# HCI Report - 7↑

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## Short summary
We were interested in the drawing abilities of different devices. To make it experimentally feasible, we opted to constrain the drawing to a simple dot-to-dot game, where there is a strong emphasis on achieving a minimum completion time.

## Hypothesis
*Completing a dot-to-dot diagram as quickly as possible will take a shorter amount of time when using a mouse than using a trackpad.*
This was hypothesised because the mouse can be moved around the desk, instead of repeatedly swiping across a trackpad, both allowing a larger area of hand movement and also a physical object to move, making it easier to hit targets.

## Experimental design

*Participants*
We tested 34 participants on both input devices, which gave us 68 results in total. Participants were a selection of people who were available in the Atrium of the MVB during the two hours the experiment was running.

*Variables*
Independent Variable: input type (mouse or trackpad).
Dependent variable: time taken to connect all the dots in the correct order.

*Task*
Each participant was instructed to use both a mouse and trackpad to join the dots of a diagram on-screen, in a specific sequence, as fast as possible. To ensure the user knew which dot to join, the next dot was highlighted in green. The timer was started once the user hit the first dot, and finished when the last dot was hit. The program conducted the timing to ensure human response time errors were not introduced.

*Experimental design*
To eliminate any learning effect between trials, two different dot-to-dot diagrams were used. To control for the distance travelled by the pointer on-screen and complexity of drawings, the diagrams were inverted versions of each other. The experiment was measured within subjects; each participant used both the mouse and trackpad. For counterbalancing, a Latin square was used to alternate the order of devices used, and which diagram was performed first.

*Validity*
For our experiment to be relevant, our experimental design must be valid.

*Construct Validity*
To ensure we were only measuring the relevant time taken to complete the task, we built time measurement into the software. Had we timed the task manually, this would have introduced extra variability due to a reaction time when the participant is signalled to start. Furthermore the use of colour-coding provided a clear indicator of the state of the task, helping to reduce scenarios where the participants fail to identify the task as unfinished (which would potentially give them a longer recorded time).

*Internal Validity*
Using within-subjects reduced potential for confounding variables as all participants took part in both conditions. All experiments were carried out within a 2 hour window and so time of day would also not be a significant confounding variable. The participant's familiarity with the given input types has potential to skew results; it may be the case that the majority of participants have greater experience with one input type over the other.

*External Validity*
Our experiment used a specific trackpad model and specific mouse model and so it is hard to claim wider applicability to other models of trackpad and model of mouse. A basic analysis would suggest that, due to the similar mechanical nature between most commercial trackpads and mice, our results should be representative of most common models. The nature of our sample group may also not necessarily form a result representative of a wider population. Gender and age have potential to influence results; our sample had an unequal male to female ratio, and nearly all the participants were Computer Science students, so our results are not representative of an overall population.

## Results

It can be seen from Figures 1 and 2 that when the trackpad is used, it usually takes more time to complete the dot-to-dot.

