Repetitive Classical Music and its Effects On Memory Retention and Recall

Word Count: 4,321

Abstract

Many students around the world face some type of disability that hinders their studying and testing capabilities in a classroom enviroment.To deal with this concurring issue, I implemented an experiment to test and see if the repetition of one classical song (“Fur Elise”) caused students to test better when it was played throughout the lesson and their end-of-subject test. There has always been a division in the auditory science community over whether music was beneficial or not to studying and attention retainer. Most studies only tested younger age groups or students with major disabilities. By testing this in a high school environment, this now applies can give a rough estimate that can conclude all high schools populations and gives the general public an idea of how music affects high-school students. This experiment was divided into two groups, the testing on AP vs on-level students. With each course, (AP and non-AP) there are 2 classes, a control one without music and a test one with music. After only one trial, due to time constraints and scheduling errors, the data concluded that music had no effect on AP students testing/memory capabilities. However, on-level students displayed an increase of 10% on their test, showcasing that music had a positive effect on memory retainment and recall, at least when it focuses on short-term memory retainment.

*Keywords*: Music, High-School, On-level vs AP, Memory Retainment, Testing

## Introduction

In the past, many scientists and psychologists have made claims stating that music has a beneficial factor on memory integration, retainment, and recall. However, there has been just as many who counter such claims, stating that music is nothing more than a distraction or declaring that there are no apparent effects on the studied patients (Ferreri & Verga, 2016). As such, the purpose of this experiment is to determine the actual effects of music on academic behavior in a high school environment; establishing whether music's effect are beneficial, distracting, or ineffective in causing any change. The experiment will be tested and conducted by enforcing Jenks High School students to listen to one specific song during class and seeing if the students will be able to better recall the information while the same song is played in the background during their final test.

### Gape and Usage

As a student suffering from ADHD, I wanted to find a new method for students to better utilize their class time by increasing their attention and memory retainment skills. If the results received from this experiment prove that music is beneficial to students' information recall abilities and information retainment capabilities, schools could incorporate this methodology to increase classrooms' grade point averages, students' passing rates, and help more achieve academic success. These results are not limited to affect only the classroom environment. Students could use the results from this study to redesign their own learning methods. Students already spend too much time outside of school studying, that they end up "'being' at school (in the studying mindset) almost all day" (Antony, Privya, & Gayathri, 2018). By finding a method that will help students better retain and memorize information provided, students' will be able to

use their afternoons relaxing and preparing for other activities. Previous studies only targeted the effect of music on kids, with and without disabilities, adults, and lacked research in the high school age group and environment. By focusing my study on high school students without disabilities, for the most part, it fills in the missing information for one age group and the results will then be applicable to other high schools.

**Literature Review**

To direct and focus my experiment, I proposed the following research question: does students' end-of-topic scores increase when one repetitive song, that is both familiar to the audience and contains either few or no shifts in style, is introduced during their learning stage and played throughout the course, including during their test? Before even starting to research, I already hypothesized that music is a beneficial factor to memory retainment, based off personal experience. One of my first initial sources helped back up this initial claim from just personal observation. From the scientific journal, Music Perception, an article named "Benefits of Music on Verbal Learning and Memory" discussed how previous studies of music's effect on verbal learning and memory showcased a positive influence on memory, but "has also been suggested to hinder mnemonic performance by dividing attention" (Ferreri & Verga, 2016). This initial information was then broken down in depth, going onto explain the different researches and findings, different types of variables that were modified, and how their conclusion, overall, does benefit memory and verbal learning, suggesting that "the extent to which music boosts these cognitive functions relies on experimental factors, such as the relative complexity of musical and verbal stimuli employed. These factors should be carefully considered in further studies" (Ferreri & Verga, 2016).

To follow that idea, “The Impact of Music on Learning and Consolidation of Novel Words” introduces the concept of how singing a text out loud to a melody may result in better recall of the words compared to just reading the text out loud. This use of music allows some patients with memory problems when it is sung to them instead of normally spoken. The overall conclusion after analyzing all three experiment conducted, couldn’t determine for sure if the act of singing the novel words to the melody allowed for better recall, however it allowed the novel words to be more strongly integrated in the mental lexicon. The advantage only was present when the melody was very familiar. In the end, they summarized that “the impact of musical presentation on learning therefore appears to extend beyond episodic memory and can be reflected in the emergence and properties of new lexical representations” meaning that music’s effect on studying is not short term and can cause new effects of lexical to surface (Tamminen, Rastle, Darby, Lucas, & Williamson, 2017).

That factor, memory retainment increases when introduced to a familiar piece, can be combined with the result from a paper published by the British Journal of Special Education. Their paper explains in their methodology that “the music for the study was selected from that suggested, on the basis of previous research with children, by Giles as ‘mood calming’” (Hallam, & Price, 1998). To determine if their previous experiment’s conclusion was effective or not, they analyzed the mean test scores found. The average score with background music was 38.5 when compared to 21.5, the score for no music (Hallam, & Price, 1998). To further support that slow and calming songs was the most effective type of music to use, the scientific article “Effects of Music and Movement Expression” goes into depth about how music styles had a variating effect on memory when race becomes a part of the experiment. The study was conducted by

introducing 2 groups of 64 kids, one group of African-Americans, the other Caucasian, were exposed to two different stories. One story was full of motion and the music following it was also active as well. The other story told was a slow story with calming music. Each story was read to both groups and the results were recorded. Results showed that African-American children remembered best when the story was highly active and so was the music. “In contrast, facilitating effects emerged for White children when the LMC (low movement content) stories were presented under the LME (low movement expression) contexts” (Cunningham, Boykin, & Allen 2017). Based on the sources stated and analyzed earlier, it is demonstrated most frequently that the music is most effective when it is both familiar and calming - the reason I end up with choosing slow music was the fact of white student population to other races at Jenks. This being said, white student’s make up the majority of the graduating class, so it would be best to focus on the group that will be analyzed and summarized as the general public so it can be related to other high-schools - which can be a result of listening it repeatedly, and when it follows a LME or contains either now or few style shifts.

As shown in the case study presented earlier, testing scores were higher with music, than without. This can be better understood by the paper published by Psychomusicology. The paper initially states that when listening to music, two possible actions may occur; the listener may recall a memory, feeling, or thought from their past or focus on one particular aspect of the music, such as a specific instrument in a piece. The main focus of the experiment was to see how the brain responds when they participant were asked to either focus on trying to bring back their memory (MEAMs) or to notice how many instruments were in the piece. When MEAMs were recalled naturally (so when users focused on how many instruments were there), the brain does

not really have any use with the medial temporal lobe, however, when being asked to focus on it, it causes the medial temporal lobe and the behavioral ratings of memory relieving increase dramatically. “Focusing on MEAMs also increased connectivity between the left hippocampus and default-mode network regions” (Kubit & Janata 2018). The main point and finding of this was when the user was forced to remember, it causes more of the brain to work together to find MEAMs, allowing the user to recall memories more effectively and more vividly, due to the integration of the brains left-hippocampus.

The last article “Effect of Music on Academic Performance of College Students” surveys college students and analyzes the data received. The paper compiled the data and made them into pie charts for an easier visual understanding. The author’s summarized their findings that “Music helps them relax and in turn increases their efficiency and focus toward academics” (Antony, Priya, & Gayathri 2018). As the paper was ending, the article pushed the readers to use music to help relax the mind more often, not just while studying, but “in our day-to-day lives. Music has a strong positive impact that can change lives for the better” (Antony, Priya, & Gayathri 2018).

