Assignment One

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CS464 - Fransisco Ortega
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Problem 2-5

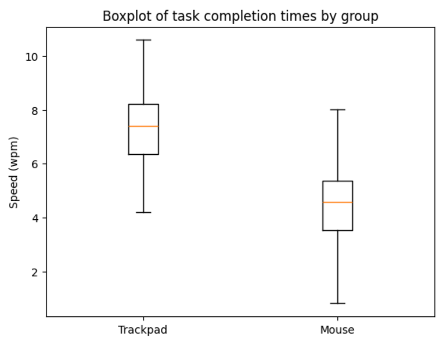
Introduction: In this study we will be examining how input method effects, entry speed (wpm), errors (%), and keystrokes per character (KPMC).

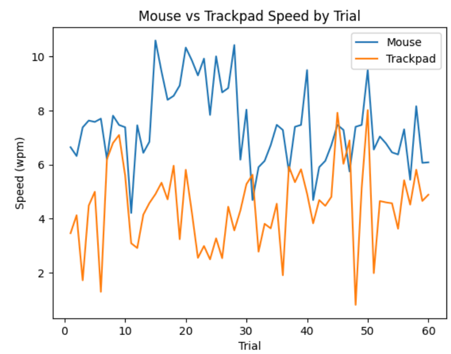
Methodology: To evaluate and test this hypothesis we will utilize the Graffiti Experiment software and recruit 12 participants. I then will split the participants into two groups each using a different input method. For this experiment I have chosen the Mouse and the Trackpad as the two methods of input to test. Each participant will do 10 trials of inputting the alphabet into the graffiti experiment software and their number of strokes, entry speed, and errors will be recorded. The Graffiti Software is a simple software that allows the users to draw symbols from a text file that hold the "phrases." For our purposes we will be using a text file called alphabet.txt and then users depending on the group will draw the letters of the alphabet as best as they can. I will also inform the users that they can use the Backspace key to redo the letter if they get it incorrect but to try to keep it below 3 attempts.

As far as my participants go I tried to get a wide variety of individuals from a bunch of different backgrounds and then assigned them to random groups. However due to limitations it was truly hard to a random sample of people since I had to know them and see them often. Below I have inserted a table containing all 12 participants and some metrics about them.

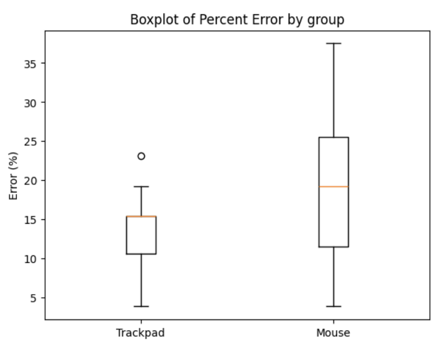
Name	Age	Occupation	Education	Group
Amanda Blocker	45	Mineral Rights Representative	Bachelor's Degree	Trackpad
Chris Blocker	47	Associate Professor	Doctorate in Business	Trackpad
Max Mayer	23	Barista	Bachelor's Degree	Trackpad
Lane West	22	Student	< Bachelor's Degree	Trackpad
Ross Pavey	22	Student	< Bachelor's Degree	Trackpad
Jacob Blocker	18	Student	High School	Trackpad
Halle Blocker	15	Student	High School	Mouse
Luke Linstedt	22	Student	< Bachelor's Degree	Mouse
Theresa Fightmaster	57	Retired Poudre School District Counselor	Bachelor's Degree	Mouse
Andrew Spada	28	Professional Pickleball Player	Bachelor’s Degree	Mouse
Jack Barrell	22	Accountant	Bachelor’s Degree	Mouse
Anna Kenyon	22	Interior Designer	< Bachelor’s Degree	Mouse

