

# PediaCore Game Report Pipeline

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## Introduction

PediaCore is a student-led startup that began as a BME design team in 2018. We work in association with the Kennedy Krieger Institute (KKI) to create video games that can be used in pediatric physical therapy. These video games are written in C# Unity and are played on a large touch screen device housed at KKII. We currently have two games in development, one of which is used by several physical therapists at KKI (bubble game).

### Bubble Game

This game involves popping bubbles that float across the screen. The speed, and size are adjustable and there are multiple game modes (ex. playing with obstacles).



Figure 1: Bubble Game Home Screen and Play Screen

### Matching Game

This game involves matching pairs of cards that are shown face down. The player can tap and untap cards to check what is underneath. They can attempt to make pairs by tapping two cards of the same type consecutively.

## Objectives

Complete PediaCore's game report pipeline in R for the bubble game and matching game. Convey meaningful statistics in a way that will be useful to physical therapists who use our device.

## Materials and Methods

My work is a continuation of a former student's (Akaash Sanyal's) implementation of a report pipeline for the bubble game. I will extend his project by implementing a pipeline for the matching game and by adding inter-trial analysis to the reports.

### Key R Packages:

1. Shiny: R's Shiny App package allows users to implement interactive websites in R.
2. RMarkdown: RMarkdown (Rmd) is a package that allows users to make well-formatted documents.

## Results

### 1. Matching Game Report Pipeline

After playing a session of the matching game, a zip file of encrypted gameplay data is generated. This output can be uploaded to the R Shiny App (hosted on our website) which directs the file to a series of R and Rmd files that unzip, decrypt, and analyze the gameplay. Every round of gameplay is considered a single "trial". The trial reports are stitched together and returned as a single report for the entire session.

Below is a selection of plots that are made for each trial in a session. Not shown are plots that demonstrate the time between touches (the inter touch interval, ITI) as well as tables for general game mode and patient information.

