

## INTRODUCTION

- Neurofeedback devices such as BCIs (Brain-Computer-Interfaces) are becoming more prominent for the development of cognitive skills such as motor imagery.
- For this research, the amount of neurofeedback for training motor imagery was manipulated in groups to test its effects on training and program proficiency through actions like passing, shooting, crossing etc.
- The guidance hypothesis was tested, where relatively less feedback is usually associated with improved motor skill learning; it can be applied to training cognitive skills (e.g., motor imagery).

## HYPOTHESES:

- Results are expected to show a positive difference in performance, meaning post- intervention tests indicate better results, translating to improved motor skill retention and development.
- Results can contribute to the field of sports psychology by giving insight into new and effective training avenues for athletes across all disciplines, as well as unlocking new territory for kinesthetic development in the general population.

## METHODOLOGY

### PARTICIPANTS:

- Currently, we have collected data from 19 participants with prior soccer experience

### PROCEDURE

- Participants completed neurofeedback soccer training over 9 sessions (3 weeks) in i-BrainTech, a BCI platform that allows participants to play a soccer program using their brain activity while receiving neurofeedback.
- Participants trained in i-BrainTech with neurofeedback provided either 50% of the time (50% group) or 100% of the time (100% group)
- To establish benchmarks for review, participants completed pre- and post- intervention tests in i-BrainTech that contained neurofeedback provided either in forms of 100%, or 0%; this was in i-BrainTech's soccer or basketball modules (a transfer sport).

### MEASURES

- Sessions had their brain activity and performance in i-BrainTech (accuracy, power) logged as key data metrics.
- Power:** soccer avatar kicks the ball with increased power when participants engage in motor imagery
- Accuracy:** soccer avatar kicks the ball with increased accuracy as concentration and focus on the target itself increase

### ANALYSIS

- For this analysis, we compared pre- and post- intervention accuracy and power across groups.

## RESULTS

- We have data on power, and accuracy across the pre- and post-intervention tests, with percentage averages across 2 different neurofeedback groups.
- For power across both the Soccer 100% and Soccer 0% tests, neither had statistically significant differences in performance across power ( $p=0.484$ ,  $p=0.643$ ), or accuracy ( $p=0.165$ ,  $p=0.421$ )
- Across the Basketball 100% and Basketball 0% tests, neither had statistically significant differences in performance across power ( $p=0.089$ ,  $p=0.870$ ) or accuracy ( $p=0.522$ ,  $p=0.921$ ).

