BEHAVIOURAL RESEARCH IN STATISTICAL METHODS

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY

HYDERABAD

Reaction time and working memory in gamers and non-gamers

Split-Second Squad

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Contents

1 Abstract

1.1 Introduction

With over 2.7 billion gamers worldwide, playing video games can be considered as one of today's favorite pastimes. Studies have explored associations between gaming and various cognitive processes such as attention, reaction time (RT), and working memory, suggesting potential cognitive benefits associated with gaming[7]. However, methodological challenges, particularly related to participant recruitment and expectancy effects, can confound research outcomes. Several studies have demonstrated positive correlations between video game expertise and cognitive-motor skills. For instance, expert gamers exhibit superior performance in tasks requiring tracking moving objects, detecting change, and task switching. Moreover, experienced gamers of first-person shooter games demonstrate enhanced accuracy and faster reaction times in cognitive tasks compared to non-gamers. Despite promising findings, methodological concerns persist. Self-selection biases might contribute to observed differences between gamers and non-gamers, potentially influencing study outcomes. Boot et al.[2] emphasized the importance of covert participant recruitment, suggesting that participants should not be aware that they are recruited based on their gaming experience to avoid biasing results.

1.2 Problem Statement

A critical methodological concern in studying the effects of gaming on cognitive-motor performance is the influence of participant expectations and response expectancies. Psychological suggestion and response expectancy theory posit that individuals' beliefs about the effects of gaming can impact task performance. For example, gamers anticipating improved performance in cognitive tasks due to gaming experience might exhibit faster reaction times based on their expectations alone. To address this issue directly, this study aimed to investigate whether asking participants about their gaming experience prior to task performance affects their cognitive-motor performance. Specifically, we formulated the following hypotheses:

1. **Hypothesis 1:** Participants identifying as gamers, questioned before the study, are expected to show improved performance in RT-based tasks compared to those questioned after the study.
2. **Hypothesis 2:** Non-gamers, queried about their gaming experience before versus after the study, are anticipated to exhibit no discernible differences in RT-based task performance.
3. **Hypothesis 3:** No significant disparities are expected between gamers and non-gamers in a digit-span memory task.

Furthermore, this study explored additional hypotheses to elucidate the impact of gaming experiences and beliefs on cognitive-motor task performance:

4. **Hypothesis 4:** Players primarily engaged in first-person shooter (FPS) games are expected to have better reaction times compared to those who play role-playing games (RPGs) or strategy games.

5. **Hypothesis 5:** Participants with awareness of media reports on the connection between video games and cognitive-motor tasks are expected to demonstrate better performance compared to those without such awareness.

6. **Hypothesis 6:** Despite differing beliefs about the correlation between video games and cognitive-motor tasks, we expect to observe whether these beliefs influence actual task performance among gamers and non-gamers.

7. **Hypothesis 7:** Faster reaction time is associated with lower accuracy, and gamers will demonstrate better performance compared to non-gamers in cognitive motor tasks.

1.3 Literature Review

Ziv et al. [1] investigated how questionnaire timing affects cognitive/motor task performance in gamers and non-gamers. They explored whether asking about gaming experience before or after tasks influenced performance and tested specific hypotheses related to response expectancies and gaming experience.

In the Choice-RT task, no significant effects of group or questionnaire timing on reaction time (RT) or correct responses were found. The Simon task showed a significant interaction between group and questionnaire timing on RT, with non-gamers exhibiting slower RTs when questioned before the task compared to after, and gamers showing the opposite pattern.The Alternate Task-Switching and Digit Span tasks did not show significant effects of group or questionnaire timing on RT or correct responses. Regression analyses revealed weak associations between gaming variables and task performance.

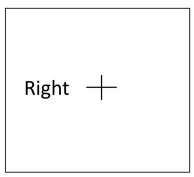
Gender differences in task performance were insignificant. Exploratory analyses suggested nuanced effects of questionnaire timing primarily in non-gamers. Beliefs about gaming's impact on task performance did not differ significantly between groups. Similarly, awareness of gaming benefits from media reports showed no significant differences. Bayesian analyses provided insights into null hypotheses for non-significant findings, emphasizing methodological considerations in gaming research.

The study's strengths included covert participant recruitment, a large sample size, and rigorous statistical analyses. Limitations included sample composition bias and limited data on detailed gaming habits. In summary, Ziv et al.'s [1] study contributes to understanding how questionnaire timing influences cognitive/motor task performance in gamers and non-gamers, highlighting methodological implications for gaming research.

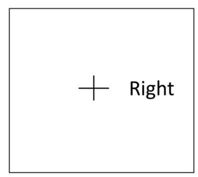
2 Methods

2.1 Reaction Time (RT) -Tasks

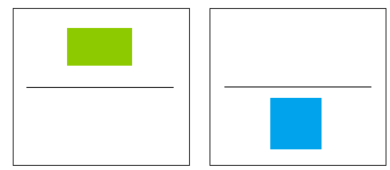
RT-based tasks were chosen to enhance processing speeds, attentional control, and visuomotor transformation, which are typically heightened in gamers compared to non-gamers. Gaming may also positively impact working memory due to shared neural pathways.



