Exploring the Influence of Font Style, Size, and Medium on Text Comprehension: A 2^3 Factorial Design Experiment

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Outline

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- Findings and Discussion
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Introduction

- Students now have two options for accessing and utilizing course materials: through traditional paper formats or digitally. However, which format helps students study more effectively is still a hotly debated topic.
- Moreover, how the presentation elements, such as font style and font size, impact student learning is also an interesting question that is of much interest to scholars.
- Varied research findings
  - No effect - Ali et al (2013); Florit et al (2023); Hermena et al. (2017)
  - Significant effect - Dressler (2019) ; Ralekar et al. (2018); Rello et al (2016)
- By analyzing empirical data and theoretical frameworks, this study investigates how font style, font size, and medium impact students' ability to comprehend text effectively.

Experimental Setup

- Experiment design: 2^3 factorial design with 3 replicates
  - Factor 1: Font Style (Calibri vs Times New Roman)
  - Factor 2: Font Size (10 pts vs 12 pts)
  - Factor 3: Medium (Paper vs Computer)
- Participants: 3 Miami University students with varying educational and cultural backgrounds
- Procedure:
  - For each run, each participant received a text passage with a random combination of font style, font size, and medium to read in 5 minutes
  - After 5 minutes, participants were given a set of 10 questions based on the text passage to assess understanding of its content
  - The number of correct answers for each participant for each round was recorded for analysis
  - Experiment consisted of 8 runs, each corresponding to a different text passage
- Analysis: Excel (Data organization and Storage); SAS 9.4 (Data Analysis)

Model Equation

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{12} X_1 X_2 + \beta_{13} X_1 X_3 + \beta_{23} X_2 X_3 + \beta_{123} X_1 X_2 X_3 + \varepsilon}$$

where Y is the number of correct answers, X_1 is the font style, X_2 is the font size, X_3 is the medium, $\varepsilon \sim \text{iid } \mathrm{N}(0, \sigma^2)$

$$X_1 = \begin{cases} -1 \text{ if Calibri} \\ +1 \text{ if Times New Roman} \end{cases} \qquad X_2 = \begin{cases} -1 \text{ if size 10} \\ +1 \text{ if size 12} \end{cases} \qquad X_3 = \begin{cases} -1 \text{ if paper} \\ +1 \text{ if computer} \end{cases}$$

$\beta_1, \beta_2, \beta_3$ are the coefficients related with main effects of font style, font size, and medium respectively