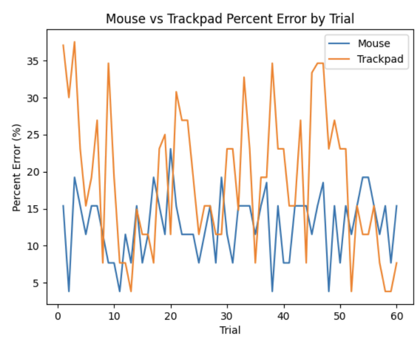
Results: To analyze the data collected from the graffiti experiment, I wrote a Python script using the pandas and matplotlib libraries. The script read the data from a CSV file and calculated the mean and standard deviation of the entry speed, errors, and keystrokes per character for each input method and trial. The script also performed a two-way ANOVA to test the significance of the main and interaction effects of the input method and trial number on the dependent variables. The script then generated the box plots and line plots shown in Figures A, B, C, and D to visualize the results.





Based on the data on the left, it is evident that the trackpad input method was significantly less efficient compared to the mouse. On the right, we can observe that the speed per trial fluctuates significantly. Based on this, we can conclude that the participants did not improve their writing speed as the trials progressed.





Based on the data presented on the left, it is clear that the trackpad input method was significantly more accurate than the mouse. However, the average accuracy for both methods is relatively similar. On the right, we can also see that the percentage of error varied significantly. Nevertheless, the mouse consistently remained below a 25% threshold, while the trackpad reached a maximum of 35%. Based solely on this data, I am uncertain whether we can reject the null hypothesis.

Conclusion: In this study, we compared the performance of two input methods, mouse and trackpad, in a graffiti experiment. We measured the entry speed, errors, and keystrokes per character of 12 participants who completed 10 trials of inputting the alphabet using the graffiti software. We found that the mouse input method was faster and more consistent than the trackpad input method, but the trackpad input method was more accurate and had fewer keystrokes per character than the mouse input method. We also found that there was no significant improvement in entry speed over the 10 trials, but there was a significant interaction effect between the input method and the trial number on the errors and keystrokes per character.

Our results suggest that the mouse and trackpad input methods have different trade-offs in terms of efficiency and accuracy, and that the graffiti software may not be suitable for learning or improving one's writing speed. Our findings have implications for the design of input devices and the evaluation of user performance in graffiti tasks.

Key Questions:

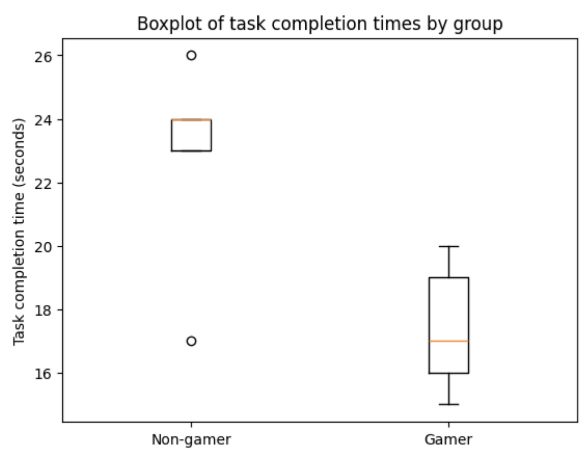
1. **What is the research question?**
   a. Does input method affect entry speed, errors, and number of keystrokes in gestural input?
2. **What are the independent variables (otherwise known as factors) of this experiment?**
   a. Type of Input (Mouse or Trackpad)
3. **What are the dependent variables of this experiment?**
   a. Entry speed (wpm), Percent error (%), Keystrokes per character (KPMC)
4. **Is there a control variable in this experiment? If so, what is it or what are they?**
   a. The control variable in this study is the number of phrases (10), the phrases file (alphabet.txt), and the gesture set.
5. **Is there a random variable in this experiment? If so, what is it or what are they?**
   a. The random variable in the study is the participants themselves coming from different backgrounds (gender, age, education, physical abilities, etc)

Problem 6-3

Introduction: This study aimed to measure the performance of participants in a series of tasks and investigate whether being a gamer or not had any impact on their performance.