Simon RT Task

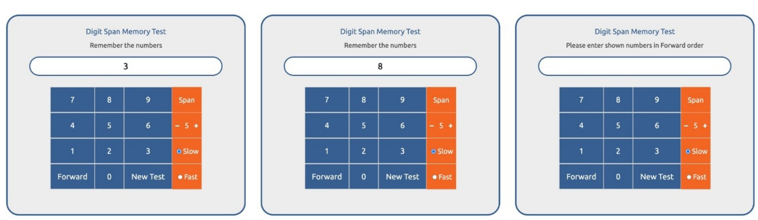


Choice RT Task



Alternate task-switching task

- **Choice-RT task:** Participants pressed “j” for “right” and “f” for “left” appearing beside a centralised cross on screen (900 ms exposure)[3][4].
- **Simon task:** Similar to Choice-RT but with words displayed on either side of the cross. Participants responded to the word irrespective of its position[5][6].
- **Alternate task-switching task:** Participants identified shapes (blue/green; square/rectangle) at top/bottom of screen. Response keys varied based on location and shape/color. Stimuli remained until a response.



Digit-span Memory task

- **Digit-span memory task:** Participants were instructed to recall sequentially presented digits on the screen, beginning with three digits and increasing by one digit up to 11. Each digit appeared for one second and was randomly selected from the digits 0 to 9 without replacement, with sequences containing up to 10 digits. For the 11-digit sequence, an extra duplicate digit was introduced randomly. The randomization process was performed using R. Sequences containing consecutive ascending or descending numbers were excluded and replaced with new random samples. This methodology is consistent with prior experimental techniques.

2.2 Methodology

Study Procedure and Dataset Overview

The dataset includes information gathered from participants regarding their video game playing habits and performance in cognitive-motor tasks. Specifically, participants were asked regarding **Hours spent playing video games per week** (general and specific to first-person shooter, strategy, or role-playing games) and **Years of experience playing video games**. A total of 187 participants were recruited, with 131 categorized into either the gamer group (playing ≥ 5 hours/week) or the non-gamer group (playing ≤ 2 hours/week). The study consisted of the below phases :

1. **Questionnaire Phase**: Participants answered questions about their video game playing habits (weekly hours and years of experience).
2. **Task Familiarization**: Participants completed one block of eight trials for each of the three RT-based tasks (choice-RT, Simon task, alternate task-switching task). Participants also completed one block of four trials for the digit span task (remembering digits).
3. **Main Study Phase**: Participants performed two blocks of 24 trials each for the three RT-based tasks. Participants performed two blocks of the digit span task, starting with three digits and ending with 11 digits (incrementing by one digit per block).
4. **Post-Task Questionnaire**: All participant groups answered questions about their beliefs regarding the connection between video games and cognitive-motor task performance. Participants also indicated their familiarity with media reports or research on the benefits of gaming for cognitive-motor tasks. These two questions were presented to all groups at the end of the study, because if they were presented at the beginning of the study they could have explicitly exposed the study's purpose.[2]

Data Preprocessing

- **Handling Missing Values:** Replace missing values with column means.
- **Outlier Detection and Treatment:** Identify outliers using z-scores (>3 or <-3) and replace with column means.
- **Data Exclusion Criteria:**
  - Exclude response times (RT) exceeding thresholds (e.g., >1000 ms for certain tasks).
  - Exclude blocks with >50% incorrect key presses.
  - Remove participants with >50% incorrect key presses in two of three RT-based tasks.
- **Normalization:** Scale numerical variables for standardized comparisons.
- **Feature Engineering:** Add a "Category" column based on most played game genre.

Data Visualization

- Correlation matrices
- Histograms
- Box plots
- Scatter plots
- Point plots
- Violin plots
- Bar graphs
- QQ plots

Data Analysis

1. **Statistical Tests**
   - **Parametric tests:** Conducted two-way analysis of variance (ANOVA) for normally distributed variables.
   - **Non-parametric tests:** Employed the Mann–Whitney test for variables exhibiting non-normal distributions.
2. **Regression Analysis**
   - **Stepwise Multiple regression:** Investigated the predictive power of video game playing habits and beliefs regarding gaming effects on cognitive-motor task performance.
   - **LASSO regression:** Because stepwise regression can lead to overfitting and over-estimation of models, we also conducted LASSO (Least Absolute Shrinkage and Selection Operator) regression—an accepted alternative to stepwise regression that deals with such problem[8]
3. **Exploratory Analyses**
   - **Bayesian statistics:** To better understand the non-significant effects or interactions, we used Bayesian statistics in our exploratory analyses.
   - **Post-hoc analyses:** Utilized for detailed examination of significant findings, incorporating Bonferroni corrections. Bonferroni post-hoc analyses and 95% confidence intervals were used for appropriate testing ($\alpha = 0.05$). Non-gamers reduced their reaction time (RT) significantly from 1135.45 ± 605.75 ms to 911.01 ± 161.57 ms when the questionnaire was completed before tasks (Cohen's $d = 0.51$). Gamers' RTs remained consistent (1007.94 ± 272.63 ms to 1054.83 ± 332.94 ms). No Group effect (F(1, 127) = 0.02, $p = 0.90$, $\eta_p^2 = 0.00$) or Questionnaire Timing effect (F(1, 127) = 1.86, $p = 0.18$, $\eta_p^2 = 0.01$) was observed. In the alternate task-switching task, a questionnaire timing effect was evident only for non-gamers in exploratory post-hoc analysis.
   - **Correlation analyses:** Employed Pearson correlation and Point Biserial correlation to identify relationships between variables.