**Method**

For each core math subject being tested upon, they must have both a control group and a trial group. Then, there must be an AP class vs non-AP class for each scenario. In the end, there will be 4 different groups used in this experiment. I plan to target a teacher who teaches both AP and on-level courses, that a way, minimizing experiment errors or uncontrollable results as different teachers may conduct their classes in different fashions and while still effectively summarizing the whole student body (Antony, Privya, & Gayathri, 2018). Once I find my teacher, I will meet with them personally and discuss the teaching plan for they day that they

must follow. Each teacher must not allow students to take notes, prevent students from knowing/studying beforehand, enforcing the same amount of class time, have the same teaching materials, having the same approach to each group, and must give different tests to prevent the groups from exchanging answers. As each subject needs to be taught differently, I will discuss with the teachers beforehand to make a detailed teaching schedule, again trying to minimize any variations and errors. If a teacher is not used for both the control group and the trial group or both the AP students and on-level students, I will be teaching the same course to the other groups, following the exact same teaching plan as well. The only variation that should occur between the groups in the experiment, other than being AP vs on level, is if a repetitive song is played or not. After the survey has been completed, giving me more information that can be used to categorize and compare the data in even more ways and give me their consent to use the student's test result as part of my data, I can start the experiment (Antony, Priya, & Gayathri 2018). Next, the song must be chosen specifically following these parameters: The paper published by Memory stated, as a result of the experiment, that the most effective memory retainment music were ones familiar to the audience. The paper published the British Journal of Special Education in agreeance with the paper from Psychomusicology suggests that the most effective type of music were songs that were calming and contained either few or no shifts in style, making "Bagatelle No. 25 in A Minor" or better known as "Fur Elise" a perfect choice. After the requirements have been met and song has been chosen, student's will then hear this song on repeat as they study, as it will become more and more familiar over the course, making it more effective to retain memory (Tamminen, Rastle, Darby, Lucas, & Williamson, 2017). Once the course's test arrives at the end of class session, the students will be taking their test on paper

with proctors, a teacher and I, so I can prevent or detect if any student is cheating, allowing me to exclude their results. Afterwards, I will immediately grade their tests and input their data onto a spreadsheet for further analysis and comparison. Since the student's grades will be on the line, student's will focus harder, activating the brain to effectively recall MEAMs better (Kubit, & Janata, 2018). The only reasons for a student's data to be excluded out of the study is if they cheated in any fashion, missed the testing date, asked to be excluded after they taking the test, or not agreed to the survey beforehand. The data that is received and has been deemed acceptable will be organized and put into their respective slots on a spreadsheet. If time permits, more than one trial of this experiment can be conducted under the same methodology. The data then will be shifted through, finding trends and determining the effect of music on academics.

**Result**

In the end, I was only able to run one trial for the whole experiment. The two math courses I choose was Pre-AP Pre-Calculus & Trig and Pre-Calculus & Trig, matching my criteria for having one AP and Non-AP version of the AP course. The teacher for Pre-AP Pre-Calculus & Trig was Mrs. Isaac, the substitute for Mrs. Sutton as she left a month prior on paternity leave. Mrs. Isaac taught her 4th hour with music (Fur Elise) and her 5th hour with no music. Down below, are the test results of each participant from her two hours. I categorized the data by first leaving student names in, so I may associate their test score, gender, and ethnicity into the data table. Once it was completed, their names were removed for confidential reasons. The students who were considered ethnic are highlighted for readability purposes.

Mrs. Sutton/Isaac 4th Hour Pre-AP Pre-Calc and Trig (MUSIC)

| Participant # | Score | Fraction | Gender | Ethnic Status |
|---|---|---|---|---|
| 1 | 4 | 1 | F | Y |
| 2 | 4 | 1 | F | Y |
| 3 | 2.5 | 0.625 | F | Y |
| 4 | 4 | 1 | F | Y |
| 5 | 3.5 | 0.875 | F | N |
| 6 | 4 | 1 | F | N |
| 7 | 4 | 1 | M | Y |
| 8 | 3.5 | 0.875 | M | Y |
| 9 | 3 | 0.75 | M | Y |
| 10 | 3.5 | 0.875 | M | N |
| 11 | 4 | 1 | M | N |
| 12 | 4 | 1 | M | N |
| 13 | 4 | 1 | M | N |
| 14 | 4 | 1 | M | N |
| 15 | 3.5 | 0.875 | M | N |
| 16 | 3 | 0.75 | M | N |
| 17 | 4 | 1 | M | N |

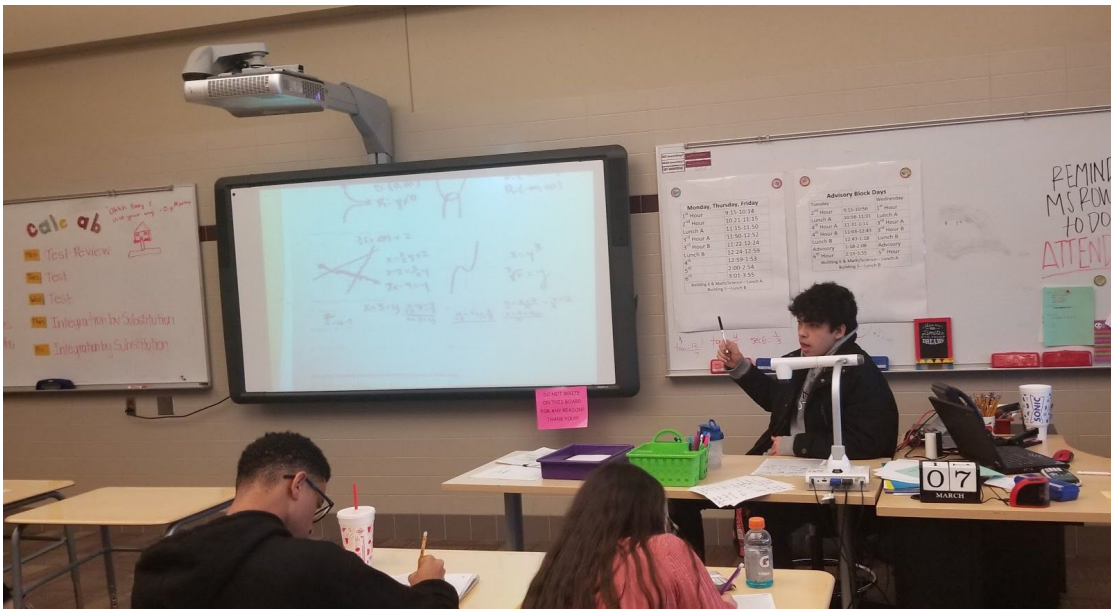
| | | | | |
|---|---|---|---|---|
| Class Average | 3.676470588 | 0.9191176471 | | |

Mrs. Sutton/Isaac 5th Hour Pre-AP Pre-Calc and Trig (NO MUSIC)

| Participant # | Score | Fraction | Gender | Ethnic Status |
|---|---|---|---|---|
| 1 | 4 | 1 | Male | Y |
| 2 | 3.5 | 0.875 | Male | Y |
| 3 | 4 | 1 | Male | Y |
| 4 | 4 | 1 | Male | N |
| 5 | 4 | 1 | Male | N |
| 6 | 3.5 | 0.875 | Male | N |
| 7 | 3 | 0.75 | Male | N |
| 8 | 4 | 1 | Male | N |
| 9 | 3.5 | 0.875 | Male | N |
| 10 | 4 | 1 | Male | N |
| 11 | 3.5 | 0.875 | Male | N |
| 12 | 2.5 | 0.625 | Female | Y |
| 13 | 4 | 1 | Female | Y |
| 14 | 4 | 1 | Female | Y |
| 15 | 3.5 | 0.875 | Female | N |
| 16 | 4 | 1 | Female | N |
| 17 | 3.5 | 0.875 | Female | N |
| 18 | 4 | 1 | Female | N |
| 19 | 4 | 1 | Female | N |
| 20 | 3.5 | 0.875 | Female | N |
| 21 | DISQ | DISQ | Female | N |
| 22 | DISQ | DISQ | Female | N |
| 23 | DISQ | DISQ | Female | N |
| Class Avg | 3.7 | 0.925 | | |

As you may notice, participants 21, 22, and 23 were disqualified. This was due to these students trying to cheat, breaking violation of the rules previous set for the experiment and student conduct policies that are implemented at every school. They were given a 0 and their

results, ethnicity, and gender were removed from further data analysis. The next two data tables come from Pre-Calc and Trig, the non-AP course. The teacher for this class was actually me, the researcher. I just used Mrs. Rowe's 3rd and 6th hour to conduct my study. The reason for me teaching was due to a scheduling error between the two teachers, not allowing them to meet up and discuss upon a single teaching plan. To adapt to the situation, I worked hands on with Mrs. Isaac and took her learning materials, her teaching plan, and copied her exact teaching style by watching her teach and recording the session on my phone so I may review on my own before it was my time to teach. For further reference, I will not be referring to the Pre-Calc & Trig classes as my own, but as Mrs. Rowe. Below are the results of me teaching with almost identical teaching method, plan, and resources as Mrs. Isaac and a picture of me doing so, proving my earlier points.




