly different across four musical stimuli ($\chi^2 = 0.55$, $df = 3$, $P = 0.91$). Likewise, ratings for texture impression of food stimuli were not significantly different among musical stimuli ($\chi^2 = 5.63$, $df = 3$, $P = 0.13$), as shown in Figure 3.2.

Figure 3.2 displays ratings of flavor pleasantness for food stimuli, which were significantly different as a function of music genre ($\chi^2 = 11.66$, $df = 3$, $P < 0.01$). Subsequently, participants liked food flavors when presented with the jazz stimulus significantly more than when presented with the hip-hop stimulus ($P < 0.01$). Similarly, ratings of overall impression for food stimuli significantly differed across the four musical stimuli ($\chi^2 = 11.10$, $df = 3$, $P = 0.01$). Participants liked food stimuli while listening to the hip-hop stimulus significantly less than while listening to other stimuli: classical ($P = 0.02$), jazz ($P < 0.001$), or rock ($P = 0.01$).

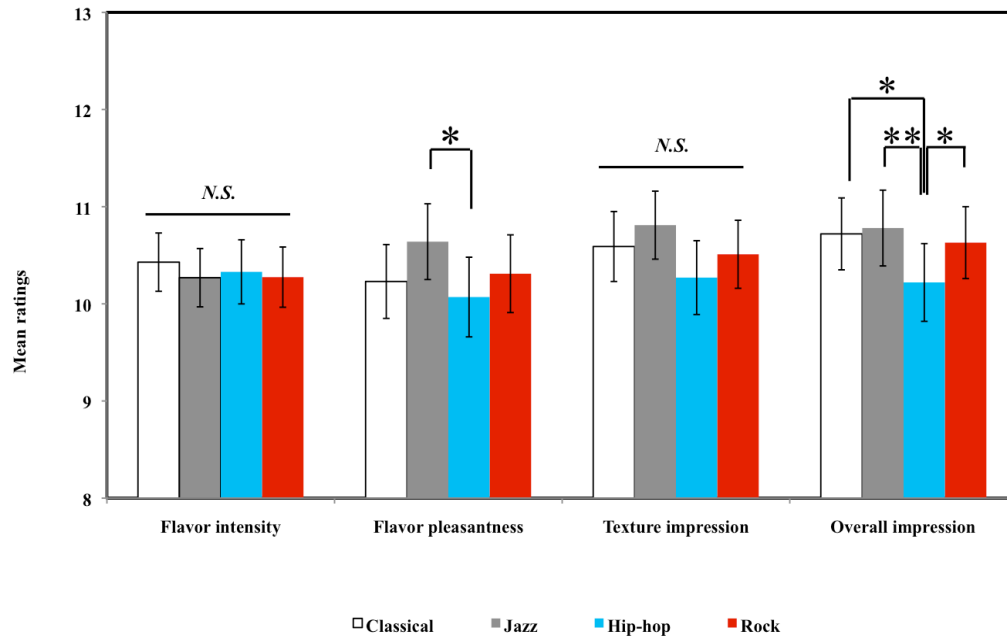


Figure 3.2. Mean ratings of flavor intensity, flavor pleasantness, texture impression, and overall impression for food stimuli across the four musical stimuli arranged by a single editor/performer. The *N.S.* indicates no significance at $P < 0.05$. * and ** indicate significance at $P < 0.05$ and $P < 0.01$, respectively. Error bars represent the standard errors of the means.

Multiple editors/performers

Table 3.3 presents mean ratings of flavor intensity, flavor pleasantness, texture impression, and overall impression for food stimuli across the four musical stimuli arranged by multiple editors/performers. Ratings of flavor intensity ($\chi^2 = 0.75$, $df = 3$, $P = 0.86$), flavor pleasantness ($\chi^2 = 1.87$, $df = 3$, $P = 0.60$), texture impression ($\chi^2 = 1.65$, $df = 3$, $P = 0.65$), and overall impression ($\chi^2 = 1.45$, $df = 3$, $P = 0.69$) showed no significant difference across four musical stimuli.

Table 3.3.

Mean ratings (\pm standard deviation) of flavor intensity, flavor pleasantness, texture impression, and overall impression for food stimuli across musical stimuli arranged by multiple editors/performers.

	Music genre			
	Classical	Jazz	Hip-hop	Rock
Flavor intensity	9.99 (\pm 3.13)	10.06 (\pm 3.07)	10.07 (\pm 3.12)	10.00 (\pm 3.30)
Flavor pleasantness	10.53 (\pm 3.52)	10.40 (\pm 3.52)	10.34 (\pm 3.75)	10.19 (\pm 3.53)
Texture impression	10.53 (\pm 2.93)	10.39 (\pm 3.19)	10.52 (\pm 3.17)	10.41 (\pm 3.13)
Overall impression	10.81 (\pm 3.18)	10.55 (\pm 3.46)	10.70 (\pm 3.56)	10.50 (\pm 3.30)

Ratings of familiarity, pleasantness, and stimulation for musical stimuli arranged by either a single or multiple editors/performers

Musical stimuli arranged by a single editor/performer

As seen in Table 3.4 Friedman tests revealed that participants rated the classical stimulus as significantly more familiar than the jazz ($P = 0.02$), the hip-hop ($P = 0.02$), and the rock ($P < 0.01$) stimuli ($\chi^2 = 8.40$, $df = 3$, $P = 0.04$). Pleasantness ratings for the four musical stimuli significantly differed ($\chi^2 = 41.63$, $df = 3$, $P < 0.001$). Participants rated the classical and jazz stimuli significantly more pleasant than the hip-hop ($P < 0.001$) and the rock stimuli ($P < 0.001$). In addition, stimulation ratings for the four musical stimuli were significantly different ($\chi^2 = 9.66$, $df = 3$, $P = 0.02$). The classical stimulus was rated significantly more stimulating than both the jazz ($P = 0.02$) and the rock stimuli ($P = 0.04$).

Table 3.4.

Mean ratings (\pm standard deviation) of familiarity, pleasantness, and stimulation for musical stimuli arranged by either a single editor/playlist or multiple editors/performers.

	Music genres			
	Classical	Jazz	Hip-hop	Rock
Musical stimuli arranged by both a single and multiple editors/performers				
Familiarity	7.48 (\pm 4.93) ^a	6.52 (\pm 4.66) ^b	6.37 (\pm 4.71) ^b	6.59 (\pm 4.84) ^b
Pleasantness	7.02 (\pm 1.86) ^a	6.96 (\pm 1.79) ^a	5.61 (\pm 2.06) ^b	5.62 (\pm 2.17) ^b
Stimulation	5.84 (\pm 2.17) ^a	5.85 (\pm 2.13) ^a	5.52 (\pm 1.99) ^a	5.63 (\pm 2.21) ^a
Musical stimuli arranged by a single editor/performer				
Familiarity	7.48 (\pm 4.78) ^a	6.37 (\pm 4.62) ^b	6.21 (\pm 4.84) ^b	6.36 (\pm 4.87) ^b
Pleasantness	6.85 (\pm 1.88) ^a	6.76 (\pm 1.78) ^a	5.69 (\pm 2.05) ^b	5.64 (\pm 2.15) ^b
Stimulation	5.97 (\pm 1.94) ^a	5.50 (\pm 2.04) ^b	5.47(\pm 1.97) ^{ab}	5.44 (\pm 2.07) ^b
Musical stimuli arranged by multiple editors/performers				
Familiarity	7.34 (\pm 5.10) ^a	6.67(\pm 4.71) ^{ab}	6.53 (\pm 4.59) ^b	6.81(\pm 4.82) ^{ab}
Pleasantness	7.17 (\pm 1.84) ^a	7.15 (\pm 1.78) ^a	5.54 (\pm 2.09) ^b	5.60 (\pm 2.20) ^b
Stimulation	5.72 (\pm 2.37) ^a	6.19 (\pm 2.17) ^a	5.57 (\pm 2.03) ^a	5.80 (\pm 2.33) ^a

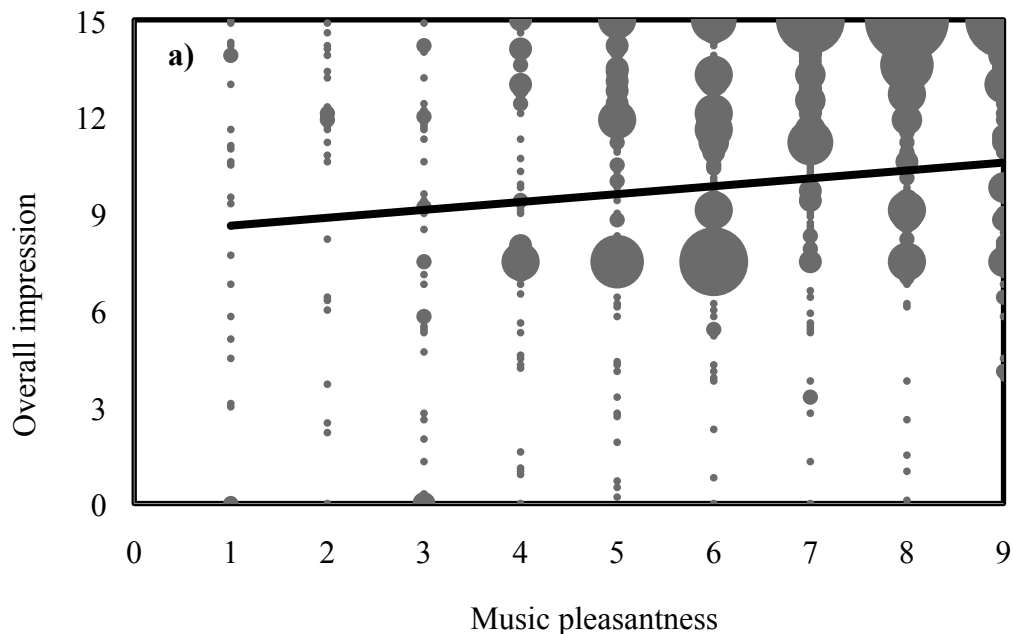
The ratings with different scripts within one row are significantly different at $P < 0.05$.

Musical stimuli arranged by multiple editors/performers

Familiarity ratings show significant differences across the four musical stimuli arranged by multiple editors/performers ($\chi^2 = 9.31$, $df = 3$, $P = 0.03$). Participants rated the classical stimulus as significantly more familiar than the hip-hop stimulus ($P = 0.01$). Additionally, pleasantness ratings for the four musical stimuli differed significantly ($\chi^2 = 72.31$, $df = 3$, $P < 0.001$). The classical and jazz stimuli were evaluated as significantly more pleasant than the hip-hop ($P < 0.001$) and rock stimuli ($P < 0.001$). However, no significant differences were seen in stimulation ratings for the four musical stimuli ($\chi^2 = 5.22$, $df = 3$, $P = 0.16$).

Relationships between individual ratings for musical and food stimuli

Spearman correlation analyses showed significant relations between individual ratings for musical and food stimuli. Flavor intensity ratings of food stimuli were significantly correlated with ratings of familiarity ($\rho_{792} = 0.18, P < 0.001$), pleasantness ($\rho_{792} = 0.15, P < 0.001$), and stimulation ($\rho_{792} = 0.25, P < 0.001$) for musical stimuli. Pleasantness ratings of food flavors showed significant correlations with ratings of pleasantness ($\rho_{792} = 0.20, P < 0.001$) and stimulation ($\rho_{792} = 0.19, P < 0.001$) for musical stimuli. In addition, ratings of texture impression demonstrated significant correlations with ratings of pleasantness ($\rho_{792} = 0.21, P < 0.001$) and stimulation ($\rho_{792} = 0.21, P < 0.001$) for musical stimuli. Similarly, ratings of overall impression for food stimuli were significantly correlated with ratings of pleasantness ($\rho_{792} = 0.20, P < 0.001$) and stimulation ($\rho_{792} = 0.19, P < 0.001$) for musical stimuli (Fig. 3.3). However, ratings of music familiarity showed no significant correlations with ratings of flavor pleasantness ($\rho_{792} = 0.06, P = 0.11$), texture impression ($\rho_{792} = 0.05, P = 0.17$), and overall impression for food stimuli ($\rho_{792} = 0.03, P = 0.43$).



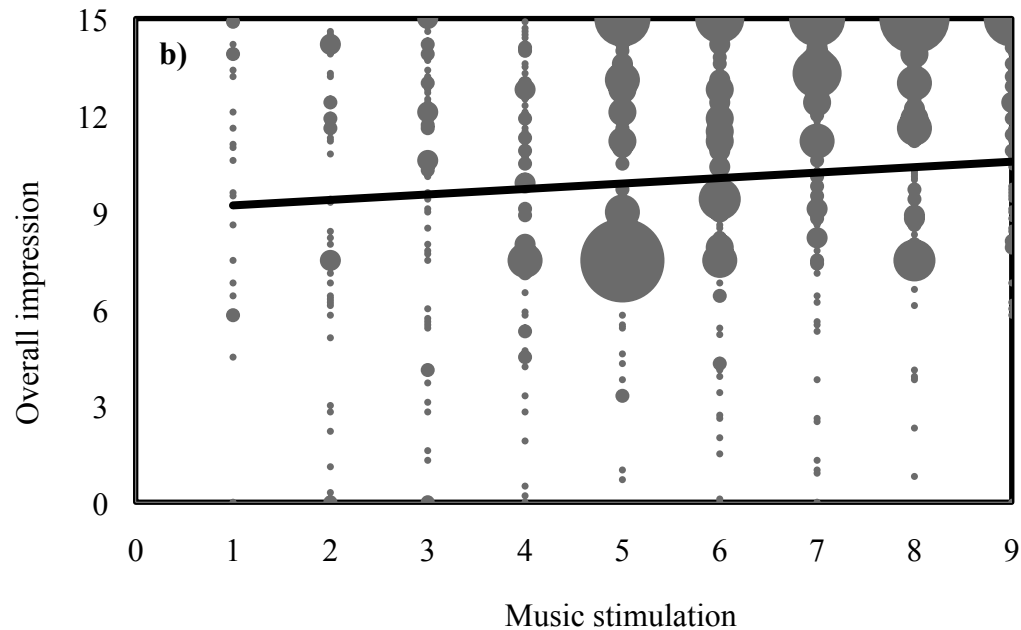


Figure 3.3. Correlations between individual ratings for overall impression of food stimuli and music pleasantness **a)** or music stimulation **b)**. The area of the bubble indicates the frequency of the response.