3 Results

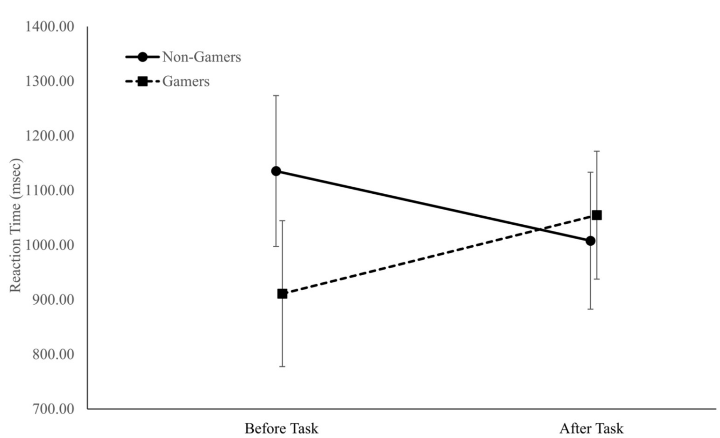
3.1 Exploratory Analysis

Gender Differences

Variable	Males (n=103)	Females (n=27)	t(df)	*p* value	Cohen's d
Choice-RT Task RT (ms)	363.04±60.38	384.40±70.42	1.58 (128)	.12	0.33
Simon task RT (ms)	495.06±62.37	511.59±69.24	1.20 (128)	.23	0.25
Alternate task switching RT (ms)	963.70±178.07 (n=100)	983.16±211.46 (n=26)	.48 (124)	.63	0.10
Digit span task correct responses	5.98±1.80	5.54±1.85	1.13 (128)	.26	0.24
Digit span task highest # of digits before 1st error	6.72±1.97	6.61±1.86	.27 (128)	.79	0.06
			Mann–Whitney U		
Choice-RT mean correct responses	23.74±.40	23.63±.72	1399.00	.95	0.23
Simon task RT mean correct responses	22.48±1.37 (n=102)	22.52±1.35	1393.00	.93	0.04
Alternate task switching mean correct responses	21.53±2.40 (n=92)	22.25±2.29 (n=24)	1389.50	.05	0.31

We initially assumed that gender differences would not impact our results. However, to confirm this assumption, we conducted independent t-tests for all dependent variables to evaluate differences between males and females. Our findings supported our initial assumption, as all of these tests yielded statistically insignificant results with low effect sizes.

Alternate task switching task including all data



For the alternate task-switching task, we decided before the study to remove all RT values over 1500 ms. However, because there was no time limit to the stimulus, durations of over 1500 ms may have been valid as well. The non-gamers significantly reduced their reaction time. Non-gamers significantly reduced their reaction time (RT) after completing the questionnaire compared to before. Gamers' RTs remained similar before and after the questionnaire. There were no significant group or questionnaire timing effects.

3.2 Stepwise multiple regression and LASSO regression analyses

Variable	Regression	group	fps_wk_hr	roleplay_wk_hr	strategy_wk_hr	media_reports	gaming_ability_connection	years_play	**R²**
Simon RT	LASSO	X	X	-	-	X	X	-	0.0315
Simon RT	Stepwise	-	-	-	-	-	X	-	0.0125
Choice RT	LASSO	X	X	X	-	X	X	X	0.0886
Choice RT	Stepwise	X	-	X	-	-	X	X	0.0264
Alternate RT	LASSO	-	-	X	X	X	X	X	0.0919
Alternate RT	Stepwise	X	X	X	-	-	X	-	0.0172

We incorporated multiple independent variables into the regression analyses, including weekly gaming hours, participation in first-person shooter, strategy, and role-playing games, gaming experience duration, beliefs regarding gaming's influence on task performance, and awareness of media reports on gaming's impact on task performance. The table presents outcomes from both stepwise and LASSO regression approaches. Notably, these models consistently produced a low R^2 value irrespective of the regression technique employed.

3.3 Bayesian analyses of null results

Alternate task switching

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{01}	error %
Null model	0.200	0.627	6.720	1.000	
quest_timing	0.200	0.132	0.610	4.734	0.036
group	0.200	0.118	0.535	5.317	0.038
group + quest_timing + group ∗ quest_timing	0.200	0.098	0.436	6.379	2.042
group + quest_timing	0.200	0.025	0.101	25.524	1.810

Choice RT

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{01}	error %
Null model	0.200	0.646	7.314	1.000	
quest_timing	0.200	0.154	0.726	4.209	0.034
group	0.200	0.152	0.717	4.253	0.034
group + quest_timing	0.200	0.036	0.149	18.032	1.075
group + quest_timing + group ∗ quest_timing	0.200	0.012	0.049	53.533	1.412

Digit Span Correct

Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{01}	error %
Null model	0.200	0.533	4.570	1.000	
group	0.200	0.280	1.554	1.906	0.022
quest_timing	0.200	0.111	0.501	4.793	0.037
group + quest_timing	0.200	0.060	0.257	8.842	1.027
group + quest_timing + group ∗ quest_timing	0.200	0.015	0.062	34.741	3.113