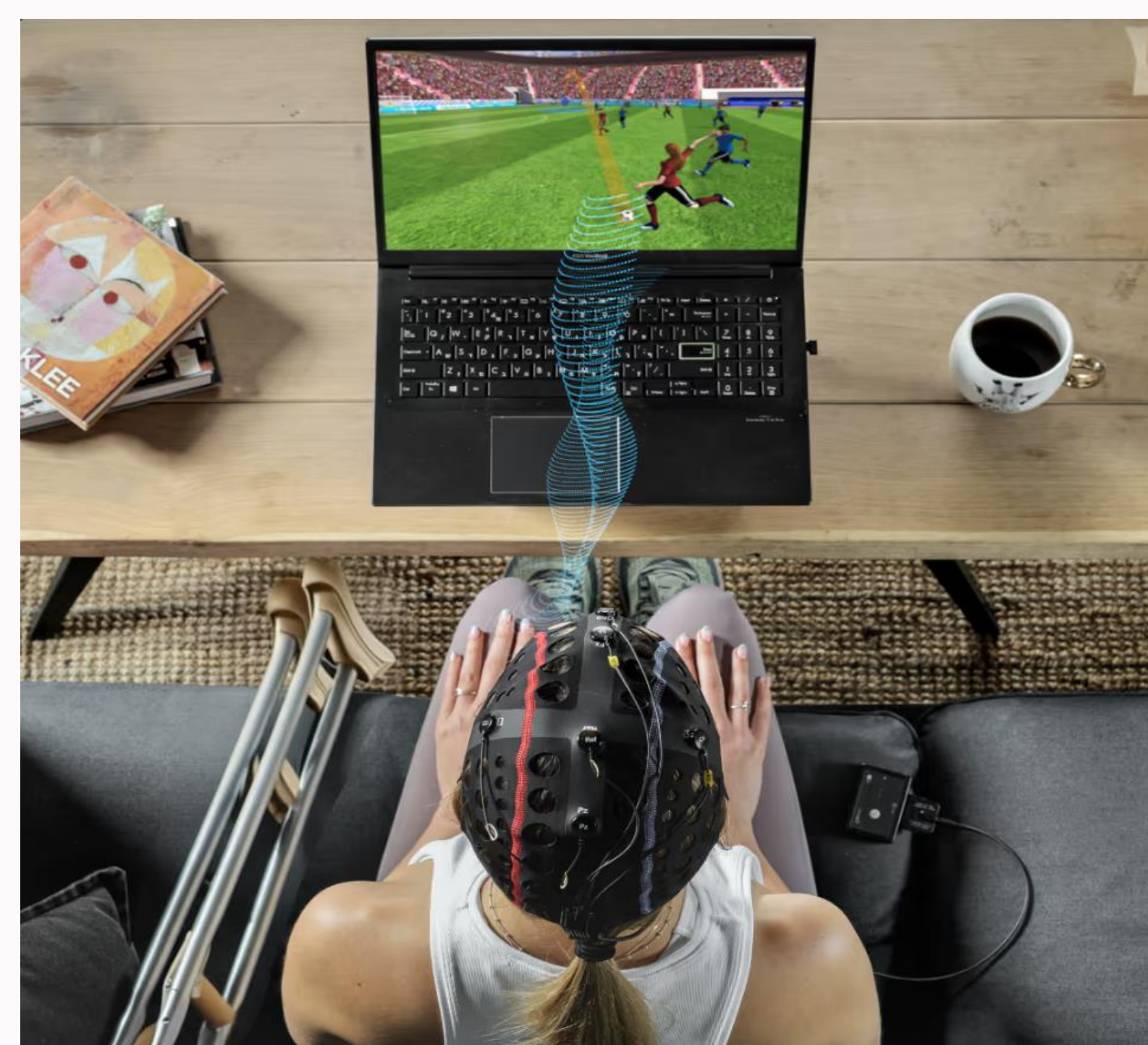


Figure 1. Neurofeedback visualization, and the i-BrainTech Interface. Source: i-BrainTech (2026).



Figure 2. Another look into the i-BrainTech UI, displaying avatars and their corresponding actions. Source: "i-Brain-Tech: Neuro-training for athletics and performance." by T. Roth, 2024 (<https://www.medica-tradefair.com/>).

