

Dropping the bass: The relationship between heart rate and expectation in electronic dance music (A preliminary report)

Emily Chen^{1†}
Ellena Yohannes¹
Samantha Burgess¹
Daniel Shanahan¹

¹ The Ohio State University, Columbus, Ohio, USA

[†] Corresponding author: chen.8217@osu.edu

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Abstract

The relationship between musical expectation and physiological stress has been examined with increasing frequency in recent years (Huron, 2006; Tarr, et al. 2016). Stress induced from either an unexpected musical event can be studied through the measurement of heart rate (Steinbeis et al., 2006). Previous studies have focused on the interaction between global features (e.g., beat subdivision and pitch height) and stress (Liu, et al. 2018), while others have found no effect of local harmonic violations on heart rate (Steinbeis et al., 2006) and little effect of rhythmic entrainment (Mütze, Kopiez, & Wolf, 2020). More research is needed that focuses on the relationship between predictors of stress through local textural and rhythmic features inherent in musical genres. This study examines the role of specific musical and stylistic features on heart rate. Specifically, we examined elements of electronic dance music (EDM), including fulfilled and avoided “bass drops”, defined as a climax of beat subdivision and pitch height which acts as a resolution for the musical phrase. Due to COVID-19, the data collection for this study is still ongoing, although we hypothesize that musical markers of stress, such as the avoidance of bass drops, are positively correlated with a heart rate.

KEYWORDS: *Heart rate, stress, electronic dance music, EDM, musical expectation*

Introduction

Listening to music has been attributed to a number of health benefits. In a meta-analysis of 400 studies that examine the neurochemical effects of music, researchers found that listening to music can broadly translate into physiological benefits (Chanda and Levitin, 2013). For example, music can help slow a person’s heart rate, lower blood pressure and ultimately reduce stress hormones such as adrenaline and cortisol. In a study testing the effect of the human stress response to music, 60 females were categorized into one of three groups (classical music, sound of water, and no acoustic

stimulation), and were given a standardized psychosocial stress test. Salivary cortisol levels, heart rate (HR), respiratory sinus arrhythmia (RSA), subjective stress perception and anxiety were analyzed to show whether or not music impacted the human stress response, and as a result, the study concluded that music *does* impact the psychobiological stress system (Thoma, 2013). Other studies have similarly shown that specifically, certain aspects of music can affect the degree of stress or relaxation a person experiences (de Witte et. al, 2020; Umbrello et. al, 2019). Van Dyck conducted research on auditory stimuli tempi and its effects on listeners’ heart rate using photoplethysmography (PPG), and found that the tempo of music has an effect on human physiological responses. He concluded that faster music can trigger arousal, and thus increases heart rate (Van Dyck, 2017). However, there is a lack of research in the field that manipulates the specific musical features to see if an expectation is or is not fulfilled. Furthermore, if the expectation is not fulfilled, we would like to examine if it leads to an increase in stress.

Musical expectation can lead to feelings of relaxation or tension in listeners with tension followed by relaxation in Western music. Oftentimes, there is no dissonance in the end of a piece because of the tendency what Lerdahl and Jackendoff (1983) refer to as a “happy-end”. Previous studies have demonstrated that musical expectations can contribute to our physiological and emotional responses through measuring heart rate, electrodermal activity, and electroencephalogram (EEG) activity (Steinbeis et. al, 2006). This study further investigates whether or not the reason for a feeling of fulfillment or unfulfillment of expectation is due to activating the human stress response (Tarr, et al. 2016).

We are currently examining whether or not an unfulfilled expectation increases cortisol levels and



elicits a demonstrably different reaction in comparison to musical stimuli that contains a fulfilled expectation. While previous research has examined the relationship between music and stress levels (Schaefer, et al, 2015), more research is needed that centers on specific stylistic predictors of stress. More specifically, we will be observing stylistic predictors of stress present in electronic dance music since there is little research that examines musical expectations in contemporary music. More research is needed that examines the relationship between one's musical expectations and their musical preferences. For this study, we aim to use excerpts of electronic dance music (EDM) which is a genre of music that has not been used as often as genres such as classical music or pop/rock.

This study aims to look closely into how the fulfillment of stylistic musical expectations or lack thereof influences one's stress response. Additionally, this study aims to observe how natural exposure to different musical genres may impact stress responses to musical stimuli. The study will also aim to examine if differences in one's overall self-perceived emotional state will affect their HR in response to the musical stimuli. With this study, we hope to focus on the question regarding how musical features that increase expectations, such as those in bass drops in EDM can be measured in terms of HR.

Method

Prior to the experiment, participants would be asked to download the app, Cardiio, which is the instrument used to measure heart rate. Each participant will schedule a Zoom meeting that will last approximately 10 minutes long. The Research Assistants will administer the survey containing questions from the Goldsmiths Musical Sophistication Index as well as demographic questions. Before any excerpts are played, the participants heart rate will be recorded using the PPG app. The participant will be instructed to show the researchers the results on their phone. Research Assistants will present one musical stimulus (either the EDM with a bass drop, or the EDM without a bass drop). After the presentation of the stimulus, the participant will record their heart rate again using the app.

Each "odd" numbered participant will listen to the excerpt with bass drop and each "even" numbered participant will listen to the excerpt without bass drop. Participants will be either listening to EDM with a bass drop or EDM without a bass drop.

Results and Discussion

As a result of COVID-19, we have not been able to collect data at this point, but are hoping to be able to in the near future with this new online paradigm. We have instead chosen to include our method and hypotheses here as a form of preregistration. An accompanying preregistration can be found on aspredicted.org. [1]

Conclusion

We are hoping that results will demonstrate the effects of specific musical features of EDM on heart rate and other possible physiological markers of stress.

Endnotes

[1] For a copy of the preregistered report, see: <https://aspredicted.org/an9tb.pdf>.

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