How Listening to Different Genres of Music Impacts Individuals' Performance on Math Computations

Brendan Chua, Christian de Ocampo, Martha Kenny

Belmont University

Abstract

Today it has become even more common for students to listen to background music while doing homework, studying for tests or completing other educational, cognitive tasks. For this experiment, we decided to see how well participants performed on a test of simple math problems with and without the addition of background music. More specifically, we wanted to see if there would be a difference in results when we compared conditions of silence, classical and metal music. We created three different tests consisting of 20 simple math questions. After answering questions about their demographics, participants took three tests: one in silence, one with classical music, and one with metal music. The tests were accompanied by instruction from the experimenters to start and stop before continuing after the one minute timer. We found that there was a significant difference between participants' test scores in the silence and classical music condition, but not between the silence and metal music condition. These results did not fully support our hypothesis, predicting that metal would be the most distracting condition. We believe this is because participants adapted to the testing environment due to lack of condition randomization.

How Listening to Different Genres of Music Impacts Individuals' Performance on Math Computations

With technological advancements in the entertainment industry increasing music's accessibility, background music has become more prevalent in our society. Listening to music while completing tasks involving complex cognitive processing, such as studying for a test or completing homework, has become popular among students. There have been research studies analyzing the impact of musical distraction on cognitive task performance, however results vary and are widely debated (Dolegui, 2013).

According to the National Association of Secondary School Principals (NASSP), it has been found that there is a positive correlation between solving mathematical problems while listening to classical music, meaning that listening to classical music increases performance. Specifically termed the Mozart Effect, researchers have concluded that calming music such as classical music speeds up the thought process of the math solver. Likewise, research has shown that classical music increases performance specifically in math scores (Maas, 2013).

While studies have found that background music can be beneficial to a student's performance on math computation. Other research challenges these findings, showing evidence that music acts as a distraction, particularly in regard to attention and recall (Furnham & Bradley, 1997). Additionally, another study has found that background music, classical and pop genres specifically, did not affect students' performance on simple math problems (Manthei & Kelly, 1999).

In order to further explore the cause/effect relationship between music and performance, we conducted an experiment to analyze how listening to classical and metal music during a

minute math test impacts college students' accuracy and speed on basic math computation problems. We predicted that participants would perform best in silence and worst when listening to metal, with moderate performance when listening to classical.

Method

Participants

For this experiment, we studied a group of 20 college students taken from the Scientific Psychology Lab 1896.03 at Belmont University. This group consisted of 84.2% female and 15.8% male with a mean age of 20.63 (*SD* = 0.76). They had all completed the appropriate schooling to be accepted into Belmont University, including entry level math courses where they learned how to do basic addition, subtraction, multiplication and division. These students were given the Participants Ethics Agreement and were required to sign in order to participate (see Appendix A).

Design

The independent variable for this experiment was the genre of music played while subjects completed a basic 20 question math computation assessment (specifically, the genres measured were classical and metal). Each math assessment was limited to a time of one minute per assessment. Participants underwent three different conditions (silence, genre classical, genre metal) presented in a set order that was the same for each participant: silence, classical, metal. The first assessment was taken in silence, which acted as the control condition because it closely mimicked a normal testing environment and acted as a baseline for comparison. Our second condition was the classical music piece, 'Canon in D' by Johann Pachelbe, which we played during the one minute math assessment. The third condition was the heavy metal rendition of Frozen's 'Let it Go' by American Awesome Alliances, which we played one minute of during the third math assessment (refer to Appendix B for links to the music). Participants had to wait for verbal instruction before starting each assessment so that every participant began and ended

each condition (silence, classical, metal) at the same time. Our dependent variable was the accuracy of the students' answers on each assessment.

Materials

In order to give these assessments to the subjects, we used Qualtrics, an online survey platform. Subjects were asked to use their personal computers to access the assessments on Qualtrics. The songs were played directly from iTunes on an iPhone connected to Harman Kardon HK206 desktop speakers (played at full volume on the speakers, five notches from full on iPhone). In the classroom, the researchers instructed the participants at which point to proceed with the survey on Qualtrics. Each assessment measured math abilities in division, multiplication, addition, and subtraction at a standard third grade level. Each assessment was equivalent in difficulty because the types of questions were evenly distributed and they all fell within; one and two-digit computation.