"Researcher teaching Mrs. Rowe's Pre-Calc & Trig - 3rd Hour (No Music)"

Mrs. Rowe 6th Hour Pre-Calc and Trig (MUSIC)

| Participant # | Score | Fraction | Gender | Ethnic Status |
|---|---|---|---|---|
| 1 | 3 | 0.75 | F | Y |
| 2 | 2 | 0.5 | F | Y |
| 3 | 3 | 0.75 | F | Y |
| 4 | 3.5 | 0.875 | F | Y |
| 5 | 3 | 0.75 | F | Y |
| 6 | 3 | 0.75 | F | Y |
| 7 | 2 | 0.5 | F | Y |
| 8 | 2.5 | 0.625 | F | Y |
| 9 | 3.5 | 0.875 | F | N |
| 10 | 3.5 | 0.875 | F | N |
| 11 | 3 | 0.75 | F | N |
| 12 | 3.5 | 0.875 | F | N |
| 13 | 3 | 0.75 | F | N |
| 14 | 3.5 | 0.875 | F | N |
| 15 | 3.5 | 0.875 | F | N |
| 16 | 1 | 0.25 | F | N |
| 17 | 2 | 0.5 | F | N |
| 18 | 1.5 | 0.375 | F | N |
| 19 | 3.5 | 0.875 | F | N |
| 20 | 4 | 1 | F | N |
| 21 | 3 | 0.75 | M | Y |
| 22 | 3.5 | 0.875 | M | Y |
| 23 | 3.5 | 0.875 | M | Y |
| 24 | 2.5 | 0.625 | M | N |
| 25 | 3 | 0.75 | M | N |
| 26 | 0.5 | 0.125 | M | N |
| 27 | 2.5 | 0.625 | M | N |
| Class Average | 2.814814815 | 0.7037037037 | | |

Mrs. Rowe 3rd Hour Pre-Calc and Trig (NO MUSIC)

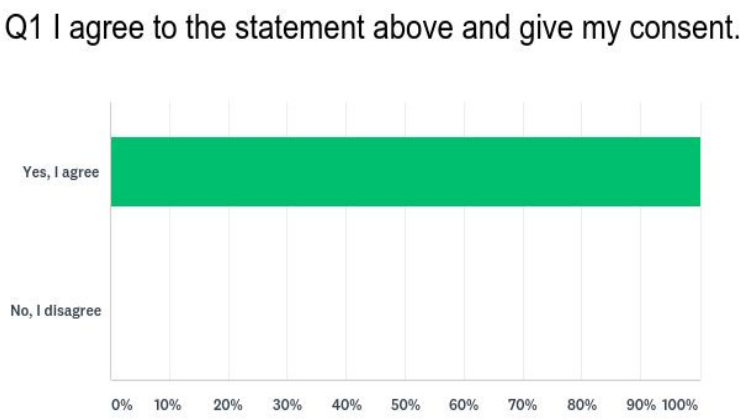
| Participant # | Score | Fraction | Gender | Ethnic Status |
|---|---|---|---|---|
| 1 | 4 | 1 | M | Y |
| 2 | 0.5 | 0.125 | M | Y |
| 3 | 2.5 | 0.625 | M | Y |
| 4 | 0.5 | 0.125 | M | Y |
| 5 | 2.5 | 0.625 | M | Y |
| 6 | DISQ | DISQ | M | Y |
| 7 | DISQ | DISQ | M | Y |
| 8 | DISQ | DISQ | M | N |
| 9 | 3 | 0.75 | M | N |
| 10 | 3.5 | 0.875 | M | N |
| 11 | 3.5 | 0.875 | M | N |
| 12 | 1 | 0.25 | M | N |
| 13 | 2.5 | 0.625 | M | N |
| 14 | 3 | 0.75 | M | N |
| 15 | 1.5 | 0.375 | F | Y |
| 16 | 4 | 1 | F | N |
| 17 | 2 | 0.5 | F | N |
| 18 | 3 | 0.75 | F | N |
| 19 | 1.5 | 0.375 | F | N |
| 20 | 4 | 1 | F | N |
| 21 | 4 | 1 | F | N |
| 22 | 3.5 | 0.875 | F | N |
| 23 | 1 | 0.25 | F | N |
| 24 | 3 | 0.75 | F | N |
| 25 | 3.5 | 0.875 | F | N |
| 26 | 2 | 0.5 | F | N |

| | | | | |
|---|---|---|---|---|
| 27 | 4 | 1 | F | N |
| 28 | 2 | 0.5 | F | N |
| 29 | 2 | 0.5 | F | N |
| Class Average | 2.596153846 | 0.6490384615 | | |

Like earlier, once again I had to disqualify participant numbers 6, 7, and 8 in Mrs. Rowe's 3rd hour. The reason for the removal of these three was not due to cheating, but lack of effort. The papers that were submitted were essentially blank. In the end, I had a total of 90 qualified participants. Out of those, I had 37 participants for Pre-AP Pre-Calc & Trig and 53 participant for Pre-Calc & Trig. I wanted to get these numbers as close to one another as possible, but the gap occurred due to student activities that had excused them from class that day or they were not present during the testing session. Out of the 90 students, 53 were female, 37 were male, 32 were ethnic, and 58 were caucasian.

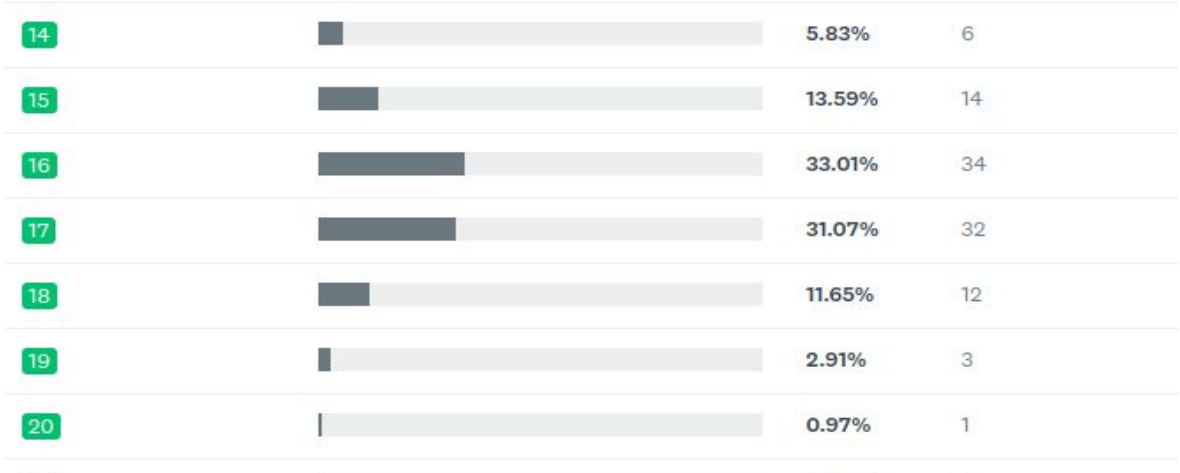
Moving on from the actual test data, this next portion will cover the data I received from the survey and consent form. Immediately, I've come upon an error that was my own fault. I made the consent form and survey confidential, as in I didn't even know who's response was who's. This prevents me from comparing students who said yes, to listening to music while studying, compared to the ones who said no and other possible comparisons. In the end, that data that was compiled can only be taken at a general public view instead of a more detailed one. The following data being analyzed is every participants that answered the survey/consent form. When needed later for deeper analysis or comparison, I will breakdown the data by class, gender, and so forth to see what the general trends are. In the end I had 104 responses to the survey/consent form.

