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27 April 2023

Project Report

The Beat of Typing: Does Music Make you Type Better?

Introduction

Music has been a significant part of human culture and experience for centuries, and its influence on our mood and emotions is well-known. One area where the effect of music has been little explored is its potential impact on cognitive performance. Specifically, there is a gap in research on whether music can enhance or inhibit our typing speed and accuracy. The ability to type quickly and accurately is a crucial skill in today's digital age, and any potential intervention that can improve our performance in this area is of significant interest. Therefore, this project aims to investigate whether listening to music while typing can improve typing speed and accuracy. By conducting controlled experiments, we hope to provide empirical evidence that can shed light on the relationship between music and cognitive performance, and contribute to a better understanding of the potential benefits and drawbacks of using music as a tool to enhance our typing skills.

Previous work

Several studies have been performed relating to the effect of music in typing speed, often with varied results and outcomes.

A Paper by Arijit K. Sengupta and Xiaopeng Xiang titled 'Effect of background music in a computer word processing task' evaluates the effect of music and induced mental load on a typing task in terms of accuracy, typing force, variability of typing force and EMG of extensor digitorum muscle. The participants were asked to bring their preferred pieces of music to listen to while performing the task. The participants were given an IQ test preceding the typing task to induce mental load.The paper reports that music negatively affects typing accuracy but also reduces musculo-skeletal stress.
A Project by Joseph E. Colona titled 'How does Music Affect typing speed?' seeks to find out the genre and tempo of music that produces the fastest typing speed. He hypothesised that fast rock would produce the fastest typing speeds. However, this hypothesis is disproved since it is found that the fast rap genre produces the fastest typing speed in the experiment. In fact, the fast rock produced the slowest typing speeds in the experiment. The results say that fast rap produced the fastest typing speeds. Slow rock produced the second-fastest typing speed.Next, slow blues, fast blues and no music got typing speeds in that order. Fast rock and slow rap produced the slowest results. The possible reason for deviation from the assumed hypothesis given by the author is that fast rock was possibly too fast and distracting to keep up with while typing, while fast rap was fast enough but not too fast and neither too distracting since it is seen that in terms of tempo alone, fast tempo tended to produce faster typing speeds in the experiment.
In the thesis titled "Music while you work: The effect of music on typing performance and experience", the author Anna Bramwell Dicks, investigated the effects of music on typing

performance and experience. The study found that participants who listened to music reported higher enjoyment but did not show any significant difference in typing speed or accuracy. However, the participants did experience a more positive mood while listening to music. In particular, the section which focuses on the tempo and time signature concludes that tempo does not have any significant effect on either the typing speed or the accuracy, although there is some effect in accuracy when we consider the tempo and time signature of the piece together. Perceptually, after a certain tempo participants felt that the music was too fast to keep track of and thus was perceived to be a distraction.

Methodology

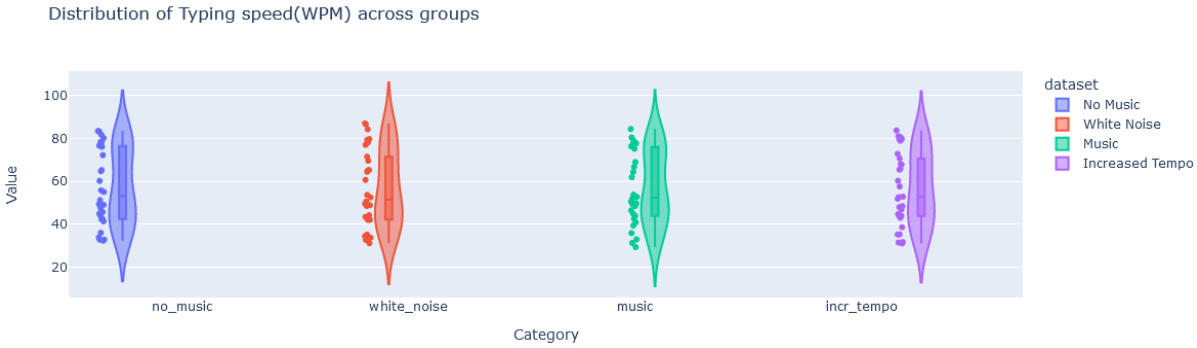
The null hypothesis of our experiment is "Music does not have an effect on the typing speed of a person." The alternate hypothesis is "Music increases the typing speed of a person." The music piece selected for the experiment is Allegro Assai movement from Mozart's Piano Concerto No 20 in D minor. This piece was chosen keeping in mind that many people might not have heard the piece which aided us in testing the effect of obscure music on typing speed.