Procedure

All participants were given a link that took them to the survey on Qualtrics. Before the assessments began, participants were asked their demographics information of their age, gender, their confidence in solving basic math problems, as well as if they usually listen to music while solving math problems. The assessments began when participants were given verbal instructions. Participants answered as many questions out of a list of 20 questions as they could before the one minute timer ran out. One of the researchers was responsible for the music. Another researcher was responsible for the stopwatch. The last researcher was responsible for vigilance, making sure participants completed a set of questions before proceeding to the next set. Participants were not

visually aware of this timer. The first assessment was taken in silence. At the beginning of the second assessment, we hit play on the classical music piece, 'Canon in D' by Johann Pachelbel. Just like the first assessment, students answered as many questions out of the list of 20 as they could before the one minute timer ran out. Finally, for the third assessment, we played a heavy metal/screamo rendition of Frozen's 'Let It Go' by American Awesome Alliances. Once participants had completed the final assessment, the experiment was over. Descriptive and inferential statistics were used to analyze the data. Specifically, a within-group ANOVA analysis of participants performance on each assessment was made.

Results

We predicted that participants would perform best in silence and worst when listening to metal, with moderate performance when listening to classical music. We did and did not find significant support for this hypothesis. A One-Way ANOVA revealed a significant difference between conditions ($F(2,54) = 3.16$, $p = 0.05$); however, using Tukey's Honest Significance Difference test, this difference was found only between the silence and classical music conditions ($p < 0.05$) and not between the silence and metal ($p = 0.21$) nor classical and metal conditions ($p = 0.75$). Specifically, while participants performed best in the silence condition ($M = 76.05$, $SD = 19.83$) they performed worst in the classical condition ($M = 58.42$, $SD = 24.38$), and only slightly better in the metal condition ($M = 63.68$, $SD = 22.16$). Refer to Figure 1 in Appendix C for details.

Discussion

Overall, this research finding was unique. Specifically, participants scored most accurately in the control condition, which was in silence. This supported our hypothesis and a previous research study by Manthei & Kelly (1999), that being there was a significant difference between the silence and classical conditions, with students performing worse in the classical condition compared to the silence condition. However, unlike our hypothesis, participants scored better in the metal condition compared to the classical condition. This is a unique results due to our conjecture that the metal condition would be more distracting. The results from another previous experiment run by Dolegui (2013) matched that of our hypothesis. This matches our hypothesis that our participants would score the best on the test in silence, but the worst on the test with the metal music. However, our results were different. As stated before, participants scores were significantly affected by the classical music condition, but scores were similar for tests taken in silence and with background metal music.

The experiment run by Maas (2013) concluded results supporting the hypothesis that classical music would have a positive correlation with math test scores. However, Maas's (2013) experiment used a sample of Algebra II students and tested them on the material they were currently learning. In comparing this to our experiment, the types of math problems used were very different. While Maas's (2013) were more complex, those that we used were much easier for participants to adapt to. In other words, participants may have gotten warmed up by taking one test and were ready to perform even better on the next.

While our results supported some previous research Manthei & Kelly (1999), there were some notable methodological issues we may have faced. First, we had a very small sample size. We were only able to run our experiment on 19 participants. Due to lack of randomization

between conditions, another factor we must account for is the simplicity of these math problems and participants' ability to adapt to the flow of the questions. We can presume that participants were able to get a feel for the types of simple math problems that were on the test by taking the first in silence. By the second test, participants were somewhat familiar with the math problems, but were distracted by the first condition. By the third test, the metal music condition, participants had not only adjusted to the type of problems on the test, but also to the additional change in condition. Refer to Appendix B - Figures 1 and 2 for an example of the actual math questions the participants took in Qualtrics. Furthermore, we do not have an accurate stopwatch to use in the experiment as initially planned. Our only source of timer is an iPhone stopwatch which was used by one of the researchers during the experiment. We could have a totally different result that may be in favor of our hypothesis and that would turn things around for this experiment.

Going forward, our experiment could be improved by using a larger sample of participants. By increasing the volume of participants, as well as diversifying the type of participants, the data would more accurately reflect the results of the sample size. In addition, the experimental design could be improved by adjusting the survey to randomize the conditions as well as the math questions for every set so that participants will not be able to predict the flow of questions or conditions. An automatic timer from Qualtrics when participants start every set of math problems will be the best way to record the one minute duration.

All the factors mentioned in the previous paragraph played a role in determining the outcomes of the experiment. It does matter a lot, especially when the results are being impacted. In general, researchers would like everything to be as specific as possible in an experiment to avoid unwanted limitations such as sample size and an inaccurate timer.