Agreement with Consent Form




First and foremost, the need of consent is mandatory before anything else can happen. Every single applicant agreed to the statement, making them liable to the rules stated before the survey starts and answering each question in complete honesty.

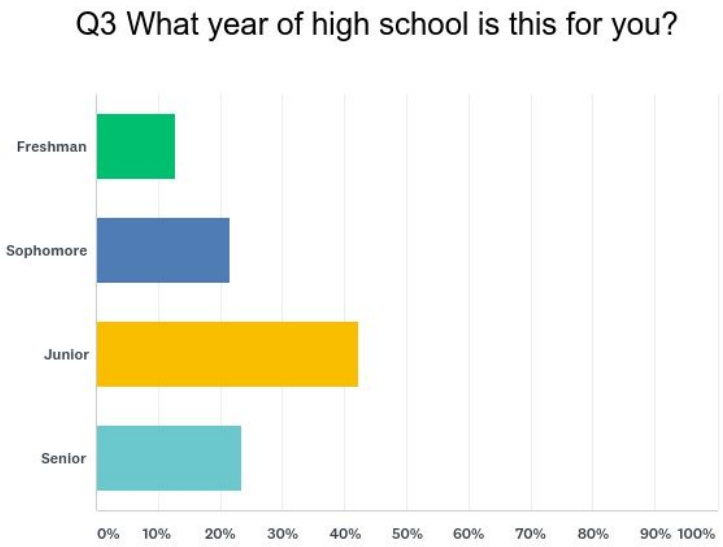
Age Groups




Even with the control group being limited to a high school environment, the age groups varies extremely. This phenomenon is mainly due to student's either accelerating through math class at a younger age or being held back, allowing for 6 participants to be 14 and even one 20

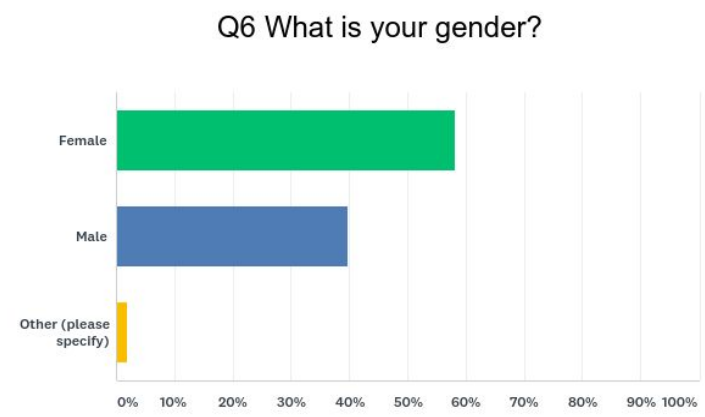
year old to be in the study. The highest number age group of the survey were 16 and 17 years old. There were 34 sixteen years old and 32 seventeen years.

Grade Level



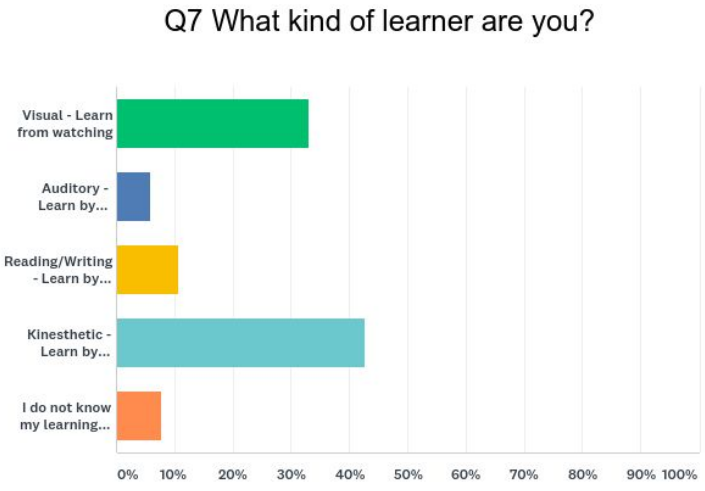

The freshmans that are present in the study are students who have progressed at a faster rate than normal, as Pre-Calc & Trig (either AP or non-AP) is usually a sophomore/junior course. The seniors are students who have a harder time with mathematics than the average student. There was a total of 13 freshmans, 22 sophomores, 43 juniors, making juniors the majority of students studied,, and 24 seniors participated in the study.

Gender




The data here is pretty self-explanatory. In total we had 103 submissions, 60 females, 41 males, and 2 other. The 2 response that were listed as other were excluded as they didn't specify what they instead identified as.

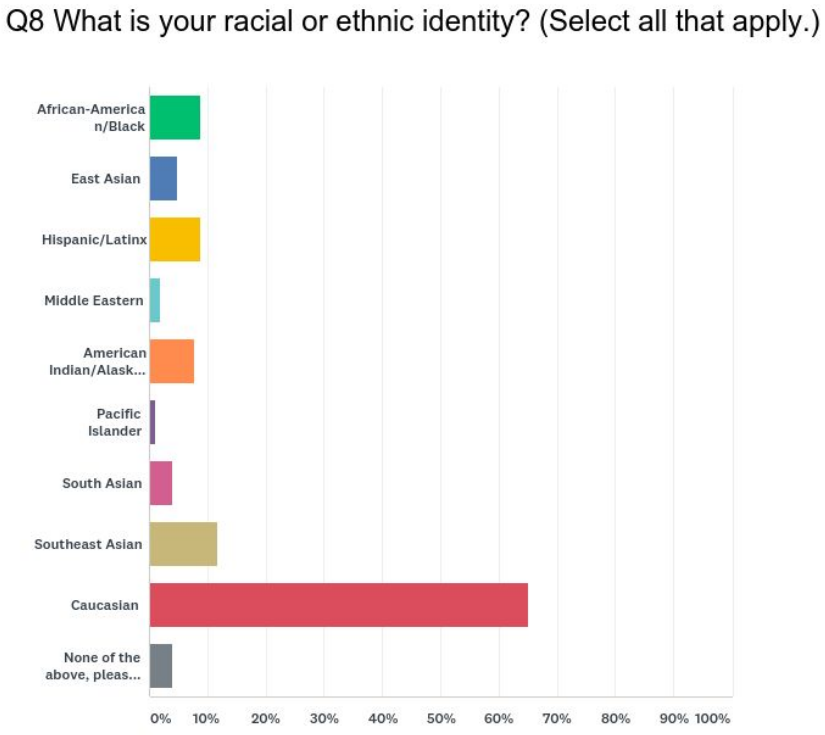
Learning Style




This question asked students what was their most effective study method. One noticeable part to take away from these responses was that less than 7% of the students stated that they were auditory based learners and over 40% were kinesthetic learners, people who learn best by doing.

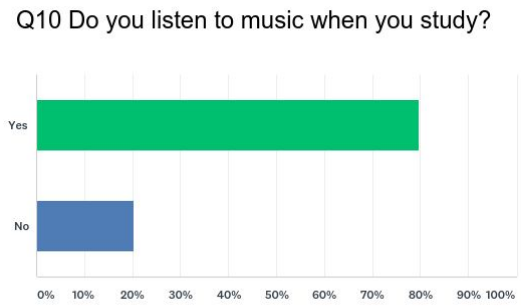
The higher number of auditory learners may cause the effect of music to be more apparent, however, the number of auditory learners that were involved in this study was lower than the nation average, which is around 30% (Louis, 2017).