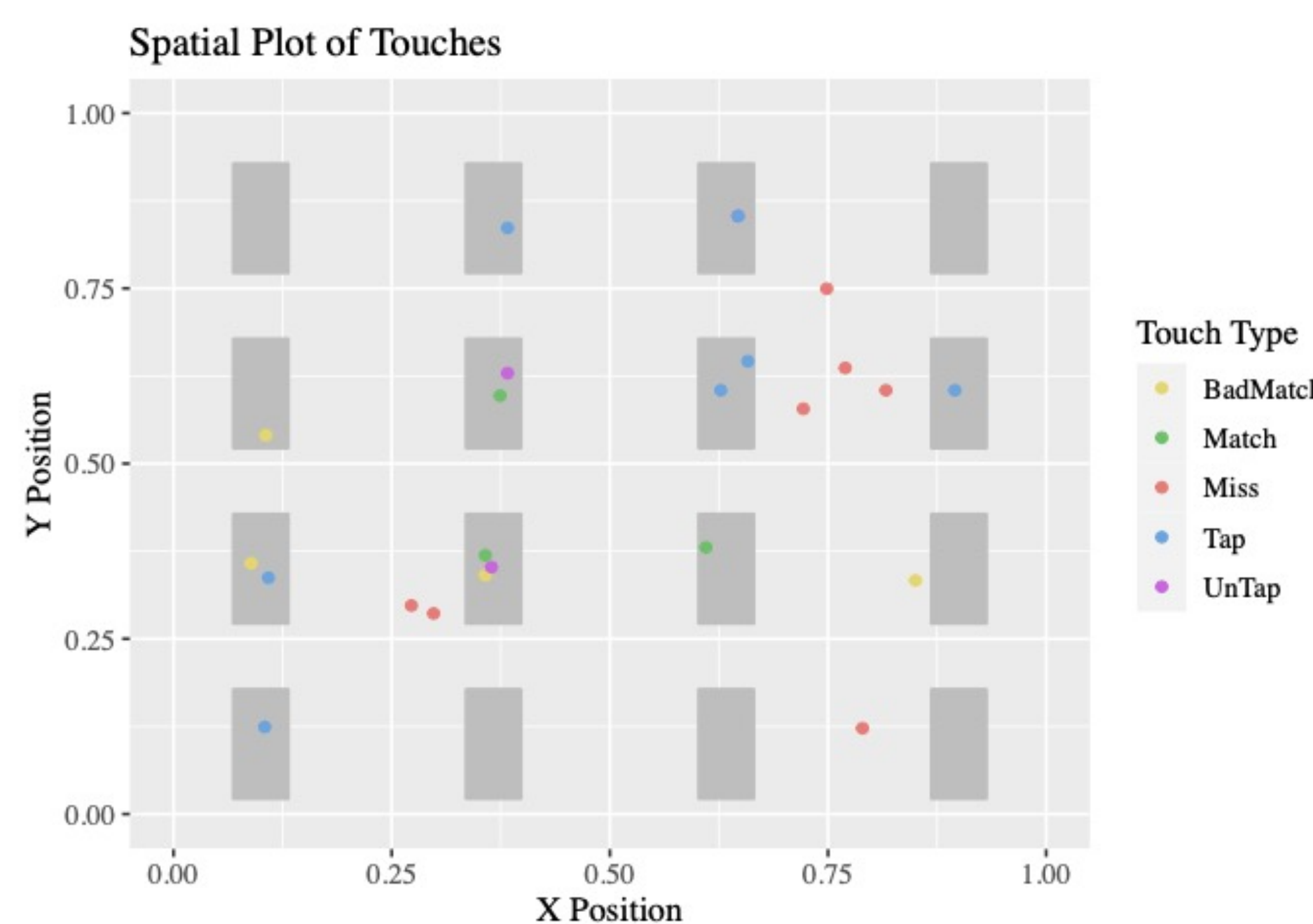


Figure 2: Spatial Plot of Touches

This plot shows the locations of all touches during the game and the locations of the cards on the board. The touches are labelled by category. A BadMatch is a touch that reveals an incorrect pair. A Match is a touch that reveals a correct pair. A Miss is a touch that does not land on any card. A Tap is a touch that reveals a card. An UnTap is a touch that hides a previously tapped card.\*

