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EXTENDED ABSTRACT

EDITOR | ADAM LINOBY

EVALUATING THE SUSTAINED EFFECTS OF ACTION GAMING ON VISUOSPATIAL PLANNING AND COGNITIVE FLEXIBILITY UNDER COGNITIVE FATIGUE

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I. Introduction

This study explores the cognitive mechanisms enabling action video game players to maintain problem-solving under cognitive fatigue, addressing gaps in cognitive benefits, causal evidence, and mechanisms. A comparative analysis with non-gamers highlights differences in cognitive resilience and problem-solving performance, offering insights into gaming's potential role in enhancing cognitive function.

II. Methods

This quasi-experimental pre- and post-test study involved 30 participants ($n = 30$; 18–30 years, Seremban), split into 15 gamers (n = 15; <7 hours gaming per week) and 15 non-gamers (n = 15, <1 hour gaming per week). Cognitive performance was assessed using the Tower of London task pre- and post-intervention, where several values were noted to indicate visuospatial planning and cognitive flexibility. The values noted are average moves and problem solving time [1]. To induce cognitive fatigue, gamers performed the Stroop test for 45 minutes and non-gamers engaged in a cognitive-neutral activity by watching "NASA's Cassini Mission" documentary, ensuring controlled intervention contrasts. Paired Sample T-test was conducted afterwards to show effect of time and to differentiate effect between groups, magnitude of mean difference was observed afterwards. Statistical significance was set at ($p<0.05$).

III. Results and Discussion

A. *Visuospatial Planning in Gamers and Non-gamers Under Cognitive Fatigue*

Although both groups show an increment of moves after cognitive fatigue induced, gamers exhibited superior visuospatial planning by having less time to solve problems (13634.78 ms) compared to non-gamers (13985.75), however the difference between pre-and-post is slightly higher for gamers (3705.11) compared for non-gamers (876.01). Figure 1 further illustrates the difference.

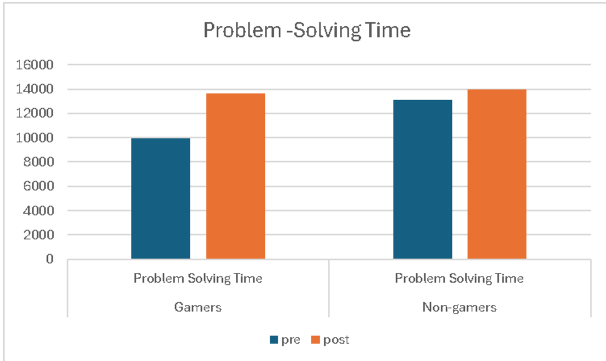


Fig. 1 Problem Solving Time (*ms*).

This indicates that their working memory fluctuated due to cognitive fatigue but still composed to solve problems faster compared to non-gamers [2].

B. *Comparative Problem-Solving Performance: Gamers vs. Non-Gamers*

Gamers significantly outperformed non-gamers in task efficiency (gamers average move = 2.80-3.08, non-gamers = 5.34-5.79) but not reaction time (gamers = 0.03-0.02, non-gamers = 0.009-0.001) after cognitive fatigue. While non-gamers exhibited a steeper decline, Gamers maintained high accuracy. In terms of faster completion times ,non-gamers excel in this, demonstrating cognitive resilience in gamers, but hasty moves by non-gamers. However, some gamers displayed overconfidence, occasionally making premature errors [3]. Figure 2 and 3 further illustrate these.

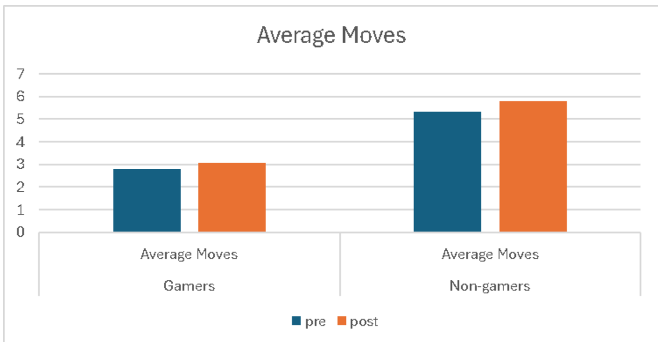
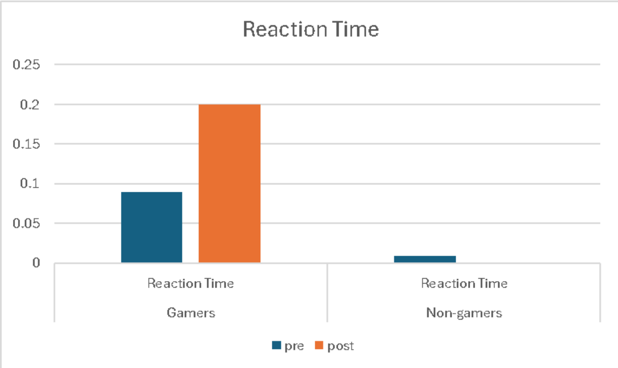
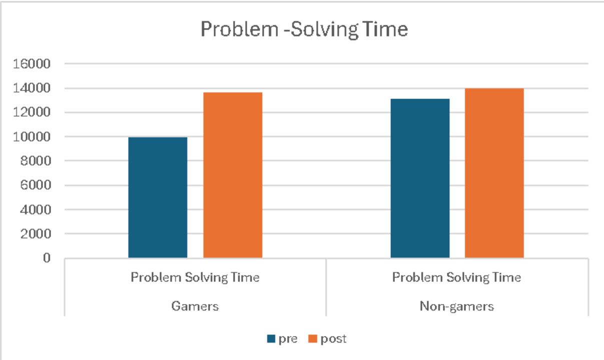