The independent variable in the study was the audio input provided as to the participants and the dependent variables are typing speed and accuracy. Extraneous variables such as time of the day, external sounds, temperature and familiarity with the keyboard were controlled as much as possible.

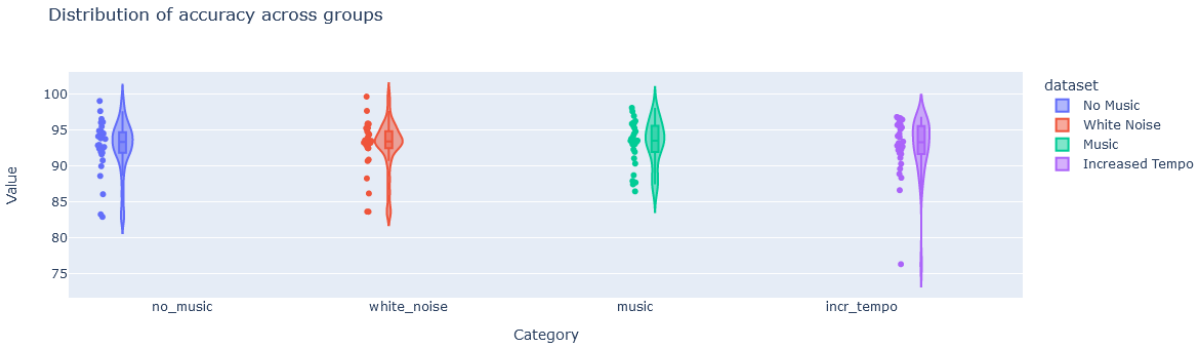
It was a within subject experiment wherein all the participants had to take part in all of the control groups. We had 4 control groups: No music, White noise, With music and music with increased tempo. According to literature, software engineers use white noise to block any external noise during coding and other works. Hence the control group was also added to test this. The tempo of the music piece was increased using an open-source software known as Audacity. The tempo in the increased music piece was by 30 bpm.

The platform used for the experiment is MonkeyType. MonkeyType chooses 200 most common English words for its tests. All the tests were of 3 minutes. After each test, the typing speed, accuracy, consistency, raw wpm and the character statistics were stored in a csv file. Participants were recruited b y circulating a google form. There were 30 participants (24M, 6F). Most of the participants were second year students of mean age 19.7 years and median 19.5 years. The study was conducted in a controlled environment. The participants were given 2 trial tests to get them acquainted with the keyboard.After each test they could take a break of a few minutes. Order bias was removed by assigning a random order of control groups to each participant.

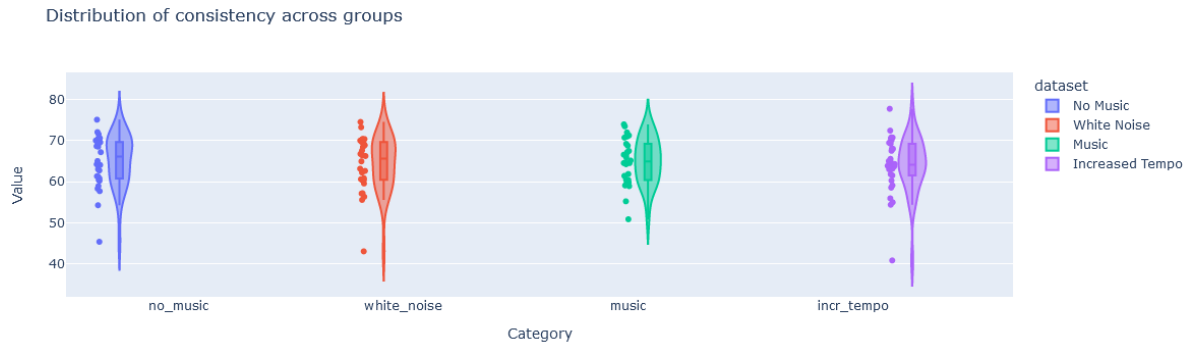
Data Visualisation



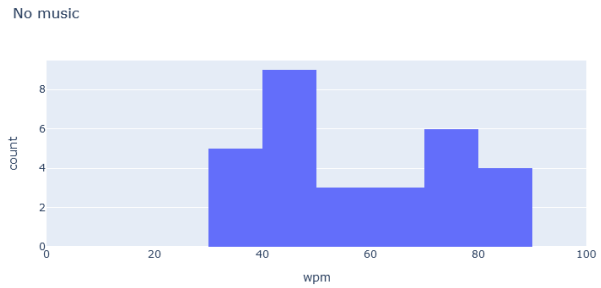
Distribution of Typing speed(WPM) across groups