Digit Span Maximum

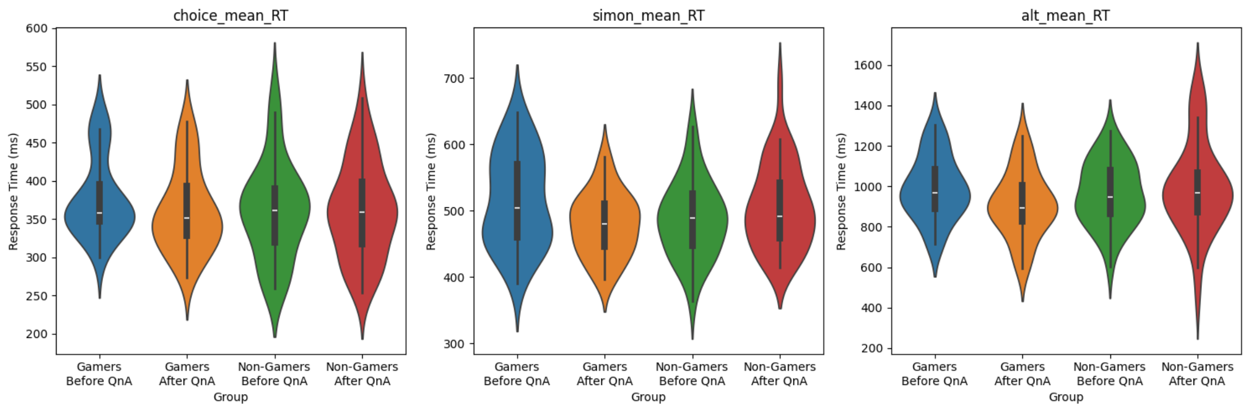
Model Comparison

Models	P(M)	P(M|data)	BF_M	BF_{01}	error %
Null model	0.200	0.588	5.705	1.000	
group	0.200	0.191	0.944	3.078	0.029
quest_timing	0.200	0.156	0.737	3.778	0.032
group + quest_timing	0.200	0.049	0.206	11.981	1.602
group + quest_timing + group ∗ quest_timing	0.200	0.017	0.067	35.508	2.834

In classical null-hypothesis significance testing, the absence of statistical significance does not directly indicate the probability of the null hypothesis itself. To overcome this limitation, we applied Bayesian statistics to assess the probability of the null hypotheses for dependent variables that did not exhibit significant main effects or interactions. The Bayes factors BF_{01} for these tasks were greater than 1, suggesting stronger support for the null hypothesis. Through Bayesian analysis, we enhance our insight into the null hypothesis's probability in the context of non-significant results.

3.4 Statistical Results

RT Differences in Gamers vs Non-Gamers Across Questionnaire Timing

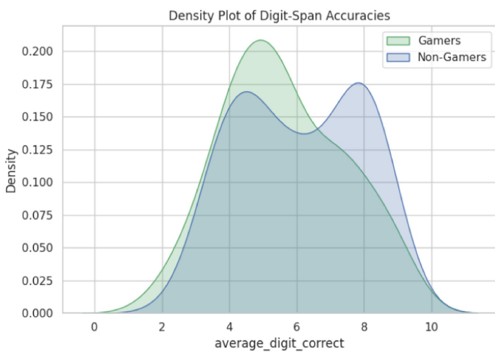


Reaction Time Distribution

- **Simon Task:** Two-way ANOVA (Group x Questionnaire Timing) revealed a significant interaction effect ($F(1, 123) = 7.30$, $p = 0.01$, $\eta^2 = 0.05$), indicating a significant interaction between Group (Gamers or Non-gamers) and Questionnaire Timing on task performance. However, no significant group effects ($F(1, 123) = 0.02$, $p = 0.88$, $\eta^2 = 0.00$) or Questionnaire Timing effects ($F(1, 123) = 0.30$, $p = 0.58$, $\eta^2 = 0.00$) were found.
- **Choice-RT Task:** Two-way ANOVA (Group x Questionnaire Timing) revealed no significant interaction ($F(1, 123) = 0.59$, $p = 0.44$, $\eta^2 = 0.01$), group effect ($F(1, 123) = 0.47$, $p = 0.49$, $\eta^2 = 0.00$), or Questionnaire Timing effect ($F(1, 123) = 1.68$, $p = 0.20$, $\eta^2 = 0.01$).
- **Alternate Task-Switching Task:** Two-way ANOVA (Group x Questionnaire Timing) revealed no significant interaction ($F(1, 123) = 3.12$, $p = 0.08$, $\eta^2 = 0.03$), group effect ($F(1, 123) = 0.77$, $p = 0.38$, $\eta^2 = 0.01$), or Questionnaire Timing effect ($F(1, 123) = 0.53$, $p = 0.47$, $\eta^2 = 0.00$).

Inferences: The statistical analysis partially supported our hypothesis. Choice-RT Task and Alternate Task-Switching Task did not exhibit significant differences based on gamers' or non-gamers' responses before or after the study. However, the Simon Task showed a significant interaction effect, indicating a notable interaction between Group (Gamers or Non-gamers) and Questionnaire Timing on task performance. Nonetheless, no significant group effects or Questionnaire Timing effects were observed in the Simon Task, contrary to our initial hypotheses.

