

# Report

IS(H) Assessed Exercise 1

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I've created three different design templates to use with my calculator. All three design templates use the same .html and .js files.

To switch to another design templates, open the html file with a URL parameter 'css'.

index.html?css=calculator1.css

index.html?css=calculator2.css

index.html?css=calculator3.css

The first design (calculator1.css) bears a flat, minimalistic interface. Using nothing but rectangles without border radius, this theme has a clean, simple look. No elements have drop shadow. Buttons don't have clear borders and nearby buttons cannot be easily differentiated. The theme uses a bright background and dark button colours. Controls are grouped by function using two (and fortunately not fifty) shades of grey. Buttons don't change their looks for hovering. This design is somewhat similar to the calculator found in newer Android releases. Despite simplicity is supposed to bring order to UI complexity, I often feel unsure where to tap when I use a piece of software that was designed using Google's new Material guidelines,. Such a level of simplification often actually impedes me in navigation. I expect this design to have the highest error rates.



The second design is of the same size as the previous theme, but utilises a different colour palette. Buttons now have well-defined edges and hover actions to make them easier to differentiate. On this template, keys are ordered in three groups. 'Clear', '=', 'Backspace' and the Memory keys have a dark colour to mark their special actions. I didn't use drop shadows or rounded edges. I expect this design to have smaller difficulty index and error rates.



The third design is the most skeumorphic and more similar to a real-life calculator than the previous two themes. Buttons are square-shaped and have rounded corners. They also have drop shadow to elevate them from the background and provide a better grasp of their shape. The calculator itself is 43% higher than #1 and #2. Keys that are used the most are now 30% bigger than ordinary function buttons. Clear and '=' have a bright orange colour. The colour palette is similar to a real calculator I own.

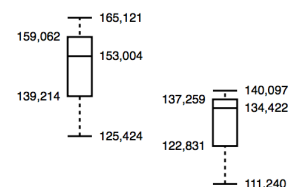
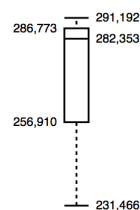


My calculator logs the coordinates of every mousedown and mouseup events in its area. It also logs questions that have been asked from the participant, and usage statistics of the Delete button. At the end of each survey the application renders a layer above the calculator interface where it displays mouse clicks. It also gives a conclusion about errors.

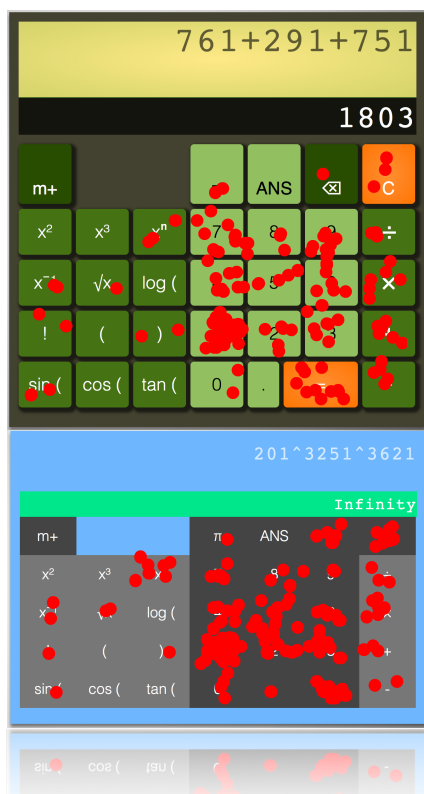
I've observed participants directly while they were using the software, and also did cooperative evaluations together. Since I do not own a computer with a mouse, I've provided test subjects with an external wireless trackpad for the duration of the experiment.

The best possible measure of efficiency in this case is the time of task completion.

As the boxplot on the right shows, the first design didn't perform well. It took more than twice as much time for every volunteer to calculate 10 random equations with it than it took with Design #3. The second and third designs were comparable regarding task completion time.