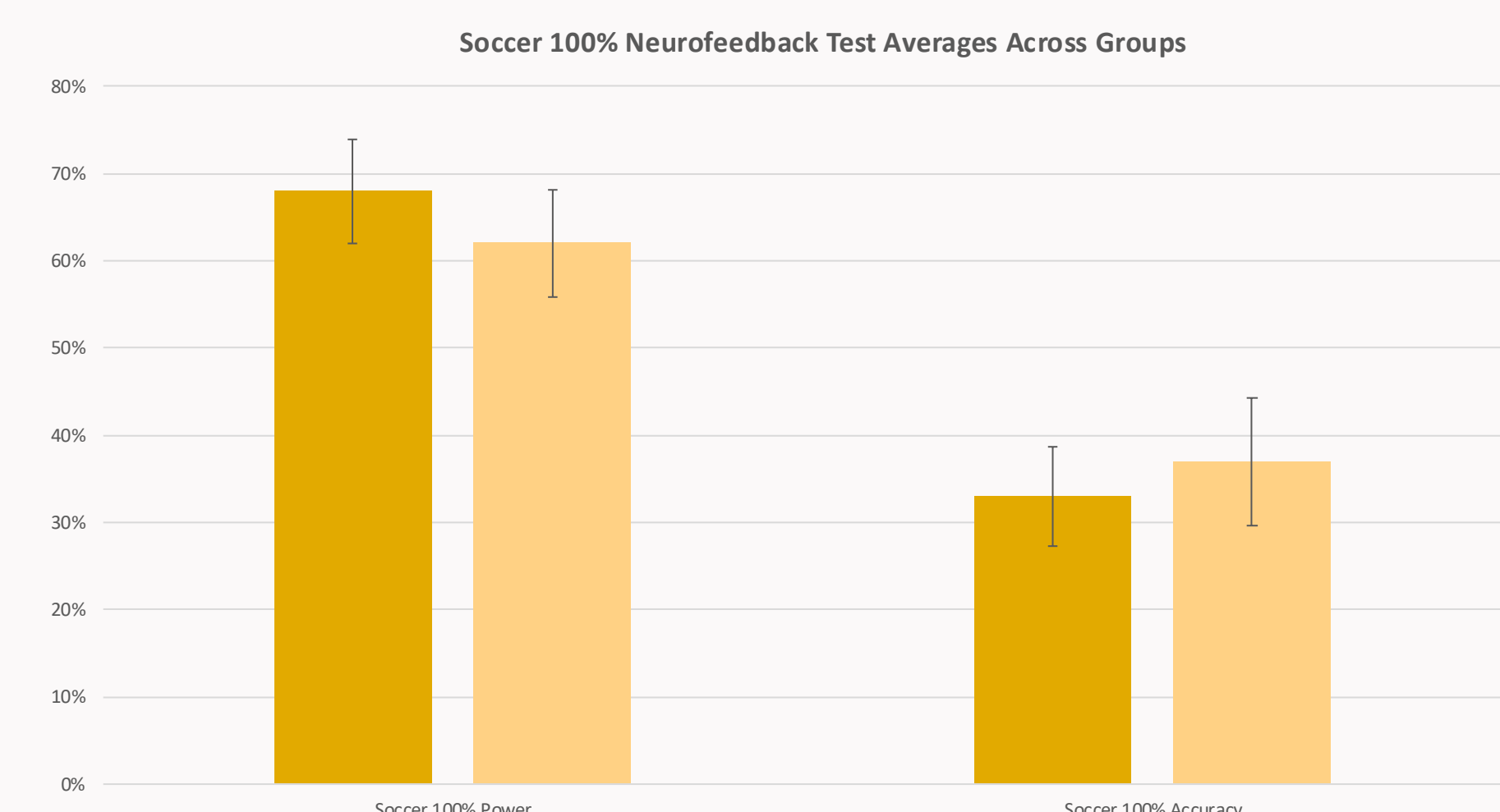


Figure 3. A bar graph representing the average power and accuracy percentages across pre- and post- intervention tests (100% neurofeedback on test)