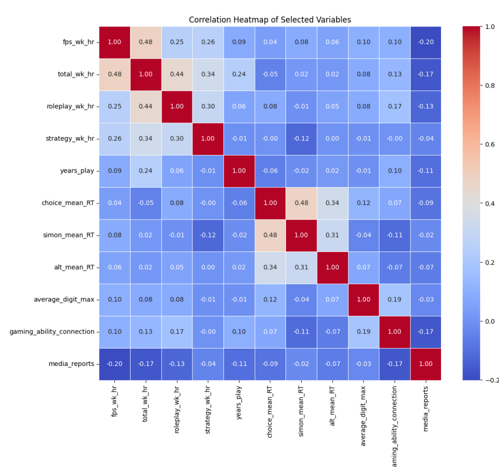
Digit-Span Memory Task Performance: Gamers vs. Non-Gamers



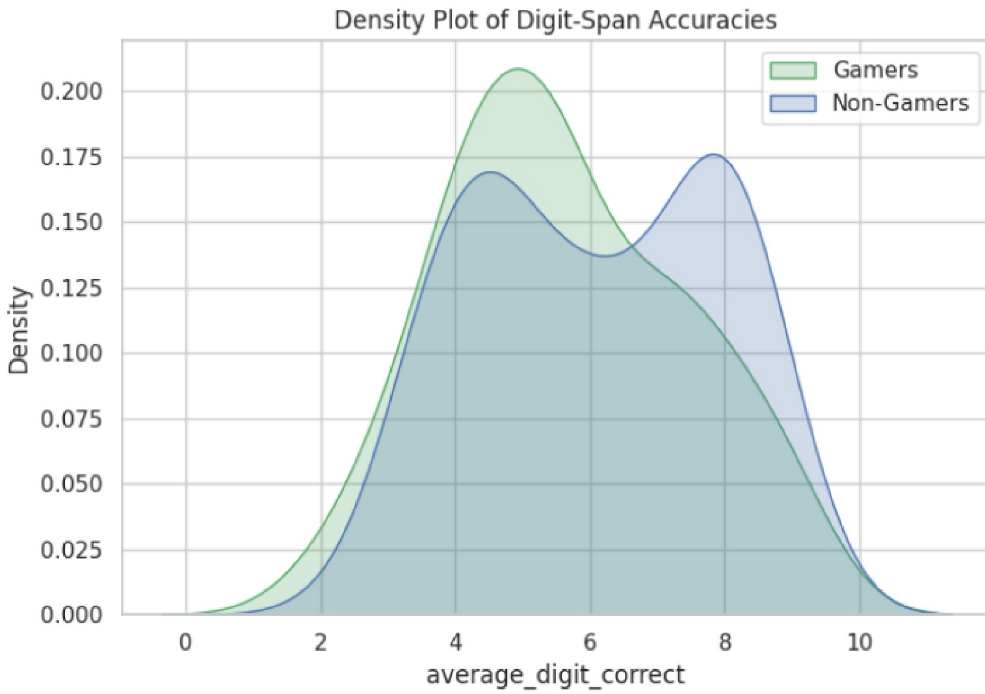
- **Mean Correct Responses:**
  - Overall mean: 5.88 (± 1.81)
  - No group effect: $F(1,127) = 2.27$, $p = 0.13$, $\eta_p^2 = 0.02$
  - No questionnaire timing effect: $F(1,127) = 0.27$, $p = 0.61$, $\eta_p^2 = 0.00$
  - No interaction effect: $F(1,127) = 0.15$, $p = 0.70$, $\eta_p^2 = 0.00$
- **Mean Highest Digits Before Error:**
  - Overall mean: 6.69 (± 1.9)
  - No group effect: $F(1,127) = 1.23$, $p = 0.27$, $\eta_p^2 = 0.01$
  - No questionnaire timing effect: $F(1,127) = 0.79$, $p = 0.37$, $\eta_p^2 = 0.01$
  - No significant interaction effect: $F(1,127) = 0.64$, $p = 0.43$, $\eta_p^2 = 0.00$

Inferences: The statistical analysis confirmed no significant differences between gamers and non-gamers in the digit-span memory task. Both mean correct responses and mean highest digits before error showed no significant group, questionnaire timing, or interaction effects. This supports our hypothesis of similar performance between gamers and non-gamers in this task.

