# Cognitive Games & Focus
# IS4800 Group Research Project

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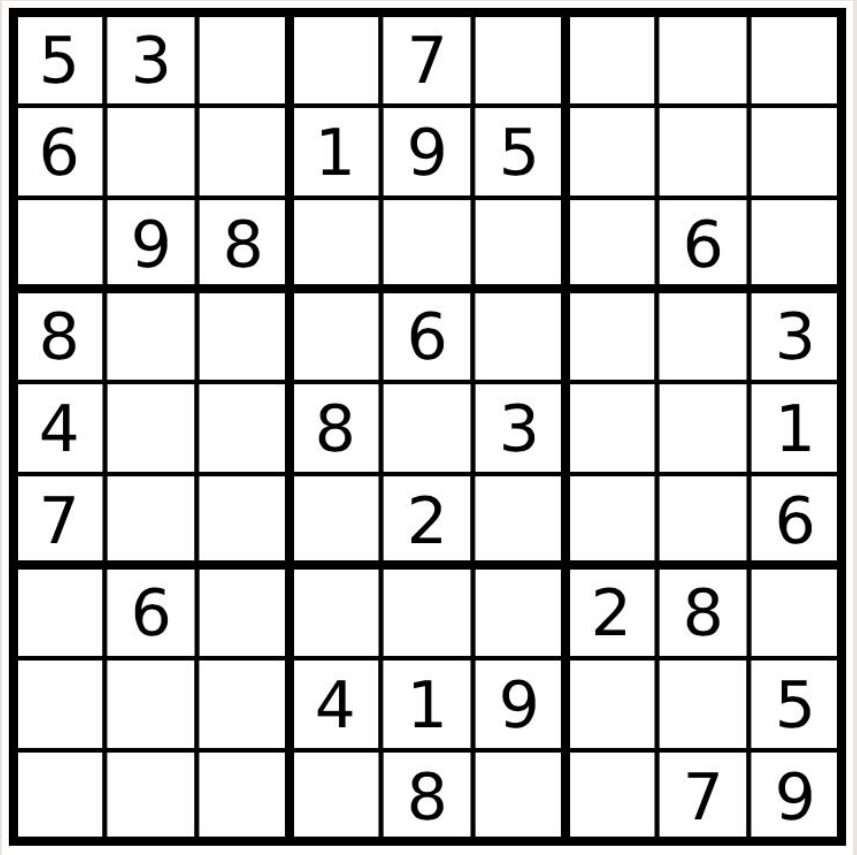
# Background

- Personal Interest in Sudoku and observed a lot of Khoury classmates playing similar cognitive games
- Previous studies have highlighted role in enhancing logical reasoning and deduction skills, making it an ideal candidate for our study
- No existing research on cognitive games' influence on computer science students.
    - investigate how playing Sudoku could potentially benefit these students, especially in terms of focus enhancement



Will playing a cognitive game, sudoku, during the school semester lead to improved levels of cognitive performance, more specifically, focus?

# Experimental Variables/Hypotheses

- Qualitative & Quantitative research (Mixed methods study)

- Independent: Playing sudoku game routinely
- Dependent: Improved levels of cognitive performance (focus)

- **Alt Hypothesis**: Playing sudoku **will** lead to improved levels of focus
- **Null Hypothesis**: Playing sudoku **will not** lead to improved levels of focus

# Experiment Methodology

- Within-group Experimental Design
- We found participants through mutuals and asked within friend-groups for volunteers
- All participants were asked to complete a cognitive **focus** assessment, which was administered at the beginning and end of the experiment
- Experiment lasted 15 days (11/14 - 11/30)
- Participants were asked to complete a survey self-assessing their focus levels and productivity every 5 days and we administered the post survey which asked participants to self-assess again (11/19, 11/24, 11/30)
- Participants were asked to play at least one game of Sudoku every day via Sudoku.com
    - At the end of the experiment, statistical data from Sudoku.com was collected