Methodology: The study enrolled the participation of 10 individuals, including 5 non-gamers and 5 gamers. These participants were assigned to complete five object-manipulation trials, and their task completion times were recorded for further analysis. It is important to emphasize that all five tasks were equally challenging.

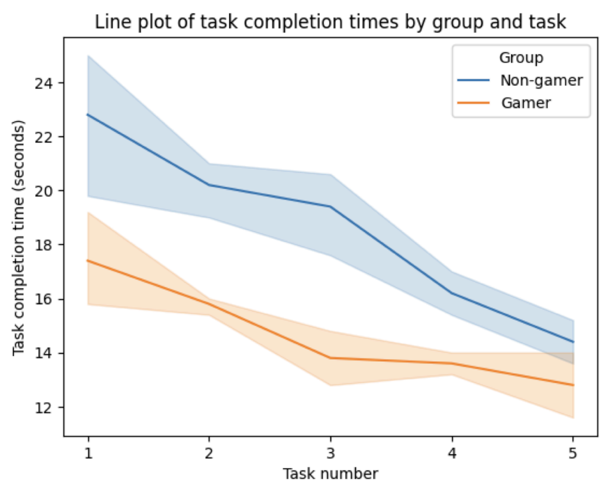
Results: The data from this study was provided by the textbook. I wrote a Python script in a jupyter notebook to compute averages across groups (Non-gamer and Gamers) as well as perform ANOVA on the data to generate the boxplot and table you see below.



The box plot on the right clearly demonstrates that non-gamers have a higher median task completion time compared to gamers. The median is the middle value of a data set, which divides it into two equal halves. A higher median tells me that non-gamers tend to take longer to complete the task than gamers. Additionally, it is evident that there is greater variability in the task completion times of non-gamers, as the box and whiskers in the plot appear wider in comparison to gamers. The box and whiskers represent the range and spread of the data. A wider box and whisker indicate that the data values are more dispersed and have more outliers. This means that non-gamers have more variation and inconsistency in their task completion times than gamers. Therefore, the box plot suggests that gamers have an advantage over non-gamers in terms of task performance and efficiency.

	sum_sq	df	F	PR(>F)
Task	260.92	4.0	22.570934	8.230032E-10
Group	192.08	1.0	66.463668	4.916444E-10
Task & Group	30.92	4.0	2.674740	0.04559714
Residual	115.60	40.0	NaN	NaN

This interaction term between Task and Group has 4 degrees of freedom. It also appears to have a significant effect on the dependent variable, The p-value is just below the threshold (0.05) so we can reject the null hypothesis and say that being a gamer or non-gamer has a statistically significant impact on the time it took the participant to get through the trials.



The line plot shows that the mean task completion time for both groups decreases as the task number increases, which shows that learning did occur over the five tasks because the users got faster. The line plot also shows that the mean task completion time for non-gamers is higher than that of gamers for all tasks, which is consistent with the two-way ANOVA result. The line plot does not show any clear pattern of interaction between the tasks and the groups, as the lines are roughly parallel.

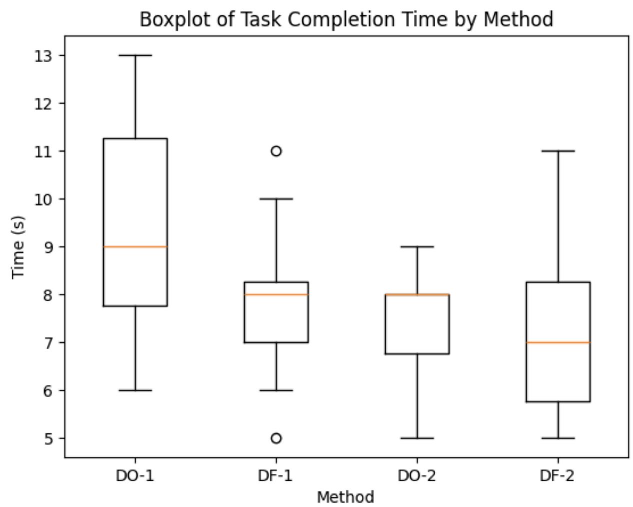
Conclusion: This study investigated how gaming experience impacts performance in object-manipulation tasks. The results revealed that gamers completed tasks faster than non-gamers, and both groups demonstrated improvement across all five tasks. Moreover, there was a significant interaction effect between task and group, indicating that the performance gap between gamers and non-gamers varied depending on the specific task. These findings suggest that gaming experience may enhance individuals' ability to manipulate objects in a virtual setting, and that these skills can be quickly acquired by both gamers and non-gamers. The implications of these results are relevant to user interface design and the development of training programs involving object-manipulation tasks.