Ethnicity



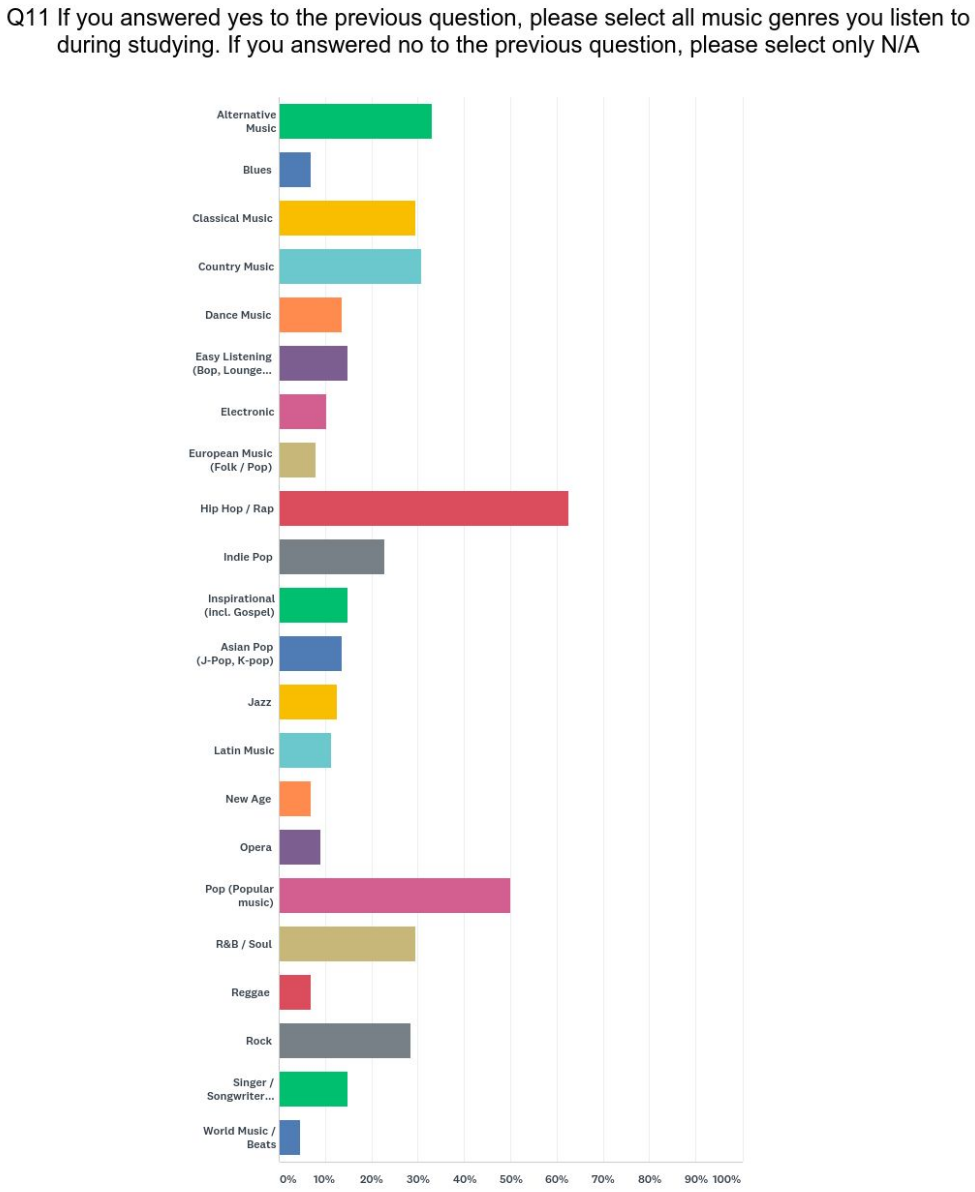

Caucasian was the biggest racial identity with it being around 65%. The next closest was Southeast Asian and then African-American. The 4 responses that were listed as none of the above were inaccurate as all 4 students specified to be “white” instead of selecting the Caucasian option.

Music While Studying



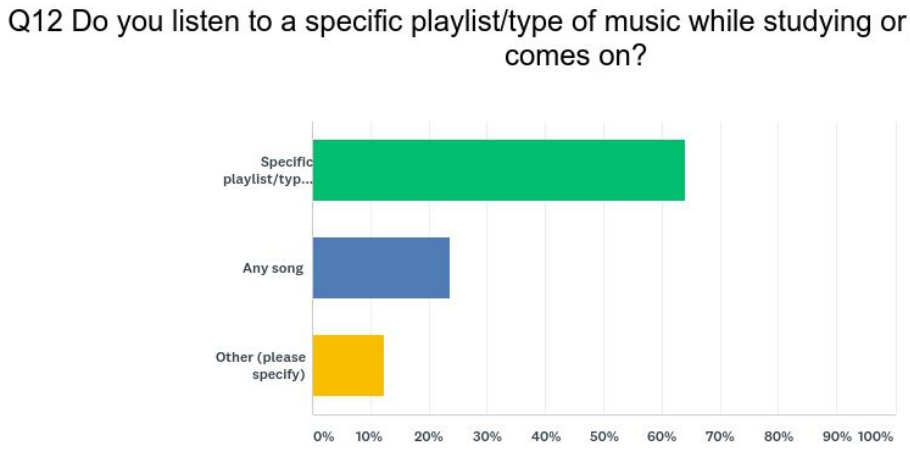

Out of the participants, almost 80% of the students said they do listen to music.

Music Taste



My study was conducted with classical music, however only 30% of the student populus selected classical as something they may listen while studying. The majority of students selected Hip-Hop (62.5%) and Pop (50%). Since I wasn't able to test with different types of music, the assumption of students listening to music that is fast paced and contains many shifts are considered distracting due to the research conducted beforehand based of previous experiments. This states that most students that are studying with music at home are not being benefited by it, but instead hindered by their study habits.

Specificalities while Studying

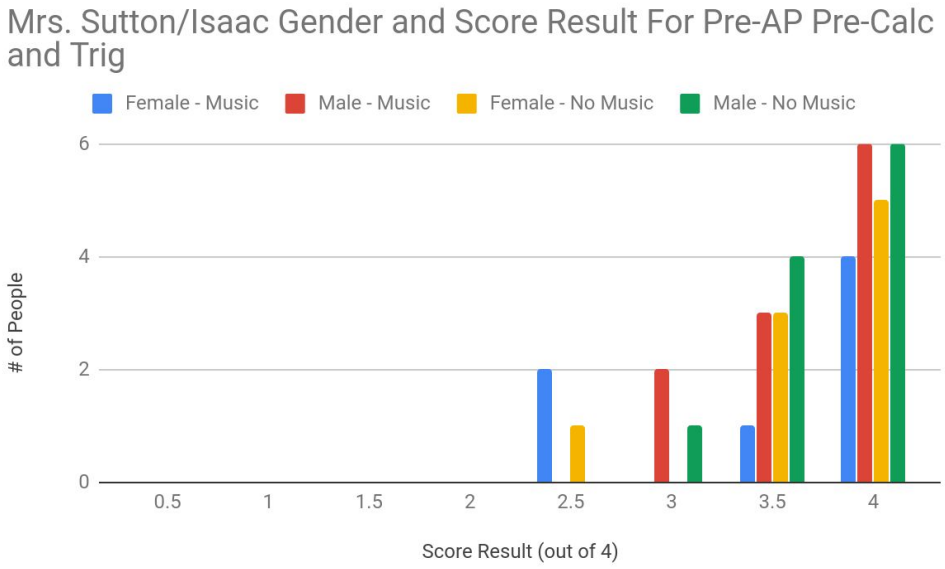



This question was an extension of the one prior to it. Over 60% of the respondents stated that they will listen to only one genre/type/playlist while studying. The remaining 40% is broken down into 30% of the applicants stalking that they will listen to anything. The other 10% were specified answers that were all excluded from the study as they responses were either not applicable or a restatement of the options given. The end result shows that 65% of people listen

to one specific area of music, whereas 35% will listen to any type of music, if they listen at all, while studying.