4. Discussion

The current study aimed to determine whether participants' food perception and acceptance can be altered by listening to different genres of background music, but also to determine how the effect of background music can vary as a function of type of food (i.e., emotional versus non-emotional foods) and source of music editor/performer (i.e., single versus multiple editors/performers). Even if music pieces are classified into an identical genre, musical components such as loudness, tempo, pitch, timbre, key, and complexity may vary between them. Therefore, the current study was set out to present four music genres transformed from a traditional music piece ("Air on the G string"), allowing the emphasis to be placed on the influences of music genre on food perception and acceptance.

Effects of music genre on sensory perception and impression for food stimuli

Our study suggests new empirical evidence that participants' overall impression for food stimuli can vary by listening to different genres of background music. For example, participants rated food stimuli significantly more pleasant while listening to the jazz stimulus than while listening to the hip-hop stimulus. Considering that music-elicited emotion is different between jazz and hip-hop stimuli (Rentfrow & Gosling, 2003; Zenter et al., 2008), the outcomes seem to result from the difference in the music-elicited emotion. Additional explanation for the results can be found in Table 3.4 where pleasantness ratings of the hip-hop stimulus were significantly lower than those of the jazz stimulus. That is, it can be thought that hedonic tone of musical stimuli altered overall impression of food stimuli. In addition to arousal, hedonic tone of stimuli plays a major role in modulating emotion and mood toward the stimuli. Furthermore, our findings indicate that hedonic tone of auditory stimuli can be transferred to hedonic ratings of subsequently or simultaneously administered stimuli, which is in agreement with previous findings (Logeswaran & Bhattacharya, 2009; Seo & Hummel, 2011; Woods et al., 2011). For example, Logeswaran and Bhattacharya (2009) showed that listening to happy or sad music increased happiness or sadness ratings for subsequently shown faces. Similar results were found in the associations between hedonic ratings of background sound and foods (Woods et al., 2011) or odors (Seo & Hummel, 2011).

In contrast to the jazz stimulus, the classical stimulus did not alter overall impression of food stimuli, although the music pleasantness and stimulation were not different between them (Table 3.4). Music familiarity, pleasantness, and arousal are important characteristics determining music preference (Davies, 1991; Fontaine & Schwalm, 1979; Gorn, 1982; Russell, 1987). However, a past study on repetition reported that what once was pleasant may become

less enjoyable if repetition makes it too familiar to the ear, so from this we would assume that those genres that are considered familiar would also be less pleasant (Russell, 1987). Therefore, higher familiarity with a classical stimulus, in comparison to a jazz stimulus, may alleviate the impacts of music pleasantness on overall impression of food stimuli. This is, to some extent, in line with our findings demonstrating no significant influence of music familiarity on overall impression for food stimuli. As shown in Figure 3.3 individual ratings of overall impression for food stimuli were significantly correlated with ratings of music pleasantness and stimulation, but not with ratings of music familiarity.

Flavor intensity and texture impression were not significantly modulated by music genre. Previous studies have shown that intensity ratings of chemosensory stimuli are more influenced by manipulating musical components such as pitch, tempo, and loudness than by varying hedonic tone of musical stimuli (Seo & Hummel, 2011; Woods et al., 2011). For example, Seo and Hummel (2011) demonstrated that hedonic tone of background sounds significantly modulates odor pleasantness, but not odor intensity. The lack of a significant result in flavor intensity can be explained by the difference in the strategic approach for intensity and pleasantness ratings. Intensity ratings are an analytical task, while pleasantness ratings are close to a synthetic task (Schifferstein & Verlegh, 1996; Seo & Hummel, 2011). Therefore, the music-elicited emotion would have less effect on the execution of analytical tasks such as intensity ratings compared to synthetic tasks such as pleasantness and overall impression ratings.

Texture is characterized as a group of physical and mechanical properties that derive from the food structure (Bourne, 2002). From neuroanatomical and functional views, emotion seems to be more associated with chemosensory stimuli such as smell, taste, and flavor than with physical properties of texture, although chemosensory and texture stimuli are commonly

processed in the orbitofrontal cortex where rewarding, punishing, and affective ratings for food stimuli take place (Rolls, 2005). In this way, compared to texture impression, flavor pleasantness for food stimuli appears to be more agitated by the difference in music-elicited emotions.

Comparison between emotional and non-emotional foods in the background music-elicited sensory perception and impression for food stimuli

Likewise, the difference between genres in music-elicited emotions seems to modulate overall impression of food stimuli. Therefore, we determined whether the effect of background music on sensory perceptions and impressions for food stimuli could vary between emotional (chocolate) and non-emotional (bell peppers) foods. Generally, sweet and fatty foods such as chocolate are considered emotional foods altering certain emotions, whereas less sweet foods, fruits and vegetables, such as bell peppers are close to non-emotional foods (Gibson, 2006; Konttinen et al., 2009). This was supported by the results of our survey; from a predetermined list of 29 common foods, people reported that chocolate and bell peppers are the foods that they most and least frequently consume when their emotional status is altered.

As depicted in Figure 3.1 participants rated chocolate, an emotional food, more pleasant while listening to the jazz stimulus than while listening to the hip-hop and the rock stimuli. However, no significant differences were observed in overall impression in bell peppers, a non-emotional food. Previous findings showed that sweet and fatty foods are more suitable for modulating certain mood and emotion (Gibson, 2006; Konttinen et al., 2009), which assist in explaining why chocolate and bell peppers showed different results in the overall impression between music genres. That is, the background music-elicited emotion can be easily transferable to the ratings of overall impression for chocolate (an emotional food) than those for bell peppers

(a non-emotional food), conveying the difference in the effect of background music on overall impression for food stimuli.

Apart from the type of food (i.e., emotional vs. non-emotional foods), it is notable that when consuming bell peppers there is a greater level of noise stemming from mastication in comparison to consuming chocolate. In addition to tempo, volume, and pitch of background music, the presence of noise from mastication can add to or detract from the attributes of a stimulus (Herrington & Capella, 1996). That is, the internal noise evoked by the mastication process could interrupt with the background music-elicited emotion, resulting in no significant effect of background music on overall impression for bell peppers.

Comparison between musical stimuli arranged by a single and multiple editors/performers in background music-elicited sensory perception and impression for food stimuli

The present study demonstrates that ratings of flavor pleasantness and overall impressions for food stimuli can be significantly different between music genres arranged by a single editor/performer (Fig. 3.2). Specifically, participants rated food flavors significantly more pleasant when presented with the jazz stimulus than when presented with the hip-hop stimulus. In addition, the participants rated food stimuli significantly less pleasant in the presence of the hip-hop stimulus compared to other stimuli. However, these significant results were not observed between music genres arranged by multiple editors/performers (Table 3.3). A potential explanation for the lack of significance in the musical stimuli arranged by multiple editors/performers is that musical stimuli by multiple editors/performers could be considered to have complex musical harmonies and textures, which results in the dilution of differences between genres in the music-elicited emotion. In contrast, musical stimuli arranged by a single

editor/performer minimize variations produced by different performers in terms of musical textures and music-induced emotion. That is, stimuli from a single editor/performer show a more pronounced genre effect causing significant differences in the music-elicited emotion. In fact, the stimulation ratings were significantly different between musical stimuli arranged by a single editor/performer, but not between those arranged by multiple editors/performers (Table 3.4). Since the multiple editor stimuli were harmonic commercial versions where the tempo and volumes were regulated and similar, we would expect to see no significant results in stimulation levels between music genres. However, the single editor stimuli composed of pitch and tempo fluctuations allow participants to focus on the potential tempo, volume, or pitch differences, which may cause variations in their stimulation levels between music genres (Mehrabian & Russel, 1974). In this way, the differences in music pleasantness and stimulation elicit dynamic emotions, which lead to significant alterations in flavor pleasantness and overall impression of food stimuli.

Implications

The current study suggests that the jazz stimulus increases flavor pleasantness and overall impression of food stimuli to a higher degree than the hip-hop stimulus. However, we cannot conclude that jazz is the music genre that is suitable for increasing overall impression of food stimuli. For example, although two music stimuli are classified into the jazz genre, musical components could be different between two jazz stimuli, which can convey differences in music-elicited emotion. In addition, as music perception and preference are affected by many factors such as listeners' demographics, experience, personality, and culture (Christenson & Peterson, 1988; Ho, 2003), the emotions elicited by an identical jazz stimulus can be different between

listeners. In order to strengthen the influences of music genre on food perception and acceptance, further studies with diverse musical and food stimuli must be carried out. A potential extension could test whether a similar genre effect is also observed when complex foods are served rather than a single food. This would be more applicable as the food matrix would be more realistic to a typical dining situation. Similarly, matching the musical stimuli with standard versions of current music pieces would create a more realistic replica of a restaurant or bar environment. Lastly, the location of the experiment could be altered to a restaurant setting to eliminate bias from the sensory booths that could potentially influence the participants' perceptions. Doing so would also provide participants with a feeling of normality as if it were a normal Friday night dinner outing rather than a pre-meditated experiment.

From our findings, food industries can integrate specific music stimuli with a conjugating food stimuli or cuisine in order to maximize their particular goal. For example, chocolate companies may incorporate their chocolate products with jazz-like background music to increase consumers' acceptance for the chocolates. A relevant study by Spence et al. (2009) demonstrated that people rated the oyster consumed more pleasant in the presence of the "sound of the sea" than in the presence of the "farmyard noises." Likewise, it would be expected that consumers' acceptability for chocolate products would increase when presented with the adequate jazz-like pieces. Together the present and future studies have potential to deliver new empirical evidence and strengthen what has already been acknowledged.

5. Conclusion

In summary, the present study lends new empirical evidence that varying musical stimuli can alter sensory perception and acceptance of simultaneously presented foods. Specifically, in

the presence of a jazz stimulus, flavor pleasantness and overall impression of the food stimuli increased. In addition, the background music-elicited flavor pleasantness and overall impression of food stimuli varied as a function of the type of food (emotional versus non-emotional foods) and the source of music editor (single versus multiple editors/performers). For example, the background music-elicited flavor pleasantness and/or overall impression exhibited only in emotional food like chocolate and only in musical stimuli arranged by a single music editor/performer. In conclusion, the current study demonstrates that food perception and acceptance can be modulated by background music genre, type of food, and source of music editor/performer. Furthermore, our findings may provide foodservice industry professionals with a better understanding for consumer behavior in the presence of particular music.

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**CHAPTER 4 – BACKGROUND MUSIC COMPONENTS CAN MODULATE SENSORY
PERCEPTION AND IMPRESSION OF FOOD STIMULI**

ABSTRACT

Research pertaining to the effect of background music on food perception and acceptance is underdeveloped. Considering the limited research this study aimed to identify whether tempo, pitch, and volume of background music can alter consumers' perception and acceptance for emotional and non-emotional foods. A traditional music piece, "Air on the G string," was edited into two tempos (i.e., slow *vs.* fast), two pitches (i.e., low *vs.* high), and two volumes (i.e., quiet *vs.* loud). As food stimuli, milk chocolate and bell pepper were selected as the emotional and non-emotional foods, respectively, based on results from a preliminary survey centering on the association between food and emotion. Following consumption, participants were asked to rate flavor intensity, flavor pleasantness, texture impression, and overall impression of chocolate and bell peppers in the presence of the musical stimuli. Flavor pleasantness was significantly higher in the fast tempo stimulus as opposed to the slow tempo stimulus. Under the loud stimulus, ratings of flavor pleasantness and overall liking for the food stimuli were significantly higher. When analyzing component effects as a function of food type, ratings of flavor pleasantness and texture impression for bell pepper were significantly higher with the fast tempo stimulus than in the silent condition. In addition, ratings of flavor pleasantness, texture impression, and overall impression for chocolate were significantly higher with the loud stimulus than with the quiet stimulus. In conclusion, the current study provides empirical evidence that food perception and acceptance can be altered as a function of the background music stimulus. Our findings may provide business owners with an explanation for consumer behavior in the presence of a particular musical component or with atmospheric modifications inducing desired consumer behavior.