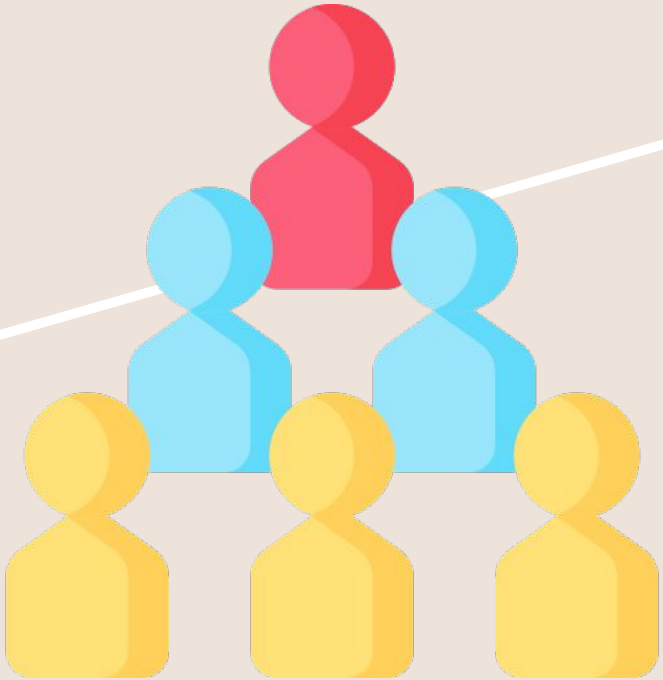

# Statistical Tests We Used

- Due to our small sample size, we were not able to assume normality so we performed non-parametric statistical tests
- **Wilcoxon Signed-Rank Test**: Was used for comparing cognitive focus test results for pre and post experiment
- **Friedman Test:** Since we had weekly survey data over multiple time points, this test was used to determine the differences in self-assessed focus levels across various points of time
- **Spearman's Rank Correlation:** Was used to assess the relationship between playing Sudoku and changes in focus levels
- We also considered qualitative analysis such as detailed feedback/observations from participants regarding their experience

# Survey Participants

| Year in University | Number of Participants | Most Common Frequency of Play | Usual Difficulty Played |
|---|---|---|---|
| 1st Year Undergrad | 2 | Often (1 - 2 times a week), Rarely (less than once a month) | Expert, Hard |
| 2nd Year Undergrad | 4 | Often (1 - 2 times a week), Rarely (less than once a month) | Easy, Medium |
| 3rd Year Undergrad | 3 | Often (1 - 2 times a week), Seldom (once a month) | Hard |
| 4th Year Undergrad | 5 | Often (1 - 2 times a week), Very often (3+ times a week) | Hard |
| Grad Student | 1 | Rarely (less than once a month) | Medium |

Table 1 Demographics of Participants



# Positive Qualitative Feedback

*‘Playing Sudoku **regularly challenged me to think strategically**, which **helped me stay sharp** during my classes.’ (P10)*

*"I found that on days when I played Sudoku, **my concentration seemed better.** I was more focused on my tasks." (P05)*

*“Somewhat! I did have an **easier time paying attention to one longer task this week**, but I'm not sure if that was an overall improvement in my concentration as a whole.”(P00)*

# Negative Qualitative Feedback

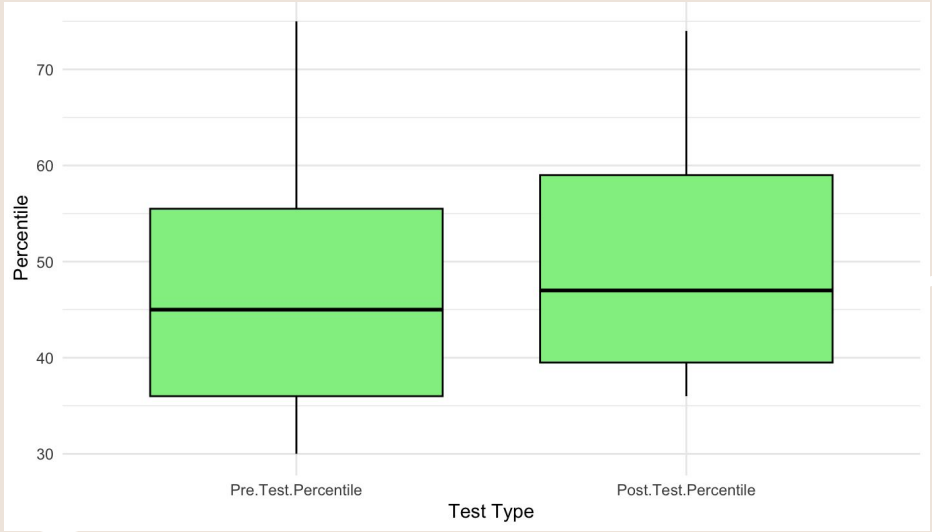
*‘Playing Sudoku was a fun activity, but it **didn't seem to impact my focus** or cognitive skills in any noticeable way.’ (P01)*