In this experiment, we tested to see how different genres of background music affect how participants perform on tests comprised of simple math computations. We found that participants scored best on the test in silence (control condition) which partly supported our hypothesis that participants would score best on the math test in silence, but worst on the math test with metal music. However, the other half of our hypothesis was not supported. Participants scored the worst on the test with classical music and slightly better on the test with metal music. While this could lead one to conclude that classical music is the most distracting of the three conditions we tested, it would require more research to do so.

References

Dolegui, A. S. (2013). The Impact of Listening to Music on Cognitive Performance. *Inquiries Journal/Student Pulse*, 5(09).

Furnham, A., & Bradley, A. (1997). Music While You Work:The Differential Distraction of Background Music on the Cognitive Test Performance of Introverts and Extraverts *Applied Cognitive Psychology*, 11(445-455).

Haas, S. (2013) *The Effect of Background Music on Math Test Performance of High School Students* Unpublished Manuscript, Oakland University.

Manthei, M., & Kelly, S. (1999). *Effects of Popular and Classical Background Music on the Math Test Scores of Undergraduate Students*, University of Nebraska at Omaha

APPENDIX A

Participant Ethics Agreement

BELMONT UNIVERSITY

RESEARCH PROJECT INFORMATION SHEET

MUSIC'S IMPACT ON INDIVIDUALS' PERFORMANCE IN MATH

Principal Investigator: Christian de Ocampo, Martha Kenny, Brendan Chua

Faculty Advisor: Anna Garr

You are invited to participate in a research study about music and math. We will be studying the impact of two different genres of music on how well individuals can complete a sheet of simple math problems.

If you agree to be part of this project, you will be asked to spend about five minutes answering a few questions and completing three sheets of simple math problems including addition, subtraction, division and multiplication. While you complete these math problems we will be playing two different songs; one per sheet as well as one in silence.

Risk and discomforts may include stress if you are easily stressed by mathematics or a change in mood due to the music played.

It is your choice whether or not to participate in this study. Even if you decide to participate now, you may change your mind and stop at any time.

We will protect the confidentiality of your research records by keeping this study anonymous. We will be using a survey program that will not ask for your name.

Information collected may be shared with other researchers involved in this project. We will not share any information that could identify you with others outside of the research team. If results of this study are published or presented, individual names and other personally identifiable information will not be used.

If you have questions about this research study, please contact faculty advisor Anna Garr – anna.garr@belmont.edu

Name of Participant (Please Print):

Signature of Participant: Date:

Signature of Investigator: Date:

APPENDIX B

Links to song used in experiment

"Frozen: Let It Go" by American Awesome Alliances.

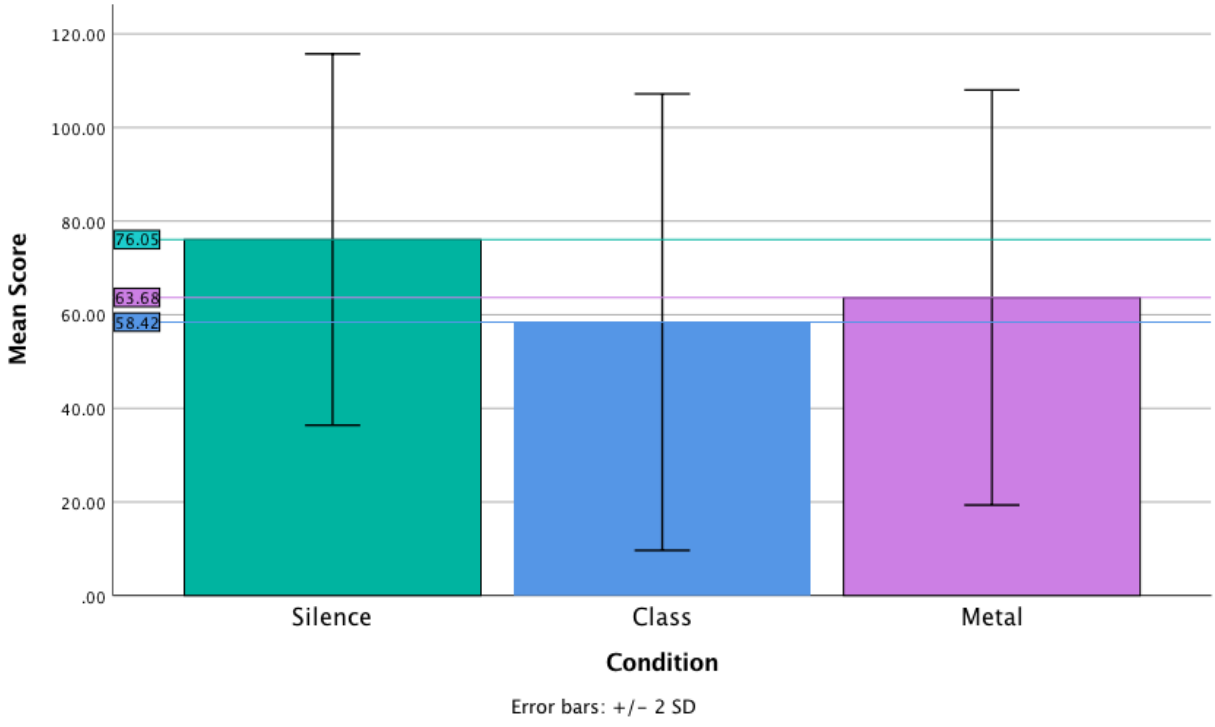
https://www.youtube.com/watch?v=_Mo6fBYZXkE

