

Do Stress Levels Affect Response Reactions to Background music?

Abstract:

Music is different sounds put together to create harmonies. Stress is a reaction to an interference that disturbs the functioning of an organism. Although many previous experiments tested the effect of music on stress levels and reactions, the correlations among three factors (perception, processing, and reaction) has not been investigated. The objective of this experiment is to test the effect of stress levels on correlations of three factors within physical response reaction with and without background music. It is hypothesized that participants with high-stress levels would have the fastest response reaction regardless of the type of music they listen to. Each participant was randomly put in one group, each group having different testing sequences. The participants then took a stress test, listened to cheerful, suspenseful, and no music for thirty seconds each, and took a “push the button activity” to test their reaction speed. Participants were divided into different groups according to their stress levels and reaction time under different music conditions was compared. Listening to music worsened participants' reactions, however it had the least influence on low stress participants. The data showed that there is no significant difference in reaction times possibly due to the small sample size. It rejects the hypothesis that high stress levels will have a faster response reaction time regardless of the music they listen to. Participants with high stress levels have a faster reaction time and so do low stress levels. Future work includes specific age requirements and extended time period for data collection.

Introduction:

Music:

Music is a vocal and or instrumental sound that is put together to create beautiful harmonies. Since early times, music has played an essential part in human life. It was appreciated by ancient, primitive, and advanced civilizations that realized its power. Music is universal as language, but it "speaks" louder than words (Yehuda, 2011). Music can create an imprint in one's mind because it is such a powerful tool. Music is effective in many ways, including improving temperament (Fisher, Khashram, Narayanan, & Pearson, 2021). People use music to change

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emotions, release emotions, match their current emotions, enjoy or comfort themselves, and relieve stress (Juslin & Västfjäll, 2008). Therefore, music is a reaction generator in terms of making one release a reaction by listening to music.

Different types of music can make one release a reaction. For example, if one is listening to slow music, classical music, or any music that makes one feel happy, it may reduce stress because it calms one down (Attin *et al.*, 2015). Depending on what is playing, people create visuals in their minds, connected to what they hear (Juslin & Västfjäll, 2008). These visuals and sounds can make one be more at ease or tense bringing out a reaction to music (Attin *et al.*, 2015). Not only does music provide for a reaction while listening to it, but it also gives a person a lasting feeling. For example, if one listens to an upbeat song, the person feels more energized afterward (Shih, Huang, & Chiang, 2012). Due to these reasons, music is commonly used in therapy to keep a patient at ease (Juslin P. N. & Västfjäll, 2008). However, music is also used in physical medical visits. Playing music for ten minutes before treatment is shown to reduce one's stress levels more than if the patient were to sit in silence 10 minutes before their treatment (Attin *et al.*, 2015). When one goes to the doctor, or one needs to be mentally treated, because of the imprint music has on a person, it can calm that person's stress levels, and that treats what is happening.

Background music is a form of music without lyrics made up of different sounds or tones or beats, etc. Background music is everywhere. It is common in many work environments, including hotels, restaurants, offices, banks, shops, and hospitals (Shih, Huang, & Chiang, 2012). Background music can also be listened to on music websites on phones, pads, laptops, etc. For example, in emotional therapy specifically, music can help one feel sad, feel happy and benefit their emotional and mental health, which keeps their stress levels low. (Attin *et al.*, 2015). All in all, background music induces emotions such as stress and or calms one's stress.

Stress:

In psychology and biology, the term "stress" describes a response or reaction to an external event or interference that disturbs and jeopardizes the functioning of an organism. While music does reduce stress, the underlying cause for the stress in the first place is also essential. Many conditions could stress one out, such as one's job (Ilies, & Dimotakis, 2010), medical

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procedures (Attin *et al.*, 2015), and one's workload (Shih, Huang, & Chiang, 2012). While all these conditions do induce stress, stress is also part of everyday life (at home, in work, in personal relations), as well as a psychological condition that is part of a crisis (trauma, wartime, illness, etc.) (Yehuda, 2011). Every person comes from a different background, their stress levels being biologically different from birth and affected through different life experiences as life goes on (Alijioki, Nislin, Sajaniemi, & Suhonen 2018). High blood pressure, a quickened heart rate, and feeling of pressure on or around the chest area are indications of stress (Yehuda, 2011).