1. Introduction

Locations where consumer consumption is responsible for driving the sales and the overall stature of the company, atmospherics play a critical role in shaping the consumer's opinion of the product; sometimes atmospherics are more influential than the product itself. In environments with music contributing to the atmospherics it is important managerially to understand the musical elements, current music trends, but more importantly, the effects on consumers stemming from differing musical stimuli. However, the various music-induced behavioral responses often go overlooked by business owners and marketers, potentially harming company profits.

Musical stimuli affect informational processing (Kellaris & Mantel, 1994), emotional and physiological changes (Anand & Holbrook, 1985), mood (Alpert & Alpert, 1990), and classical conditioning (Gorn, 1982; North & Hargreaves, 1996), which are portrayed through various behavioral responses. The Mehrabian-Russel (MR) model (Mehrabian & Russel, 1974), which proposes that individuals respond emotionally to environmental stimuli such as background music, leading to an approach-avoidance behavior, can help explain such musical-stimuli-induced behavioral responses. In service environments, approach-avoidance behaviors are observed in evaluations of service environment, service experience, shopping duration, and spending behavior (Donovan & Rossiter, 1982; Herrington & Capella, 1996). Observed willingness to move towards, stay in, perform well in, and return to the environment containing the stimuli are all considered approach behaviors, whereas distancing, fleeing, or escaping the particular environment are avoidance behaviors (Donovan & Rossiter, 1982).

Music genre is important to selecting appropriate atmospherics, however the genre is not responsible for the elicited emotional behavior, rather the components that make up the song in

the genre are the driving forces (Pachet & Cazaly, 2000). In an assortment of studies it has been reported that emotions affect sensory perception, pleasantness, and food choice (Gibson, 2006; Nakagawa, Mizuma, & Inui, 1996; Pollatos et al., 2007; Seo & Hummel, 2011). For example, loud noises have shown a decrease in perceived intensities of taste stimuli in foods when compared to quiet noises (Woods et al., 2011; but also see Stafford et al., 2012). Considering previous findings suggesting the cause and effect relationship between musical components and behavioral responses, in addition to emotional influences on sensory perceptions, the current study focuses on the impact of musical components on consumer's food perception and acceptance. The musical piece used in the present study was altered into an upper and lower extreme of each musical component, specifically, tempo, pitch, and volume. It would be expected that upper and lower extremes induce music-elicited emotions leading to a variation of approach-avoidance behaviors (Mehrabian & Russel, 1974), resulting in differences in food perception and acceptance between musical components.

Tempo, a descriptor used to define a musical piece' rate progression, after thorough research still lacks a definitive range (Milliman, 1986; Webster & Weir, 2005; Wilson, 2003). To accommodate for context-induced tempo variations, an appropriate range of 70-110 bpm is suggested (Bruner, 1990). Tempos below or above are considered slow and fast, respectively. Chewing behavior is effected by the tempo of a sound stimulus, as shown in a study where individuals increased their bites per minute as the tempo increased, and decreased their behavior as the tempo decreased (Milliman, 1982). Tempo also has an emotional effect as fast tempos elicit happy and pleasant emotions, whereas slow tempos elicit tranquil and sentimental emotions (Hevner, 1937). The second structural music component investigated was the relative highness or lowness of the stimulus, which is characterized as pitch (Bruner, 1990). Previous studies

demonstrated that a high pitch music stimulus enhances both sweet and sour flavor perceptions, whereas in the presence of a low pitch music stimulus perceptions of bitter and salt decrease (Crisinel and Spence, 2010a; Mesz et al., 2011). Studies consistently demonstrate that low pitch stimuli are perceived as sad in comparison to perceivably happy, high pitch stimuli (Gundlach, 1935; Hevner, 1937; Rigg, 1940; Watson, 1942). The magnitude of a sound stimulus is coined the term volume; loud volumes can elicit feelings of liveliness whereas quiet volumes can induce peaceful feelings (Cooke, 1962). Under conditions of a loud sound stimulus, participants perceived higher flavor intensities in the sweet items compared to flavor intensities in salty items, which can be explained by the cascade of loud volumes enhancing stress, which induces cravings for sugar (Ferber & Cabanac, 1987).

People are overcome with emotions and feelings induced by particular stimuli and resort to activities to alleviate the elicited emotion. For example, when overcome with feelings of stress people tend to consume sweet and fatty foods as a release (Gibson, 2006). Consumption of energy dense and sweet foods is significantly correlated with emotional eating; the same is not true of vegetables and fruits, insinuating certain foods (e.g., “emotional foods”) seem more suitable to mediate emotions (Konttinen, Männistö, Sarlio-Lähteenkorva, Silventoinen, & Haukkala, 2010). It is proposed that music-elicited emotions aid in modulating the effect of music stimuli on food perception and acceptance, but also perceptions and acceptance for certain foods are more influenced by emotional status. Considering these two points, an additional aim was to answer how the effect of musical component on sensory perception and acceptance may vary between emotional and non-emotional foods; we expected the impact to be more pronounced in emotional foods such as chocolate, rather than in a non-emotional food such as bell peppers.

Aforementioned, the overall objective of the current research was to determine whether musical components contained in a background music stimulus can influence sensory perception and acceptance for foods consumed simultaneously, as well as ascertaining whether the influence changes as a function of food type (i.e., emotional vs. non-emotional). Although atmospheric characteristics have been researched, this study delves in to examine the atmospherics on a more intricate level with an aim of providing foodservice and business professionals with astute expectations of how consumers will behave in an environment when exposed to a particular sound stimulus.

2. Materials and methods

2.1. Participants

Sixty-one healthy North American volunteers (46 females and 15 males) with an age range from 18 to 30 years [mean age \pm standard deviation (SD) = 26 ± 3 years] participated in this experiment. Prior to the experiment, all participants completed the questionnaire shown in Appendix 1.6 and reported no clinical history of major diseases including diabetes, cancer, cardiovascular diseases, and renal diseases. They also reported no smelling, tasting, or hearing impairments. All participants were informed thoroughly about the experimental procedure and provided informed written consent (Appendix 1.5) before participation.

2.2. Musical stimuli

As an auditory cue, the traditional music piece: “Air on the G string” (an adaptation by August Wilhelmj of the Air, the second movement in the Orchestral Suite No. 3 in D major, BWV 1068, composed by Johann Sebastian Bach) was used. This piece was arranged by an

individual composer and edited to highlight three musical components (tempo, pitch, and volume) containing both ends of the spectrum for each component, which can be seen in Table 4.1. Using a sound editor program (Power Sound Editor Free, ver. 6.9.6., PowerSE Co., Ltd.), all six musical stimuli were edited to last for approximately three minutes and administered through headphones (Model MDR-W08L, Sony, Tokyo, Japan).

Table 4.1.
Musical component characteristics of music stimuli used in this study

Musical stimuli					
Pitch		Tempo		Volume	
High	Low	Fast	Slow	Loud	Quiet
A5 (880.0Hz)	A2 (110.0Hz)	92 bpm	40 bpm	88 dB	53 dB
to	to				
C7 (2,093.0Hz)	C4 (261.6Hz)				

2.3. Food stimuli and presentation

The food stimuli used in this study were selected based on a preliminary survey associated with “emotional foods.” A total of 150 volunteers (92 females and 58 males) with an age range from 18 to 76 years (mean age \pm SD = 38 \pm 15 years) participated in the survey (Appendix 1.1). Participants selected foods they consume when their mood or emotion is altered from a predetermined list of 29 frequently consumed foods. Foods having the highest and lowest selections were chosen for the experiment. From the results (Appendix 1.2), chocolate ($N = 92$) and bell pepper ($N = 3$) were chosen as the emotional and non-emotional foods, respectively.

With this being considered, milk chocolate (The Hershey Co., Hershey, PA) and red bell peppers (Wal-Mart Distributor, Fayetteville, AR) were selected. These food stimuli were purchased from the local supermarket one day before the experiment. The chocolate was stored at room temperature and prior to serving it was broken into bite size pieces (3.5 x 2.0 x 0.5 cm).

Bell peppers were stored in a refrigerator (4 °C) and taken out one hour prior to evaluation in order to reach room temperature, then sliced into small pieces (3.5 x 3.0 x 0.5 cm).

2.4. Procedure

The experiment was conducted at the Sensory Evaluation Service Center at the University of Arkansas (Fayetteville, AR). A constant experimental setting, including ambient temperature (20 °C), was maintained throughout the entire experiment. Data collection was obtained using a computerized sensory data acquisition system, Compusense[®] five (Release 4.6-SP3, Compusense Inc., Guelph, ON, Canada). Participants sat in individual sensory booths on a chair 70 cm from a computer monitor. They were instructed to place headphones snugly on their ears. Once participants were logged into the computer system, the first musical stimulus began. Thirty seconds after initial music presentation, a food sample (i.e., chocolate or bell pepper) placed in a soufflé cup with a three-digit code was presented. After consuming the food and music stimuli simultaneously, participants were asked to rate flavor intensity and pleasantness on two 15-cm line scales ranging from 0 (extremely weak; extremely unpleasant) to 15 (extremely strong; extremely pleasant). Then, using two 15-cm line scales ranging from 0 (extremely dislike) to 15 (extremely like), participants were asked to rate the food stimulus in terms of texture liking and overall liking. Lastly, subjects assessed the pleasantness and stimulation of the presented musical stimulus using two 9-point category scales ranging from 1 (extremely unpleasant; extremely non-stimulating) to 9 (extremely pleasant; extremely stimulating). Once each participant finished answering the coordinating questions the music stimulus was stopped. Participants used the ballot shown in Appendix 1.8.

A 60 s break of silence was administered prior to presentation of the next musical stimulus. During this pause, spring water was provided to participants for palate cleansing. At this time participants were instructed to refrain from removing their headphones until completion of the entire experiment. Once the break concluded, all participants were presented five more musical and food stimuli pairings. These pairings were presented in a sequential monadic fashion according to the Williams Latin Square Design (Williams, 1949). To minimize subjects' sensory fatigue this study was administered over three consecutive days. Participants attended at the same time on all three days and saw one of three components (i.e., tempo, volume, or pitch) on each day, for a total of six pairings a day and eighteen pairings total. The presentation of musical stimuli was counterbalanced across participants.

2.5. Data analysis

Data analysis was completed using SPSS 21.0 for WindowsTM (IBM SPSS Inc., Chicago, IL, U.S.A.). The Shapiro-Wilk Normality test (Shapiro & Wilk, 1965) concluded that the null hypothesis stating the data came from a normally distributed population was rejected ($P < 0.05$); therefore, non-parametric statistical methods were executed for data analysis. However, with non-parametric methods the panelist effects are not taken into consideration.

When determining whether ratings for sensory perceptions and impressions were altered as a function of musical component stimuli, the non-parametric Friedman test (Friedman, 1937) was performed. When the Friedman test indicated a statistical significance, the Wilcoxon signed-rank test was used for further analysis of individual paired comparisons. In addition, the Friedman test determined whether musical stimuli ratings for pleasantness and stimulation differed between the musical components. To examine relationships between music

pleasantness/stimulation and food sensory perception/acceptance, Spearman partial correlation analyses were used; to determine the relationship between music pleasantness (or stimulation) and food sensory perception/acceptance, music stimulation (or pleasantness) was controlled.

3. Results

Comparison between musical component stimuli in background music-elicited sensory perception and impression regardless of food type

Pitch

Across three pitch stimuli, there was no significant difference in food stimuli ratings of flavor intensity ($\chi^2 = 1.19$, $df = 2$, $P = 0.55$), flavor pleasantness ($\chi^2 = 4.02$, $df = 2$, $P = 0.13$), texture impression ($\chi^2 = 3.28$, $df = 2$, $P = 0.19$), and overall impression ($\chi^2 = 4.52$, $df = 2$, $P = 0.10$).

Tempo

Ratings of flavor pleasantness for food stimuli were significantly different as a function of music tempo ($\chi^2 = 6.30$, $df = 2$, $P = 0.04$). Subsequently, participants rated food flavors when presented with the fast tempo stimulus as significantly more pleasant than when presented with the slow tempo ($P = 0.03$) and silent stimuli ($P = 0.001$). Ratings of flavor intensity ($\chi^2 = 0.75$, $df = 2$, $P = 0.69$), texture impression ($\chi^2 = 5.65$, $df = 2$, $P = 0.06$), and overall impression ($\chi^2 = 2.93$, $df = 2$, $P = 0.23$) for food stimuli were not significantly different among music tempo stimuli.

Volume

Flavor intensity ratings of food stimuli were not significantly different across music volume stimuli ($\chi^2 = 1.84$, $df = 2$, $P = 0.40$). Likewise, ratings for texture impression of food stimuli were not significantly different among music volume stimuli ($\chi^2 = 3.43$, $df = 2$, $P = 0.18$).

Ratings of flavor pleasantness for food stimuli were significantly different as a function of music volume ($\chi^2 = 9.87$, $df = 2$, $P = 0.007$). Participants rated the food stimuli flavor significantly more pleasant in the loud stimulus in comparison to the silent stimulus ($P = 0.006$). In addition, overall impression ratings for the food stimuli were significantly different ($\chi^2 = 10.64$, $df = 2$, $P = 0.005$). When paired with the loud volume stimulus the food stimulus was liked significantly more than with the silent stimulus ($P = 0.006$).

