User Study

Participants Recruitment

Due to the limited timetable allotted for the User Study, participants were recruited via social media and other platforms. Unfortunately, this resulted in primarily male participants, so the results are **not** gender-balanced. Additionally, due to the limitations of the experiment, participants are all college students, which skews the age distribution heavily between 18-35. The study only observes students, due to the limitations imposed by the timeline for the project.

Pre-Survey

Users were first asked to complete a Pre-Survey, to gather some information about themselves, including gender, age, any disabilities associated with the eyes, and overall experience with computers and VR systems. Additionally, this also served as their consent form.

Experiment

As this experiment is conducted with the use of a VR Headset, there is no need to use a lab setting for the VR portion. We begin by having a participant attempt to catch a ball by bouncing it off a wall for several minutes. This is our control for their hand-eye coordination. They repeat this portion of the experiment after completing the trial with the VR Headset.

For the VR portion of the experiment, participants were tasked with surviving for as long as possible (up to three minutes) in the application. They were given two minutes to understand the controls and premise of the game before starting. Participants were told that they were free to stop at any time, and for any reason.

For the non-VR control and subsequent test, we were measuring the percent catch rate over a time of three minutes.

Internal / External Validity

The validity of the experiment is put simply, questionable at best. We cannot generalize any results to the population, as we failed to gather a diverse enough set of users, with the supermajority of them being male in between the ages of 18-24. The results from those participants however, should be valid. The VR portion of the experiment is conducted using a VR headset, which guarantees that they were all working in the same environment. We had less control over the area for the control and post VR catch test, as we just did it outside where there was a useable wall, but it was kept the same for all participants.

Results and Analysis

Unfortunately, we were only able to gather nine participants for the experiment. After logging their data, everything was imported into RStudio to attempt to do create a generalized linear model. After some tinkering and removal of useless variables, we were left with the following model:

```
Call:
lm(formula = post_catch_percent ~ pre_catch_percent + vr_time +
    vr_exp + app_feel, data = sparseDF)

Residuals:
        1         2         3         4         5         6         7         8         9
-2.7706969  1.8525407  1.7574338 -3.4862234 -0.6268572  3.8057169 -0.0001042 -2.7198041  2.1879945

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       49.66084   14.85226   3.344   0.0287 *
pre_catch_percent  0.62279    0.15408   4.042   0.0156 *
vr_time            0.03637    0.04094   0.888   0.4246
vr_exp            -3.04859    1.26617  -2.408   0.0737 .
app_feel          -3.36216    1.60973  -2.089   0.1050
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.654 on 4 degrees of freedom
Multiple R-squared:  0.9282,    Adjusted R-squared:  0.8565
F-statistic: 12.93 on 4 and 4 DF,  p-value: 0.01471
```

Figure 1: Linear Model

The model settled on attempted to predict the change in their catch_percent based on their original results, their time in the VR application, their previous VR experience, and their post-experiment response on the application feel. The variable with the highest significance was their pre-experiment catch percentage, which does not bode well for the rest of the results. The VR application was deemed to not have any significant impact on their results.

For our hypothesis that states VR applications are an effective method to increase a person's hand-eye coordination, we would unfortunately not be able to definitively say that at this time. However, we do not believe that this experiment disproves the possibility.

Due to time limitations, and the fact that it was all done within the course of a single day, it is unlikely to see immediate change in a person's motor skills from our brief trials. It may be worth fleshing out the procedure more, and seeing what effect it has on participants if practiced over a longer period of time.

Another potential problem lies with the application itself. Users were asked to rate the feel of the application in the post survey, and the average score was a 2.9 out of 5. Improvements to the app could also change the effect it has on the participants.