When the body is stressed, the sympathetic nervous system (SNS) contributes to what is known as the "fight or flight" response. "fight or flight" is when the nervous system senses something that is dangerous or worth causing one stress and the body either fights it or flees the danger. This is a response reaction, and that is how the nervous system contributes to it. When in a stressed state, if there has been no outlet, then the person experiencing the stress is more likely to have trouble sleeping and mood in general, possibly leading to a depressive state (Dewald-Kaufmann, J.F., *et al.*, 2014). Emotional burnout also makes it more challenging to manage stress while increasing it. Emotional burnout is the state of emotional exhaustion due to stress making one incapable of doing their regular tasks (Ilies & Dimotakis, 2010). The source of stress is not always a specific stressor; it is the feeling of being out of control and not being able to have complete control over one's stressful situations. In addition, stress can physically manifest itself as well; more stressed people are more likely to end up with coronary heart disease, high blood pressure, faster heart rate etc.. (Yehuda, 2011). Physical manifestations of stress can occur when one's body is preparing to fight or run away. It is an innate response in our bodies; however, in more recent times, the human race has become less capable of releasing this tension and stress, leading to physical ailments by keeping the body stressed and ready to flee or fight.

Stress affects one's ability to function, presenting itself in anxiety, depression, and physical ailments. This is due to unhealthy ways of expressing stress and releasing stress hormones, subsiding the stress in one's body. For example, when humans were less technologically advanced than present day, they would physically respond to danger through running or fighting, hence the fight or flight response. However, in the modern era, it has become

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more difficult for humans to physically respond to danger, therefore being unable to release stress hormones. (Yehuda, 2011). Fight or flight could also happen mentally as well because if a person is dealing with a mental danger/situation and not a physical one the person could fight and cry or the person could just leave the situation. Stress is not only produced from the perception of a threat, it also has to do with the accessibility of resources to deal with that stressor (Attin *et al.*, 2015).

Stress will stay bottled up inside if one is not provided with the necessary materials or circumstances to release stress or eliminate the threat. Such as when one hand in an assignment for work or school, they have released their mind of stress but not physically their body (Attin *et al.*, 2015). Another factor that heavily contributes to stress is the media. The media heavily affects one's stress levels through people being compared to body types or personalities. Media figures give people bad images of their bodies, making them wish they looked like these models and social figures, giving them an unhealthy amount of stress to cope with the comparison of features. Body image has led to much stress, especially in young teens; they believe that they must look for a sure way to match what they see on tv. This leads them to have stress walking outside and going to school in fear of anyone seeing their body (Young *et al.*, 2012).

Adolescents suffer from stress; this comes from the many changes in their life all at once, and their relationships paired with a heavy workload makes it difficult for them to get the recommended amount of sleep. Sleep is an essential function, and it helps to relieve stress. Therefore, if one is not getting proper sleep, it could affect them psychologically and lead to stress. The proper amount of sleep is not the only factor here; however, it is also the quality of sleep. Regardless of how many hours one gets, one would still feel stressed if the sleep was not comfortable or refreshing. (Dewald-Kaufmann J.F.*et al.*, 2014). While teens get the worst sleep, adults are also affected by their job workloads, keeping them awake and unable to relieve stress. While less sleep does contribute to stress; The main factors are worries, tension, uncertainties about the outcome, lack of control, pain, and perceived or actual threat to physical integrity due to a forthcoming event. However, when stress levels are too high, some people take minor threats such as presenting to their boss or teacher as a threat to their physical being (Attin *et al.*, 2015). Being so incapable of releasing stress is due to an ancient response of human bodies from when

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one would run away from a threat or fight it. Now humans receive threats from what will physically harm them and a build-up of unreleased stress from other more tangible threats. Minor threats could be stressful if one has been unhealthily coping with stress from real threats to their well-being (Antolínez D. & Agres K. R. 2008).

While an overflow of stress is unhealthy, there is good stress, and as long as you manage it, stress can be beneficial. When humans are in crisis, the brain releases the hormone cortisol; this makes one's heartbeat faster and their muscles tense. This is preparing a person for their fight or flight response. When you have psychosomatic trauma, this can cause one's body to have a harmful amount of stress, and not releasing it properly could lead to confusion in one's body's stress response. An excessive amount of unreleased cortisol could make one react to a minor threat as if their lives were in danger. However, stress takes less of a toll on one when they have people to help them through it. If one was losing their supportive relationships, they could have an even harder time responding to stress (Berkhof H. *et al.*, 1996). While these are all ways that stress can be caused, music such as background music is a therapeutic way to calm that stress which may bring down stress levels.