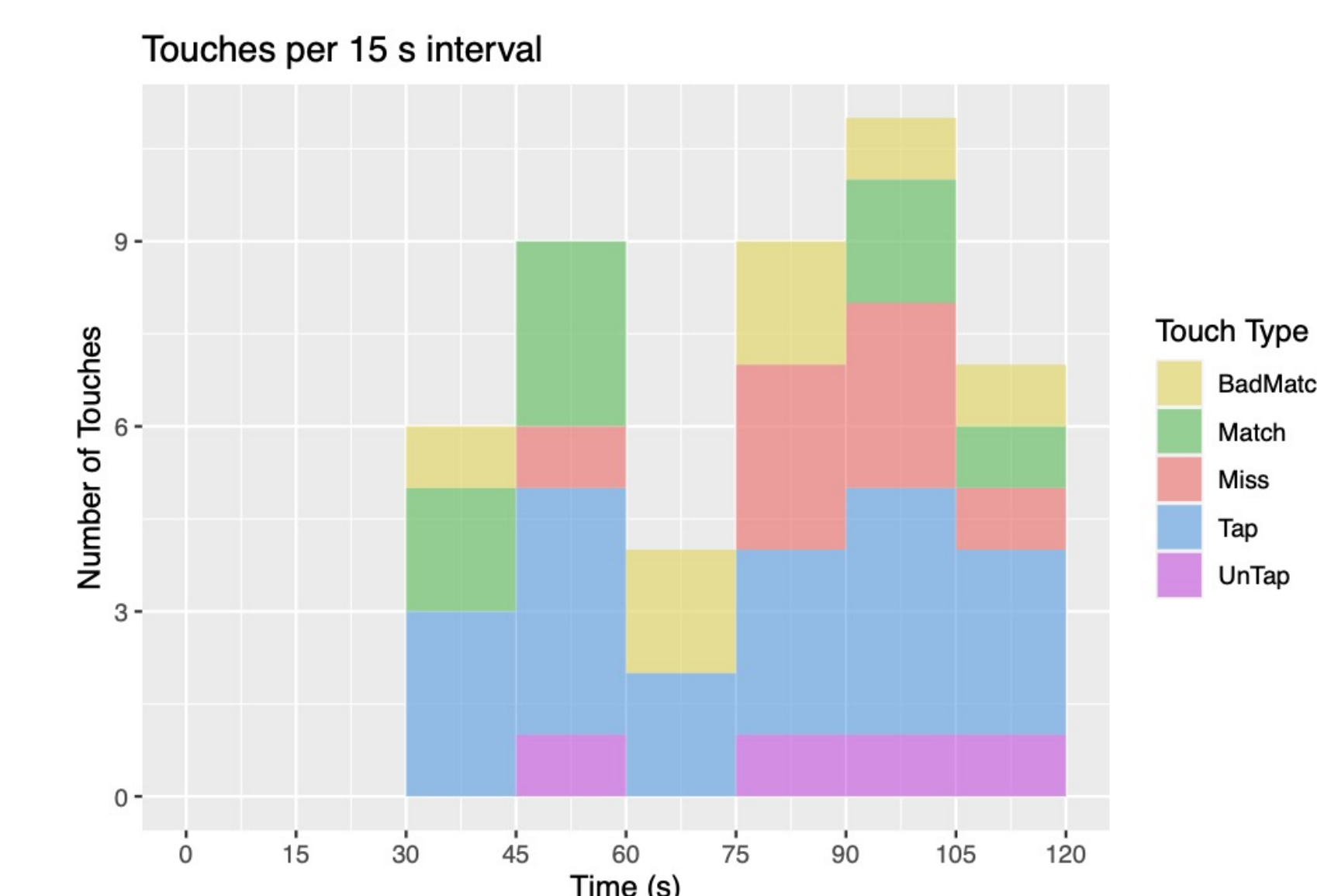


Figure 3: Touch Frequency All Types

This histogram displays the proportion of types of touches in 15 second segments of gameplay. This proportion is useful to observe the patient's cognitive engagement by displaying their attempts to match cards.\*\*

\*Some taps are being mislabeled by the game. This is being looked at by the game development team.  
\*\*The time data is currently given with respect to "time remaining" instead of "time passed". This is being modified by the game development team.