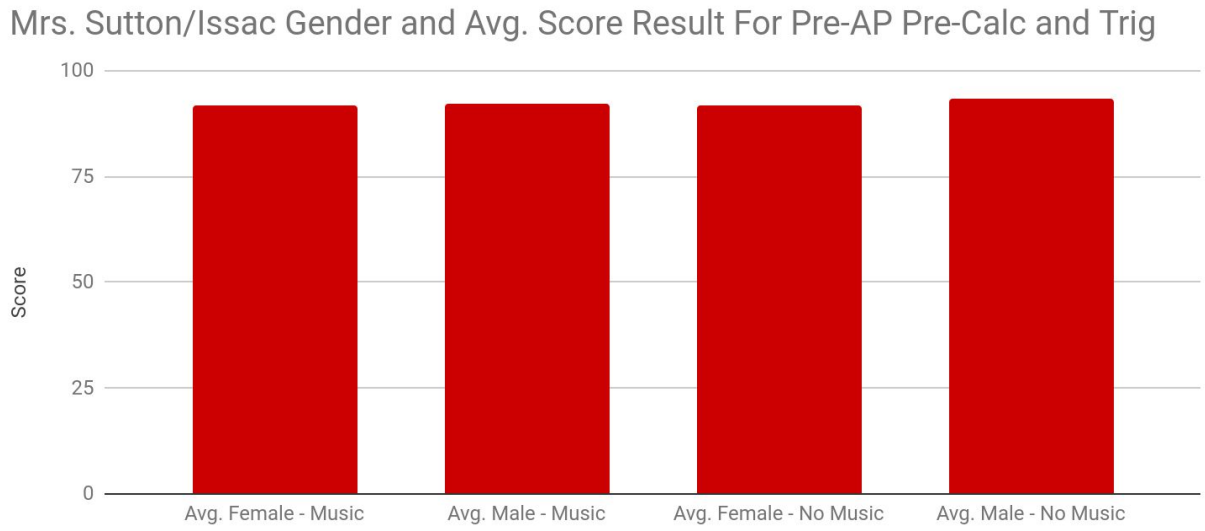
**Data Analysis and Conclusion**

Stated earlier in the methodology, I would be the one grading the test and inputting each students results into a spreadsheet. Once that was done, I started adding on additional information to each student's data such as ethnic status and gender. With these two additions, the data compiled can be analyzed in new lenses. First thing first, I analyzed how students from the same course tested against one another with and without the addition of music. The one you see to the right is Mrs. Sutton's two classes. The divisions I used was gender and the presence or lack of music. The graph showcases how male and female tested, how many had the same score, and the differentiation between music and none. From the graph, 12 males had a perfect score of 4, 6 with music and 6 without, 7 males had a 3.5, 3 with music and 4 without, and finally, 3 males score a 3, 2 males with music and 1 without.

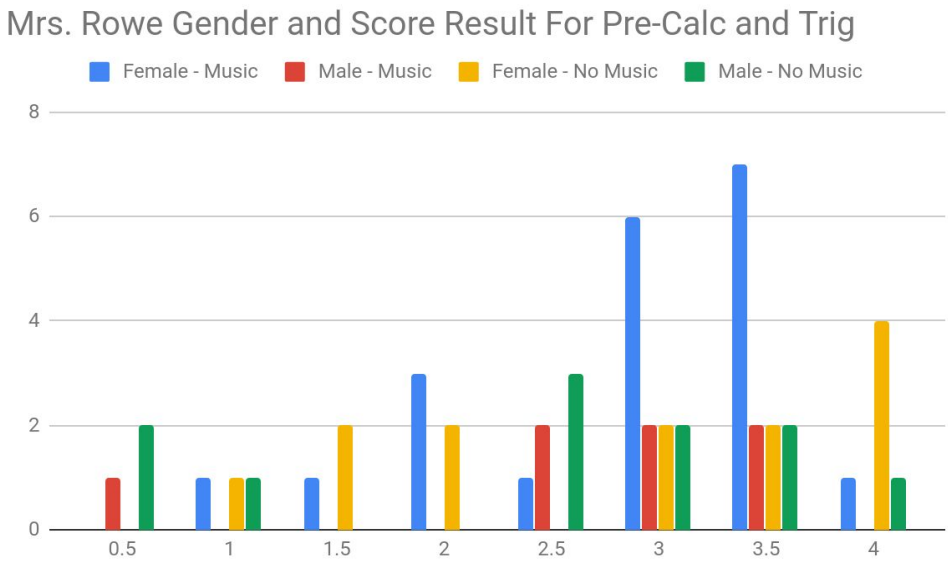



Females on the other hand scored worse in both scenarios. Nine females scored a 4, 4 with music and 5 without music, 4 females scored a 3.5, 3 without music and 1 with, and 3 females received

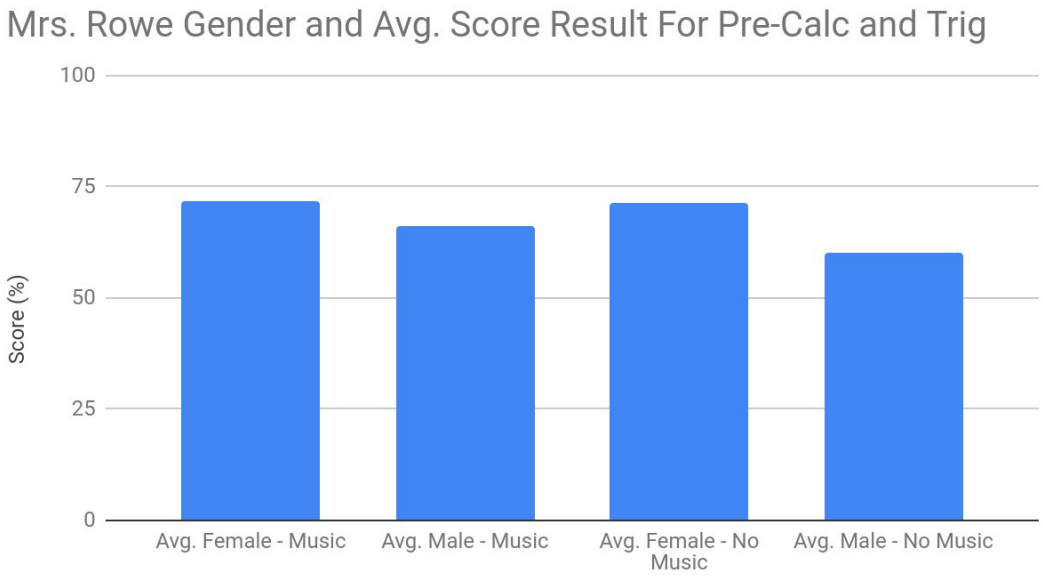
a 2.5, 1 without music and 2 with. The graph below shows the average score of males and females with and without music. The end result showcases that there is almost no real change whatsoever.



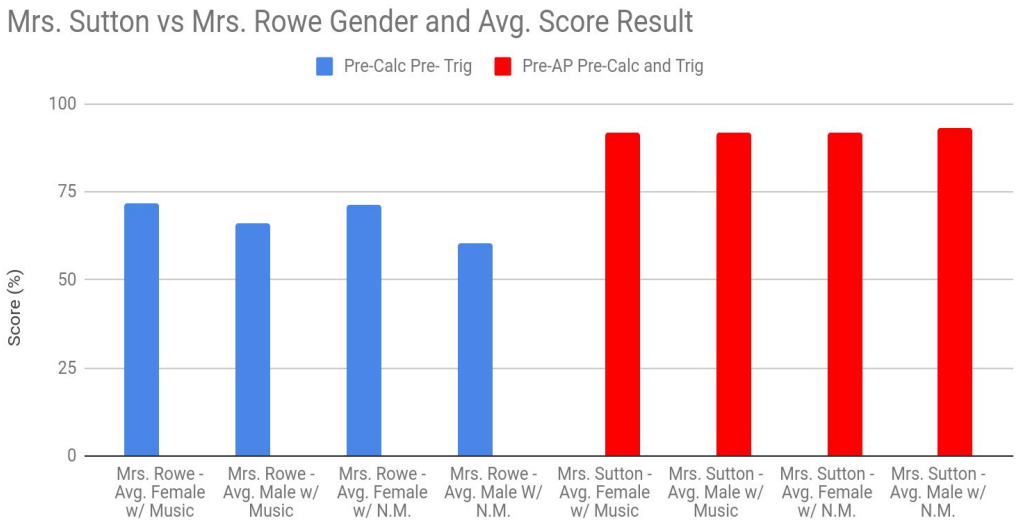

Females with and without music scored an average of 91.75% on the exam, whereas males with music scored a 92% and males without music scored a 93%. The cases changes when analyzing on-level Pre-Calc & Trig. For Pre-AP the range for test scores only varied to 2.5 where as on-levels ranged all the way down to 0.5 points.