*"I **didn't notice any change**" (P06)*

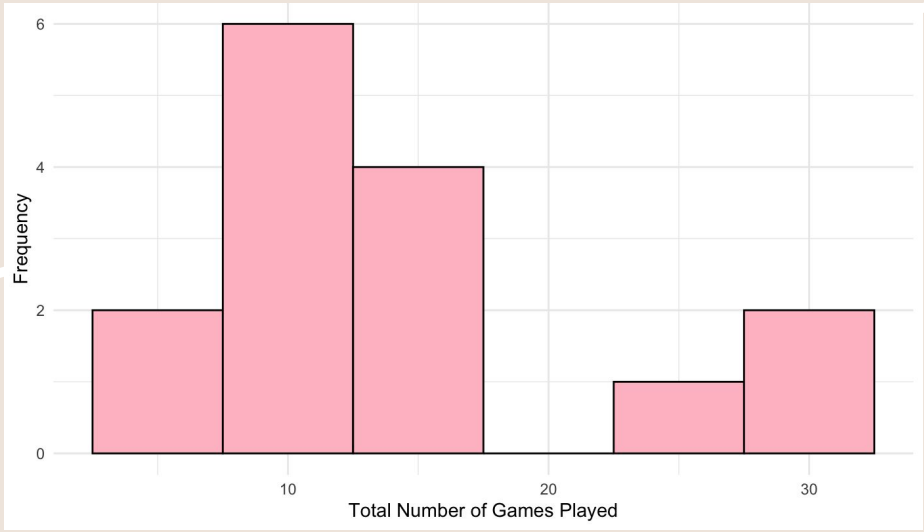
*“I really **didn't feel any different** after playing Sudoku regularly.”(P07)*

*“There **was no significant difference** in my daily routine or academic performance on the days I played Sudoku compared to when I didn't."(P12)*