Comparison between emotional and non-emotional foods in the background music-component-elicited sensory perception and impression

Pitch-chocolate

As shown in Figure 4.1a, there were no significant effects of music pitch on ratings of flavor intensity ($\chi^2 = 0.34$, $df = 2$, $P = 0.84$), flavor pleasantness ($\chi^2 = 3.91$, $df = 2$, $P = 0.14$), and overall impression ($\chi^2 = 0.95$, $df = 2$, $P = 0.62$). However, Figure 4.1a shows that texture impression of the chocolate stimulus was significantly different between musical pitch stimuli ($\chi^2 = 6.10$, $df = 2$, $P = 0.04$). That is, chocolate texture was liked significantly more in the presence of the low pitch stimulus compared to the high pitch stimulus ($P = 0.01$).

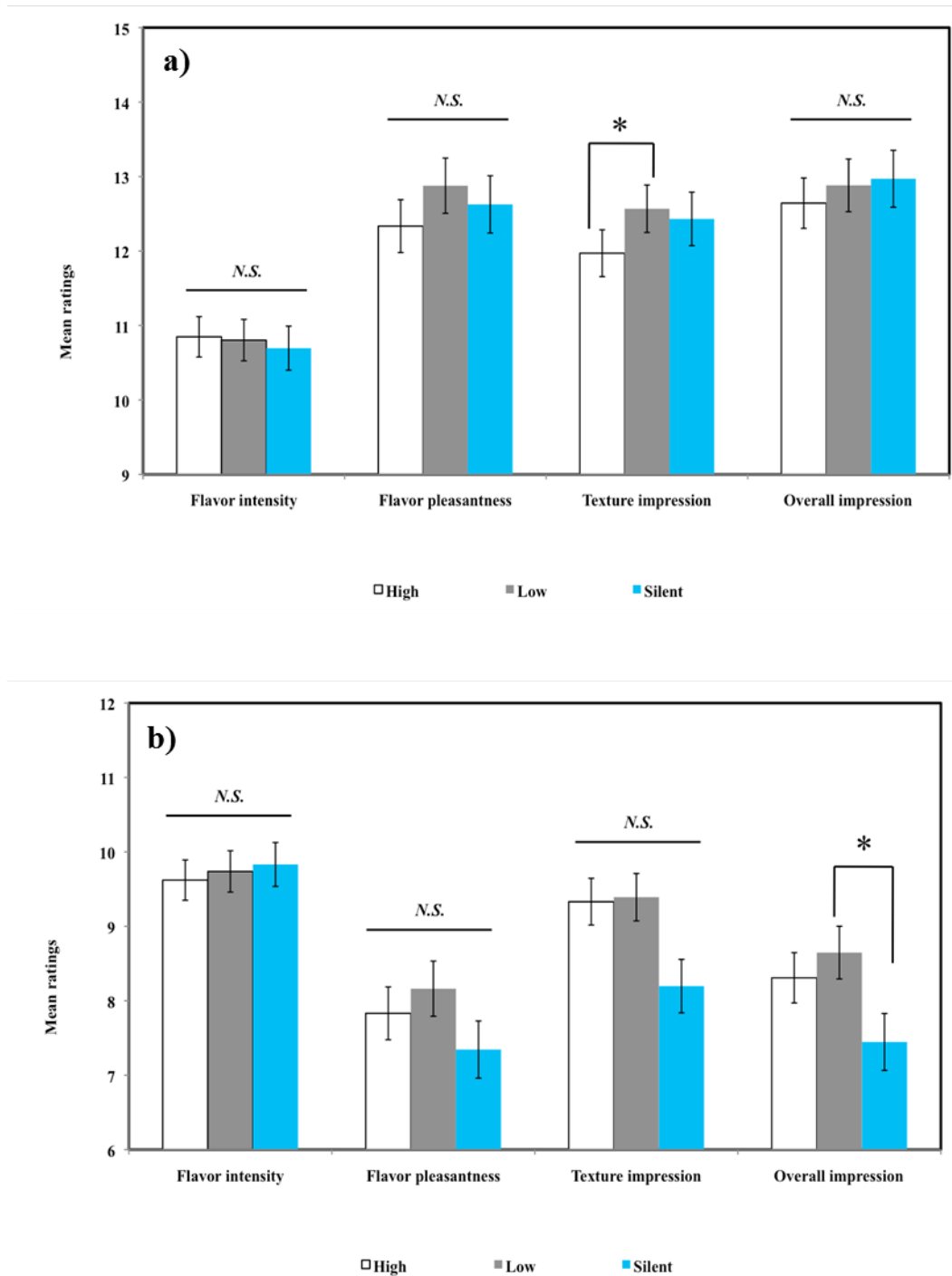


Figure 4.1. Mean ratings of flavor intensity, flavor pleasantness, texture impression, and overall impression for chocolate **a)** and bell pepper **b)** across the three pitch stimuli. The *N.S.* indicates no significance at $P < 0.05$. * indicates significance at $P < 0.05$. Error bars represent the standard errors of the means.

Pitch-bell pepper

Mean ratings of flavor intensity ($\chi^2 = 0.92$, $df = 2$, $P = 0.63$), flavor pleasantness ($\chi^2 = 0.98$, $df = 2$, $P = 0.61$), and texture impression ($\chi^2 = 0.93$, $df = 2$, $P = 0.63$) for bell peppers were not significantly different among music pitch stimuli as displayed in Figure 4.1b. Conversely, overall impression ratings for bell peppers were significantly different between musical pitch stimuli ($\chi^2 = 6.12$, $df = 2$, $P = 0.04$), expressing that participants liked bell peppers overall significantly more in the presence of the low pitch stimulus as opposed to the silent stimulus ($P = 0.02$).

Tempo-chocolate

Figure 4.2a presents mean ratings of flavor intensity ($\chi^2 = 0.14$, $df = 2$, $P = 0.93$), flavor pleasantness ($\chi^2 = 0.87$, $df = 2$, $P = 0.65$), texture impression ($\chi^2 = 1.08$, $df = 2$, $P = 0.58$), and overall impression ($\chi^2 = 0.13$, $df = 2$, $P = 0.94$) for chocolate as a function of music tempo; none of which showed a significant difference across the music tempo stimuli.

Tempo-bell pepper

Flavor intensity ratings ($\chi^2 = 1.04$, $df = 2$, $P = 0.59$) and overall impression ratings ($\chi^2 = 4.83$, $df = 2$, $P = 0.09$) of bell peppers in the presence of music stimuli varying in tempo did not display significance. However, ratings of flavor pleasantness ($\chi^2 = 8.44$, $df = 2$, $P = 0.02$) and texture impression ($\chi^2 = 9.56$, $df = 2$, $P = 0.008$) were significantly different as a function of tempo. Figure 4.2b displays that in the presence of the fast tempo stimulus participants rated flavor significantly more pleasant than the silent stimulus ($P = 0.003$). Also shown is that while

listening to the silent stimulus, texture of bell peppers was liked significantly less when listening to both the slow tempo ($P = 0.013$) and fast tempo ($P = 0.028$) stimuli.

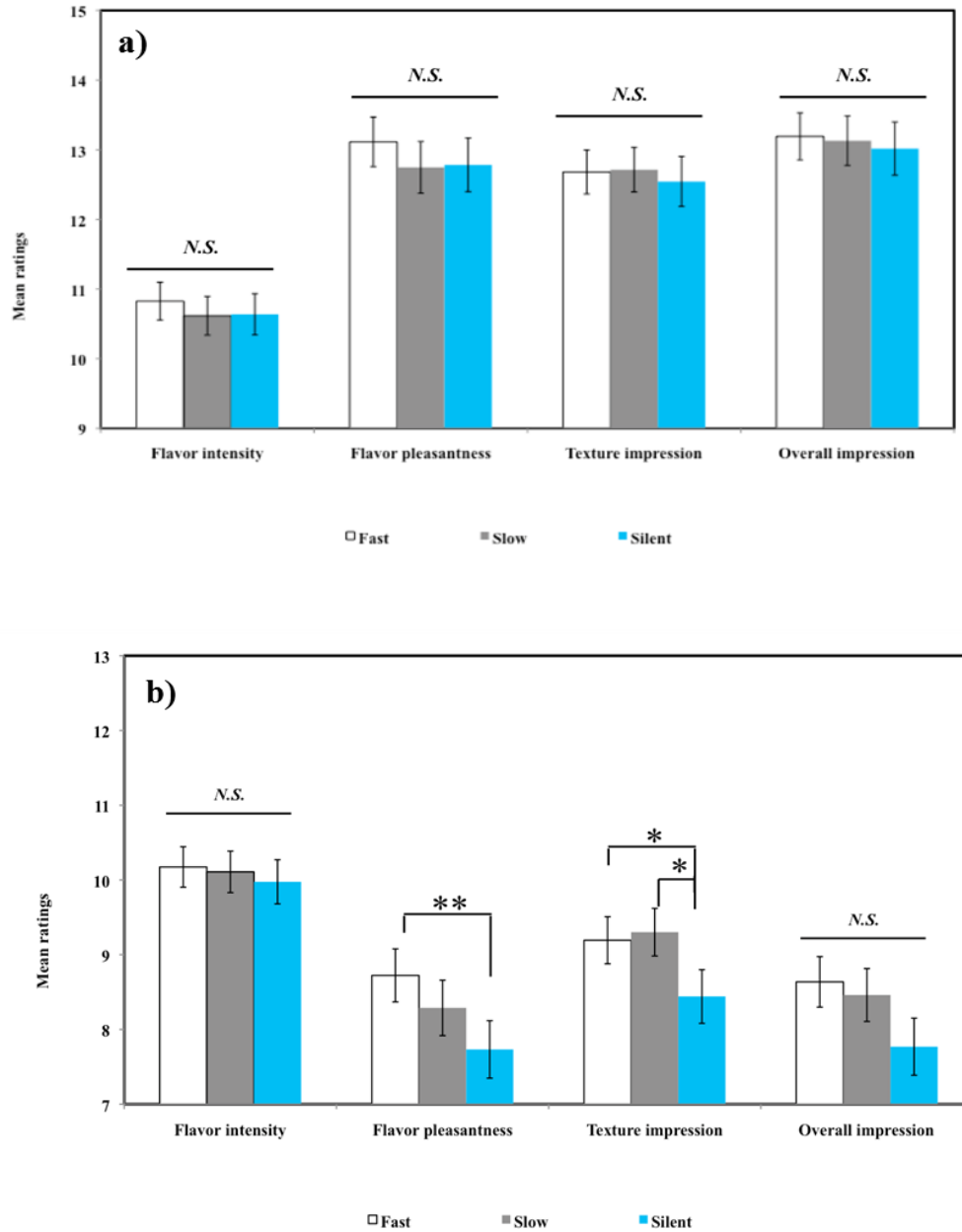


Figure 4.2. Mean ratings of flavor intensity, flavor pleasantness, texture impression, and overall impression for chocolate **a)** and bell pepper **b)** across the three tempo stimuli. The *N.S.* indicates no significance at $P < 0.05$. * and ** indicate significance at $P < 0.05$ and $P < 0.01$, respectively. Error bars represent the standard errors of the means.

Volume-chocolate

Figure 4.3a depicts mean ratings for chocolate flavor intensity ($\chi^2 = 2.87$, $df = 2$, $P = 0.24$), flavor pleasantness ($\chi^2 = 11.21$, $df = 2$, $P = 0.004$), texture impression ($\chi^2 = 6.37$, $df = 2$, $P = 0.04$), and overall impression ($\chi^2 = 10.82$, $df = 2$, $P = 0.004$) as a function of music stimuli volume. In the presence of the loud stimulus, flavor pleasantness ($P = 0.008$), texture impression ($P = 0.007$), and overall impression ($P = 0.006$) were rated significantly higher than the quiet stimulus as well as the silent stimulus. Intensity ratings of chocolate flavor did not show any significant differences among volume stimuli.

Volume-bell pepper

Figure 4.3b presents mean ratings for bell pepper flavor intensity ($\chi^2 = 8.69$, $df = 2$, $P = 0.013$), flavor pleasantness ($\chi^2 = 1.47$, $df = 2$, $P = 0.48$), texture impression ($\chi^2 = 0.34$, $df = 2$, $P = 0.84$), and overall impression ($\chi^2 = 3.02$, $df = 2$, $P = 0.22$) as a function of music volume. Flavor intensity ratings of bell peppers were marginally lower under the loud condition compared to both the silent ($P = 0.06$) and quiet ($P = 0.05$) conditions, but not significant at $P < 0.05$.