Rationale:

This experiment tested the effect of stress levels on correlations of 3 factors within physical response reaction with and without background music. Most previous experiments tested the effect of music on stress levels, however this experiment tests response reaction while listening to music based on stress levels. Music in previous experiments is shown to demonstrate an increase in performance, however there are no experiments on participants reaction time whilst listening to music (Mohan & Thomas, 2019). Additionally, Although many previous experiments tested the effect of music on stress levels and reactions, the correlations among 3 factors (perception, processing, and reaction) has not been investigated. A person uses response reactions daily. Specifically, three factors: perception which is hearing and knowing what you need to respond to, then processing to understand and focus on how you are going to react, and finally, the reaction which is the response to the perception. Apprehending more about both our physical response reaction functions and what may disrupt it, this research is essential because it helps show how to potentially train ourselves to have more control over our responses. It tests

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the nervous system because it contributes to what is known as the "fight or flight" response when the body is stressed. The body shifts its energy resources toward fighting off what they are stressed about. There will be three types of music pieces: Cheerful (upbeat), Suspenseful (slow and meant to creep one out at times), and no music. There will be two types of background music used in the experiment because one wants to see if stress levels impact response reaction to different types of background music, not just one type.

Hypothesis:

It is hypothesized that participants with high-stress levels will have the most impatient response and fast response reaction regardless of the type of music they listen to. Organisms respond to physical and psychological stress with behavioral and physiological defenses. If the stress is too powerful, too prolonged, then a somatic or psychological dysfunction may be expressed, such as stress emotions, such as anger, anxiety, panic, and fright (Yehuda, 2011). Response reaction will be sudden because if the music is suspenseful, it is most likely a challenging one, resulting in a scared reaction. Stress levels will add to that scaredness if high, which would most likely lead to an impatient response reaction.

Methods:*3.1 Pre- Experiment Procedure :*

The age group for the participants is 14-18 years old. The participant filled out the consent form. Consent forms consisted of the participants' parent/guardian's names, the student's names, their parent/guardians' signatures, the date the form was filled out, the students' signatures, and the student's emails. After the consent forms have been given back, the email on the form was used to email the participant a schedule form asking what periods one is free (the experiment should take at least 1-2 periods and that that information is collected the day before and the day of the experiment. The introductory surveys was sent to complete before the experiment (On the day of the experiment but still before the experiment begins).

3.2 Procedure :

In the introductory survey students were asked few questions on their age, stress levels based on a stress test (Perceived Stress Scale (PSS scale)) they take from the internet (the link is in the introductory survey) that gave them a number and how stressed (example: 28 & moderate)

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and what stresses them out and how they deal with stress (to know if they listen to music when they deal with stress), and then a few questions about music such as what is their favorite genre of music, what is the purpose of the participant listening to music (to see if they listen more to music when they want to have fun or when they are mostly stressed), and a scale from 1-5 on how important music is to the participant (one being not important and 5 being extremely important). Students created a passcode in order for all of the students’ personal information to remain kept to them (confidential). The email of the student was collected but because of confidentiality purposes the email was only used to email the person in case something went wrong in the experiment and when we needed to email them the survey’s. The stress test that was used, uses the Perceived Stress Scale (PSS). Originally created by Cohen et al (1983), it is a highly recognised psychological tool for measuring the perception of stress that’s clinically validated and widely used by the NHS and other reputable medical services.

Thirty seconds of three different music tracks were prepared for the participants before the meeting and a stress test as well as a push the green button activity to measure response reaction and its time. Then the participants will be put into groups. There are 3 tests that are shown below:

Test #1	Test #2	Test #3
Listen to cheerful music for 30 seconds and then do a press the green button activity and see how fast or slow they pushed the button after listening to the music.	Listen to suspenseful music for 30 seconds and then do a press the green button activity and see how fast or slow they pushed the button after listening to the music.	Listen to no music for 30 seconds and then do a press the green button activity and see how fast or slow they pushed the button) after listening to the music.