Correlation matrix of Key Features



Digit-Span Memory Task: Similarities between Gamers & Non-Gamers

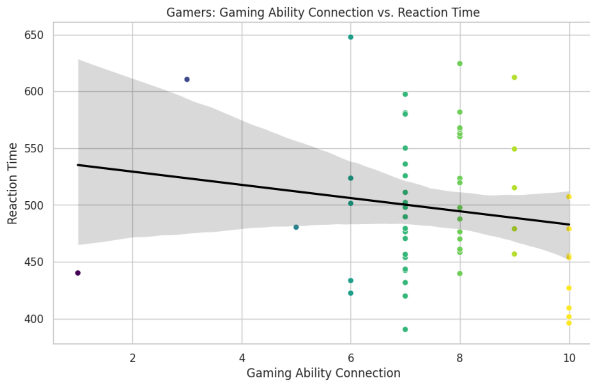


Digit span Accuracies

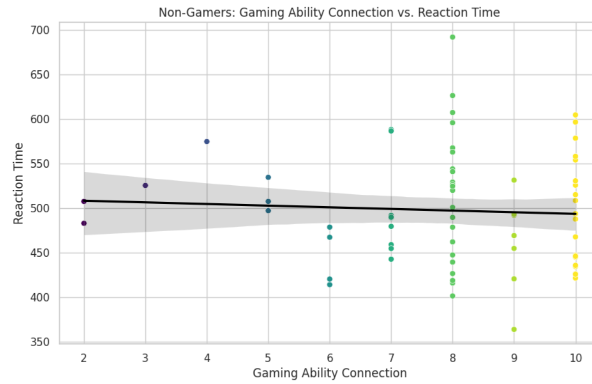
- **Mean Correct Responses:**
  - Overall mean: 5.88 (± 1.81)
  - No group effect: $F(1,127) = 2.27$, $p = 0.13$, $\eta_p^2 = 0.02$
  - No questionnaire timing effect: $F(1,127) = 0.27$, $p = 0.61$, $\eta_p^2 = 0.00$
  - No interaction effect: $F(1,127) = 0.15$, $p = 0.70$, $\eta_p^2 = 0.00$
- **Mean Highest Digits Before Error:**
  - Overall mean: 6.69 (± 1.9)
  - No group effect: $F(1,127) = 1.23$, $p = 0.27$, $\eta_p^2 = 0.01$
  - No questionnaire timing effect: $F(1,127) = 0.79$, $p = 0.37$, $\eta_p^2 = 0.01$
  - No significant interaction effect: $F(1,127) = 0.64$, $p = 0.43$, $\eta_p^2 = 0.00$

Inferences: The statistical analysis confirmed our hypothesis that there are no significant differences in digit-span memory task performance between gamers and non-gamers. The results revealed no significant group effects, questionnaire timing effects, or interaction effects for mean correct responses and mean highest digits before error. These findings suggest that performance in the digit-span memory task was consistent across gamers and non-gamers, aligning with our initial hypothesis.

Perceptions of Video Game Impact on Cognitive-Motor Task Performance



Gamers



Non-Gamers

For the **Alternate Task Switching task**:

- Pearson Correlation Test revealed:
  - No significant correlation for non-gamers (Coefficient = -0.004, $p = 0.71$)
  - No significant correlation for gamers (Coefficient = -0.13, $p = 0.25$)

For the **Simon task**:

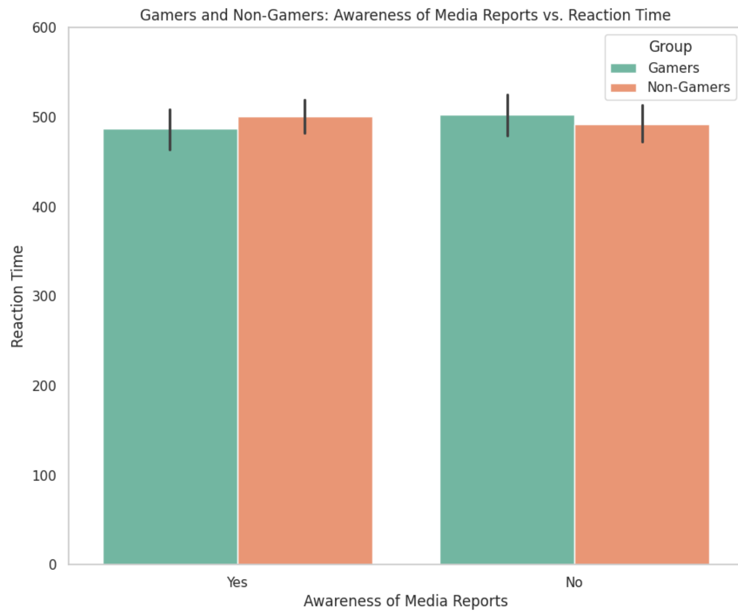
- Pearson Correlation Test revealed:
  - No significant correlation for non-gamers (Coefficient = -0.115, $p = 0.23$)
  - No significant correlation for gamers (Coefficient = -0.097, $p = 0.40$)

For the **Choice-RT task**:

- Pearson Correlation Test revealed:
  - No significant correlation for non-gamers (Coefficient = 0.112, $p = 0.25$)
  - No significant correlation for gamers (Coefficient = 0.043, $p = 0.70$)

Inferences: The results of the Pearson Correlation Test indicate that there is no significant correlation between participants' beliefs about gaming ability and cognitive-motor task performance across all tasks, regardless of their gaming status (gamers or non-gamers).

Media Reports on Video Games and Cognitive-Motor Task Performance



For the **Simon task**:

- Point-Biserial Correlation Test revealed:
  - No significant correlation for non-gamers, Coefficient = 0.019, $p = 0.85$
  - No significant correlation for gamers, Coefficient = -0.12, $p = 0.3$

For the **Choice-RT task**:

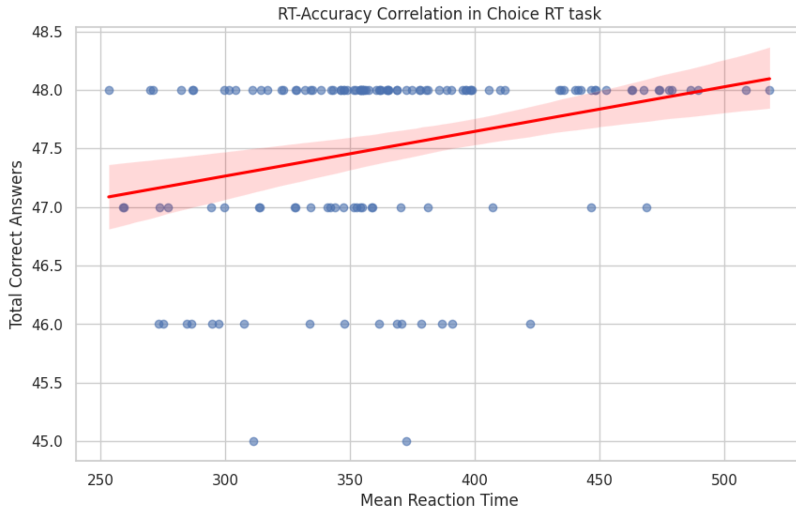
- Point-Biserial Correlation Test revealed:
  - No significant correlation for non-gamers, Coefficient = -0.121, $p = 0.214$
  - No significant correlation for gamers, Coefficient = -0.073, $p = 0.524$