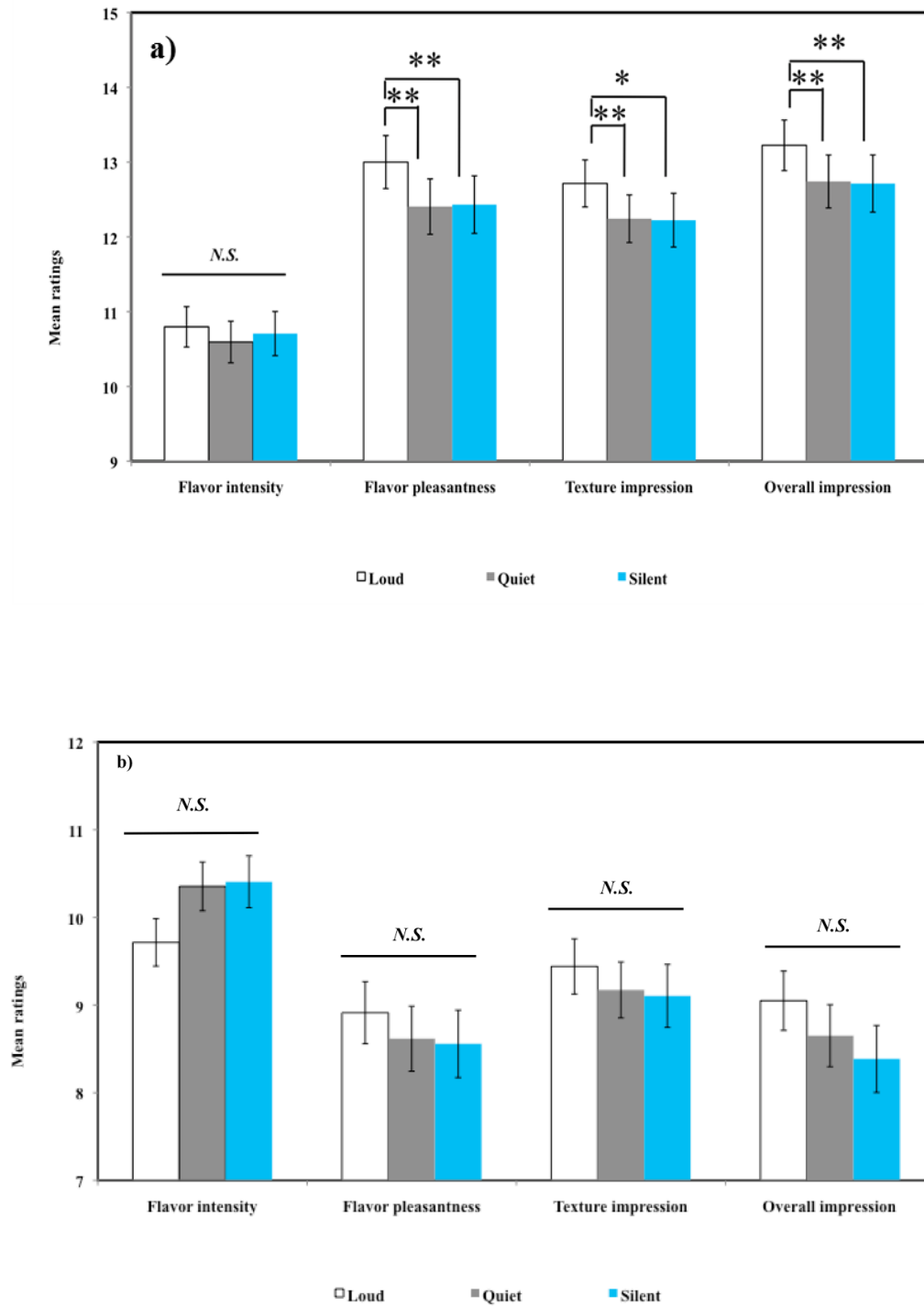


Figure 4.3. Mean ratings of flavor intensity, flavor pleasantness, texture impression, and overall impression for chocolate **a)** and bell pepper **b)** across the three volume stimuli. The *N.S.* indicates no significance at $P < 0.05$. * and ** indicate significance at $P < 0.05$ and $P < 0.01$, respectively. Error bars represent the standard errors of the means.

Ratings of pleasantness and stimulation for musical stimuli as a function of musical component

Pitch

The pleasantness and stimulation ratings for the music stimuli varying in pitch were both significantly different. The low pitch stimulus was rated as significantly more pleasant ($P \leq 0.001$) and stimulating ($P = 0.01$) in comparison to the high pitch stimulus, which is presented in Table 4.2.

Tempo

There was no significant difference in the pleasantness ratings of music stimuli varying in tempo ($P = 0.91$). However, the fast tempo stimulus was significantly more stimulating than the slow tempo stimulus ($P = 0.036$), as seen in Table 4.2.

Volume

Wilcoxon signed ranks tests revealed that participants rated the loud volume stimulus as significantly more pleasant than the quiet ($P \leq 0.001$) stimulus. In addition, stimulation ratings for the volume stimuli were significantly different. The loud stimulus was rated significantly more stimulating than the quiet stimulus ($P \leq 0.001$), as shown in Table 4.2.

Table 4.2.

Mean ratings (\pm standard deviation) of pleasantness and stimulation for music component stimuli.

Tempo	Music Stimuli	
	Fast	Slow
Pleasantness	7.37 (\pm 1.42)	7.33 (\pm 1.57)
Stimulation	6.56 (\pm 1.99)	6.27 (\pm 2.02)
Pitch	High	Low
Pleasantness	5.66 (\pm 2.34)	7.07 (\pm 1.84)
Stimulation	5.24 (\pm 2.33)	5.93 (\pm 2.21)
Volume	Loud	Quiet
Pleasantness	7.44 (\pm 1.39)	5.71 (\pm 1.59)
Stimulation	6.56 (\pm 1.79)	5.02 (\pm 1.66)

In each row, values in bold indicate statistical significance exists between the means at $P < 0.05$.

Correlations between music pleasantness/stimulation and food sensory attributes

Pitch

Ratings of music pleasantness were significantly correlated with ratings of flavor pleasantness ($P = 0.049$) and overall impression ($P = 0.04$). In comparison, the ratings of music stimulation were significantly correlated with the ratings of flavor intensity ($P = 0.04$) and texture impression ($P = 0.03$), which are presented in Table 4.3.

Tempo

Table 4.3 also shows the significant correlations of music pleasantness with flavor pleasantness ($P < 0.001$), texture impression ($P < 0.001$), and overall impression ($P < 0.001$) of food stimuli. No significant relationships between music pleasantness and flavor intensity were shown. However, ratings of music stimulation were significantly correlated with not only ratings

of flavor pleasantness ($P = 0.03$) and overall impression ($P < 0.001$), but also with ratings of flavor intensity ($P < 0.001$).

Volume

When looking at the correlations between the volume stimuli stimulation/pleasantness ratings and the food stimuli ratings, the only correlation that showed statistical significance was between music stimulation and flavor intensity ($P < 0.001$).

Table 4.3.

Spearman partial correlation coefficients of music pleasantness and stimulation with flavor intensity, flavor pleasantness, texture impression, and overall impression for food stimuli.

	Flavor intensity	Flavor pleasantness	Texture impression	Overall impression
Pitch				
Music pleasantness	0.02 (0.78)	0.13 (0.049)	0.10 (0.11)	0.13 (0.04)
Music stimulation	0.13 (0.04)	0.12 (0.06)	0.14 (0.03)	0.12 (0.06)
Tempo				
Music pleasantness	0.12 (0.06)	0.28 (<0.001)	0.24 (<0.001)	0.40 (<0.001)
Music stimulation	0.24 (<0.001)	0.14 (0.03)	0.13 (0.05)	-0.27 (<0.001)
Volume				
Music pleasantness	-0.02 (0.73)	0.08 (0.24)	0.05 (0.45)	0.13 (0.05)
Music stimulation	0.17 (<0.01)	0.08 (0.24)	0.10 (0.11)	0.06 (0.39)

In each row, values in bold indicate statistical significance among the correlation at $P < 0.05$.

4. Discussion

The current study aimed to determine whether participants' food perception and acceptance can be altered by listening to background music with alterations to components of tempo, pitch, and volume, but also to determine how the effect of background music can vary as a function of type of food (i.e., emotional vs. non-emotional). Music pieces varying in structure can induce different moods resulting in differential behaviors and perceptions (Alpert & Alpert, 1986, 1988). Taking this into consideration this study presented the same original music composition with alterations to the structural components of tempo (fast and slow), volume (loud and quiet), and pitch (high and low) allowing the emphasis to be solely placed on the influences of musical component on food perception and acceptance.

Comparison between musical component stimuli in background music-elicited sensory perception and impression regardless of food type

Pitch

Our study did not show any significant differences in flavor intensity, flavor pleasantness, texture impression, and overall impression of the food stimuli when exposed to the three different pitch stimuli of high, low, and silent. However, for each of the attributes the low pitch stimulus was rated highest. It is surprising that only a few studies have examined the link between pitch and music-elicited responses, furthermore, the few studies conducted present contradicting results. An association between pitch and perceived happiness surfaces in some studies so that a high pitch stimulus is interpreted as exciting or happy in comparison to a low pitch music stimulus, which is perceived as sad (Gundlach, 1935; Hevner, 1937; Rigg, 1940; Watson, 1942). Although our results were not statistically significant, the trend suggested the

opposite; when consumed in the low pitch stimulus food stimuli were rated higher in flavor intensity, flavor pleasantness, texture impression, and overall impression, as opposed to in the presence of the high pitch stimulus. Scherer and Oshinsky (1977) observed the same positive association between pleasantness and the low pitch stimulus, as did Ilie and Thompson (2006).

This apparent inconsistency may be explained by various mechanisms of music-elicited responses. Listeners rely on both the cultural and perceptual cues of a music stimulus to accurately express an emotional response (Balkwill & Thompson, 1999). When a stimulus contains more cues, perceptual and cultural, the emotional expression tends to be stronger, resulting in stronger perceptions (Balkwill & Thompson, 1999). When cultural cues are absent, or when a music stimulus is unfamiliar, the listener must rely heavier upon perceptual cues, in this case pitch, to understand the intended emotional response of the stimulus (Balkwill & Thompson, 1999). The base music stimulus used in this current study might have been unfamiliar to some consumers due to the component alterations and/or the absence in modern day music. Therefore, consumers may have solely relied on the pitch, resulting in less accurate emotional responses, causing some similarities and some discrepancies between past studies, but also a lack of statistical significance. However, this could be interpreted in the opposite way, meaning when the stimulus is unfamiliar and non-cultural, participants may rely on the pitch stimulus itself. Thus, it is expected that the low pitch stimulus will induce sad, depressed, and less aroused responses, whereas the high pitch stimulus will evoke positive responses (Gundlach, 1935; Hevner, 1937; Rigg, 1940; Watson, 1942).

Tempo

In contrast to the pitch stimuli, the tempo stimuli displayed significant differences in the evaluations of flavor pleasantness of the food stimuli. Specifically, in the fast tempo condition consumers evaluated the food stimuli flavor as more pleasant than in the presence of the slow tempo stimulus. Although the results were not significant, ratings for flavor intensity and overall impression followed the same trend of possessing higher evaluations under the fast tempo stimulus. A food texture is based on the characteristics of the physical and mechanical properties making up the food structure and matrix (Bourne, 2002). Although texture and chemosensory stimuli are both controlled in the orbitofrontal cortex, the home of affective ratings for food, chemosensory stimuli such as smell, taste, and flavor, appear to be more correlated with emotions than are the physical properties like texture (Rolls, 2005). Consequently, the lack of tempo-induced differences in food stimuli texture impression may be a result of heightened susceptibility in flavor pleasantness to differing music-elicited emotions.

In previous findings, when sound or music stimuli are presented it has been shown that pieces presented in a fast tempo manner elicit feelings of happiness and pleasantness, whereas slow tempo stimuli produce tranquil, sentimental, and solemn feelings (Hevner, 1937). Our findings are consistent with these assumptions, but the positive ratings seen with the fast tempo may also be explained by classical conditioning, which is the act of transferring positive feelings from one stimulus to another subsequent or simultaneous stimulus (Woods et al., 2011). This is visible in correlations between music pleasantness and flavor pleasantness, texture impression, and overall impression, but also with correlations between music stimulation ratings and flavor intensity, flavor pleasantness, and overall impression. Logeswaran and Bhattacharya, (2009) showed that listening to happy or sad music increased ratings of happiness or sadness for

subsequently shown faces. The same results were present when examining the associations between hedonic ratings of background sounds with foods (Woods et al., 2011) and odors (Seo & Hummel, 2011). By combining the aforementioned we would assume that the happiness and pleasantness of a fast tempo stimulus would be transferred to the consumed food, which was apparent in our study.

Volume

Classical conditioning was also visible in the presence of the volume stimuli. According to Table 4.2 the loud volume stimulus was evaluated as more pleasant in comparison to the quiet stimulus, which may be attributed to the significantly higher ratings of flavor pleasantness and overall impression of the food stimuli in the presence of the loud volume stimulus. Loud volumes of sound stimuli are associated with liveliness, energy, and agitation, whereas quiet volumes are usually peaceful, gentle, and dreamy (Cooke, 1962). As a sound is heard at a loud optimum volume a continuum of effects is created on the listeners evaluation of pleasure, so as the listener encounters the sound stimulus a pleasurable mood is activated, eliciting a positive response, causing overall satisfaction (Novak et al., 2010). However, a stimulus exceeding the volume zone of tolerance creates dissatisfaction (Beverlan et al., 2006).

