Music and Motor Cognition: Investigating Typing Efficiency Under Different Auditory Conditions

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Abstract

This report investigates whether background music and task length affect typing speed and accuracy using the MonkeyType platform. Participants completed 25-word and 100-word typing tests under both classical instrumental music and no-music conditions. Two-way ANOVA analysis revealed that task difficulty significantly affected words per minute (WPM), while background music had minimal influence on typing performance. Accuracy showed marginal differences with task length but not music. The findings suggest that classical music does not impair typing performance, while task complexity plays a larger role in typing efficiency.

I. Introduction

"Does background music or task length affect typing speed and accuracy in a 25-word and 100-word MonkeyType test?" This experiment investigates how background music and task length influence typing speed (WPM) and accuracy using the digital typing program MonkeyType [1]. It examines whether different auditory conditions, classical instrumental music (experimental) versus no music (control), and varying task lengths (short: 25 words vs. long: 100 words), affect typing performance. By measuring both words per minute (WPM) and accuracy, we aim to determine whether background music and/or task difficulty significantly affect typing efficiency.

II. Background

Through conducting a literature review, we gathered sufficient background information to give insight into the historical conclusions, research, and motivations of our project, as well as to form a well-grounded set of hypotheses.

A. Literature Review

Early research by Ransdell and Gilroy indicates that background music can hinder writing speed and accuracy, portraying it as a distraction during language-related tasks [2]. Similarly, Silverberg concludes that upbeat music or background dialogue negatively affects typing speed, suggesting that classical music may be more conducive to better performance [3]. Kämpfe et al. conducted a meta-analysis showing that while background music may aid simple, repetitive tasks, it can impair performance on more complex tasks requiring higher cognitive load and sustained attention [4]. This distinction is particularly relevant to typing tasks, where longer or more cognitively demanding activities are more susceptible to interference.

Additionally, age and mental fatigue may further influence typing performance, as younger and middle-aged adults show different strategies when faced with prolonged tasks [5]. These results highlight that longer or more cognitively demanding tasks may be especially vulnerable to interference.

III. Methods

This section outlines the experimental design, data collection, and analysis methods used to examine the effects of music and task difficulty on typing performance.

A. Data Collection

Participants completed the typing tasks and received an accuracy score, total time, and typing rate from MonkeyType [1], used to determine the relationship between music and typing performance. This data was recorded and later analyzed in R to conduct ANOVA testing and draw conclusions.

B. Study Participants

Target Group: University of Toronto St. George post-secondary students. *Sample Size:* 16 participants (consent provided).

C. Independent Variables

The primary independent variable is the type of music played during the task: *classical instrumental music* vs. *no music* (control). Music has been shown to influence cognitive processes (e.g. attention, memory) that may affect typing performance. By altering music conditions, we aim to see whether it enhances focus or distracts. We selected Mozart's *Requiem in D Minor, K.626: Sequence: VI. Lacrimosa dies illa*.

A secondary independent variable is task difficulty, labeled by word count: *short* (25 words) vs. *long* (100 words). This differentiates difficulty levels and clarifies the effect of music on various task demands.

D. Dependent Variables

The primary dependent variable is **typing speed**, measured in words per minute (WPM). By comparing WPM across conditions, we see whether background music affects speed. The secondary dependent variable is **typing accuracy**, measured as the percentage of correctly typed words. By comparing accuracy across trials, we evaluate whether music improves focus or introduces distractions.

E. Hypotheses

We present six hypotheses concerning the effect of background music and task difficulty on typing performance, using H_0 for the null hypothesis and H_1 for the alternative.

Hypotheses for Typing Speed:

- **Main Effect of Music:**
  - H_0: No difference in typing speed (music vs. no music).
  - H_1: Speed is lower with music, due to distraction [2], [3].
- **Main Effect of Task Length:**
  - H_0: No difference in typing speed (short vs. long tasks).
  - H_1: Speed is lower in long tasks due to greater cognitive load [4].
- **Interaction Effect:**
  - H_0: No interaction; music's effect is the same for short and long tasks.
  - H_1: Longer tasks exacerbate music's negative impact [4], [5].

Hypotheses for Typing Accuracy:

- **Main Effect of Music:**
  - H_0: No difference in typing accuracy (music vs. no music).

  - H_1: Accuracy is lower with music [2], [3].
- **Main Effect of Task Length:**
  - H_0: No difference in typing accuracy (short vs. long tasks).
  - H_1: Accuracy declines in longer tasks [4], [6].
- **Interaction Effect:**
  - H_0: No interaction; music effect is independent of task length.
  - H_1: Longer tasks intensify music's interference on accuracy [4], [5], [6].

For data analysis, we use ANOVA:

$$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk} \quad (1)$$

where y_{ijk} is the outcome (WPM or Accuracy), α_i is music factor, β_j is task length factor, and $(\alpha\beta)_{ij}$ is the interaction.