β_{12} is the coefficient of the interaction effect of font style and font size

β_{13} is the coefficient of the interaction effect of font style and medium

β_{23} is the coefficient of the interaction effect of font size and font medium

β_{123} is the coefficient of the interaction effect of the three factors

Findings and Discussion

Figure 1: Residual Plots for Original Data

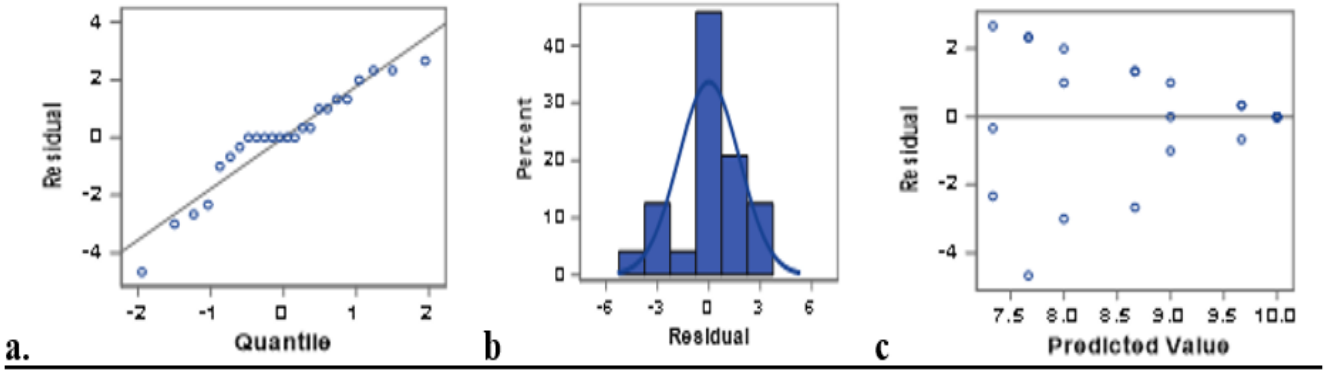

Figure 2: Residual Plots for Box-Cox Transformed Data

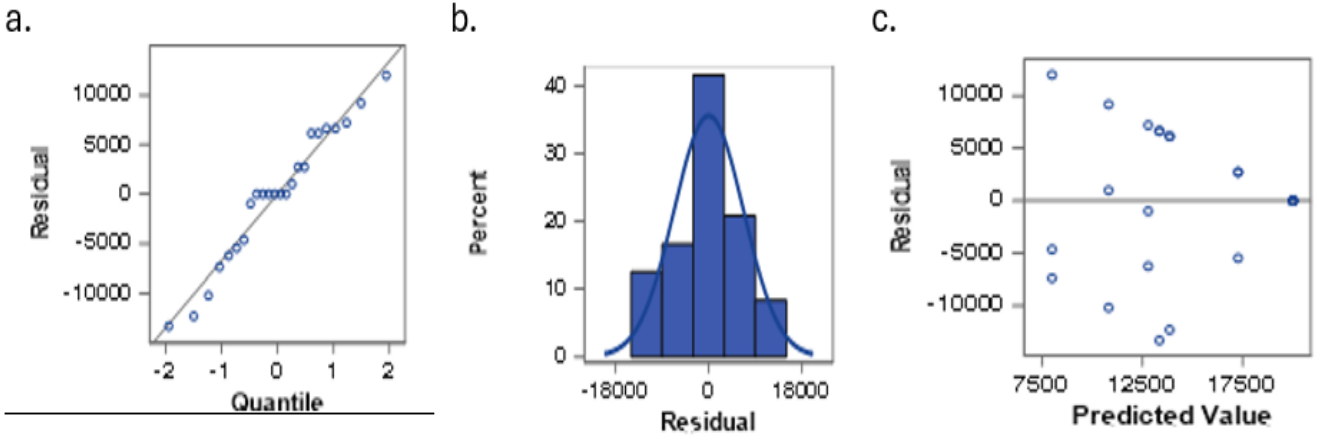

Table 1: Anova Table

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	386282057	55183151	0.85	0.5632
Error	16	1037833577	64864599		
Corrected Total	23	1424115633			

Table 2: Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	14508	1643.98650	8.82	<.0001
F. style (A)	1	1609.54167	1643.98650	0.98	0.3421
F. size (B)	1	5.04167	1643.98650	0.00	0.9976
Medium (C)	1	145.47500	1643.98650	0.09	0.9306
F. style*F. size (AB)	1	2512.12500	1643.98650	1.53	0.1460
F. style*medium (AC)	1	-953.54167	1643.98650	-0.58	0.5700
F. size*medium (BC)	1	-2026.07500	1643.98650	-1.23	0.2356
F. style*F. size*medium (ABC)	1	1469.10833	1643.98650	0.89	0.3848

Conclusion

- Through our experiment, we discovered that font style, font size, and medium don’t have significant effect on how students comprehend text.
- **Theoretical Framework:** Cognitive Load Theory (CLT)
  - The ability of students to understand texts might depend more on other factors rather than the nature of the text and the medium through which it is presented.
  - According to germane and intrinsic aspects of the CLT, the comprehension ability depends more on students’ efforts and their previous knowledge of subject matter (Sweller, 2010; Sweller, 1988).

Recommendations

Practice

- It is thus recommended that students should commit more effort into studying their lecture materials irrespective of the characteristics of the texts or the medium in which they presented.
- Educators and publishers must ensure consistency and continuation in study materials in subsequent levels.

Future Research

- Future studies are recommended to explore this topic further with a larger sample size to obtain a more informative result.
- Further research could be conducted by using complex and familiar topics to examine the topic in different familiarity contexts.