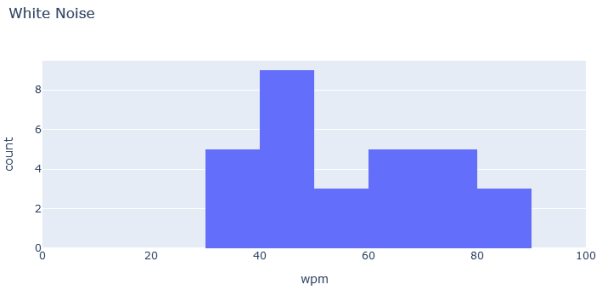
Distribution of Accuracy across groups



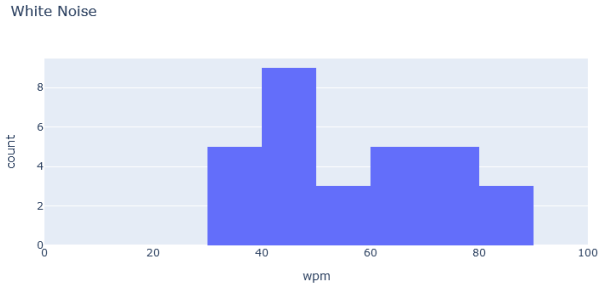
Distribution of Consistency across groups



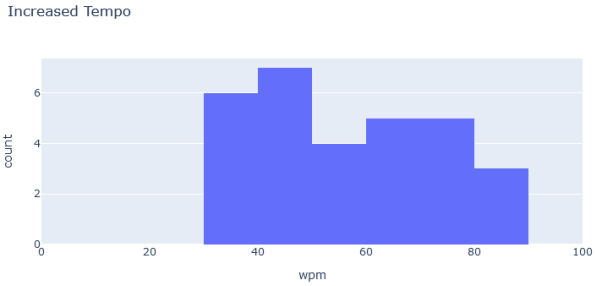
Distribution of participants according to typing speed in No music group



Distribution of participants according to typing speed in white noise group



Distribution of participants according to typing speed in with music group



Distribution of participants according to typing speed in increased tempo group

Results

Shapiro-Wilk Test

The Shapiro-Wilk test is a test of normality, it determines whether the given sample comes from the normal distribution or not. This is a hypotheses test and the two hypotheses are as follows:
Ho(Accepted): Sample is from the normal distributions.(Po>0.05)
Ha(Rejected): Sample is not from the normal distributions

[p-values]	No Music	White Noise	Music	Increased Tempo
WPM	0.010	0.039	0.038	0.053
Raw WPM	0.021	0.036	0.032	0.045
Accuracy	0.006	0.001	0.063	0.063
Consistency	0.023	0.028	0.487	0.487

According to the test, our data does not follow normal distribution in terms of wpm, rawWpm, accuracy and even consistency.

Bimodality

Seeing the distribution of the data on the histogram which shows two peaks, we separated the data into two parts, novice(wpm < 60 in no music condition) and expert (wpm >= 60 in the same condition).
We then applied the Shapiro-Wilk test in these two groups and found that the wpm, rawWpm, accuracy and consistency values follow a normal distribution within both groups.

[p-values]	No Music	White Noise	Music	Increased Tempo
WPM	0.281	0.215	0.221	0.366
Raw WPM	0.283	0.390	0.210	0.829
Accuracy	0.240	0.157	0.091	0.001
Consistency	0.223	0.074	0.831	0.008

Novice (WPM < 60 in No Music)

[p-values]	No Music	White Noise	Music	Increased Tempo
WPM	0.083	0.343	0.204	0.224
Raw WPM	0.295	0.626	0.648	0.530

[p-values]	No Music	White Noise	Music	Increased Tempo
Accuracy	0.886	0.468	0.776	0.487
Consistency	0.082	0.140	0.260	0.317

Expert (WPM >= 60 in No Music)

Hence we infer that we have a bimodal distribution with two groups, novice and expert, where the data is normally distributed within each group.[1]

Repeated Measures ANOVA

Repeated measures ANOVA is used to find whether there is a statistically significant difference between the means of three or more groups in which the same subjects are displayed in each group. A repeated-measures ANOVA has the following null and alternative hypotheses involved:

- H_0: $\mu_1 = \mu_2 = \mu_3$(In other words, population means are equal)
- H_a: According to it, at least one population mean differs from the rest

	[p-values]
WPM	0.7310
Raw WPM	0.3561
Accuracy	0.7658
Consistency	0.2333

Novice (WPM < 60 in No Music)

	[p-values]
WPM	0.5970
Raw WPM	0.7698
Accuracy	0.9798
Consistency	0.8560

Expert (WPM >= 60 in No Music)

Since RANOVA assumes the normality of data, we have performed it separately for the two groups(novice and expert). According to this test, the means of the parameters (wpm, rawWpm, accuracy and consistency) do not differ significantly between each music condition for both the groups.