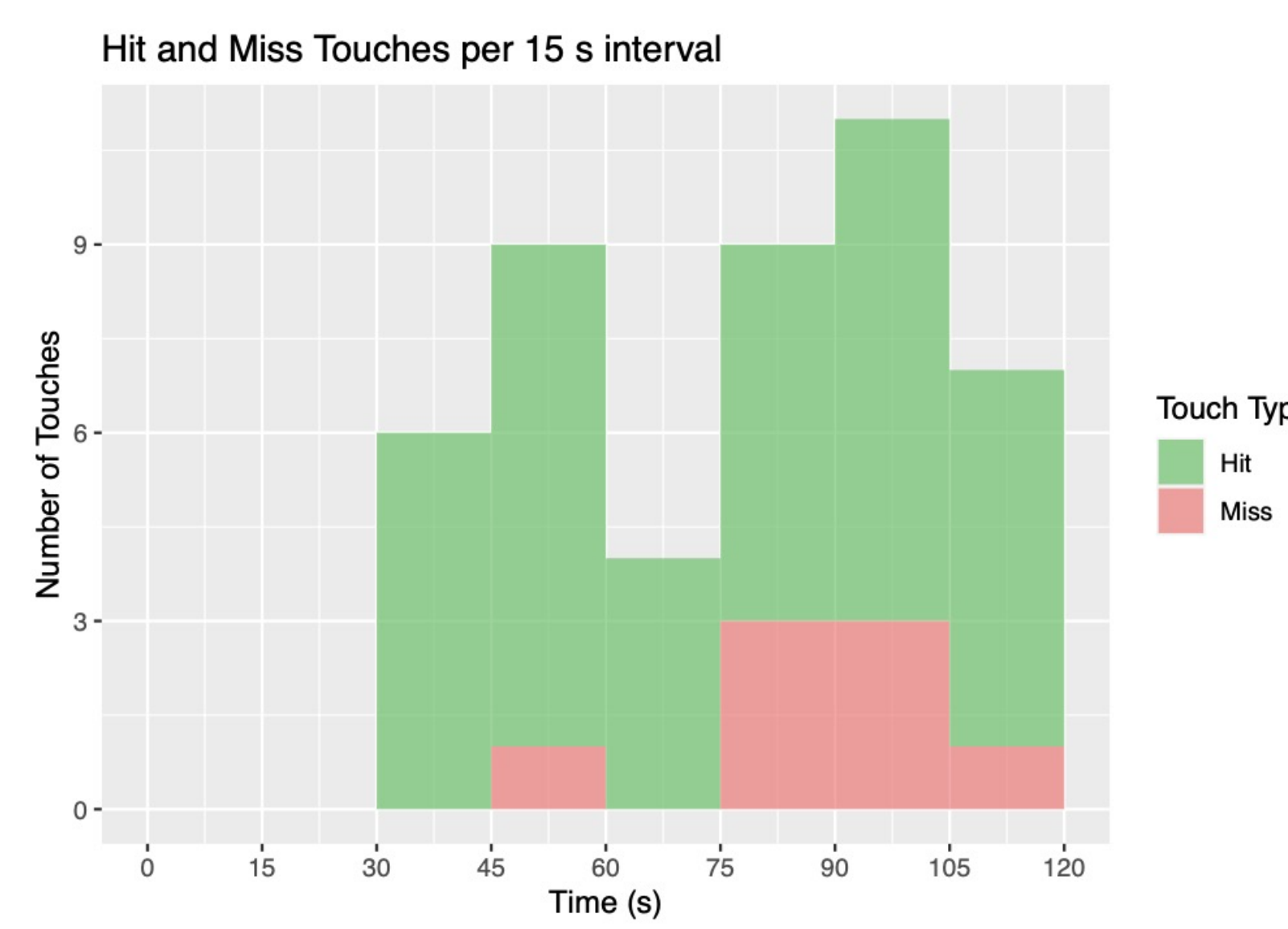


Figure 4: Touch Frequency Hit and Miss Types

This histogram displays the proportion of hits to misses in 15 second segments of gameplay. In this plot, a hit is any touch that lands on a card. This proportion is useful to observe the patient's physical engagement by displaying their attempts to touch cards.\*\*

### 2. Inter-Trial Summary Analysis

A single page summary of all trials in the uploaded session is prepended to matching game and bubble game reports. Below I have shown the elements of an inter-trial summary for a bubble game report.

#### Summary Information

Trial Name	Game Mode	Mean Bubble Size	Mean Bubble Speed	% Pop Touches
Pre-test for Session #NA	Standard	1.7	2.46	33%
Trial 1 for Session #NA	Standard	1.7	2.21	52%
Trial 2 for Session #NA	Obstacles: Vertical	1.7	2.51	50%
Trial 3 for Session #NA	Obstacles: Vertical	1.7	2.54	50%
Trial 4 for Session #NA	Obstacles: Horizontal	1.7	2.43	31%
Trial 5 for Session #NA	Obstacles: Horizontal	1.7	2.24	62%
Post-test for Session #NA	Standard	1.7	2.36	42%

### Figure 5: Summary Table

This table summarizes the trials in a session by reporting characteristic gameplay statistics such as game mode and the total percentage of popped bubbles.