Fig. 2 Average Moves to Solve Problems (number of moves).





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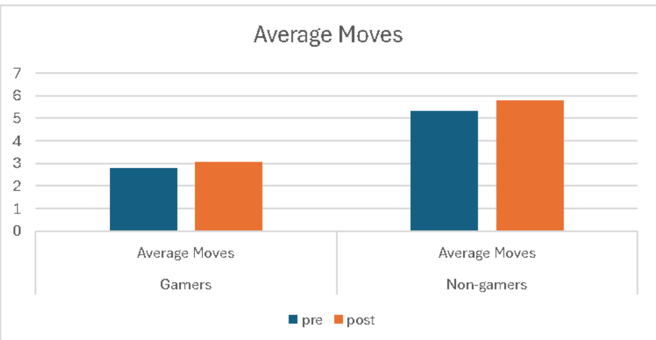

Fig. 2 Reaction Time (*ms*)

D. *Statistical Analysis of Performance after Cognitive Fatigue*

The statistical results below confirm significant differences in problem-solving efficiency, reaction speed, and accuracy between gamers and non-gamers, reinforcing gaming's potential cognitive benefits. Statistical significance can be seen for average moves made and problem solving time, but nor reaction time within both groups as depicted in Table 1.

TABLE I
DIFFERENCES BETWEEN PRE-POST GAMERS AND NON-GAMERS

Metric	Non-Gamers	Sig.	Gamers	Sig.
Average Moves Made	-0.46 ± 0.69	0.02*	-0.28 ± 0.45	0.03*
Problem-solving Time (*s*)	-876.00 ± 653.45	0.01*	-3705.11 ± 1058.08	0.01*
Norm. Reaction Time (*ms*)	0.009 ± 0.01	0.08	0.05 ± 0.09	0.08

E. *Impact of Cognitive Fatigue on Endurance*

Fatigue affected non-gamers more severely, causing slower reaction times and increased errors. Gamers exhibited higher cognitive endurance, maintaining their problem-solving efficiency despite fatigue. These findings suggest that gaming may train the brain to sustain optimal cognitive performance under prolonged cognitive demands.

IV. CONCLUSIONS

This study revealed that gamers possess enhanced cognitive abilities that improve problem-solving under fatigue, but resilience to fatigue-related decline remains comparable to non-gamers. These findings emphasize the need to explore mechanisms linking gaming expertise and fatigue management, contributing to understanding cognitive endurance and its practical implications.

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REFERENCES

[1] Unterrainer, J. M., Rahm, B., Kaller, C. P., Leonhart, R., Quiske, K., Hoppe-Seyler, K., ... & Funke, J. (2004). Planning abilities and the Tower of London: Is this task measuring a discrete cognitive function? *Journal of Clinical and Experimental Neuropsychology,* 26(6), 770-786. https://pubmed.ncbi.nlm.nih.gov/15370380/

[2] Baniqued, P. L., Lee, H., Voss, M. W., Basak, C., Cosman, J. D., Desouza, S., ... & Kramer, A. F. (2013). Video games and board games: Effects of playing practice on cognition. *Frontiers in Psychology,* 4, 626. https://www.researchgate.net/publication/369558241_Video_games_and_board_games_Effects_of_playing_practice_on_cognition

[3] Lundgren, T., Kenttä, G., & Pihlstedt, P. (2020). Comparison of psychological and cognitive characteristics between elite and non-elite athletes: A focus on cognitive functions. *International Journal of Environmental Research and Public Health*, 17(18), 6756. https://pmc.ncbi.nlm.nih.gov/articles/PMC7369982/