Comparison between emotional and non-emotional foods in the background music-component-elicited sensory perception and impression

Pitch

When hedonic ratings were considered based on the type of food (emotional vs. non-emotional), both chocolate texture impression and bell pepper overall impression were evaluated

significantly higher in the presence of low pitch, which is opposite of what we expected. It has been shown that as a pitch rises or falls the intensity of emotions grows or diminishes, respectively. Pulling from some previous studies, happiness levels and pitch are considered to have a direct correlation; a stimulus performed in a high pitch is portrayed as more exciting compared to the sad portrayal of a low pitch stimulus (Gundlach, 1935; Hevner, 1937; Rigg, 1940; Watson, 1942). In contrast, a few other studies have observed the association between high pitch stimuli and low-arousal emotions like gracefulness and serenity, in addition to the association between low pitch stimuli and high-arousal emotions like vigor and agitation (Hevner, 1937). Drawing from these studies, it is suggested that the relationship between one affective dimension and pitch may depend on the level of the other affective dimension (Jaquet et al., 2012). Additionally, other studies have shown that perceived sweetness intensity increases with a high pitch stimulus (Crisinel & Spence, 2010a; Mesz et al., 2011). Considering these results we expected that flavor intensity ratings of chocolate would be highest under the high pitch condition, however, the opposite was observed. Regardless, previous findings suggest that sweet and fatty foods are more suitable for modulating certain moods and emotions (Gibson, 2006; Konttinen et al., 2009), which helps clarify why the effects of background music differed between chocolate (emotional food) and bell pepper (non-emotional food).

The pleasantness and stimulation ratings of the music stimulus alone were both higher in the presence of the low pitch stimulus, as were particular attribute ratings, which again presents a possible scenario of classical conditioning. Consumer liking for a music sample influences evaluation on the object being consumed or evaluated (Murray et al., 1992; Park & Young, 1986), so when music is liked, evaluations tend to be more favorable (Gorn, 1982). This effect

was evident in that the positive feelings of pleasantness for the low pitch music stimulus were transferred to hedonic ratings of the foods consumed under the low pitch stimulus.

Tempo

Hedonic ratings for the chocolate stimulus presented no significant differences between fast, slow, and silent stimuli. Comparatively, shown in Figure 4.2b flavor pleasantness and texture impression of bell peppers were evaluated significantly higher in the presence of the fast tempo stimulus than in the slow tempo stimulus. These results are consistent with other studies in that fast tempo stimuli elicit happy and pleasant feelings in comparison to tranquil, sentimental, and solemn feelings elicited by slow tempo stimuli (Hevner, 1937). In addition, Caldwell and Hibbert (2002) have shown that participants prefer music with more arousing structural elements, such as those in a fast tempo stimulus, transferring positive feelings from the music stimulus to the product being evaluated.

Boundaries defining fast and slow tempos are difficult to define, as differences in age and demographics contribute to the acceptable tempo range (Milliman, 1986). As a result, the true effects of tempo may be masked (Caldwell & Hibbert, 2002). Additionally, noise stemming from mastication can add or detract from hedonic attributes of a stimulus (Herrington & Capella, 1994). More importantly, a music stimulus' structure elicits the emotional response, which in turn triggers the behavioral response in the form of a perception. The slow and fast tempo stimuli were not significantly different with respect to music pleasantness, limiting the emotional response variation, resulting in a lack of significance among the chocolate hedonic ratings. On the other hand, the fast tempo stimulus was evaluated as significantly more stimulating than the

slow tempo stimulus. As a result, the flavor pleasantness and texture impression ratings for bell peppers were significantly higher in the presence of the fast tempo stimulus.

Volume

Sweet items have exhibited higher flavor intensities when consumed with loud noises (Ferber & Cabanac, 1987), however flavor intensity was the only attribute for chocolate that was not significantly different between the loud and quiet stimuli (Fig. 4.3a). Similarly, the degree of liking tends to be higher for sweet samples in the presence of the loud stimulus (Ferber & Cabanac, 1987), which is consistent with our overall impression ratings for chocolate. Different structural aspects of music stimuli can evoke different moods (Alpert & Alpert, 1986, 1988), aiding in the explanation for why evaluations of chocolate attributes differed between the loud and quiet volume stimuli. In previous findings, the amplitude of sound was directly related to food stimulus quality, pleasantness (Zampini & Spence, 2004), and increased liking (Spence & Shankar, 2010). Considering the collective effects of the aforementioned, there is sufficient evidence to support our findings of chocolate flavor pleasantness, texture impression, and overall impression rating highest under the loud volume condition.

People tend to consume sweet and fatty foods to alleviate stress (Gibson, 2006) forming a strong correlation between the consumption of energy dense, sweet foods and emotional eating, but a lack thereof with vegetables and fruits (Konttinen, Männistö, Sarlio-Lähteenkorva, Silventoinen, & Haukkala, 2009), suggesting certain foods (e.g., “emotional foods”) are more suitable to alter and mediate emotions. These emotions tend to result in a visible behavioral response (Bruner, 1990; Clynes & Nettheim, 1982; Gardner, 1985; Herrington, 1996), which are evident through the difference in attribute ratings between chocolate and bell pepper. When

consuming the chocolate stimulus participant ratings for flavor pleasantness, texture impression, and overall impression showed significance, whereas flavor intensity was the only attribute that showed a significant difference in bell pepper ratings. This suggests that with the chocolate (e.g., “emotional food”) different emotions were elicited resulting in different behavioral responses.

Flavor intensity of bell peppers was the only attribute that showed significance, as it was significantly higher when consumed simultaneously with quiet and silent stimuli as opposed to the loud stimulus (Fig. 4.3b). This result aligns with another study where levels of pleasure increased in the presence of a quieter music stimulus (Novak et al., 2010), which may result from contrasting effects between a sound stimulus and flavor intensity (van Wassenhove et al., 2008). Changes in the volume or other structural components of a sound stimulus, can add or detract from the overall liking of the evaluated stimulus resulting from classical conditioning (Christensen & Vickers, 1981). For instance, if a participant evaluates the quiet sound stimulus as more pleasant, this positive impression may add to the hedonic ratings, hereby increasing them (Zampini & Spence, 2004).

Sounds are not only influential when heard externally through the ear, but also through internal processes such as mastication. Regardless of the type of food (i.e., emotional vs. non-emotional) it has been noted that when consuming bell peppers a greater level of noise stems from mastication in comparison to consuming chocolate. This has led to differing results and assumptions. Herrington and Capella (1994) proposed that loud internal noise produced by the mastication process could interfere with background music-elicited emotions, resulting in a lack of significant effects from the background music stimulus. In comparison, Spence and Shankar (2010) proposed that increasing the volume of mastication could increase the perceived pleasantness and texture of the food stimulus.

Ratings of pleasantness and stimulation for musical stimuli as a function of musical component

As seen in Table 4.2 significant differences were observed in each of the three sets of musical stimuli for ratings of pleasantness and stimulation. The stimuli pairs differed from one another composed of fluctuating components (pitch, tempo, and volume) allowing participants to focus on the potential effect of the component under study. Each component is associated with emotions influencing behavioral responses, so we would expect to see variations in participants' stimulation and pleasantness levels for the differing components (Mehrabian & Russel, 1974).

Pitch

In previous studies, the pitch of a sound stimulus has been correlated with perceived happiness, specifically, a high pitch sound is interpreted as exciting or happy in comparison to a low pitch stimulus perceived as sad (Gundlach, 1935; Hevner, 1937; Rigg, 1940; Watson, 1942). However, high pitch sounds have also been associated with emotions of anger and fear, while low pitch sounds have been associated with feelings of pleasantness (Ilie & Thompson, 2006; Scherer & Oshinsky, 1977). Considering the contradictory results from the previous studies our data could have followed either trend, but in fact ours trended with the latter. Participants rated the low pitch stimulus as more pleasant and stimulating. The same relationship was observed in Gomez and Danuser' research (2007), arousal levels were negatively correlated with pitch, so in the presence of low-pitch stimuli, high levels of arousal were expressed. It is evident that there are interactions between pitch, pleasantness, and stimulation, which lends a hand to the idea that pitch effects are ambiguous and complex (Gabrielsson & Lindstrom, 2010). For example, when partial correlations were run our findings presented significant correlations between music pleasantness and flavor pleasantness and overall impression, whereas music stimulation was

significantly correlated with flavor intensity and texture impression. The pleasantness ratings for the low pitch stimuli and the corresponding positive flavor pleasantness and overall impression ratings for the food stimuli manifest this association, which may signify classical conditioning (Gorn, 1982).

Personality factors are instrumental in perceptions; extraverts have low levels of cortical arousal and need higher levels of stimulation to become aroused (Eysenck, 1967), whereas introverts prefer lower levels of auditory stimulation (Stelmack & Campbell, 1974). Considering this, our subjects may qualify as extroverts on a higher level than they do as introverts, resulting in higher stimulation ratings of the low pitch stimulus, as evident in our study. However, without actually testing our participants the interaction between personality and auditory stimulation cannot be concluded, in fact a different relationship may be present. Females have a smaller ear canal allowing higher pitches to be heard in comparison to a male, so females may have differing perceptions of high-pitched music in terms of pleasantness in comparison to men (Helbruck et al., 1984). In our study the gender ratio was 3 to 1 with thirty-one more female participants than male participants. The disproportionate ratio may suggest another reason why our results favored one inconsistency over the other.

Tempo

Of the psychophysical cues, tempo is commonly associated with emotional responses (Hevner, 1935). Consistently throughout studies it has been found that fast tempo sounds elicit happy and pleasant emotions, whereas slow tempos elicit tranquil, sentimental, and solemn emotions (Hevner, 1937). Our results did not show any significant effects in pleasantness ratings between the slow and fast tempo stimuli (Table 4.2). However, the fast stimulus was evaluated as

significantly more stimulating than the slow tempo stimulus, which is consistent with past research that has shown tempo effects perceptions of music appeal, arousal, and behavioral intentions toward the music (Kellaris & Kent, 1991). Specifically, faster music elicits positive satisfaction (Caldwell & Hibbert, 2002), in turn increasing emotional responses, resulting in higher arousal levels (Anand & Holbrook, 1985). Participants may have perceived the fast tempo stimulus as more complex, which tends to be associated with increased arousal responses (Berlyne, 1971). Caldwell and Hibbert (2002), have claimed that music with more arousing structural elements, such as fast tempo, are preferred.

Volume

Variations between volume stimuli in the music-elicited emotions may lead to an approach-avoidance behavior (Mehrabian & Russel, 1974), resulting in the difference in pleasantness and stimulation perceptions of the music stimuli. Approach behaviors are those that signify acceptance of the said environment, such as moving towards, staying in, or returning to the environmental stimuli (Mehrabian & Russel, 1974). On the contrary, avoidance behaviors consist of moving away, and leaving the environment (Mehrabian & Russel, 1974). In the presence of louder volumes feelings of liveliness, energy, and/or agitation are triggered (Cooke, 1962). As seen in Table 4.2 the loud volume stimulus was perceived as significantly more pleasant and more stimulating, which align with previous findings suggesting that as volume increases, levels of arousal also increase (Smith & Curnow, 1966). Level of arousal in a stimulus affects behavioral activity; increased rates of activity are associated with higher levels of arousal or stimulation (Smith & Curnow, 1966). Thus, a loud volume stimulus increases the rate of chewing, indicating that the loud stimulus is perceived as more arousing or stimulating (Novak et

al., 2010). According to Caldwell and Hibbert (2002), listeners prefer music with a structural element that increases arousal, which may help to explain why the loud volume stimulus was both significantly more stimulating and pleasant as shown in Table 4.2. In terms of correlations presented in Table 4.3 the only sensory attribute that was correlated with the volume stimuli perception was flavor intensity; an association was present between the more stimulating and pleasant loud stimulus and the high ratings of flavor intensity. This correlation remains consistent with previous observations of participants perceiving sweet items as more intense in the presence of a loud volume stimulus (Ferber & Cabanac, 1987).

Implications

This present study demonstrates that the low pitch stimulus increases texture impression of chocolate and overall impression of bell pepper to a higher degree than the high pitch stimulus. Previous studies have arrived at similar results of low-pitched music being associated with greater ratings of pleasantness, but others have observed the opposite outcome (Scherer & Oshinsky, 1977). An attempt at explaining the unpredictable association and outcome may be attributed to the pitch range dependence on the listener and the ambiguity masking the true musical structure effects (Caldwell & Hibbert, 2002). However, a better explanation may lie in the three-way interaction, suggesting that pitch effects on felt emotions depend on the specific musical piece and therefore its musical structure (Jaquet et al., 2012). The low pitch stimulus in our study was perceived as more pleasant and more stimulating in comparison to the high pitch stimulus, which is consistent with some studies, but contradicts others. Regardless, the results may have differed if another music piece varying in structure was used, but also if alterations to the ballot had been made. Instead of using the word ‘arousal’ due to appropriateness, we selected

‘stimulation,’ which may have led to confusion in both the experimenters and the participants. The same issue was apparent in Ilie and Thompson’s research (2006), which they justified by explaining differences in how ‘arousal’ was conceptualized by the experimenters, as well as explained to and understood by the participants. Similarly, we should have defined and explained ‘stimulation’ to our participants, later verifying they all understood the meaning of the word, before progressing.

In terms of interpreting tempo-elicited effects, the fast stimulus increased flavor pleasantness and texture impression of the bell peppers, in addition to the stimulation perception overall. An emotional vs. non-emotional food effect is seen here, in that the chocolate stimulus paired with the tempo stimuli did not present any significant differences. This could be a result of several factors. One most probable cause can be explained by the lack of significant difference in music pleasantness between the slow tempo and fast tempo stimuli. The structure of a music stimulus evokes the emotional response, perceptions, and behavior. The two tempo stimuli were not significantly different in pleasantness ratings, so the music-elicited emotional responses differed minimally, resulting in a lack of significance among hedonic ratings for the chocolate stimulus. Comparatively, ratings of music stimulation were significantly higher in the presence of the fast tempo stimulus. Stimulation ratings are typically correlated with physical property evaluations of a stimulus; hence the significant increase in texture impression of bell peppers in the fast tempo stimulus. Additionally, an acceptable tempo range is not distinguished as it depends with age, culture, and other demographic characteristics that make it hard to define clear boundaries (Milliman, 1986). This ambiguity may even overpower the true effects of the tempo stimuli (Caldwell & Hibbert, 2002).

