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Genre v. BPM in Time Perception

Melissa Fan[1] and Travis Hartley[#]

[1]Conestoga High School
[#]Advisor

ABSTRACT

This paper investigates the impact of music on time perception by examining two factors: genre and beats per minute (BPM) of songs. The study explores whether there is a significant difference in time perception when individuals listen to classical music compared to pop music and how varying song speeds affect time perception. Participants from Conestoga High School were selected through a convenience sample during Unity Fair and were asked to estimate when 15 seconds had elapsed while listening to different songs. The results indicated that there was no significant difference in time perception between classical and pop music. However, there was a significant difference in time perception for songs with different BPMs. The study suggests that song speed plays a more substantial role in affecting time perception than genre. Further exploration of music's impact on cognitive functions and time perception in longer intervals is proposed for future research.

I. Introduction

How does music impact time perception? This question originated through a combination of two specific events. The first was a discussion I had in my Spanish class a few weeks prior, where the class conferred with each other about whether there was a difference in listening to songs with lyrics or not while studying. Some students, including myself, found lyrics, often accompanied by lively melodies and captivating verses, to be distracting during study sessions, while others perceived them as invigorating. This line of inquiry led to the "genre" aspect of our research, prompting an investigation into the impact of pop versus classical music on time perception.

The second event was during a Statistics class discussion, where Mr. Hartley brought up the idea of whether people would be able to tell how much time had passed without counting. While we eventually discarded the notion of not counting entirely, it sparked the idea of combining it with our exploration of music's influence on time perception. Consequently, we hypothesized that the tempo or speed of a song, measured in beats per minute (BPM), might also play a role in shaping time perception. Songs were chosen based on BPM with the following ranges: 130-140, 100-110, and 70-80.

Prior to conducting the experiment, we hypothesized that both the music genre and the BPM would significantly influence time perception, although we anticipated that BPM would exhibit a more pronounced effect.

II. Hypothesis Testing

Is there a significant difference in time perception when a student from Conestoga High School is listening to classical music compared to pop music?

μ_c = the true average value of a student's measured time passed when listening to classical music.

μ_p = the true average value of a student's measured time passed when listening to pop music.

H_0: $\mu_c - \mu_p = 0$

H_a: $\mu_c - \mu_p \neq 0$

We will conduct a one-sample t-test for a difference in means at the 95% confidence level.

Is there a significant difference in time perception when a student from Conestoga High School is listening to songs at different speeds measured by beats per minute (BPM)?

μ_1 = the true average value of a student's measured time passed when listening to a song with a BPM between the range 130-140

μ_2 = the true average value of a student's measured time passed when listening to a song with a BPM between the range 110-100

μ_3 = the true average value of a student's measured time passed when listening to a song with a BPM between the range 70-80

H_0: $\mu_1 = \mu_2 = \mu_3$

H_a: Not all average values of measured time are equal.

We will conduct a one-sided ANOVA test at the 95% confidence level.

III. Methods

To facilitate a comprehensive examination of music's impact on time perception, a set of six diverse songs, each representing different combinations of genre and speed, was meticulously chosen. The selected songs included "Applause" by Lady Gaga (Pop Genre, 130-140 BPM), "Fur Elise" by Ludwig van Beethoven (Classical Genre, 130-140 BPM), "Hips Don't Lie" by Shakira (Pop Genre, 100-110 BPM), "Canon in D" by Johann Pachelbel (Classical Genre, 100-110 BPM), "Bohemian Rhapsody" by Queen (Pop Genre, 70-80 BPM), and "Clair de Lune" by Claude Debussy (Classical Genre, 70-80 BPM). Random number assignment, facilitated through dice rolling, was used to ensure unbiased selection during the experimentation process.

Participants were selected using a convenience sample during Unity Fair, as they volunteered to participate in the experimental study. To offer an incentive to participate in the study, students were offered pieces of candy.
For the experiment, participants were instructed to roll a die, before putting on headphones and closing their eyes to prevent seeing any nearby clocks or other time-measuring devices. Participants were told to start when they heard music begin playing and indicate when they thought 15 seconds had elapsed by saying "stop" out loud. Time passed was measured using a scientific stopwatch, and all answers were recorded alongside which song had been assigned. The stopwatch and "play" button of the music player were clicked simultaneously by the same person to best ensure the most accurate time measurement for each participant.

SCRIPT TEXT: Thank you for participating in our experimental study! You will roll a die and receive a random number from 1-6; this number will correspond to a pre-chosen song. Once the song begins playing, close your eyes and tell us when 15 seconds have elapsed. Once you finish, you may take a piece of candy from the bowl. Do you have any questions?

IV. Results

Group Name	n	mean	SD	min	Q_1	med	Q_3	max
1: 0	68	16.608	3.649	8.97	13.905	16.5	18.905	26.63
2: 1	76	16.209	2.48	10.12	14.105	15.75	18.15	22.13

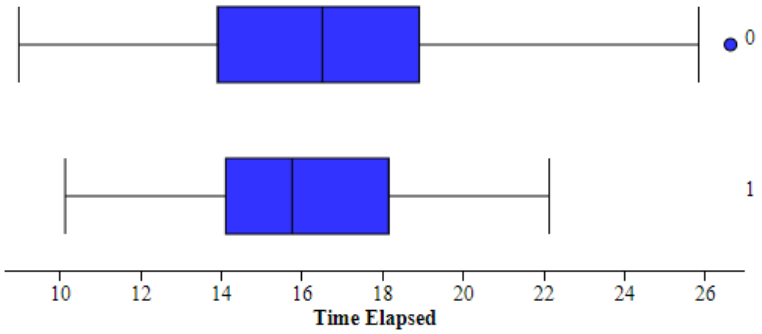

Figure 1. *"Genre vs. Time Elapsed" statistics summary and boxplot. The label 0 corresponds to "Classical" and the label 1 corresponds to "Pop". The "Classical" distribution contains a single high outlier.*

t	P-value	df
0.76	0.449	116.117

Figure 2. *"Classical vs. Pop" t-test for significance. The test was conducted at the 95% significance level.*