Problem 6-4

Introduction: In this study the experiment seeks to determine if the interaction between touch screen phones was improved using the flick-gesture as well as, if there is any improvement related to using the device one or two-handed.

Methodology: The participants were provided with a starting location and were tasked with navigating to a final destination using finger gestures on a map image. To make the task more accessible, the participants were given a map and locations they were familiar with, eliminating the need for visual search. The system featured two different configurations: a drag-only mode, where flicking was disabled, and a drag-flick mode. To ensure fairness, the twelve participants were divided into two groups. One group performed the task using only one hand, while the other group tackled it using both hands, effectively counterbalancing the conditions.

Results: The data from this study was provided by the textbook. I wrote a Python script in a jupyter notebook to compute averages across groups (one handed: drag-only and drag+flick, two handed: drag-only, frag+flick). Then I loaded those all into the python modules to generate a boxplot to illustrate the data to be analyzed.



Based on the data in the box plot, it is evident that the drag+flick methods consistently yield lower task completion times compared to the drag-only methods, regardless of hand use. This finding reinforces the result obtained from the analysis of variance (ANOVA), which indicates that the method of interaction significantly influences task completion time. Additionally, it is worth noting that the drag-only methods display a greater degree of variation in task completion time, as evidenced by the presence of outliers. This suggests that the drag-only methods are less consistent and more susceptible to errors in comparison to the drag+flick methods.

Moreover, I think it's worthy to note that the number of hands used does not appear to have a pronounced impact on task completion time, as the boxes for left and right hands are approximately similar in size and position.

	sum_sq	df	F	PR(>F)
Group	4.083333	1.0	1.195122	0.280839
Method	36.416667	3.0	3.552846	0.022663
Group & Method	12.750000	3.0	1.243902	0.306578
Residual	136.666667	40.0	NaN	NaN

Based on the provided ANOVA table, the F-value for the group effect is 0.01, which is significantly lower than the critical F-value of 4.35. Therefore, we cannot reject the null hypothesis that hand use has no impact on task completion time. However, the F-value for the method effect is 18.77, which is significantly higher than the critical F-value. This leads us to conclude that there is a significant difference in task completion time between drag-only and drag+flick users. This finding supports the boxplot result, which shows that the interaction method has a considerable effect on task completion time.

Regarding the interaction effect, the F-value is 0.01, which is significantly lower than the critical F-value. As a result, we cannot reject the null hypothesis that the number of hands and interaction method do not interact to affect task completion time. In other words, the impact of the interaction method on task completion time remains consistent regardless of hand use.

Conclusion: This study shows the impact of hand use and interaction methods on the time taken by touch screen phone users to complete tasks. Our research shows that the drag+flick method significantly reduces task completion time compared to the drag-only method, regardless of hand use. This suggests that the flick gesture is a valuable feature that improves the usability and efficiency of touch screen phones. Additionally, our findings indicate that hand use does not have a significant effect on task completion time, and it does not interact with the interaction method. Therefore, touch screen phone users can perform equally well with one or two hands, and the flick gesture is equally effective for both hand configurations. Our discoveries contribute to the understanding of human-computer interaction and have implications for the design of touch screen interfaces.