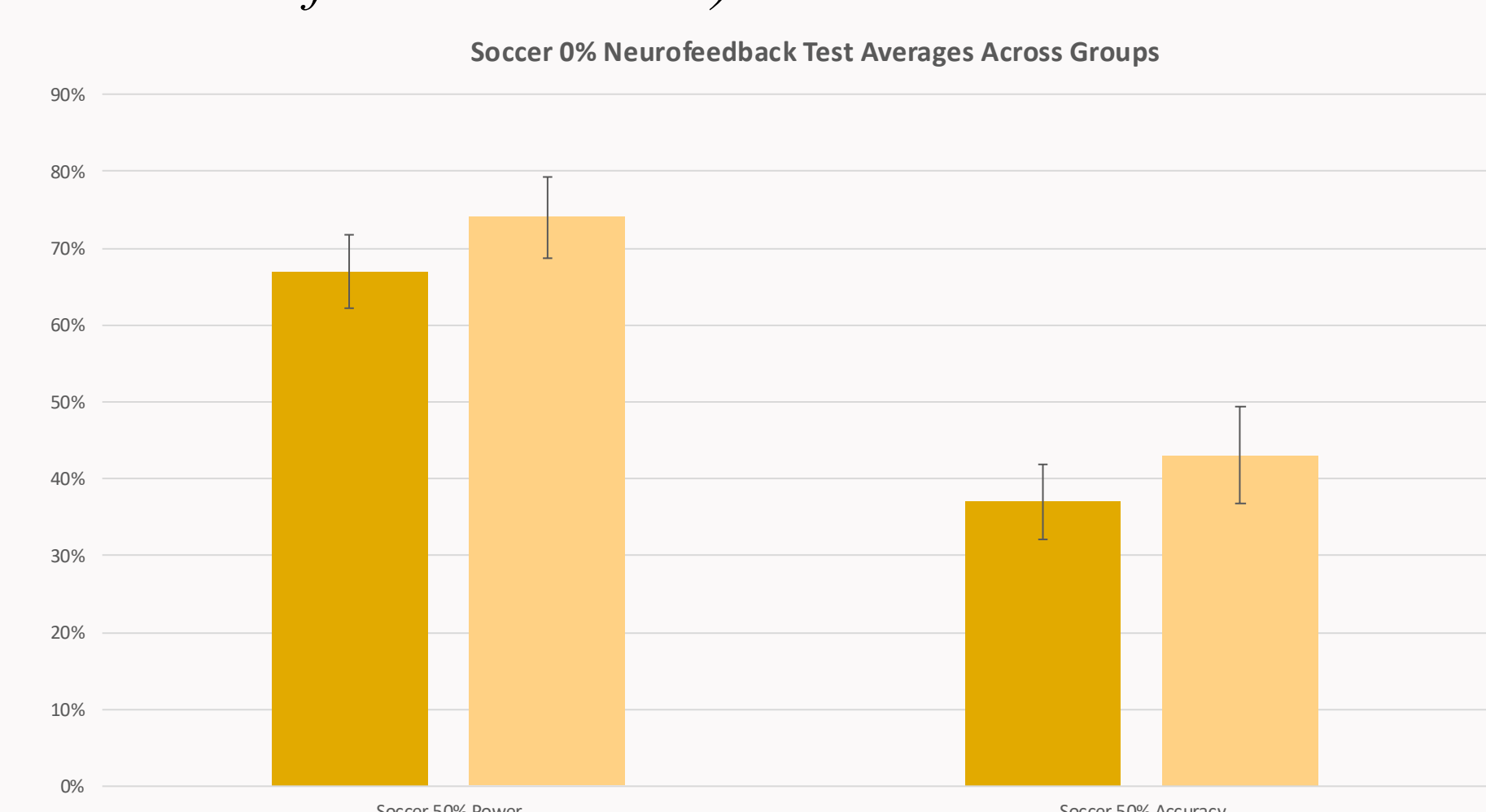


Figure 4. A bar graph representing average power and accuracy percentages across pre- and post- intervention tests (0% neurofeedback on test)