IV. Experimental Design

This section describes the refined experimental procedure and the rationale for updating the original design.

A. Refined Experimental Design

The experiment was carried out in a quiet room. Noise-cancelling headphones ensured consistency in the music condition. Participants completed two typing tests, one with 25 words and another with 100 words, under *music* (classical) or *no music*. Due to no major differences with a 50-word test, we extended the longer task to 100 words. This approach is supported by research indicating that longer tasks can reduce noise and better reveal performance differences [7].

Participants were instructed to type as quickly and accurately as possible. The MonkeyType platform recorded WPM and accuracy automatically. Short breaks were given to minimize fatigue. We used a 90% confidence interval ($\alpha = 0.10$) to increase statistical power given a small sample size.

V. Results

We applied repeated-measures ANOVA, assumption testing, and effect size calculations. Main effects for music, task length, and their interaction were tested. Shapiro-Wilk and Q-Q plots checked normality; Levene's test checked variance homogeneity. Partial eta-squared (η_p^2) assessed practical significance.

A. Does Music and Task Length Affect Typing Speed (WPM)?

No significant difference emerged between music and no music for typing speed ($F(1,56) = 0.238,\ p = 0.632$). However, task length showed a significant effect ($F(1,56) = 5.2158,\ p = 0.03737$), and the interaction was non-significant ($F(1,56) = 0.069,\ p = 0.797$).

Median WPM was higher for short tasks (e.g., 86.0 w/music vs. 78.0 w/o music) compared to long tasks (75.5 w/music vs. 70.0 w/o music). See Fig. 1. Normality was met for WPM (Shapiro-Wilk $p = 0.162$), and Levene's test ($p = 0.469$) indicated equal variances. These can be confirmed through Fig. 2. Effect sizes showed a small effect for music ($\eta^2 = 0.017$) and a more substantial one for task length ($\eta^2 = 0.258$).

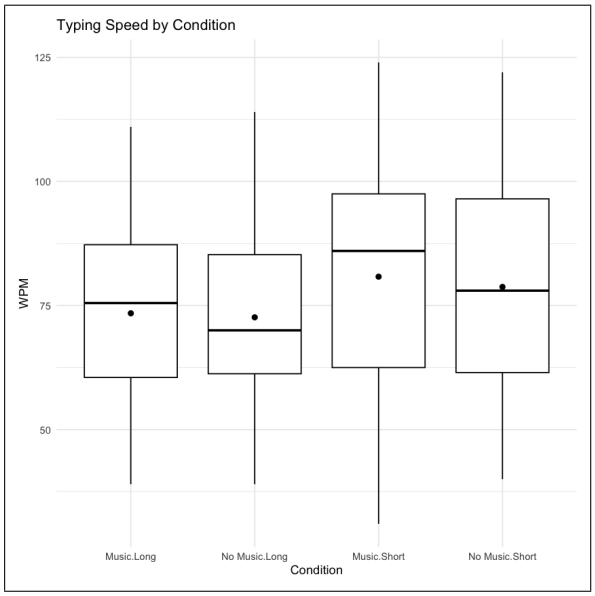

Fig. 1. Box plots of typing speed (WPM) across music vs. no music and short vs. long tasks.

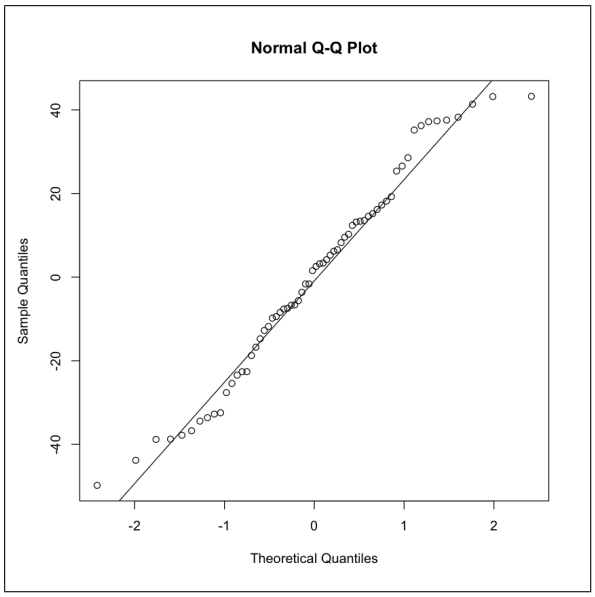

Fig. 2. Q-Q plot of the residuals for the WPM ANOVA model.

B. Does Music and Task Length Affect Typing Accuracy?

Music vs. no music did not significantly affect accuracy ($F(1,56) = 0.004,\ p = 0.9533$). Task length was marginally significant ($F(1,56) = 2.958,\ p = 0.106$),

and the interaction was also non-significant ($F(1,56) = 0.111,\ p = 0.744$).