References

Ali, A. Z. M., Wahid, R., Samsudin, K., & Idris, M. Z. (2013). Reading on the Computer Screen: Does Font Type Have Effects on Web Text Readability?. International Education Studies, 6(3), 26-35.

Dressler, E. (2019). Understanding the effect of font type on reading comprehension/memory under time-constraints.

Florit, E., De Carli, P., Rodà, A., Domenicale, S., & Mason, L. (2023). Precursors of reading text comprehension from paper and screen in first graders: a longitudinal study. Reading and Writing, 36(7), 1821-1843.

Hermena, E. W., Sheen, M., AlJassmi, M., AlFalasi, K., AlMatroushi, M., & Jordan, T. R. (2017). Reading rate and comprehension for text presented on tablet and paper: Evidence from Arabic. Frontiers in psychology, 8, 257.

Ralekar, C., Saha, P., Gandhi, T. K., & Chaudhury, S. (2018). Effect of devanagari font type in reading comprehension: An eye tracking study. In Intelligent Human Computer Interaction: 10th International Conference, IHCI 2018, Allahabad, India, December 7–9, 2018, Proceedings 10 (pp. 136-147). Springer International Publishing.

Rello, L., Pielot, M., & Marcos, M. C. (2016, May). Make it big! The effect of font size and line spacing on online readability. In Proceedings of the 2016 CHI conference on Human Factors in Computing Systems (pp. 3637-3648).

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive science, 12(2), 257-285.

Sweller, J. (2010). Element interactivity and intrinsic, extraneous, and germane cognitive load. Educational psychology review, 22, 123-138.

THANK YOU FOR LISTENING!!