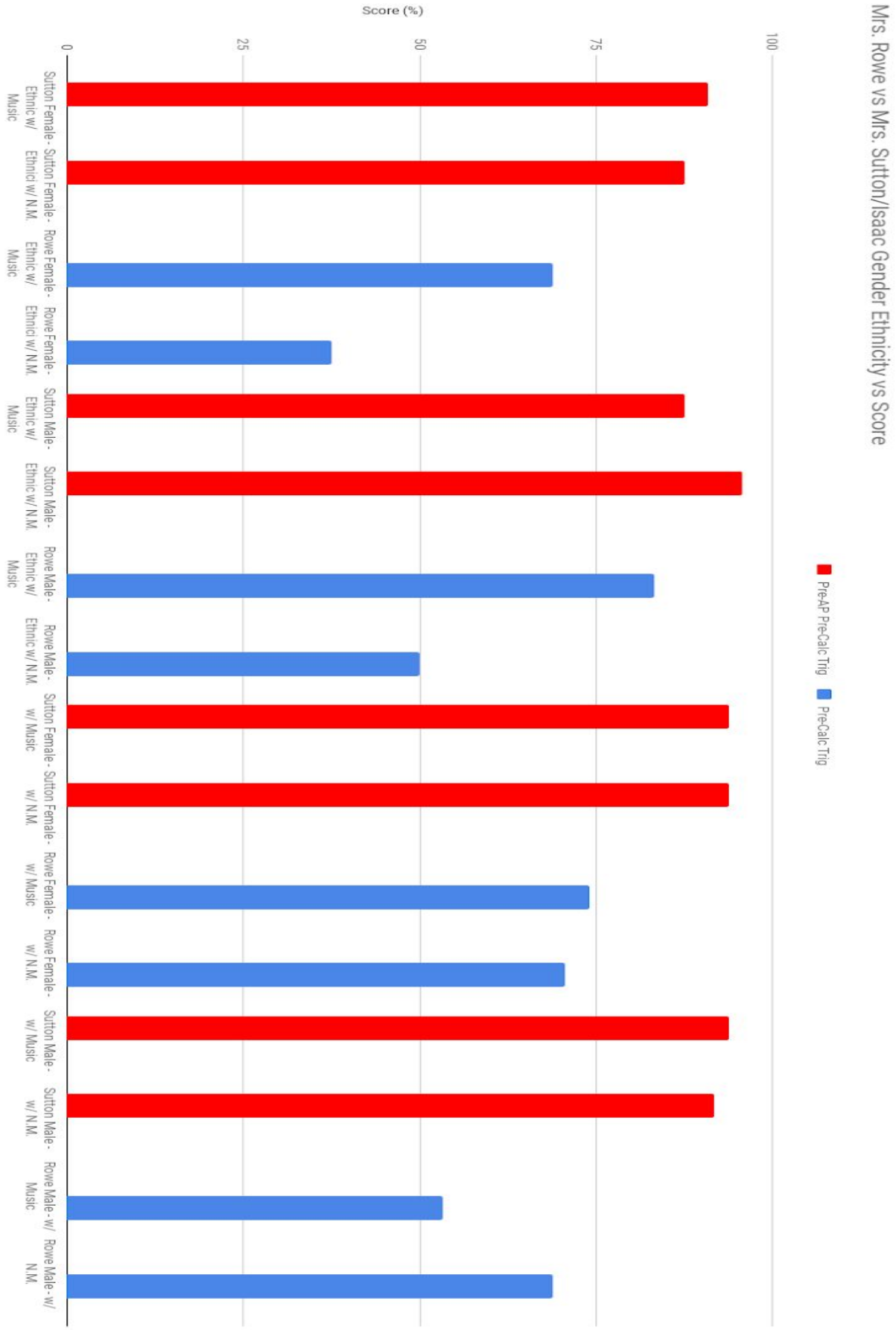
Using the same style analysis, the graph below shows the average scored of males and females on on-level math with and without music. In both cases, students tested better with music. Females dropped from 72% to 71% when music wasn't present and males dropped from 66% to 60.25%. A much more significant change was noticed in the male, compared to females.




In this chart here, it demonstrated both classes and it's averages, comparing it with one another, showcasing that the AP version of the course's students was not as majorly



affected as the on-level students. What was surprising to me was the fact the no music on-level students tested worse than the ones with music. I say this due to when I was teaching them, after seeing what was missed the most in the class prior, I spent more time covering those issues, asking more often that the class prior if all students understood what was being explained. The last analysis I made was the gender, ethnic status, and average grade. Go to page 26 for the graph. Every group had a decrease in score without music except for ethnic females in Pre-AP Pre-Calc & Trig and non-ethnic males in Pre-Calc & Trig. The biggest drop in score was ethnic males in Pre-Calc & Trig. With music, the score average was 83%, and without music, the score dropped to 50%. The next biggest drop in score was for ethnic females in Pre-Calc & Trig. Starting at 69% and dropping to 38%. In the end, the effect of music was only apparent in students who were not in AP and it had a beneficial effect when it was introduced and kept throughout the lesson and test.


Mrs. Rowe vs Mrs. Sutton/Isaac Gender Ethnicity vs Score
Score (%)
0
25
50
75
100
Pre-AP PreCalc Trig
PreCalc Trig
Sutton Female - Ethnic w/ Music
Sutton Female - Ethnic w/ N.M.
Rowe Female - Ethnic w/ Music
Rowe Female - Ethnic w/ N.M.
Sutton Male - Ethnic w/ Music
Sutton Male - Ethnic w/ N.M.
Rowe Male - Ethnic w/ Music
Rowe Male - Ethnic w/ N.M.
Sutton Female - w/ Music
Sutton Female - w/ N.M.
Rowe Female - w/ Music
Rowe Female - w/ N.M.
Sutton Male - w/ Music
Sutton Male - w/ N.M.
Rowe Male - w/ Music
Rowe Male - w/ N.M.

**Implication & Limitations**

From the data gathered, it is implied that advanced students (Pre-AP/AP) are neither really benefited or harmed with the addition of music. Whereas on-level students drastically increase in score with the addition of classical music in their testing environment. Based off the data collected, music should be implicated into non-AP courses. AP courses could adopt this method, but it doesn't seem like it would have any effects on scores. The teachers in on-level courses should use classical music that is slow and contains only up to one shift in their course and have it played throughout the test as well. Students should also integrate this into their own personal learning at home by primarily listening to slow classical music instead of anything else. By following these actions, students will have better utilized their time, limiting the amount of wasted study time. Teachers can expect their class averages to be raised.

I tried my best to limit errors in the research, but there are still many possible factors that still could have affected the scores/results received from the students. Such limitations could be teaching experience. Mrs. Isaac has taught for over 10 years. Even though I mimicked her teaching style as effectively as I could, I am still a student without any experience. This being said, with me being a student, I felt like their was also a lack of respect and understanding of their situation when I was teaching. 3rd hour Pre-Calc & Trig was the hardest class for me to control as over half the students knew me personally, treating me as their friend and classmate instead of being treated like the teacher I was in the situation. Another factor is student participation effort. Like stated earlier, I had to disqualify 3 participants for lack of effort that I caught upon. Some students could have still potentially not utilize their full potential for the task at hand.

**Further Research**

The final and biggest limitation was the lack of trials. Due to constraint of time and teacher's acceptance to join me, I was only able to run one trial. Even though I had 90 participants, equalizing the data as the general public, I was still lacking the repetition and proof that my data was accurate. If given more time to research, I would have liked to include other classes as well, specifically science and language courses. The results demonstrated that music had at least some effect with words and the research provided from my literature review showed that the experiments were mainly focused on words instead of mathematics. For those two reasons, science classes, a mixture of math and language, and language arts classes would be the perfect test. If results come back positive for at least one class, the music practice should be adopted and intertwined with said courses lessons to best benefit students. Another idea to focus upon was other type of music and its effect. There are many ways to tackle this idea, but primarily, there should be a study where participants were allowed to listen to whatever they liked vs no music as well. Since some students are already used to listen to one specific genre of music, it may benefit them to stick with that one type.