For the **Alternate-Task Switching Task**:

- Point-Biserial Correlation Test revealed:
  - No significant correlation for non-gamers, Coefficient = -0.071, $p = 0.47$
  - No significant correlation for gamers, Coefficient = -0.053, $p = 0.64$

Inference: In conclusion, the independent analysis for gamers and non-gamers regarding awareness of media reports regarding playing video games and the ability to perform cognitive-motor tasks did not reveal any significant correlations. Media reports did not affect reaction times in any of the tasks studied.

Relation between Reaction times and Accuracy



For the **Simon task**:

- Pearson Correlation Test revealed:
  - No significant correlation for non-gamers, Coefficient = -0.1, $p = 0.301$
  - Negative correlation for gamers, Coefficient = -0.243, $p = 0.03$

For the **Alternate Task Switching task**:

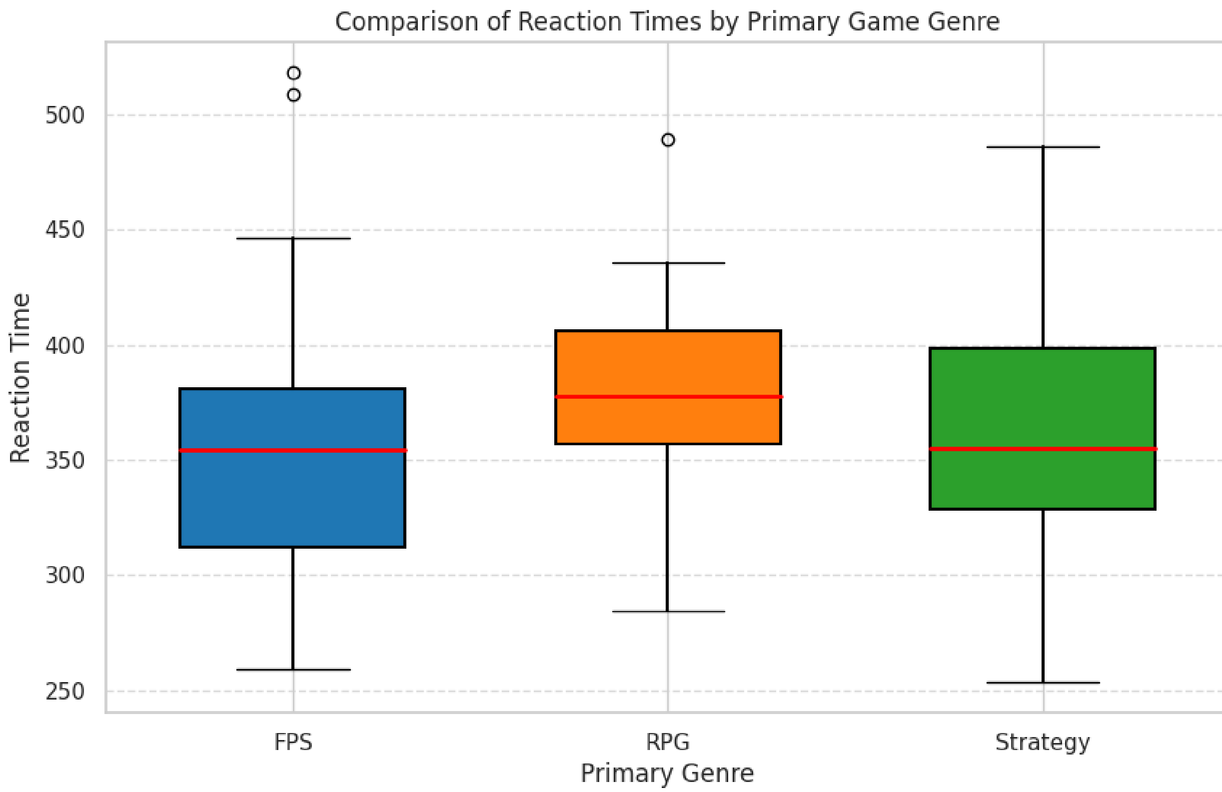
- Pearson Correlation Test revealed:
  - No significant correlation for non-gamers, Coefficient = -0.11, $p = 0.26$
  - No significant correlation for gamers, Coefficient = 0.039, $p = 0.73$

For the **Choice-RT task**:

- Pearson Correlation Test revealed:
  - Positive correlation for non-gamers, Coefficient = 0.326, $p = 0.0006$
  - No significant correlation for gamers, Coefficient = 0.064, $p = 0.57$

Inferences: The analysis reveals varied relationships between reaction times and accuracy across tasks for gamers and non-gamers. In the Simon Task, gamers exhibited a negative correlation, indicating that as reaction times decreased, accuracy increased. However, non-gamers did not show significant correlations in this task. The Alternate Task Switching Task showed no significant correlations for both groups. In the Choice-RT Task, non-gamers demonstrated a positive correlation, suggesting that as reaction times increased, accuracy also increased, while gamers did not show a significant correlation in this task.