In the presence of the volume stimuli a food type effect was also present, specifically, differential hedonic ratings infer that the chocolate (e.g., “emotional food”) induced different emotions triggering different behavioral responses and perceptions than the bell pepper (e.g., “non-emotional food”). When chocolate was consumed, the ratings of flavor pleasantness, texture impression, and overall impression increased in the loud volume stimulus. However, the generalization made that the “emotional food” has an impact on sensory ratings cannot always be assumed as there may be other influences stemming from the type of food such as sweetness, consistency, or mastication. For example, in one study a sweet food may be considered more intense under the loud stimulus condition (Ferber & Cabanac, 1987), but with the same sound stimulus a sweet stimulus of different consistency may show lower ratings of intensity due to contrast effects cross-modally (Woods et al., 2011). Flavor intensity ratings of bell pepper increased in the presence of the quiet stimulus, which was consistent with past studies claiming loud volumes decreased perceived intensities of taste stimuli (Cooke, 1962). Sounds due to mastication have been researched and results have shown various effects, some even contradictory. In our study the loud stimulus increased flavor pleasantness regardless of food type, which was similar to a previous study suggesting loud stimuli increase pleasantness and texture of the food stimuli (Spence & Shankar, 2010). Comparatively, in regards to bell pepper, flavor intensity was the only attribute that significantly differed, leading us to believe mastication from consuming bell peppers interfered with the background music-elicited emotions, masking the true effects of the background music stimulus (Herrington & Capella, 1996). The optimal volume range (62-67 dBa) induces pleasurable moods, positive responses, and overall satisfaction (Novak et al., 2010), so the potential overlap with the quiet stimulus (55-65 dBa)

may explain the pleasant emotions acquired. Furthermore, this may be another occurrence of classical conditioning.

Although our findings present some conclusions it is important to consider all of the stimuli and environmental characteristics in which the study was performed. For instance, it was carried out in a sensory lab using pieces of Hershey chocolate and fresh bell peppers. The emotional influence or perceptions formed may differ if the same study was performed in a Starbucks versus a Dunkin Donuts or using Godiva versus Hershey chocolate as the food stimuli. Starbucks is composed of different atmospherics compared to Dunkin Donuts, which may lead to different mood states resulting in different behavioral responses (Herrington, 1996). Similarly, consuming Godiva chocolate as opposed to Hershey may stimulate a different brain process, triggering a different emotional reaction that may be due to a memory, the financial investment, or a personality trait. Taking these environmental influences and purchase types into consideration, the present findings may be altered due to a variety of or interactions between characteristics.

Music is of utmost importance to people who play, compose, and listen to it as it has the ability to induce emotions that are perceived or felt by the individual (Juslin & Sloboda, 2010). Previous evidence shows that music induces brain-mind and bodily reactions similar to those induced by other non-musical stimuli, so as the music stimulus is recognized, brain processes begin, altering the mood state and emotional reaction, leading to visible behavioral responses (Bruner, 1990; Clynes & Nettheim, 1982; Gardner, 1985; Herrington, 1996; Menon & Levitin, 2005). This systematic pathway of informational processing and emotional responses is susceptible to change as varying music structures evoke different moods and behaviors (Alpert & Alpert, 1986, 1988), but change also occurs with music complexity (Burke & Gridley, 1990),

listener's age (Yalch & Spangenberg, 1993), musical knowledge (Vanderark & Ely, 1993), cultural background (Wright, 1975), and music familiarity (Davies, 1991).

Variables influencing preference for structural characteristics have been vaguely identified, but investigation is on the rise. Cultural factors, formal musical education, exposure, and developmental processes are known to be influential, but individual differences such as experience, gender, and personality may also account for variation in stimulus evaluation (Serafine, 1988). With respect to gender, the assumption is that women experience and express emotions more frequently and intensely than men (Jaquet et al., 2012). Furthermore, musical structure variations can alter gender responses, so that women focus more on pleasure ratings, whereas men focus more on stimulation ratings (Jaquet et al., 2012). Felt emotions arising from a music stimulus are identified not only by the musical structure, but also by personal and situational factors, making such emotions extremely personable (Scherer & Zentner, 2011). These emotions are provoked through paths similar to those triggered by other emotion eliciting events like memory retrieval, appraisal processes, or proprioceptive feedback (Scherer & Zentner, 2011).

Additionally, personalities should be considered when doing further studies, because according to Eysenck (1967) extroverts need higher levels of stimulation in comparison to introverts. If a population contains more extroverts the ratings and perceptions may be heavily weighted to one side, not because of the stimulus itself, but because of participant personalities. In future studies it would be beneficial to survey the participants' in terms of personality by having them complete the Eysenck personality test.

Since these events and experiences differ between people, the elicited response, perception, or emotion will vary across subjects, leading to fluctuating, contradictory, and

sometimes inconclusive results (Scherer & Zentner, 2011). Given that musical stimuli are various and plentiful, the aforementioned potential issues of the study are inherent and unavoidable in all studies involving music-elicited emotions. Research opportunities leading to further explanations of the association between music pitch and perceived emotions are necessary to obtain the clarity the other two components, tempo and volume, possess (Gabrielsson & Lindstrom, 2010).

5. Conclusion

In conclusion, the present study supports previous studies, but also offers new empirical evidence that varying musical stimuli through components such as tempo, pitch, and volume, can alter sensory perception and acceptance of simultaneously consumed foods. Specifically, as consumers listened to the low pitch, loud volume, and fast tempo stimuli their ratings of stimulation increased relative to the stimuli counterparts. Additionally, in the presence of the fast tempo stimulus participants evaluated the flavor pleasantness of the food stimuli significantly more pleasant than both the slow and silent stimuli. Similarly, the food stimuli flavor was significantly more pleasant when paired with the loud stimulus as opposed to the silent condition. In summary, the current research suggests that altering components of a music stimulus and the type of food served may modulate consumers perception and acceptance of the food consumed. Furthermore, our findings may assist foodservice industry professionals in determining the most suitable music stimulus structure to obtain a desired consumer behavior or outcome.

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CHAPTER 5 – GENERAL CONCLUSIONS AND FURTHER DIRECTIONS

The present research has led us to new empirical evidence suggesting that varying musical stimuli can alter sensory perceptions and acceptance of simultaneously presented foods. Specifically, in the presence of a jazz stimulus, perceived flavor intensity, flavor pleasantness, texture impression, and overall impression have the potential to increase. Similarly, the type of food (emotional *vs.* non-emotional) and the music editor (single *vs.* multiple) influence the sensory perceptions and acceptance of both the musical stimulus and/or the food stimulus. In our second study, three music components had altering effects on the presented food stimuli. For instance, the presence of the fast tempo stimulus increased participants' ratings for chocolate flavor pleasantness and bell pepper texture impressions. Altering the pitch of the music stimulus affected ratings of texture impression for chocolate and ratings of overall impression for bell pepper, specifically, when a low pitch stimulus was presented, ratings increased. Additionally, the loud volume stimulus increased subjects' evaluations of all chocolate attributes in addition to the bell pepper flavor intensity, as opposed to the quiet counterpart. Our findings may provide business owners with an explanation for consumer behavior in the presence of a particular musical stimulus or with atmospheric modifications allowing desired consumer behavior.

Although our results suggest that in the presence of a jazz stimulus sensory perceptions and acceptance of the consumed food increase, we cannot conclude that a jazz stimulus will have this same genre effect on food perception and acceptance in each environment and occurrence. Similarly, a loud volume stimulus increasing intensity and overall liking, a low pitch stimulus increasing texture and overall liking, and a fast tempo increasing flavor pleasantness are results sequestered from our present data that should not be considered a conclusion applicable to all future experiments. For example, if we were to base our hypotheses off of other results, we would expect a high pitch stimulus to increase the chocolate (sweet) flavor intensity, however

this was not the case in our research. Multisensory integration occurs between stimuli and emotional responses, so we would expect evaluations of fast tempo, high pitch, and loud volume stimuli to be more pleasant based on the emotions elicited (Cooke, 1962). However, previous findings, including ours, show conflicting results; quiet volume and slow tempo stimuli were more pleasant (Woods et. al., 2011). It is challenging to accredit our findings to one factor such as tempo, pitch, volume, single editor, multiple editors, or genre because separating the music piece characteristics is difficult. When separating the characteristics it takes away from the music piece as a whole leaving the influence unidentifiable to some extent. The music structure is made up of several things and by taking away a certain component, the music piece is no longer the same and the true effects may be masked.

Due to the contradictory nature, it is important to remember two key factors suggesting that 1) the pathway resulting in an emotional response is susceptible to change as individual preferences vary with music structural components (Kellaris, 1992), music complexity (Burke & Gridley, 1990), listener's age (Yalch & Spangenberg, 1993), musical knowledge (Vanderark & Ely, 1993), cultural background (Wright, 1975), personal experiences (Yalch & Spangenberg, 1993), and music familiarity (Davies, 1991), and 2) these emotional responses stem from the effects music poses on informational processing (Kellaris & Mantel, 1994), emotional and physiological changes (Anand & Holbrook, 1985), mood (Alpert & Alpert, 1990), and classical conditioning (Gorn, 1982; North & Hargreaves, 1996). Considering the aforementioned, an emotional response is determined by many contributing factors that may differ between individuals. Therefore, our current results can only serve as a reference, rather than a proven fact.

Currently, the results lead us to propose that in the presence of a loud volume, a fast tempo, low pitched, or jazz stimulus, impressions of sensory attributes will be positively

influenced, but to strengthen this theory, further studies must be carried out. A potential extension could test whether a similar genre effect is observed when complex foods are used rather than a single food. This would be more applicable as the food matrix would be more realistic to a typical dining situation. Similarly, matching the music stimulus with standard versions of current music pieces would create more of a lifelike replica of a restaurant or bar environment. Lastly, the location of the experiment could be altered to a restaurant setting to eliminate distractions or bias from the sensory booths that could potentially influence the participants' perceptions. Doing so would also provide participants with a feeling of normality as if it were a normal Friday night dinner outing rather than a pre-meditated experiment. In addition, taking into consideration demographic components like gender and personality of those participating may lead to some overlooked interactions within the results. Even though informational processing and emotional responses will influence the results that lie within, collectively, the present and future studies have potential to deliver new empirical evidence and strengthen what has already been acknowledged.

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APPENDIX 1.1.

**RESEARCH COMPLIANCE PROTOCOL APPROVAL LETTER FOR MUSIC GENRE
INFLUENCE STUDY AND MUSICAL COMPONENT STUDY**

June 12, 2012

MEMORANDUM

TO: Han Seok Seo
Tonya Tokar

FROM: Ro Windwalker
IRB Coordinator

RE: New Protocol Approval

IRB Protocol #: 12-04-663

Protocol Title: *Effects of Background Sound on Chemosensory Perception and Chewing Pattern*

Review Type: ☐ EXEMPT ☒ EXPEDITED ☐ FULL IRB

Approved Project Period: Start Date: 06/11/2012 Expiration Date: 05/20/2013

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (<http://vpred.uark.edu/210.php>). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 600 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.

APPENDIX 1.2.

**CONSUMER INFORMED CONSENT FORM FOR MUSIC GENRE INFLUENCE STUDY
AND MUSICAL COMPONENT STUDY**

INFORMED CONSENT

Title: Effects of Background Sound on Chemosensory Perceptions

Researchers:

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Administrators:

Iroshi (Ro) Windwalker, CIP

IRB/RSC Coordinator
Research Compliance
University of Arkansas
210 Administration Building
Fayetteville, AR 72701
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irb@uark.edu

Description: Description: The proposed project aims to determine whether background sound can influence food perception and intake. This project consists of three different experiments and participants (you) will take part in one of these experiments. You should have no impairment in olfactory, gustatory, and auditory functions. In the experiment, you will be asked to evaluate odors (Experiment 1), taste solutions (Experiment 2), or food samples (Experiment 3) in the presence of either background sound or silence, respectively. You will be asked to rate the perceived intensity and pleasantness of odor (Experiment 1), taste (Experiment 2), or flavor and texture (Experiment 3) in the presented stimuli. In addition, your chewing frequency will be assessed by using surface electromyography (EMG) and joint vibration analysis (JVA) on your facial surface. The surface EMG and JVA will measure the masticatory muscle activity and the friction/vibration created during your chewing, respectively. Finally, to investigate the effect of personality on background sound-induced food perception, you will be asked to answer a short version of Eysenck Personality Questionnaire in the experiment. It will take 50 to 90 minutes to complete each experiment (e.g. Experiment 3: 90 minutes).

Risks and Benefits: There is no risk associated with this experiment. All stimuli in this research are commercially available products at a local supermarket or chemical company. The surface EMG is the worldwide standard non-invasive method for measuring muscle-specific activity in skeletal muscles. In addition, JVA is a fast and non-invasive method for measuring muscle-specific activity and this method has been often used in the dental office. This project helps you extend your knowledge base of food perception.