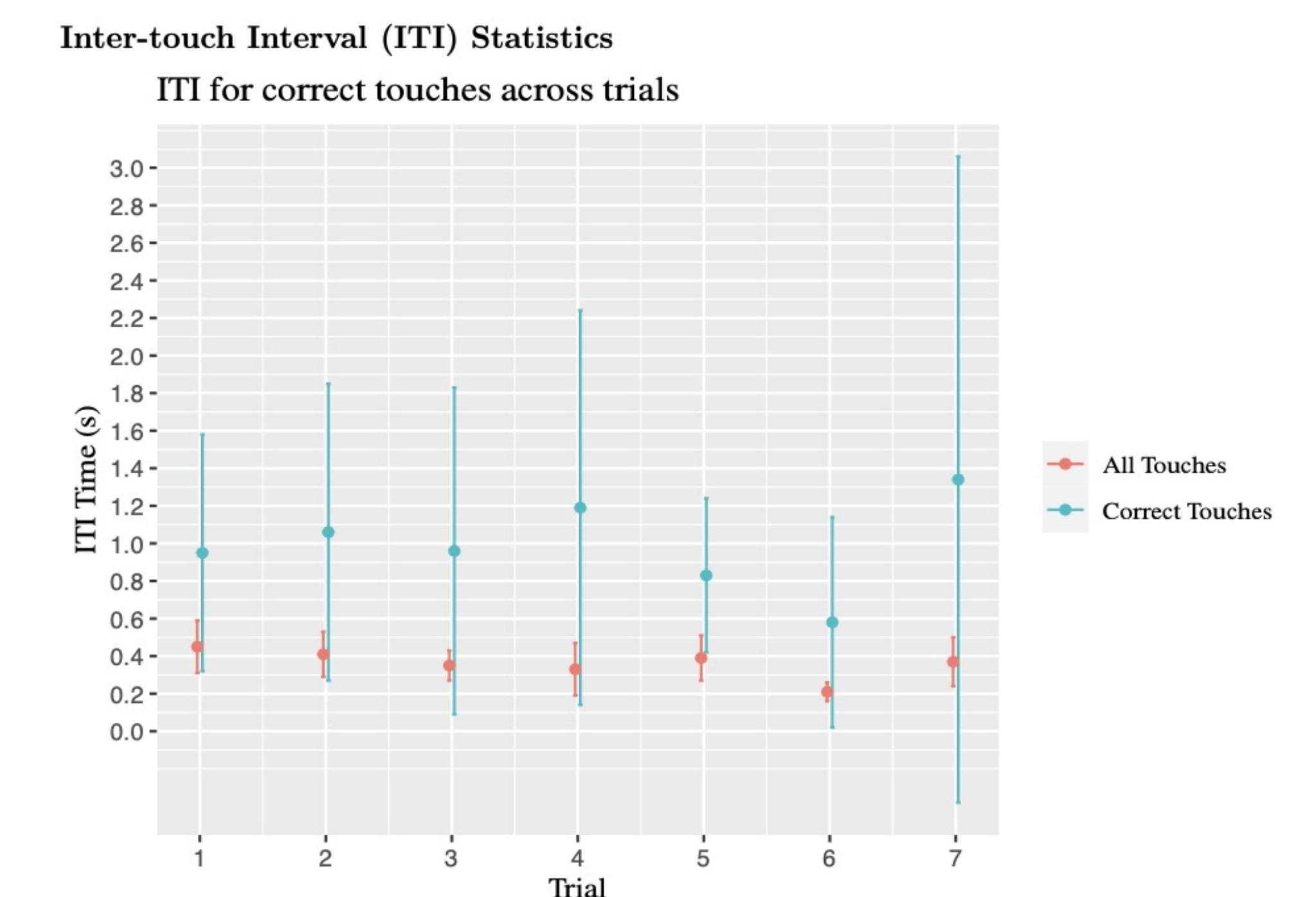


Figure 6: Inter-Touch Interval Summary Plot

The inter touch interval (ITI) data captures the user's level of engagement with the game. A high disparity between the ITI for all touches and the ITI for correct touches would indicate that the user is randomly and rapidly touching the screen. This plot shows the progression of their engagement across trials.

## Conclusion and Next Steps

This project found success in conveying meaningful statistics that capture both the patient's engagement as well as their performance during a game session. Still, there remain bugs that need to be resolved before deploying the matching game analysis to physical therapists. Our next steps are to attempt to categorize types of movements and to implement analysis across game sessions.