Table 1: The tests that the participants undergo:

The students will be put in a group sequencing using these three testing groups as shown below:

Group A	Group B	Group C
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<ul style="list-style-type: none"> ● Test # 1 	<ul style="list-style-type: none"> ● Test # 3 	<ul style="list-style-type: none"> ● Test # 2
<ul style="list-style-type: none"> ● Test #2 	<ul style="list-style-type: none"> ● Test #1 	<ul style="list-style-type: none"> ● Test #3
<ul style="list-style-type: none"> ● Test #3 	<ul style="list-style-type: none"> ● Test #2 	<ul style="list-style-type: none"> ● Test #1

Table 2: Group sequencing

Participants were randomly divided into 3 groups. Each group had a different sequence in order to take the tests (Table 2). After listening to 30 seconds of a music track (whether it was cheerful music (test 1)(volume 50), suspenseful music (test 2)(volume 50)(experimental groups), or 30 seconds of silence/no music (test 3)(silent)(control), participants were asked to take a “push the button” activity while the music was still be playing without headphones (constant).

3.3 Reaction time procedure:

The results after clicking the screen on the activity showed how fast they clicked the screen in milliseconds and seconds (which was shown as a time). The time was recorded by us for the participants reaction time for the seconds and milliseconds it took (ex: 8 seconds 5 milliseconds) so the participant did not get disrupted. Then after the test the participants took the results recorded and transferred it to the mid survey on a google form when it is being completed. The participants then took a mid survey at this point in the experiment after completing every test in the group sequence (each trial/test in the group sequence was 1 minute apart) (the mid survey is taken 3 times per person). In the mid survey after the participants entered their passcode, they indicated how they felt with a “check of all the apply” box question as well as, the type of music one listened to, the time that is recorded by us is based on what the student got on the activity, and the way that the student felt before they listened to the music. The questions that were asked all measure emotional response reaction.

Finally, there is one question asked before the end of the experiment and it will be recorded in one final survey. The survey asks for one's passcode (so that it is known who it belongs to while also keeping anonymity), and there was one more question asking if the person was distracted in any ways while taking the experiment because that could compromise the

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results. After all of the tests, the experiment was wrapped up and there was gathering of data and results via google forms and all of this information was kept confidential in a secure excel sheet that is disposed of when no longer needed.

Data analysis:

The data that was collected in the table above and was then placed in Microsoft Excel to turn it into a graph. ANOVA was used to compare groups A, B and C stress levels; these p-values show no significance due to the small sample size. There were four graphs to represent all the results. The first graph compared all our data. It was a bar graph with nine different bars in three different categories of whether their stress levels were low, moderate or high. In each category there are three bars that depend on what type of music the participants listened to while taking the reaction time test, no music, cheerful music and suspenseful music. This was all on the x-axis. The music category bars were the averages of the participants' clicking time that depended on their stress group, low, moderate and high. The category for no music was represented in blue bars, cheerful music was represented by orange bars and suspenseful music was represented by gray bars. There were also error bars on the figure.

The second figure was a scatter chart that represented the participants reaction time while they listened to no music in correlation to their stress levels before beginning the experiment. There was a trendline to compare the data. On the x-axis there were stress levels and on the y-axis there was reaction time in milliseconds (mms). The third figure was similar to a scatter chart but it represented the participants reaction time while they listened to cheerful music in correlation to their stress levels before beginning the experiment. There was a trendline to compare the data. On the x-axis there was stress levels and on the y-axis there was a reaction time in milliseconds (mms). The fourth figure was also a scatter chart that represented the participants reaction time however the participants listened to suspenseful music in correlation to their stress levels before beginning the experiment. There was a trendline that compared the data. On the x-axis there were stress levels and on the y-axis there was the reaction time in milliseconds (ms).