Median accuracy decreased slightly for longer tasks (e.g., short: 96.5% w/music vs. 94.0% w/o; long: 91.5% w/music vs. 92.5% w/o). Fig. 3 shows this pattern. Although residuals violated normality (Shapiro-Wilk $p = 0.00017$), Levene's test ($p = 0.531$) showed equal variances across conditions. These conclusions can be investigated using Fig. 4. Effect sizes were negligible for music ($\eta_p^2 = 0.0002$) and small for task length ($\eta_p^2 = 0.1647$).

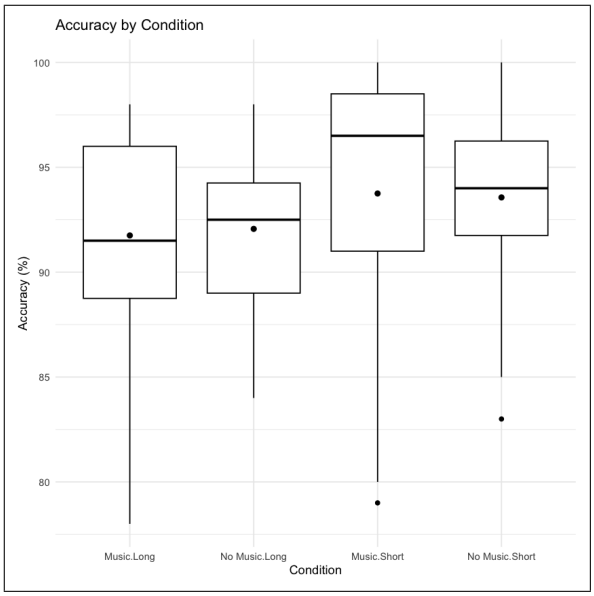

Fig. 3. Box plots of accuracy (%) across music vs. no music and short vs. long tasks.

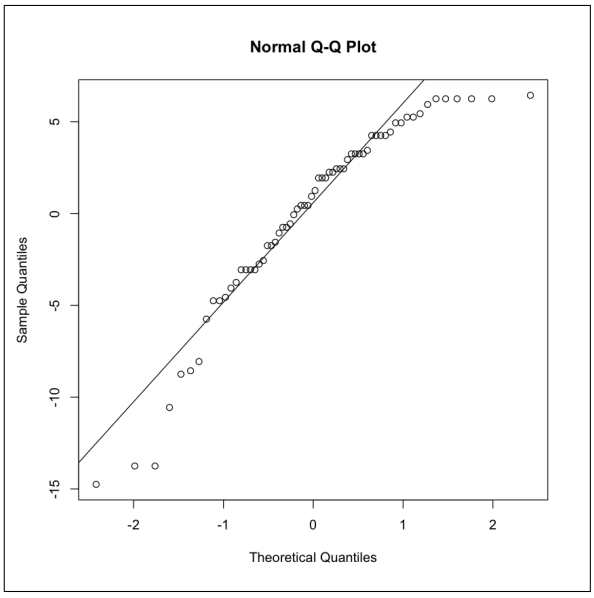

Fig. 4. Q-Q plot of the residuals for the Accuracy ANOVA model.

C. Correlation between WPM and Accuracy

A Pearson correlation showed a significant positive association ($p < 0.001$) between WPM and accuracy. Faster typists tended to be more accurate, implying that raw speed is tied to correctness (i.e., you cannot achieve a high WPM with large numbers of errors).

VI. Discussion

We interpret the findings, outline broader implications, and discuss strengths, limitations, and future directions.

A. Implications on the Research Question

Background music did not significantly affect WPM or accuracy, while task difficulty (long vs. short tasks) played a key role. Classical instrumental music may be less cognitively demanding than lyrical music [2], [3]. As tasks get longer and mental fatigue grows, typing performance declines.

B. Implications in Broader Contexts

In workplaces or classrooms where classical music is used for ambiance, this study suggests no major detriment to typing speed or accuracy. Task complexity appears to be a more accurate predictor of performance [5].

C. Experiment Strengths

- **Well-Controlled Design:** Standardized typing platform and random assignment reduce bias.
- **Robust Statistical Analysis:** ANOVA, assumption tests, and effect sizes align with best practices.

D. Experiment Limitations

- **Small Sample Size (N=16):** May not detect smaller effects.
- **Music Selection:** Mozart's *Requiem* features dramatic shifts that might have unique cognitive impacts.

E. Potential Future Experiments

- **Varying Genres and Emotional Tone:** Investigate whether pop or lyrical music has a stronger interference effect.
- **Increased Task Complexity:** Evaluate cognitively demanding tasks (coding, essay writing) under musical conditions.

VII. Conclusion

Task difficulty exerts a stronger influence on typing performance than classical background music. Longer tasks reduce WPM and accuracy, likely due to mental fatigue. These findings suggest classical music can be used without significantly harming productivity, but task length must be considered when designing study or work sessions.

References

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