Voluntary Participation: Your participation in the research is completely voluntary. There are no college credits for participating. Ten to twenty dollars will be paid for participation reward (\$10 for Experiments 1 and 2; \$20 for Experiment 3).

Confidentiality: You will be assigned a code number and all information will be recorded anonymously. All information will be kept confidential to the extent allowed by law and University policy. Results from the research will be reported as aggregate data.

Right to Withdraw: You are free to refuse to participate in the research and to withdraw from this study at any time. Your decision to withdraw will bring no negative consequences — no penalty to you.

Informed Consent: I, _____ (please print), have read the description, including the purpose of the study, the procedures to be used, the potential risks and side effects, the confidentiality, as well as the option to withdraw from the study at any time. Each of these items has been explained to me by the investigator. The investigator has answered all of my questions regarding the study, and I believe I understand what is involved. My signature below indicates that I freely agree to participate in this experimental study and that I have received a copy of this agreement from the investigator.

Signature

Date

If you have questions or concerns about this study, please contact one of the researchers listed above. For questions or concerns about your rights as a research participant, please contact the University's IRB Coordinator listed as "Administrator" above.

APPENDIX 1.3.

AUTHOR DOCUMENTATION FROM MAJOR PROFESSOR

Author Documentation from Major Professor

As thesis director, I, Dr. Han-Seok Seo, confirm this:

I, Alexandra J. Fiegel, am the first author of the publications used in this thesis and I have completed at least 51% of the work on these publications.

Han-Seok Seo, Ph.D.

Date

Assistant Professor of Sensory Science
Department of Food Science
University of Arkansas
2650 N. Young Avenue
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APPENDIX 1.4.

PRELIMINARY EMOTIONAL FOOD SURVEY

Questionnaire

People often consume specific foods or drinks when their emotion or mood undergoes change (e.g., depression or excitement). How about you? Please place a “V” in the “Mark” column next to all food or drink items that you consume when your mood or feeling is altered.

No.	Mark	Food/Drink Items	No.	Mark	Food/Drink Items
1		Candy	16		Broccoli
2		Ice Cream	17		Bell Peppers
3		Chocolate	18		Peanuts
4		Gum	19		Egg
5		Cookies	20		Cheese
6		Cake	21		Milk
7		Pizza	22		Chicken
8		Chips	23		Meat balls
9		Pudding	24		Steak
10		Popcorn	25		Hamburger
11		Salty snack	26		Soda
12		Banana	27		Coffee
13		Apple	28		Tea
14		Orange	29		Alcoholic beverages
15		Pickle			

1. Gender: _____ Male _____ Female

2. Age: _____ years old

3. E-mail address (if you would like to participate in a future emotional food study):

APPENDIX 1.5.

PRELIMINARY EMOTIONAL FOOD SURVEY RESULTS

<u>Preliminary Emotional Food Survey Collection Results</u>				
<u>Food</u>	<u>Female</u>	<u>Male</u>	<u>Total Responses</u>	
Chocolate	67	25	92	
Alcohol	50	40	90	
Ice Cream	57	27	84	
Cookies	50	18	68	
Soda	45	19	64	
Candy	45	18	63	
Chips	46	13	59	
Salty Snack	40	18	58	
Coffee	30	24	54	
Pizza	29	21	50	
Cake	31	12	43	
Tea	23	17	40	
Gum	21	14	35	
Cheese	22	9	31	
Burger	14	11	25	
Peanuts	14	9	23	
Steak	8	12	20	
Pudding	13	4	17	
Popcorn	8	9	17	
Banana	10	4	14	
Pickle	11	3	14	
Chicken	7	6	13	
Milk	5	7	12	
Meat Balls	5	4	9	
Orange	4	2	6	
Apple	5	1	6	
Eggs	1	3	4	
Broccoli	1	3	4	
Bell Peppers	1	2	3	
Total	663	355	1018	
<u>Participants</u>	<u>Total</u>	<u>Mean Age</u>	<u>Standard Deviation</u>	<u>Age Range</u>
<u>Females</u>	92	41 yrs	15 yrs	19-72 yrs
<u>Males</u>	58	35 yrs	13 yrs	18-76 yrs
<u>Total</u>	150	39 yrs	15 yrs	18-76 yrs

APPENDIX 1.6.

CONSUMER HEARING, TASTE, AND SMELL SCREENER FOR MUSIC GENRE INFLUENCE STUDY

Scoring Criteria

Please complete all questions on this form.

Subject ID: _____

1. Gender: _____ Male _____ Female

2. Age: _____ years old

3. Height: _____ feet

4. Weight: _____ pounds

5. Tuning Fork Assessment (2x):

Was the sound to the participant louder/longer in front of the ear or behind the ear?

Front _____ Behind _____

Did the participant hear equally in both ears? Yes _____ No _____

6. Identification Assessment:

Correct response total _____/12

1	Orange	Strawberry	Blackberry	Pineapple
2	Smoke	Glue	Leather	Grass
3	Honey	Vanilla	Chocolate	Cinnamon
4	Chive	Peppermint	Fir	Onion
5	Coconut	Banana	Walnut	Cherry
6	Peach	Apple	Lemon	Grapefruit
7	Licorice	Gum	Spearmint	Cookies
8	Cigarette	Coffee	Wine	Smoke
9	Cloves	Pepper	Cinnamon	Mustard
10	Pear	Plum	Peach	Pineapple
11	Chamomile	Raspberry	Rose	Cherry
12	Bread	Fish	Cheese	Ham

7. Taste Spray Assessment (3x):

	Sweet	Sour	Bitter	Salt
Red				
Blue				
Green				
White				

Correct Identification total _____/4

-----CUT HERE-----

8. Please write down your Name and E-mail address.

Name: _____

E-mail address: _____

APPENDIX 1.7.

**CONSUMER SOCIO-DEMOGRAPHIC AND HEALTH STATUS QUESTIONNAIRE FOR
MUSIC GENRE INFLUENCE STUDY AND MUSICAL COMPONENT STUDY**

Please complete all questions on this form.

Subject ID: _____

1. Gender: _____ Male _____ Female

2. Weight: _____ pounds

3. Age: _____ years old

4. Height: _____ feet

5. Ethnic background

_____ White

_____ Black or African American

_____ Hispanic or Latino

_____ American Indian and Alaska Native

_____ Asian

_____ Native Hawaiian and Pacific Islanders

6. Self-Assessment: How is your HEALTH STATUS in general?

☐

Very bad

☐

Bad

☐

Neither bad nor
good

☐

Good

☐

Very good

7. Self-Assessment: How is your SMELL FUNCTION in general?

☐

Very bad

☐

Bad

☐

Neither bad nor
good

☐

Good

☐

Very good

8. Self-Assessment: How is your TASTE FUNCTION in general?

☐

Very bad

☐

Bad

☐

Neither bad nor
good

☐

Good

☐

Very good

9. Please check if you have any problem in the following cases.

____ Respiratory disease

____ Digestive disease

____ Cardiovascular disease

____ Renal disease

____ Liver disease

____ Cancer

____ Diabetes

____ Mental diseases

____ Endocrine disorder

____ Significant trauma

____ Immunodeficiency

____ Musculoskeletal problem

____ Smell dysfunction

____ Taste dysfunction

____ Eating disorder

10. Allergy: Do you have any ALLERGIES to foods, odors, or fragrances?

____ No

____ Yes, I am allergic to _____

11. Smoking: Are you a smoker?

____ No

____ Yes, I smoke _____ cigarettes a day.

(Cut Here)

12. Please write down your Name and E-mail address.

Name: _____

E-mail address: _____

APPENDIX 1.8.

CONSUMER COMPUSENSE BALLOT FOR INFLUENCES OF MUSIC GENRE, EDITOR
SOURCE AND FOOD TYPE ON FOOD PERCEPTION AND IMPRESSION

Welcome

Please enter your registration ID # from your blue card on the following screen.

Then please slide your blue card through the window to begin the test.

Panelist Code: _____

Please place the headphones on your ears so that they are comfortable and snug. Today you will be hearing several samples of music while tasting several food samples. You will be given a total of 9 samples and are asked to answer several questions per sample.

PLEASE DO NOT TAKE OFF THE HEADPHONES AT ANY POINT DURING THE TEST!

Question # 1 - Sample _____

With all things considered please rate your OVERALL MOOD at the current moment.

Extremely Unpleasant

Extremely Pleasant

|-----|

Question # 2 - Sample _____

With all things considered please use the scale below to rate your OVERALL HUNGER LEVEL.

Extremely Hungry

Extremely Full

|-----|

Please take a few seconds to just listen to the music sample.

You will be receiving a food sample shortly.

You will now receive your sample. Once you receive it please press the 'continue' button below.

Please consume AT LEAST HALF of your sample to answer the following questions. Please place a mark on the line scale below showing your impression of the following attributes.

Question # 3 - Sample _____

After tasting the sample please use the scale below to rate the **FLAVOR INTENSITY** of this sample.

Extremely Weak

Extremely Strong

|-----|

After tasting the sample please use the scale below to rate the **FLAVOR PLEASANTNESS** of this sample.

Extremely Unpleasant

Extremely Pleasant

|-----|

After tasting the sample please use the scale below to rate the **OVERALL IMPRESSION** of **TEXTURE** of this sample.

Dislike Extremely

Like Extremely

|-----|

Question # 4 - Sample _____

With everything considered what is your **OVERALL IMPRESSION** of this sample.

Dislike Extremely

Like Extremely

|-----|

Question # 5 - Sample _____

How **FAMILIAR** would you consider yourself with the music sample just presented?

Extremely Unfamiliar

Extremely Familiar

|-----|

Question # 6 - Sample _____

With all things considered how **PLEASANT** was the music sample?

- ☐ Extremely Pleasant
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐ Extremely Unpleasant

Question # 7 - Sample _____

With all things considered please rate the **STIMULATION** of the music sample?

- ☐ Extremely Stimulating
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐ Extremely Non-stimulating

Question # 8 - Sample _____

With all things considered please rate your **OVERALL MOOD** at the current moment.

Extremely Unpleasant

Extremely Pleasant

|-----|

PLEASE take a sip of **WATER**

Please pass your tray through to get your next sample.

We require a 1-minute break before the next sample. Please stay seated with your headphones on.

QUESTIONS 1-8 are repeated for all nine samples before continuing on to Question 9

Question # 9

Please enter your first and last name.

Question # 10

Please enter your age.

Question # 11

Please enter your email address.

Question # 12

If you work at or attend the University of Arkansas which of the following are you?

- ☐ Undergraduate Student
- ☐ Graduate Student
- ☐ Hourly Worker
- ☐ Faculty/Staff
- ☐ Do not work at the U of A

THANK YOU FOR PARTICIPATING!
Please take your blue card to the front desk to check out.

APPENDIX 1.9.

CONSUMER COMPUSENSE BALLOT FOR INFLUENCES OF MUSICAL COMPONENT
AND FOOD TYPE ON FOOD PERCEPTION AND IMPRESSION

Welcome

Please enter your registration ID # from your blue card on the following screen.

Then please slide your blue card through the window to begin the test.

Panelist Code: _____

Please place the headphones on your ears so that they are comfortable and snug. Today you will be hearing several samples of music or periods of silence along with tasting several food samples. You will be given a total of 6 samples and are asked to answer several questions per sample.

PLEASE DO NOT TAKE OFF THE HEADPHONES AT ANY POINT DURING THE TEST!

Please take a few seconds to just listen to the music sample or enjoy the period of silence.
You will be receiving food samples shortly.

You will now receive your sample. Once you receive it please press the 'continue' button below.

Question # 1 - Sample _____

Please consume enough of your sample to answer the following questions. Please place a mark on the line scale below showing your impression of the following attributes.

After tasting the sample please use the scale below to rate the **FLAVOR INTENSITY** of this sample.

Extremely Weak

Extremely Strong

|-----|

After tasting the sample please use the scale below to rate the **FLAVOR PLEASANTNESS** of this sample.

Extremely Unpleasant

Extremely Pleasant

|-----|

After tasting the sample please use the scale below to rate the **OVERALL IMPRESSION** of **TEXTURE** of this sample.

Dislike Extremely

Like Extremely

|-----|

Question # 2 - Sample _____

With everything considered what is your **OVERALL IMPRESSION** of this sample.

Dislike Extremely

Like Extremely

|-----|-----|

Question # 3 - Sample _____

With all things considered how **PLEASANT** was the music sample?

****If you did not hear any music with this sample please select the middle choice****

- ☐ Extremely Pleasant
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐ Extremely Unpleasant

Question # 4 - Sample _____

With all things considered please rate the **STIMULATION** of the music sample?

****If you did not hear music with this sample please select the middle choice****

- ☐ Extremely Stimulating
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐ Extremely Non-stimulating

PLEASE take a sip of **WATER**

Please pass your tray through to get your next sample.

We require a 1-minute break before the next sample. Please stay seated with your headphones on.

QUESTIONS 1-4 are completed for all six samples before continuing on to Question 5

Question # 5

Please enter your first and last name

Question # 6

Please enter your age

Question # 7

Please enter your email address

Question # 8

If you work at or attend the University of Arkansas which of the following are you?

- ☐ Undergraduate Student
- ☐ Graduate Student
- ☐ Hourly Worker
- ☐ Faculty/Staff
- ☐ Do not work at the U of A

THANK YOU

Please take your blue card to the front desk to check out.

SEE YOU TOMORROW!!

This same ballot was used for all three days of testing

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