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Results:

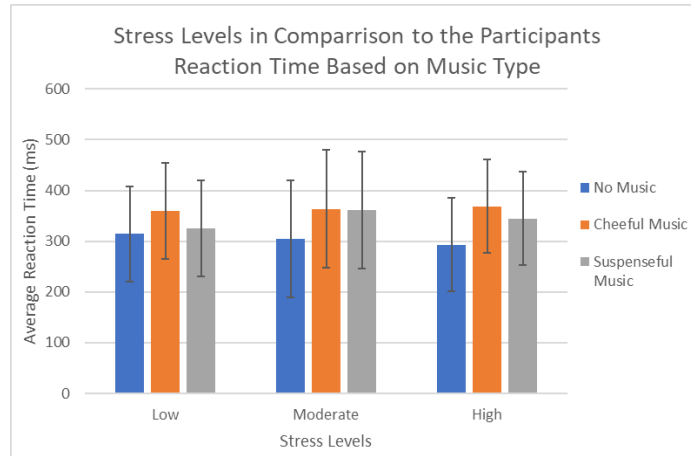
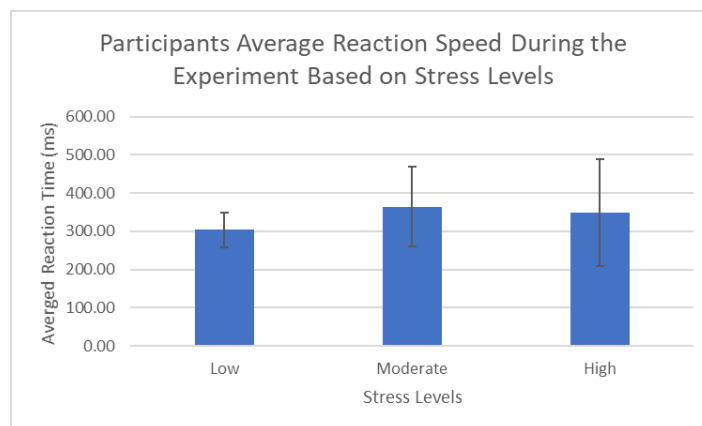


Figure 1: Stress levels in comparison to the participants reaction time based on music type, is used to compare the participants stress levels to the music listened to. Each bar was used to show the average reaction time of the participants while they listened to certain types of music, grouped into different stress groups, low, moderate and high. Error bars were used based on the standard deviation of each respective group. ANOVA was used to compare the data to each other; there was no significance found due to the small sample size. No matter stress levels, while listening to no music all participants had a faster reaction time. It appeared that the music, regardless of the types, worsened the reactions more in moderate and high stress level groups. Low stress level groups appeared to be less affected by music.



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Figure 2: This represents the participants’ average reaction time based on their stress levels. This is a collection of the participants reaction time average during the experiment depending on stress levels. During the course of the experiment participants who have moderate stress levels tended to have a slower reaction time while participants who have low stress levels generally had faster reactions during the course of the experiment.

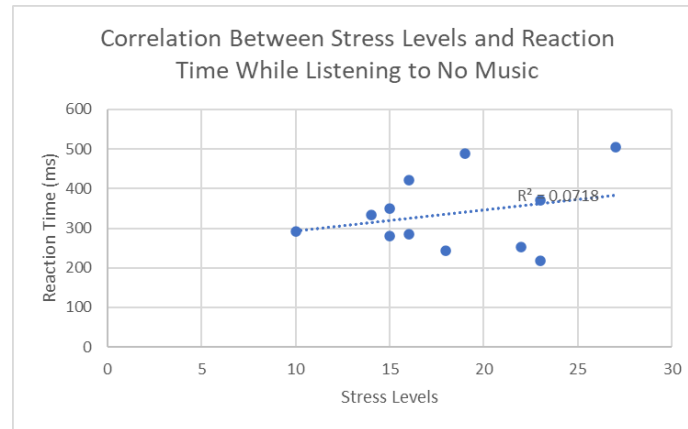


Figure 3: The correlation between stress levels and reaction time while listening to no music, this represents the participants' individual stress levels and their typing time while listening to no music. The trendline shows an upward trend however the correlation is weak (R-squared value is 0.0718). The low R-squared value shows that the results don't follow a trend.