Group Name	n	mean	SD	min	Q_1	med	Q_3	max
1: 75	51	17.191	3.188	11.69	14.44	16.94	19.29	26.63
2: 105	46	15.572	2.905	8.97	13.9	15.135	17.17	25.84
3: 135	47	16.344	2.978	11.69	13.94	15.81	18.84	24.59

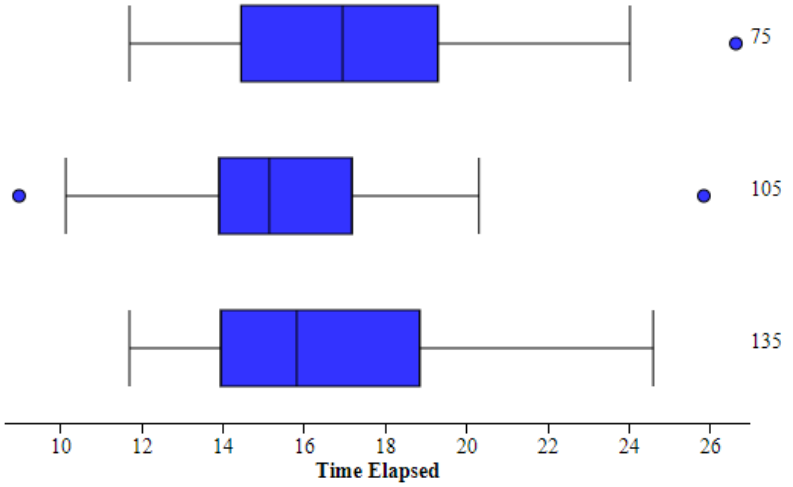

Figure 3*. "Song BPM vs. Time Elapsed" summary statistics and boxplot. The numbers correspond to the song's BPM: 75 BPM, 105 BPM, and 135 BPM. The 75 BPM distribution contains a single high outlier. The 105 BPM distribution contains both a low and high outlier.*

Source	df	Sum of Squares	Mean Square	F-value	P-value
Group	2	63.58	31.79	3.459	0.034
Error	141	1295.829	9.19		
Total	143	1359.409			

Figure 4. *ANOVA test results. The table displays the outcomes of conducting a one-way ANOVA test on three different song BPM's effect on time perception.*

Source	df	Sum of Squares	Mean Square	F-value	P-value
Regression	2	24.94	12.47	1.318	0.271
Error	141	1334.469	9.464		
Total	143	1359.409			

Figure 5. *Multiple-linear regression test results. The table displays variance analysis using multiple-linear regression with song genre and BPM as explanatory variables.*

V. Conclusion

The primary objective of this study was to investigate the potential correlation between a song's genre and its influence on time perception, as well as the relationship between song speed (measured in BPM) and time perception. Comparing Classical music to Pop music genres, the obtained p-value of 0.449 exceeded our predetermined significance level ($\alpha = 0.05$), leading us to fail to reject the null hypothesis. Consequently, there is insufficient empirical evidence to support the notion that there exists a significant difference in time perception between Classical and Pop music.

However, when examining different song speeds of 75 BPM, 105 BPM, and 135 BPM, the resulting p-value of 0.034 fell below our significance level ($\alpha = 0.05$). Consequently, we were able to reject the null hypothesis, suggesting that there is statistically significant evidence to propose that song speed does indeed influence time perception. Using multi-linear regression analysis, because the resulting p-value is 0.271, which is greater than our significance level $\alpha = 0.05$, we are able to conclude that while there may be significant evidence to suggest that there is a difference between a song's BPM and its effect on time perception, the relationship between the variables and time perception cannot effectively be described using a line or linear correlation.

VI. Discussion

While conducting the experiment in the atrium, some possible error may have occurred as our surroundings were quite noisy and a couple of participants reported that it was difficult to hear the song, even with the volume at full capacity. Upon reflection, we realized that one of the songs particularly, "Clair de Lune", appeared to start playing around two seconds after it started, and when the stopwatch was clicked. We later subtracted two seconds from each time measurement to enhance result accuracy, however, it is possible that there was a different time for different people than when they began the experiment. In an ideal scenario, the surroundings would have been much quieter to give students the space to fully concentrate on the task at hand.

This study opens avenues for further investigation, particularly regarding the impact of song speed (BPM) on various cognitive functions, including concentration. Potential research could involve assigning students to perform specific tasks, such as coloring pages or mazes, while being timed to determine the duration of completion. Randomly assigning different BPM songs, akin to the current experiment, would facilitate an analysis of the potential correlation between song speed and task completion time.

Additionally, exploring the effect of music on time perception in more extended time intervals presents area for future exploration. Although a 15-second interval was chosen for the current experiment to minimize waiting time during data collection, examining longer intervals, such as 30 seconds or one minute, could reveal further insights into how music influences time perception over prolonged durations.

VII. Limitations

The experiment was conducted with a voluntary sample, as with the limited population of high school students, we wanted to obtain as many results as possible to meet the requirements of the Central Limit Theorem and the Law of Large Numbers. It is possible the voluntary aspect of the sample may have affected the sample in certain ways that would not have occurred if participants had been selected completely at random.

VIII. Acknowledgements

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