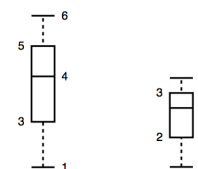


Time/ms to complete 10 equations  
(CSS 1, 2, 3 respectively)



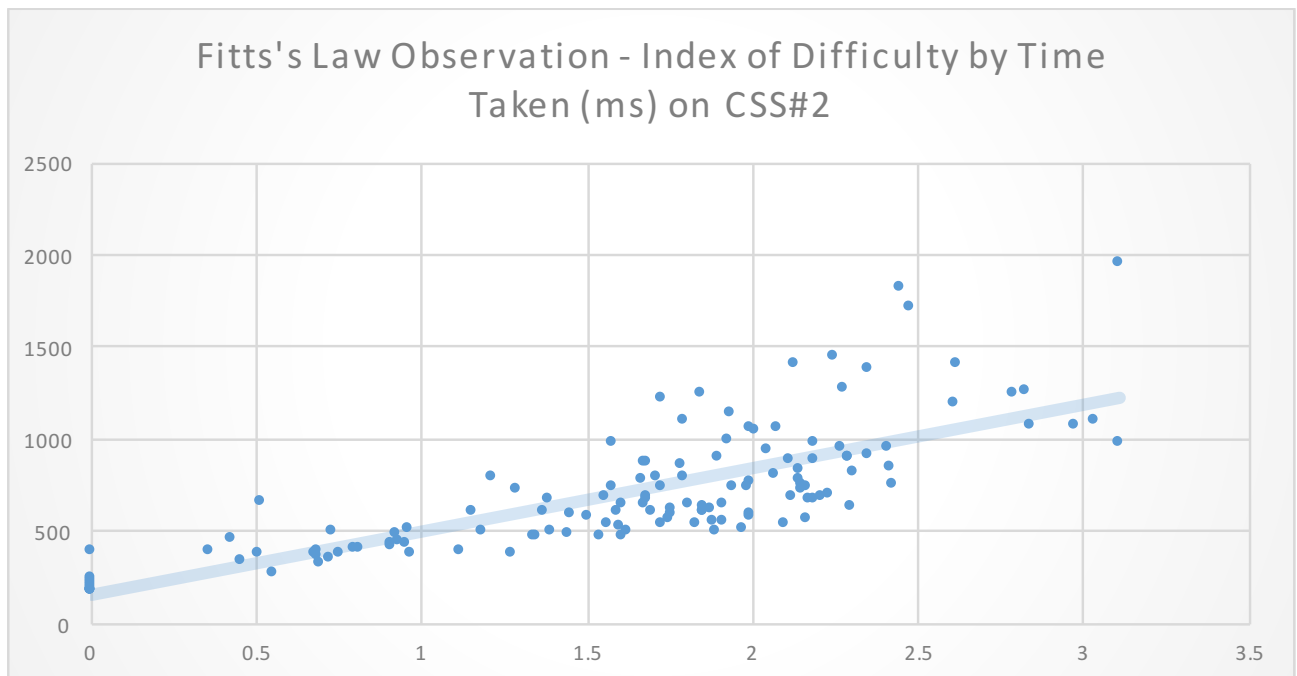
Design #1 didn't perform well at number of mistakes, either. While the two other designs once again delivered comparably, there were more than 3 times as many mistakes made in #1 than in #3.

The main difference is the thick separator between the buttons in Design #2 and #3. Not only were there tremendously less taps on areas between buttons, Calculator #3 could even ignore those taps thanks to its thick button bezel. Since the buttons on Design #1 join



Number of mistakes made  
(CSS 1, 2, 3 respectively)

without neutral border, mistaps had a more profound effect there.



I was able to observe on all three designs' measurements that the relationship between movement time and the Index of Difficulty is linear.

The average Index of Difficulty matches my experiences. They are 1.9, 1.8, 1.6, for Design #1, #2, #3, respectively. The larger buttons on #3 greatly helped it reach a better score.

After the direct observation, each participant engaged in a short cooperative evaluation session. All participants agreed that while Design #3 wasn't the most aesthetically pleasing theme, it was definitely the easiest to use.

I've completed the Ethics Checklist of the University's School of Computing Science. Boxplots on Page 2 were created with <http://bl.ocks.org/mbostock/4061502>.

