Case Study #6 (Maxi)
- Information Processing and ATM Design

Introduction

The primary purpose of an ATM is for quick withdrawal of cash from the bank. Your objective is to redesign the ATM panel (if necessary) for optimum speed of cash withdrawal using your knowledge of information theory and information-processing/decision-making. Design parameters that may affect performance include:

- Form of layout: Square layout as on a keypad vs an in-line layout as on a typical keyboard
- Type of layout: Calculator keypad vs. phone keypad (compare the two on your own calculator and cell phone)
- Type of entry: Physical keys vs. virtual keys on a screen activated by mouse (as on the Fitts’ Tapping Task and Choice Reaction Time modules in Design Tools)
- Size of layout: size of keys and spacing of keys

For the purpose of this exercise, assume the minimum number of steps to remove FAST CASH. Once your ATM card is inserted, there are only 6 buttons to press (using your index finger only):

- 4 digits for your ATM pin number
- ENTER to confirm entry of pin number
- FAST CASH to withdraw the automatic $60

Procedure

1. Calculate the index of difficulty for a square layout and in-line layout (figure given at the end of this instruction). Assume that the home position for the index finger while entering the pin number is digit 5 (since the numbers could be random for a general case). Disregard 0, ENTER, and FAST CASH.

   - Index of Difficulty
   
   \[ ID = \log_2 \left( \frac{2\bar{D}}{W} \right) \]

   - \( \bar{D} \): the average distance from home button (5) to every other number.
   - \( W \): the width of one button.

2. Determine the best layout, either square or in-line layout, by using the Index of Difficulty. Only the best layout will be used for further work.

3. Pick one person of your group to act as the typical ATM user. He/she will perform all the necessary information processing activities.
4. Use the Fitts’ Tapping Task module in Design Tools to find the processing time for movements between different size keys and key spacing.
   - Choose two combinations and run two trials each. Select the best combination.

5. Perform the Fitts’ Tapping Task physically based on the best combination that was chosen above. Draw the boxes with the appropriate dimensions and the distance on a piece of paper and use a stopwatch for timing.
   \[ t_{avg} = \frac{\text{time to perform the 100 taps}}{100 - \#\text{errors}} \]

6. Consider the tradeoff in the index of difficulty, i.e. larger keys are faster to hit, but a greater distance which slows down the response.

7. Perform the Simple Reaction Time module in Design Tools to find the intercept of the Hick-Hyman Plot.
   - Any color, 20 trials
   - Record the average reaction time

8. Perform the Choice Reaction Time module in Design Tools to find three other data points for the Hick-Hyman Plot.
   - Perform the three tests, 20 trials each
   - Record the average reaction time

9. Plot data in Excel and calculate the equation of the line. You will get a linear equation like \( y = mx + b \), which is \( RT = a + bH \) in this case (\( RT \) is the reaction time).

![Hick-Hyman Plot Example](image)
10. Use the $RT$ equation that you got to calculate
   - Channel capacity (bandwidth)
   - Response time for 10 equally likely alternatives
   - Response time for a 4 digit number, like a pin number (e.g. 9306)
   - ($T_1$) Response time for the following 6 key strokes: 4 digit number, ENTER, and FAST CASH

11. ($T_2$) Redesign the ATM layout to what you think would be a better one. Have your ATM user mock the 6 key strokes (4 random digits, ENTER, and FAST CASH) and record the time it took the user to do it with a stopwatch. (The experimenter reads the (random) numbers right before the subject enters it into the keypad, since that is the procedure that you predicted. Obviously, you can enter own pin number more quickly, since you have practiced the task; but that wouldn’t be a fair comparison.) The drawing is EXTRA CREDIT.

12. ($T_3$) Have your ATM user go to a real ATM. Have the user mock the 6 key strokes (4 random digits, ENTER, and FAST CASH) and record the time it took the user to do it with a stopwatch ($T_3$). (The experimenter reads the (random) numbers right before the subject enters it into the keypad, since that is the procedure that you predicted. Obviously, you can enter own pin number more quickly, since you have practiced the task; but that wouldn’t be a fair comparison.)

13. Compare $T_1$, $T_2$, and $T_3$, recommend the best one and comment why you think it is the best.

**Extra Checklist for the Report**

Besides all the sections required for the report in the Report Writing Guide, make sure that you include the following:

- A table with the two values of index of difficulty
- Average tapping times from Fitts tapping tests (there should be at least 3 values)
- A table with the average reaction times that you got from the Simple Reaction Time test and the three Choice Reaction Time tests
- The Hick-Hyman plot of your ATM user
- The four calculations using the RT equation. Channel capacity, Response time for 10 equally likely alternatives, Response time for 4 successive digits (not equally likely alternatives), Response time for the following 6 key strokes: 4 random digits, ENTER, and FAST CASH
- Your new ATM layout design
- A table that contains the three different reaction times that you are supposed to compare ($T_1$, $T_2$, and $T_3$)
- A discussion about the 3 reaction times.
- Discuss the final performance test. How close were you? If it’s not that close, why not?
Figure 8: Square Layout ATM