Appendix

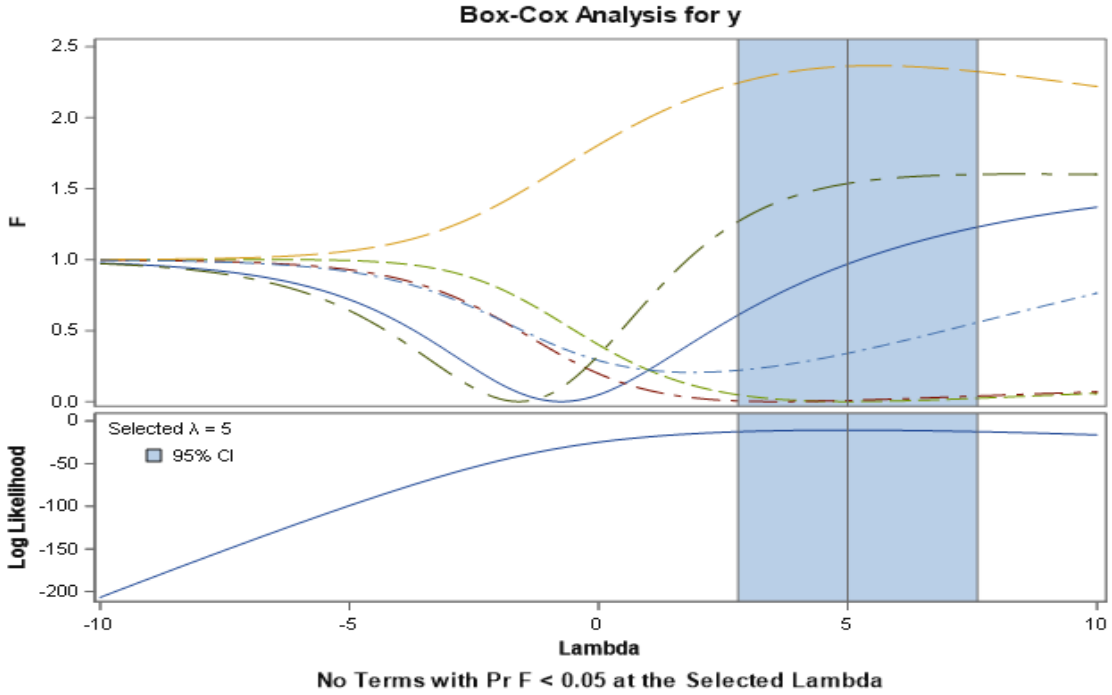

Figure 1. Box-Cox Analysis for the Response Variable

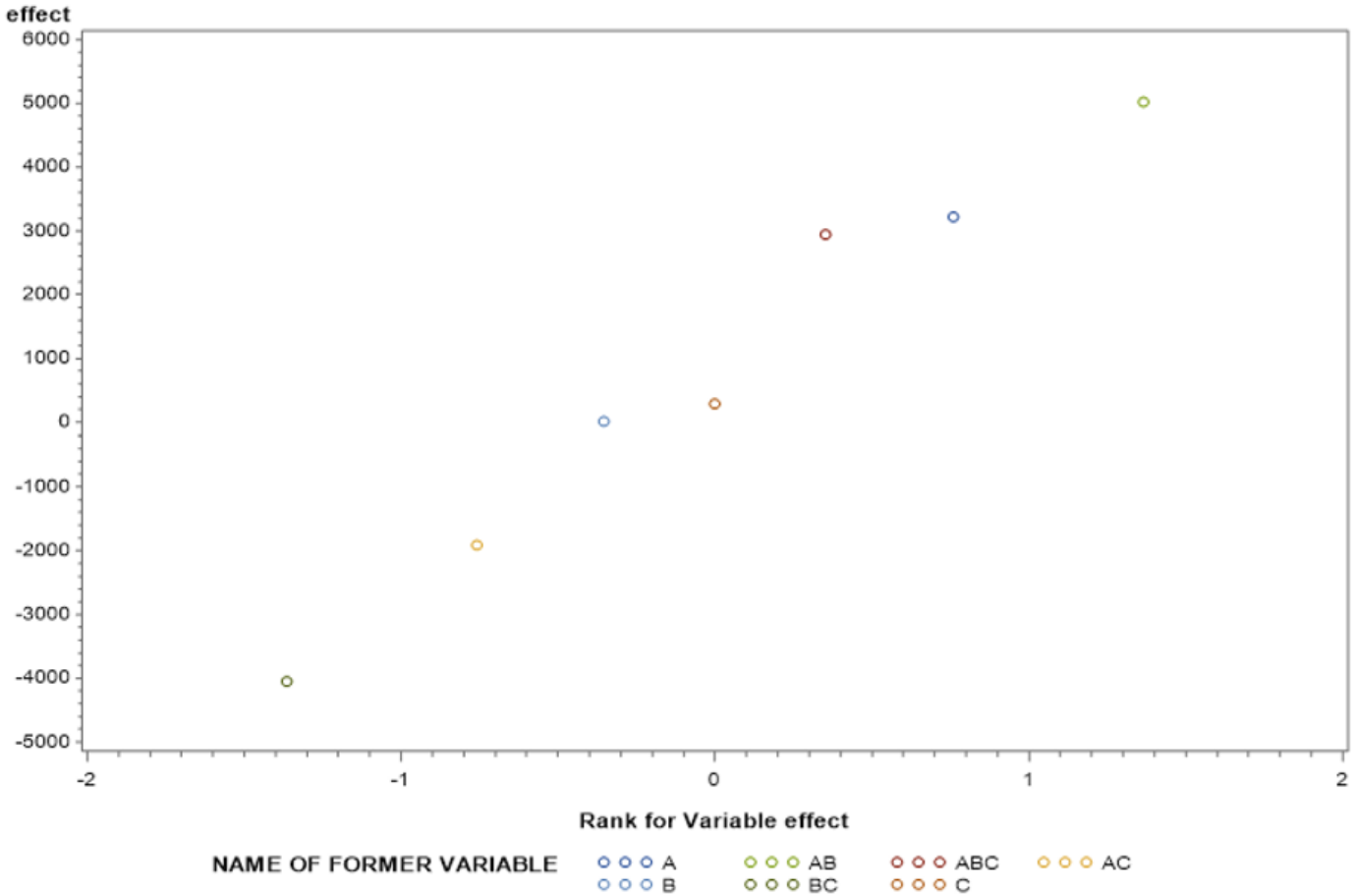

Fig 3.4. Percentage Probability Plot