"Canon in D" by Johann Pachelbel

https://www.youtube.com/watch?v=Ptk_1Dc2iPY

APPENDIX C

Figure 1 - Mean score of test performance per condition



Appendix D

Figure 1 - Screenshot of actual math questions in Qualtrics - Addition and multiplication

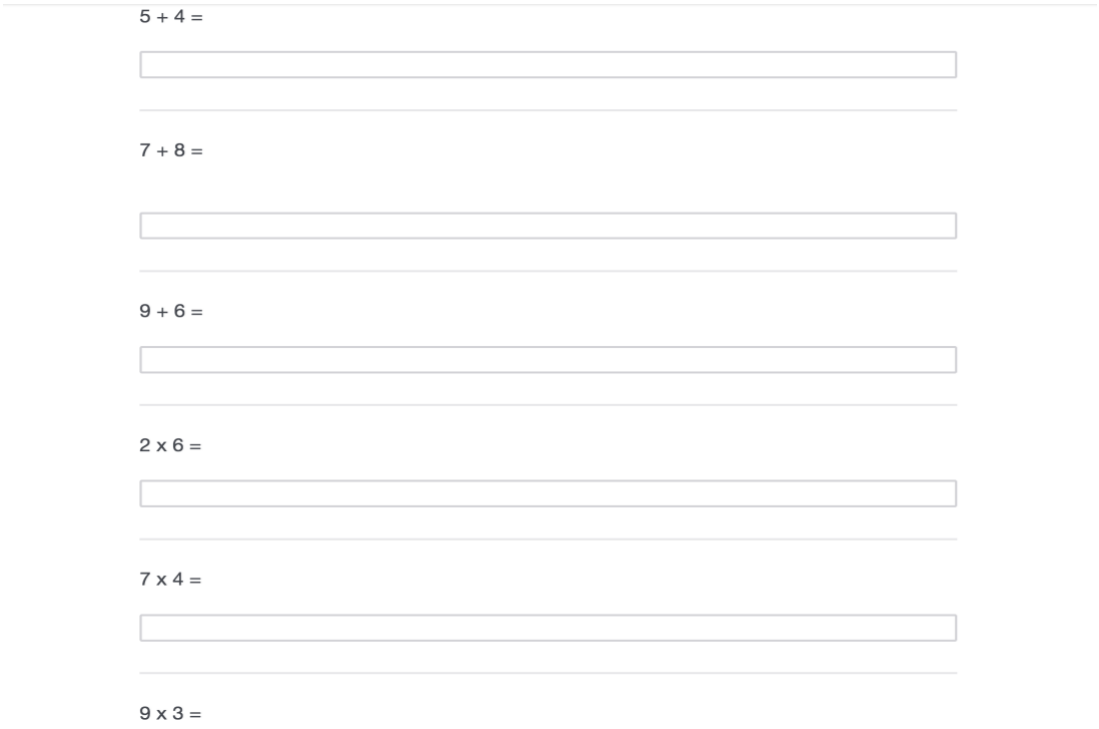


Figure 2 - Screenshot of actual math questions in Qualtrics - Subtraction and division