# Analysis through Visualizations in R

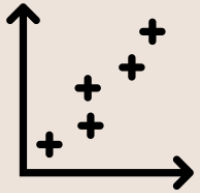


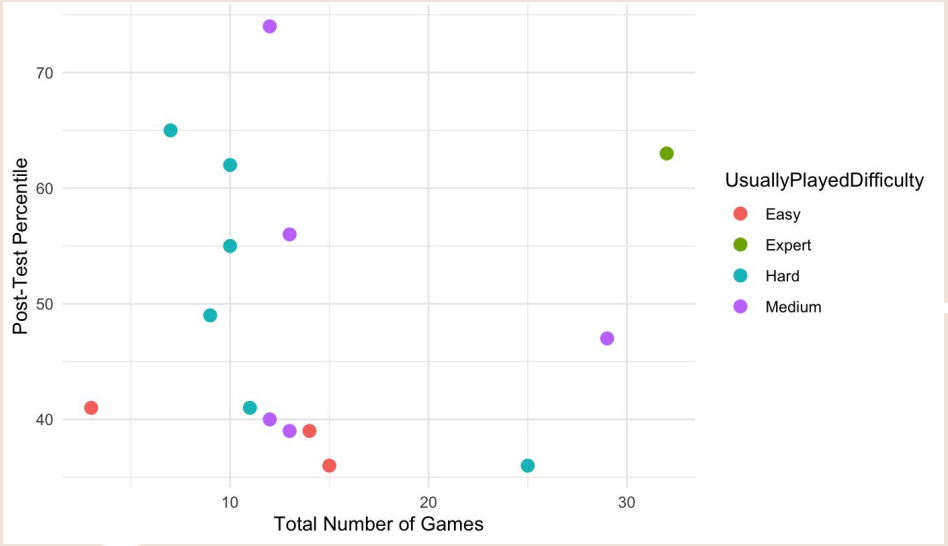

Graph 1 Boxplot of Pre-Test and Post-Test Percentiles



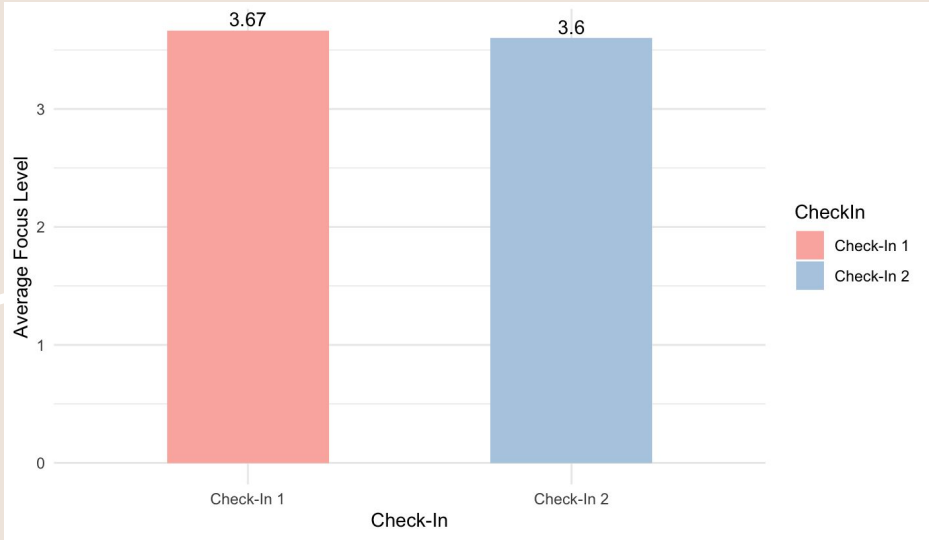

Graph 2 Histogram of Total Number of Sudoku Games Played

# Analysis through Visualizations in R






Graph 3. Scatter Plot of Total Games vs. Post-Test Percentile




Graph 4. Comparison of Average Focus Level

# Statistical Tests Conducted Via R

## Wilcoxon Signed Rank Test

```
##  Wilcoxon signed rank test with continuity correction
##
## data:  sudoku_data$`Pre-Test Percentile` and sudoku_data$`Post-Test Percentile`
## V = 46, p-value = 0.7061
## alternative hypothesis: true location shift is not equal to 0
```

# Statistical Tests Conducted Via R

## Friedman Rank Sum Test

```
##  Friedman rank sum test
##
## data:  cbind(sudoku_data$Focus1, sudoku_data$Focus2, sudoku_data$Focus3)
## Friedman chi-squared = 1.8974, df = 2, p-value = 0.3872
```

# Statistical Tests Conducted Via R

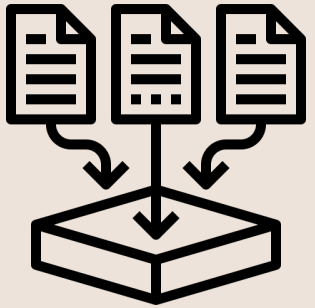
## Spearman's Rank Correlation

```
##  Spearman's rank correlation rho
##
## data:  sudoku_data$TotalNumGames and avgChange
## S = 462.24, p-value = 0.5338
## alternative hypothesis: true rho is not equal to 0
## sample estimates:
##       rho
## 0.1745743
```

# Team Challenges

- **Data Collection**
  - Ensuring a sufficient response rate for the surveys was a challenge
    - Initially we were relying on students in the class, based on the low response rate we branched out to our own network of classmates that were computer science majors

- **Data Interpretation**
  - Having multiple surveys left us with multiple datasets that we had to join together and clean
    - Cleaned the individual survey responses
    - Joined together into a master dataset



# Discussion

- Null Hypothesis Not Rejected
- Improvement in Focus and Cognitive Function
- Effects of Cognitive Games on Individuals

# Limitations

- Our participants consisted mostly of CS majors
- The sample size is small and the duration of our experiment was short
- Reliance on self-reported data and the use of only Sudoku as our cognitive game, may have influenced our findings.

# Future Work

- Broadening the range of cognitive games examined
  - Identify more effective tools for enhancing focus
- Implementing more objective measures of focus
  - Tracking task completion times or error rates
- Long-Term Impact Study
  - Investigate impacts on productivity, learning outcomes, and user behavior over time.

# References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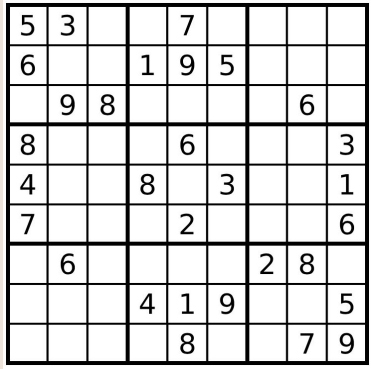


# Thank You!
# Questions?

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