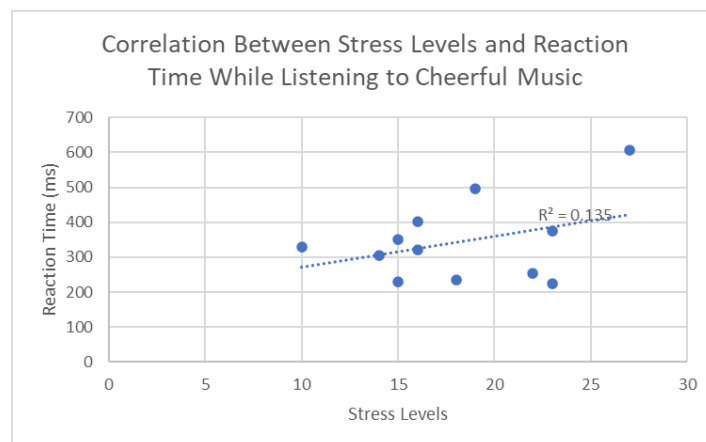


Figure 4: The correlation between stress levels and reaction time while listening to cheerful music, this represents the participants' individual stress levels and their typing time while

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listening to cheerful music. The trendline shows an upward trend however the correlation is weak (R-squared value is 0.135). The low R-squared value shows that the results don't follow a trend. While this trend is stronger than the trend seen with no music it is still a weak correlation.

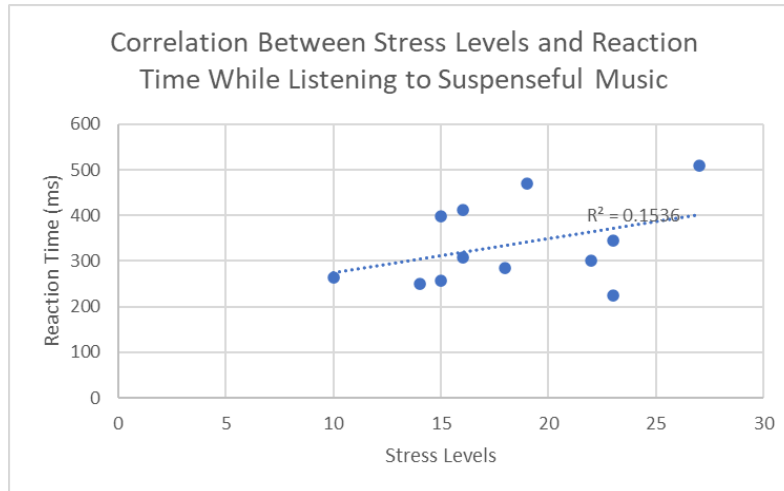


Figure 5: The correlation between stress levels and reaction time while listening to suspenseful music, this represents the participants' individual stress levels and their typing time while listening to suspenseful music. The trendline shows an upward trend however the correlation is weak (R-squared value is 0.1535). The low R-squared value shows that the results don't follow a trend. While this trend is stronger than the trend seen with no music and cheerful music it is still a weak correlation.

Discussion:

It appeared that all music, regardless the music type, worsened the reactions appeared more in moderate and high stress level groups. Low stress level groups appeared to be less affected by music, however, the data showed that there is no significant difference in reaction time depending on stress levels when listening to certain types of music due to the small sample size. It rejects the hypothesis that high stress levels regardless of music type listened to would result in short reaction times compared to lower stress levels with the same music. In all tests music appeared to have distractive effects especially in higher stress level groups.

There are some factors that may have caused room for error during the experiment. Some of those factors that have to be taken into account include age because depending on the age the

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stress levels may vary so someone that is 14 might have different results than someone who is 16. Another factor to take into consideration is the number of days it takes to conduct the experiment because the stress levels may vary depending on the day. Finally, the last limiting factor to take into account is that even though the music that is chosen is supposed to give the person a specific reaction it might give the opposite depending on the person's mood. In other words, the music may make some participants uncomfortable.

Future work would include more specific age requirements, a reduced time period for trials, an extended time period for data collection as well as the participants' mood being recorded and taken into account when presented with the tests. A more specific age requirement being taken into account would make the results more accurate as age can vary stress levels with no external factors. A reduced time period for trials would allow for more accurate data collection, possibly changing the results due to there being less of a change in the stress levels over the time period of the experiment. An extended time period for data collection would possibly provide more participants making the data more reliable and accurate. The participants mood is also another factor that should be taken into account during future work as their mood can affect the participants results and make some information less accurate and dependent on stress and dependent on the participants mood. Overall there are things that could be improved upon to make the results more accurate and significant however in this experiment there is no information suggesting that high stress levels regardless of the type of music played affects a person's reaction time.

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