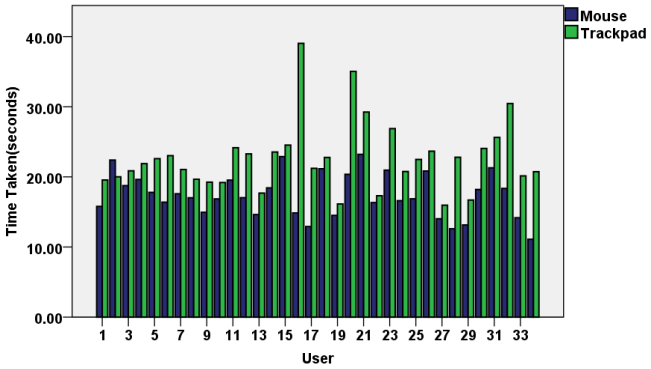


**Figure 1:** Bar chart of the time taken by each of the 34 participants

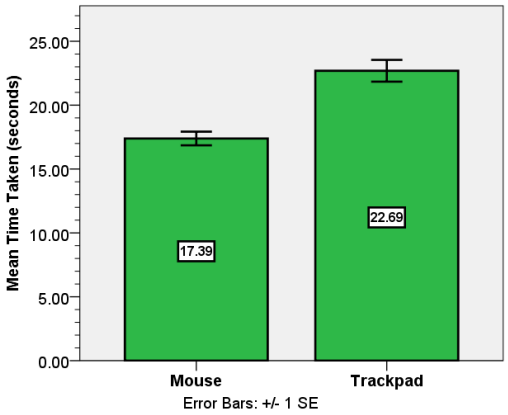


**Figure 2:** Bar chart of mean time taken

The error bars on Figure 2 are Standard Error. This was calculated by dividing the standard deviation of each method by the square root of the number of participants.

Figure 3 has a histogram for each input type, rotated and placed like a population pyramid. These show that the trackpad frequencies are skewed to the left, supporting the idea that the mouse is faster.

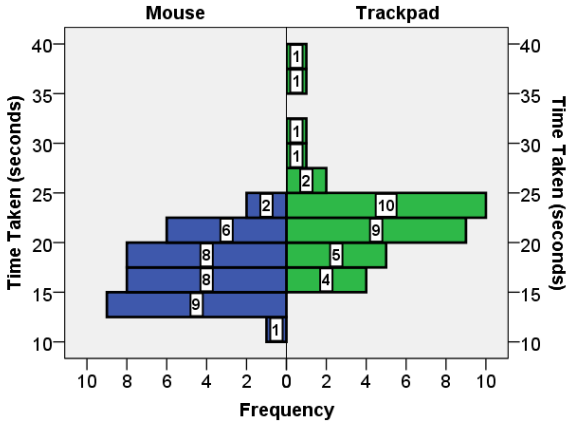


**Figure 3:** Population Pyramid

The Boxplots in Figure 4 show that there were two outliers in the trackpad results, and the range was wider than the mouse.

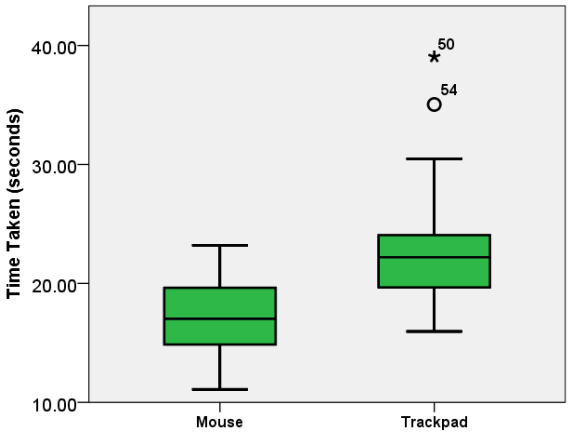


**Figure 4:** Boxplots

Normality tests were conducted on the data collected for the mouse and trackpad. The results of both the Kolmogorov-Smirnov and Shapiro-Wilk tests can be seen in Figure 5.

| | Kolmogorov-Smirnov | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig | Statistic | df | Sig |
| **Mouse** | 0.076 | 34 | .200 | .981 | 34 | .793 |
| **Trackpad** | .179 | 34 | .007 | .874 | 34 | .001 |

**Figure 5:** Results of the Normality Tests

The significance value for the mouse is higher than 5%, meaning the the mouse results are normally distributed. Whereas the trackpad results are not normally distributed, since the significance is less than 5%.

The two sets of scores that come from the same participants, and data normality has been violated, so the one-tailed Related-Samples Wilcoxon Test was chosen as most appropriate.

## Conclusion

The one-tailed Related-Samples Wilcoxon Test gave a significance value of zero, therefore using our significance level of 5% the null hypothesis can be rejected, and the conclusion drawn that the mouse is faster than the trackpad at completing a dot-to-dot diagram.

## Team organization

| | |
|---|---|
| Luke Storry | 21% |
| Ewan Stanley | 18% |
| Albie Baker-Smith | 16% |
| Ben Fossett | 10% |
| Constantinos Vrontos | 17% |
| Ellis Gawthorpe | 18% |