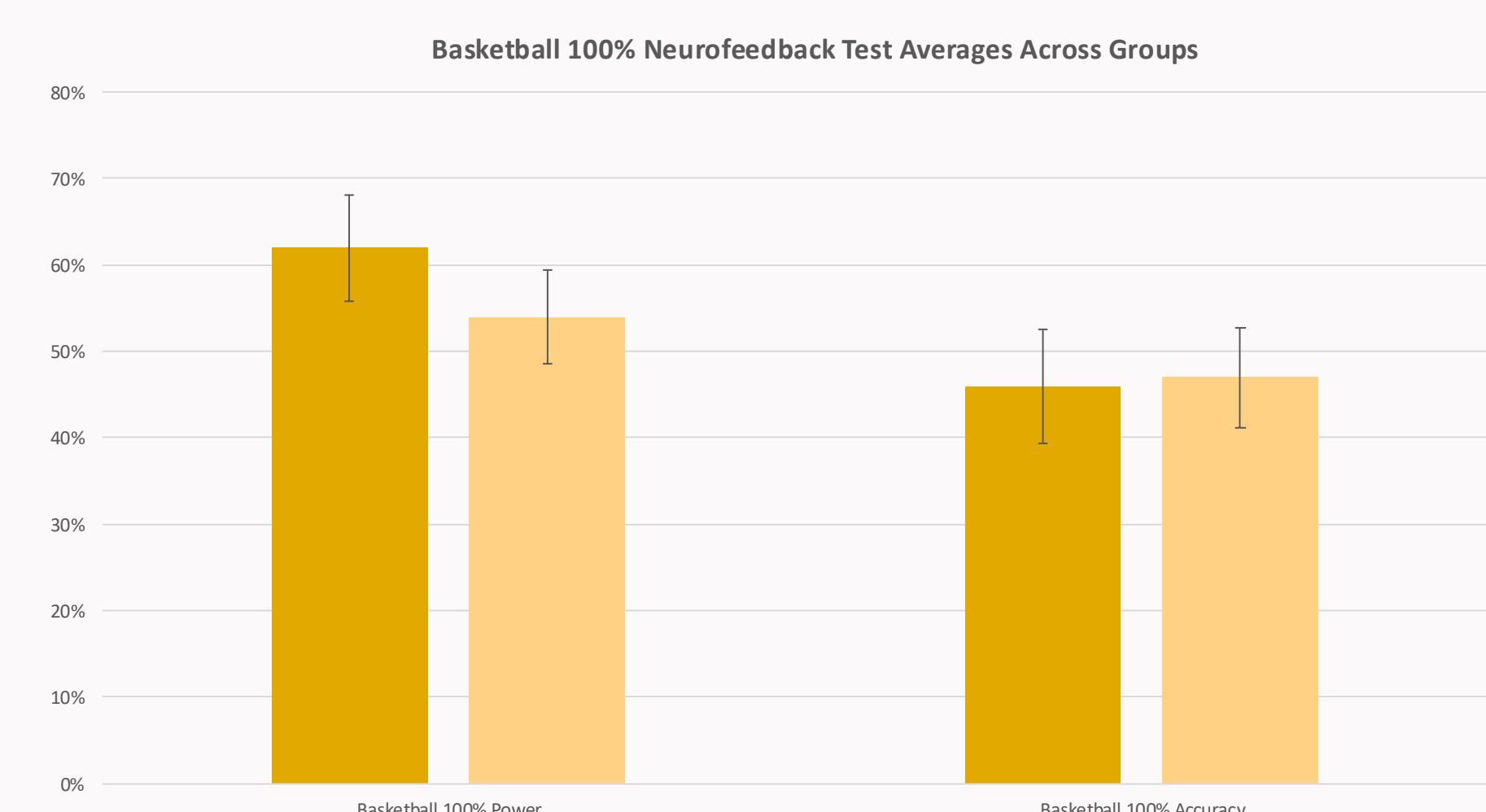


Figure 5. A bar graph representing average power and accuracy percentages across pre- and post- intervention tests (100% neurofeedback on tests)