Friedman Test

The Friedman Test is a non-parametric alternative to the Repeated Measures ANOVA. It is used to determine whether or not there is a statistically significant difference between the means of three or more groups in which the same subjects appear in each group.
The Friedman Test uses the following null and alternative hypotheses:

- The null hypothesis (H_0): The mean for each population is equal.
- The alternative hypothesis: (H_a): At least one population mean differs from the rest.

If the p-value of the test is less than 0.05, we can reject the null hypothesis.

[1] Determining Normality seems to be a bit tricky with less sample data, more info can be found here.

	[p-values]
WPM	0.7310
Raw WPM	0.3561
Accuracy	0.7658
Consistency	0.2333

Friedman Test on whole sample

According to this test, the means of the parameters (wpm, rawWpm, accuracy and consistency) do not differ significantly between each music condition.

Student's Paired t-Test

Tests whether the means of two paired samples are significantly different.
Assumptions
- Observations in each sample are independent and identically distributed (iid).
- Observations in each sample are normally distributed.
- Observations in each sample have the same variance. Observations across each sample are paired. Interpretation

- H_0: the means of the samples are equal.
- H_1: the means of the samples are unequal.

p-value > 0.05 affirms H_0, otherwise it affirms H_1

p-values across all control groups pairs of control groups

WPM

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.419	0.869	0.343
White Noise	-	-	0.523	0.840
Music	-	-	-	0.383
Increased Tempo	-	-	-	-

Accuracy

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.669	0.311	0.975
White Noise	-	-	0.513	0.719

Music	-	-	-	0.371
Increased Tempo	-	-	-	-

Consistency

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.340	0.916	0.123
White Noise	-	-	0.413	0.803
Music	-	-	-	0.347
Increased Tempo	-	-	-	-

Extra

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.186	0.779	0.959
White Noise	-	-	0.306	0.193
Music	-	-	-	0.753
Increased Tempo	-	-	-	-

Missed

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.919	0.211	0.927
White Noise	-	-	0.145	1.000
Music	-	-	-	0.204
Increased Tempo	-	-	-	-

Wilcoxon's Signed Rank t-Test

Tests whether the distributions of two paired samples are equal or not.

Assumptions

- Observations in each sample are independent and identically distributed (iid).
- Observations in each sample can be ranked.
- Observations across each sample are paired.

Interpretation
- H_0: the distributions of both samples are equal.

• H_1: the distributions of both samples are not equal.

p-value > 0.05 affirms H_0, otherwise affirms H_1

p-values across all control groups pairs of control groups

WPM

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.503	0.839	0.452
White Noise	-	-	0.626	0.612
Music	-	-	-	0.299
Increased Tempo	-	-	-	-

Accuracy

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.641	0.289	0.824
White Noise	-	-	0.489	0.887
Music	-	-	-	0.700
Increased Tempo	-	-	-	-

Consistency

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.328	0.839	0.229
White Noise	-	-	0.245	0.839
Music	-	-	-	0.253
Increased Tempo	-	-	-	-

Extra

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.169	0.819	0.831

White Noise	-	-	0.188	0.133
Music	-	-	-	0.940
Increased Tempo	-	-	-	-

Missed

[p-values]	No Music	White Noise	Music	Increased Tempo
No Music	-	0.894	0.440	0.820
White Noise	-	-	0.198	0.917
Music	-	-	-	0.364
Increased Tempo	-	-	-	-

Conclusion

We aimed to investigate the effect of music on a person's typing speed. Specifically, the hypothesis put forward was that music would have significant impact on typing speed. To test this hypothesis, we carried out experiments and collected data on various variables, including music tempo, typing speed, and accuracy.

After analysing the data, we concluded that there was no correlation between the different variables tested and that the hypothesis was not supported. This means that the presence or absence of music, its tempo, and other variables had no significant effect on the typing speed of the participants.

We note that our findings are consistent with the results of a previous study conducted by Dr. Anna Bramwell-Dicks, which also found no correlation between music and typing speed. However, in the study conducted by Dr. Dicks, she did find a slight difference in accuracy, suggesting that music may have a slight effect on this variable, which is in contrast to our finding.