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## Appendix A:
## Basic Student Information Survey & Music Taste

**Introduction:**

If you are reading this survey, that means your teacher has already approved to use this class as part of the experiment. The teacher will be introducing a new idea or lesson to you this week and you will be tested over it by the end of the week. I am asking you to participate in this research project. I am asking permission for you to complete a survey and to receive the grade you get from the end of week test. All information collected is anonymous. However, the data compiled may be used in presentations/publications. By answering these questions, you are allowing your answers to be used for a research project conducted at Jenks High School.

1. I agree to the statement above and give my consent.
    - Yes, I agree
    - No, I disagree
2. What is your age?
3. What year of high school is this for you?

Freshman Sophomore Junior Senior

4. What is your weighted GPA, on a scale of 0-5? (Example: 4.2) This information can be found on your Naviance account.
5. What is you unweighted GPA, on a scale of 0-4? (Example: 3.8) This information can be found on your Naviance account.
6. What is your gender?
    - Female
    - Male
    - Other (please specify)
7. What kind of learner are you?
    - Visual - Learn from watching
    - Auditory - Learn by listening
    - Reading/Writing - Learn by reading and/or taking notes
    - Kinesthetic - Learn by doing/practice
    - I do not know my learning style
8. What is your racial or ethnic identity? (Select all that apply.)
    - African-American/Black
    - East Asian
    - Hispanic/Latinx
    - Middle Eastern
    - American Indian/Alaskan Native
    - Pacific Islander
    - South Asian
    - Southeast Asian

Caucasian

None of the above, please specify...

**Experiment Questions:**

9. What class are you involved in for this experiment?

Pre-AP Pre-Calc and Trig - Mrs. Isaac 2nd Hour

Pre-AP Pre-Calc and Trig - Mrs. Isaac 4th Hour

Pre-AP Pre-Calc and Trig - Mrs. Isaac 5th Hour

Pre-Calc and Trig - Mrs. Rowe 1st Hour

Pre-Calc and Trig - Mrs. Rowe 3rd Hour

Pre-Calc and Trig - Mrs. Rowe 6th Hour

10. Do you listen to music when you study?

Yes

No

11. If you answered yes to the previous question, please select all music genres you listen to during studying. If you answered no to the previous question, please select only N/A

Alternative Music

Blues

Classical Music

Country Music

Dance Music

Easy Listening (Bop, Lounge, Swing)

Electronic

European Music (Folk / Pop)

Hip Hop / Rap

Indie Pop

Inspirational (incl. Gospel)

Asian Pop (J-Pop, K-pop)

Jazz

Latin Music

New Age

Opera

Pop (Popular music)

R&B / Soul

Reggae

Rock

Singer / Songwriter (inc. Folk)

World Music / Beats

N/A

12. Do you listen to a specific playlist/type of music while studying or just any song that comes on?

Specific playlist/type of music
Any song
Other (please specify)

**Rules:**

To participate in this study you must obey the following rules: You will not be allowed to take notes or study the lesson outside of the class. If your classroom will be listening to one song throughout the week, you are not to listen to this piece outside of the classroom. You are not to listen to any other songs while participating in class. If your classroom is not introduced to a song, you are not to listen to music while participating in the class. You are not to discuss the lesson outside of the classroom to other peers.

13. I agree to the statement above and give my word that I will follow the rules.

Yes, I agree
No, I disagree

## Appendix B:
## The Effects of Music on Memory Recall and Memory Retainment

**Research question fueling this study:** Do students' end-of-topic score increase when one repetitive song, that is both familiar to the audience and contains either few or no shifts in style, is introduced during their learning stage and played throughout the course, including during their test?

**Reasons for choosing the topic of interest and research question/project goal:** The purpose of this experiment is to see how listening to one song during class lessons can help students recall the information better on a test when the same song is played on repeat. If the results received from this experiment prove that music is beneficial to students' information recall abilities and information retainment, school could incorporate this methodology to increase classrooms' grade average, passing percentage, and help more students achieve academic success. These results are not limited to affect only the classroom environment. Students could use the results to redesign their own learning methods to better obtain the information required for academic success.

**Previous researches dealing with music, memory recall, and studying:**

1. Kubit, B., & Janata, P. (2018). Listening for Memories: Attentional Focus Dissociates Functional Brain Networks Engaged by Memory-Evoking Music. Psychomusicology: Music, Mind & Brain, 28(2), 82-100. doi:10.1037/pmu0000210
2. FERRERI, L., & VERGA, L. (2016). BENEFITS OF MUSIC ON VERBAL LEARNING AND MEMORY: HOW AND WHEN DOES IT WORK?. Music Perception, 34(2), 167-182. doi:10.1525/mp.2016.34.2.167
3. Tamminen, J., Rastle, K., Darby, J., Lucas, R., & Williamson, V. J. (2017). *The impact of music on learning and consolidation of novel words.* Memory, 25(1), 107–121. https://doi.org/10.1080/09658211.2015.1130843

**Hypothesis:** Based of researches previously conducted, student's who listen to one repetitive song while studying in the classroom and hearing the same song on the test should improve student's memory recall, enabling students to perform better on the exam.

**Experiment:** For each core subject that will be tested upon, Math, Science, and Language Arts courses, each must have a control group and a trial group. Then, there must be an AP class vs non-AP class for each scenario. In the end, there will be 12 different groups used in this experiment. I plan to target teachers who teach both AP and on-level courses, that a way, minimizing experiment errors or uncontrollable results as different teachers may conduct their classes in different fashions. Once I find my 3-6 teachers, I will meet with them personally and discuss the teaching method they must follow. Each teacher must not allow students to take notes, to prevent students from studying at home, have the same amount of class time, have the same teaching materials, have the same approach to each group, and must give different tests to prevent the groups from exchanging answers. As each subject needs to be taught differently, I will discuss with the teachers beforehand to make a detailed teaching schedule, again trying to

minimize any variations and errors. If a teacher is not used for both the control group and the trial group or both the AP students and on-level students, the teachers who will be teaching the same course to different groups must meet up and follow the exact same teaching plan as well. The only variation that should occur between the groups in the experiment, other than being AP vs on level or being in different subjects, is if a repetitive song is played or not. After the survey has been completed giving me more information that can be used to categorize and compare the data in even more ways and consent to use the student's test result as part of my data. Once the course's test day arrives, the students will be taking their test on Canvas so it can detect if any student is cheating, allowing me to exclude their results, and I will be able to receive the students' score immediately. The only reasons for a student's data to be excluded out of the study is if they cheated in any fashion, missed the testing date, asked to be excluded after they taking the test, or not agreeing to the survey beforehand. The data that is received and acceptable will be organized and put into their respective slots on a spreadsheet. If time permits, more than one trial of this experiment can be conducted under the same methodology.

**Data gathering procedure:** The data gathered will be through Survey Monkey for personal information and consent and Canvas, giving me students test results. Once data has been received, it will be compiled on varying spreadsheets, comparing different categories.

**Statistical treatment:** The study will determine if there is a beneficial, harmful, or negligible impact on student's recall if one specific song is present during both the lessons and exam. If necessary or time permits, further tests will be conducted to determine the statistical significance of the correlations.

**School(s) participating in the study:** Jenks High School.

**Dates when the study will be conducted on:** As soon as possible after November 30th, 2018 till March 1st, 2019.

**Number of groups involved**: There are going to be 12 groups. Each group needs at least 15 students who are willing to participate in the study. If all goes according to plan, there will be 150-200 students in the study.

**Time needed:** Each group will be studying for one school week, having their exams on that week's Friday. There will be 180 minutes devoted to studying in class, and another 45 minutes to complete the exam.

**Specific data items needed from school records:** Student test results.

**If you have any additional questions, please email me at chriswhiterules@gmail.com.**

**By receiving this paper, you have already given consent and permission to participate in the study and will be following the rules stated in the survey. If you choose to be excluded, please contact my email as soon as possible. There is no penalty to be excluded, such as there is no reward for participating.**