Understanding How Different Game Genres Impact Reaction Time



Notes: Passed Levene's test for homogeneity of variances. Normality can be assumed due to sample size > 25.

- **Choice-RT task:**
  - ANOVA result: `F_onewayResult(statistic=1.05, pvalue=0.34)` - Not statistically significant
- **Alternate-Task Switching Task:**
  - ANOVA result: `F_onewayResult(statistic=0.23, pvalue=0.78)` - Not statistically significant
- **Simon task:**
  - ANOVA result: `F_onewayResult(statistic=1.47, pvalue=0.23)` - Not statistically significant

Inferences: The study investigated whether individuals who play FPS games show improved reaction times compared to those playing other game genres. However, the ANOVA tests found no statistically significant differences in reaction times across game genres for the Choice-RT, Alternate-Task Switching, and Simon tasks. Therefore, this study provides no evidence supporting the notion that playing FPS games enhances reaction times relative to other game genres.

4 Conclusion and Discussion

4.1 Discussion

The study investigated the impact of completing a video games questionnaire on cognitive/motor task performance in gamers and non-gamers. Key findings include:

- **Gamer Performance:** Gamers exhibited quicker reaction times (RTs) in the Simon task after completing the questionnaire, suggesting a partial validation of the hypothesis of enhanced RT-based task performance.
- **Non-Gamer Performance:** Non-gamers also showed faster RTs in the Simon task and an alternate task-switching task when completing them before the questionnaire, contrary to expectations. This indicates a negative impact of questionnaire timing on non-gamers' performance.
- **Memory Task Performance:** The data supported the hypothesis that questionnaire timing would not have comparable effects on the digit-span memory task, suggesting that completing the questionnaire did not significantly impact performance in this task.
- **Questionnaire Timing Impact:** Timing of questionnaire delivery affects both gamers and non-gamers, potentially explaining observed differences in previous studies. Gamers perform better after answering gaming habit questions, while non-gamers perform worse.
- **Greater Effect on Non-Gamers:** Non-gamers experienced a greater negative impact from completing the questionnaire compared to gamers. This is indicated by their decreased performance in tasks like the Simon task and alternate task-switching, in contrast to the positive effect observed in gamers' Simon task performance.
- **Beliefs About Gaming and Performance:** Gamers and non-gamers had similar beliefs about gaming and cognitive-motor task performance. However, completing the questionnaire had opposite effects on gamers and non-gamers, supporting psychological suggestion and response expectancy theory.
- **Influence of Stereotypes:** People showed less-than-optimal task performance when they believe they are expected to be less proficient at the task, a phenomenon referred to as stereotype threat. For example, studies have demonstrated that golfers performed worse when informed that women typically excel at putting tasks, illustrating how stereotypes can affect performance.
- **Influence of Psychological Suggestion:** Psychological suggestion might have boosted gamers' motivation to excel in gaming-related tasks, potentially resulting in improved performance. Although the precise mechanism warrants further study, heightened motivation is associated with enhanced focus and task performance.

- **Task Performance Differences:** Questionnaire timing affected gamers and non-gamers differently. The Simon task, of moderate difficulty, showed the most impact, with gamers improving post-questionnaire. In the alternate task-switching task, non-gamers also showed timing effects, suggesting task difficulty moderates stereotype effects.
- **Subtle Priming Effects:** The study's findings reflect the subtlety of priming effects, which require participants to indirectly recognize the study's focus through the questionnaire. This approach aligns with psychological research emphasizing natural behavior and human variability.

4.2 Conclusion

Our study suggests that questioning participants about their gaming experience before cognitive-motor tasks can impact performance differently for gamers and non-gamers, potentially moderated by task difficulty. These results have methodological implications for future research on gamer differences and video-game training. Additionally, our findings support psychological suggestion and response expectancy theory. Here are the conclusions for each hypothesis presented:

1. **Hypothesis 1:** We hypothesized that asking gamers about their gaming experience before the study would improve their performance in reaction time (RT) tasks compared to asking after the study. This was partially supported, as gamers showed faster RTs in the Simon task after answering the video games questionnaire. The Bayes factors generally favored the null hypothesis, except for inconclusive findings in certain models
2. **Hypothesis 2:** Our hypothesis that non-gamers would not show this effect was not supported. Non-gamers exhibited faster reaction times (RTs) in the Simon task and alternate task-switching task when performed before answering the questionnaire, suggesting a negative impact of questionnaire timing on non-gamers' performance.
3. **Hypothesis 3:** Our hypothesis that similar effects would not be found for the digit-span memory task was supported by the data of the current experiment.
4. **Hypothesis 4:** The study did not find significant differences in reaction times based on the type of games played (FPS vs. RPGs/strategy games), suggesting that gaming genre may not have a straightforward impact on cognitive-motor task performance.
5. **Hypothesis 5:** There were no significant findings indicating that awareness of media reports on gaming and cognitive tasks influenced task performance, contrary to the hypothesis.
6. **Hypothesis 6:** The study did not find evidence that personal beliefs about gaming influence task performance in the expected manner, highlighting the complex nature of psychological factors in this context.
7. **Hypothesis 7:** While gamers showed a negative correlation between reaction time and accuracy in the Simon Task, suggesting faster reactions improved accuracy, this relationship was not consistently observed across tasks or for non-gamers.

5 Citations and References

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Project by Split Second Squad

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