Overall, our study suggests that the hypothesis that music has no effect on typing speed was not supported by the data, although there may be some minor effects on other variables such as accuracy.

Limitations and Future scope

Despite the study's findings, there are several limitations that should be considered when interpreting the results. One of the primary limitations is the sample size of the study. While we collected data from a considerable number of participants, recruiting even more participants could provide more data and potentially improve the study's findings. This would allow us to analyse a more extensive range of data and make more conclusive statements regarding the relationship between music and typing speed.

Another potential limitation of the study is that we did not perform a causative analysis of the results from existing research. While the study's data may be consistent with previous research, a more detailed examination of the underlying causal mechanisms would help to provide a deeper understanding of the relationship between music and typing speed.

We could also consider including the time signature of the music along with the tempo in future studies. This could help to determine whether the structure of the music has any influence on typing speed. Additionally, including different genres of music could help to determine if certain types of music have a more significant effect on typing speed than others.

Another potential factor that could be investigated in future studies is the effect of vocals in music on typing speed. Our study only examined instrumental music, and the addition of vocals to the music could potentially have a different effect on typing speed.

Furthermore, we used the unfamiliarity of the music as a factor in selecting the music piece for the experiment. A future study could explore the effect of familiar music on typing speed, as this could provide a better understanding of how personal preferences and familiarity with the music might influence typing speed.

In conclusion, while the study found no significant correlation between music and typing speed, there are several limitations that must be considered. The recruitment of more participants, causative analysis of existing research, inclusion of time signature and music genres, and examination of the impact of vocals and familiarity could all provide valuable insights into the relationship between music and typing speed.

Concepts taken from the course

There were many concepts that proved to be valuable as we worked to design and conduct a study on the effects of music on typing ability.

One of the key insights that helped us in our study was the role of familiarity in music cognition. We learned that listeners tend to prefer music that is familiar to them and that this familiarity can impact how they perceive and process musical information. In our study, we decided to use unfamiliar music pieces to eliminate any potential biases related to prior exposure or familiarity with the music.

Another concept that we applied was the use of physical features of music, such as tempo, as a factor in the experiment. We learned that tempo can have a significant impact on listener mood and attention and that it may also affect typing ability. By including tempo as a variable in our study, we were able to explore this hypothesis and test its validity.

We learned about the important distinction between correlation and causation in our study. We recognised that just because there may be a correlation between music and typing ability, it does not necessarily imply a causal relationship. We carefully designed our study to control for confounding variables and draw accurate conclusions.

We also learned about the mechanistic perspective of studies conducted in Cognitive Science. Rather than relying on physical features to explain human judgments, we should explain them with intermediary judgments/percepts. By doing so, we can develop a more nuanced understanding of the complex relationships between music & cognition. We included this in our future scope.

Most importantly, we recognised the importance of making judgments based on input information available, rather than the efficacy of an algorithm. Meaning, instead of looking at high accuracy of

predicting people's typing speed based on other parameters would be of no research value to in field of music cognition, as that high percentage would be the property of the algorithm, not of the information that is available to us. Therefore, by carefully analysing the data we collected and drawing meaningful conclusions from our statistical analyses, we were able to provide valuable insights into the effects of music on typing ability.

Individual Contribution

I took on several important responsibilities to ensure the project was conducted successfully. My first responsibility was to ideate the project and develop the research question to be explored. This involved reviewing existing research to understand the state of knowledge on the topic and identify gaps or areas for further investigation. Based on this, I developed the research question and study design, taking into account factors such as sample size, data collection methods, and statistical analyses.

Once the study was underway, I was involved in several other key tasks. These included assisting with the collection of data and ensuring that the data was clean and free of errors or inconsistencies. I also audited the data visualisation graphs to ensure that they accurately represented the data and highlighted any interesting patterns or trends.

After the data was collected and cleaned, I took on the responsibility of conducting the statistical analysis. This involved using appropriate statistical tests to examine the relationship between music and typing ability, and to draw meaningful conclusions from the data. By carefully analysing the results of the statistical tests, I was able to identify any patterns or trends that emerged from the data and to draw inferences about the impact of music on typing ability.

I believe that my contributions to this project were essential to its success. Through careful ideation and planning, diligent data collection and cleaning, and rigorous statistical analysis, we were able to shed new light on the question of whether music helps improve typing ability. The insights gained from this study could have important implications for a range of fields, from education to workplace productivity, and I am proud to have played a role in this exciting and meaningful research.