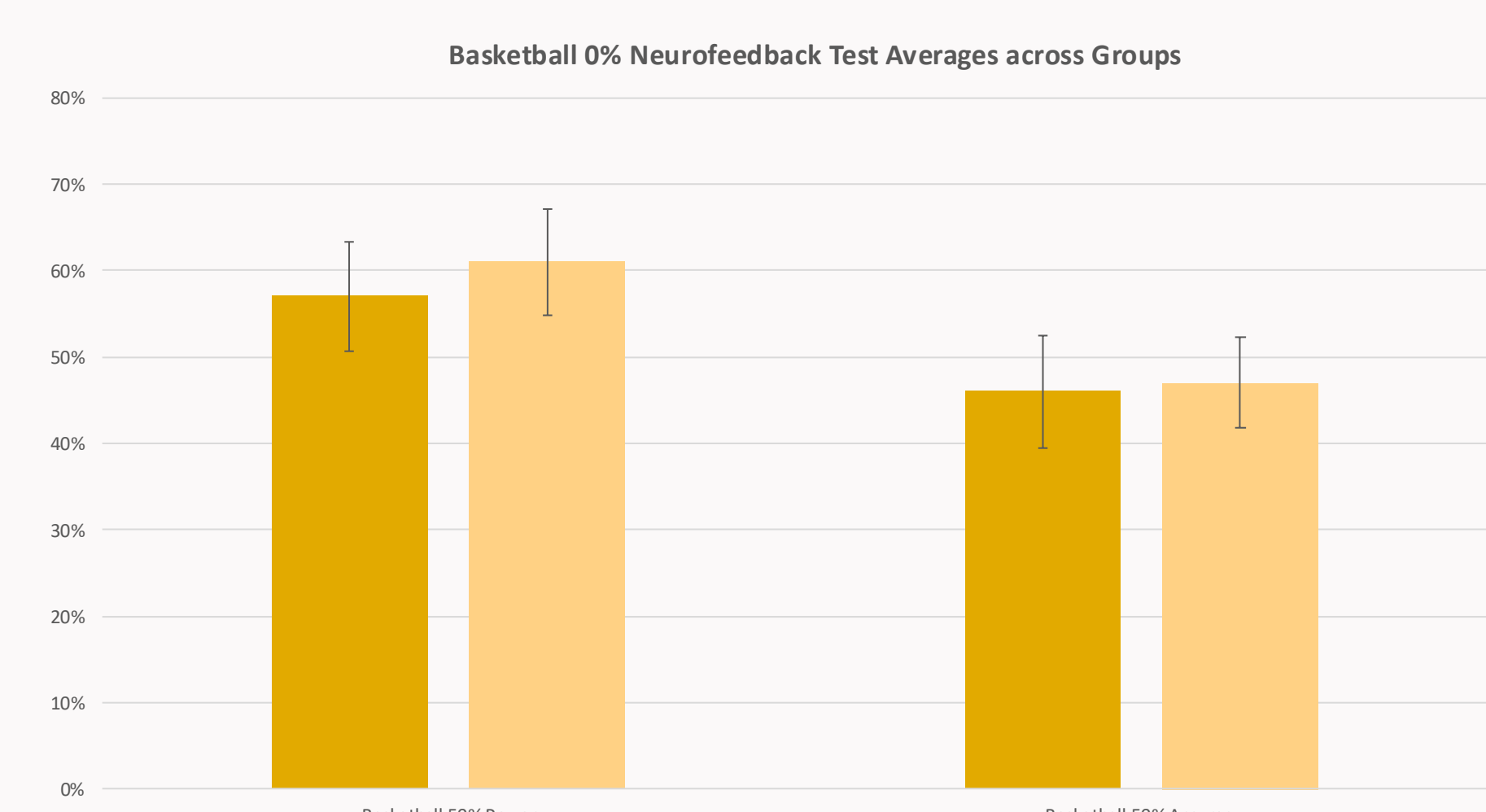


Figure 6. A bar graph representing the average power and accuracy percentages across pre- and post- intervention tests (0% neurofeedback on tests).

## CONCLUSIONS

- After analyzing the preliminary data, the presence of relatively less neurofeedback does not necessarily represent better success and engagement with the soccer interface at this stage of the experiment.
- From the results, observable improvement in both power and accuracy are seen in the test with 0% feedback (Soccer and Basketball) across both groups, however these results are not statistically significant so far. The test with 100% feedback (Soccer and Basketball) displayed inconsistent results, with some degradation in power averages yet some accuracy improvement. These results were also not statistically significant.
- It is unclear as to whether these results will become statistically significant with more trials and data. We anticipate data from 17 more participants, which could change statistical trends.

## FUTURE DIRECTIONS

- Further data collection and analysis of brain data (rather than only i-BrainTech performance data) may uncover novel statistical trends in the data that are not evident with our preliminary sample size
- Possible avenues to expand upon in this study include the specific improvement/change to physical performance, linking back to what neurofeedback group they were in, and analyzing their real motor skill development.
- Additionally, sport-specific improvements possibly be expanded upon, such as focusing on training with basketball modules instead of soccer; ultimately, to then see if motor skills improve with different training methods (basketball).

## REFERENCES

