Qwirky Qwerty? A Proposed Experiment

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Research question and hypothesis

Will changing the placement of two keys on the Qwerty keyboard result in a more accurate and/or faster typing experience? In this proposed study, data from the use of a modified soft Qwerty keyboard, with the keys *t* and *f* switched, will be analyzed. The objective of this research project is to create, or at least, collect data that would help create a modified keyboard that is more efficient than Qwerty. Participants will have to type an identical phrase using the Qwerty keyboard and the modified keyboard. Based on data collected from multiple sessions (e.g. WPM, learning curve), the study will compare the differences in performance between the two keyboards.

T and *f* are swapped for multiple reasons. "Th" is the most common bigram in the English language [2]. Having both *t* and *h* in the home row, with *t* mapped to the left hand and *h* mapped to the right hand, will hopefully speed up typing the combination. Of the 50 most frequent words in the English language, the words that are composed of the letter *f* are also exclusively made up of letters on the top row, with the exception of the word "from" [2]. In addition, with our placement of *f*, these common words can be typed by alternating hands for each letter, which will hopefully result in faster typing. Furthermore, *t* and *f* are only one key away from each other, thereby minimizing the layout change. We considered not to place *t* and *h* next to each other because we wanted to avoid possible finger collisions.

We predict that after multiple sessions, each user will have an increase in words per minute when using the modified keyboard. If the participants' WPM falls below their WPM on the standard keyboard at the end of the study due to time constraints, we expect to see a rising learning curve that trends toward a faster WPM, similar to [1]. It is important to note that WPM does not just account for speed but also accuracy.

Apparatus

An Android mobile phone application (app) that we will call Qwirky Qwerty will be created for the study. This app (minimum SDK: API 21 Android 5.0 Lollipop) will be installed on an LG Nexus 5 with a 2GB Snapdragon 800 RAM, a 4.95 inch display (70.8% screen to body ratio), and a 1080x1920 pixel screen resolution.

The layout of the keys in the modified keyboard included in Qwirky Qwerty is identical to the Qwerty keyboard except for keys t and f. In our keyboard, keys t and f are swapped (f is placed between r and y, t is placed on the home row between d and g). The letter keys are equally spaced apart, have equal widths, and are directly above or below each other. The top row is comprised of the letters q to p. The home row is comprised of the letters a to l plus an additional extra character key below key p. The bottom row starts with an one letter key-width caps lock key followed by the keys z to m. The period key and the backspace key follow key m, respectively. The spacebar key is directly below keys x to b, with a width of four letter keys. The properties of the letter keys, such as size and spacing, are defined in an XML resource file in the source code and are as follows:

- keyWidth="10%p"
- horizontalGap="0px"
- verticalGap="0px"
- keyHeight="60dp"

When the app is opened, the user is shown a phrase they will have to type. The phrase is randomly picked by the app from a collection of phrases that we will store on the app. The phrases will be made up of words that appear frequently in the English language. There is a blank text field where the participant types the words they see on the screen. Typing is done on a word-by-word basis. This means that when the user is finished typing a word (by pressing the spacebar or an appropriate punctuation mark), this word disappears from the text field, which is left blank for the next word.

The app records the time (in seconds) that it takes for each participant to finish typing the phrase. The app will start recording time when the user presses their first key and will stop recording time when the user presses the spacebar or an appropriate punctuation mark on their last word. It also records the total number of keystroke errors for each word. The data is shown on-screen at the end of the typing task for the researchers to collect.

Participants

We will recruit up to 14 participants and hold 30-minute sessions with each of them for up to 6-7 days (or until the learning curve starts to the plateau). We believe 14 is a good number because if there are too little participants, then we won't see a correlation in the data. It is important that our number of participants is an even number because we want half of the participants to start off with the Qwerty keyboard and the other half to start with our modified keyboard. This will also be further explained in the Tasks & Procedure section. These volunteers will most likely be students or young professionals, although we would not deny anyone who wants to join our study.

The only specific requirement that we would like to enforce on our participants is that they must be an avid soft keyboard user. It is important for the participant to understand the feel of typing on a soft keyboard. If we recruited a volunteer that has never typed on a soft keyboard, then that participant could be typing slowly because they are not familiar with an onscreen keyboard. If the participant is unfamiliar with the soft keyboard, then they might generate other errors that would not exist among our experimental errors. If possible, we would also like to look for participants who own Android phones. The Qwirky Qwerty keyboard is only available on Android, so iOS users might generate mistakes because they are not comfortable with typing on an Android phone. If we find participants who type on an Android often, then our results would be less skewed. Other than that, there are no other specific characteristics or requirements.

Experimental Design

The two keyboards we will be testing on our participants are the Qwerty keyboard and our own Qwirky Qwerty keyboard. Therefore, our independent variable, the keyboard, has two levels. The Qwerty keyboard is, of course, the standard. The Qwirky Qwerty is the modification of the Qwerty keyboard with the letters *t* and *f* switched. We will later be able to compare these two levels to see which keyboard is more efficient. It is only natural that our experiment is within-subjects. Each participant will be using the Qwerty keyboard as well as the Qwirky Qwerty during our sessions. The reason why we decided on this method is because we need to compare the words per minute between our keyboard and the Qwerty keyboard, and keep track of the learning curve. Without comparing it to the Qwerty keyboard, we'll have no way of knowing if our keyboard is efficient and "better" than the Qwerty keyboard.

Tasks and Procedure

We will be giving each participant a phrase to type out. They will be typing this phrase using the Qwerty keyboard and our Qwirky Qwerty Keyboard. Each time we meet with the participant, the typing phrase will be different. The results will not reliable if each participant types the same phrase every time. (What if they just memorized the placement of the keyboard and the upcoming words?) This phrase will be made up of words that are frequently used in the English language. Each phrase will be based on Norvig's [1] modernized study of Mark Mayzner's corpus. Here is an example of a phrase we will make our participants test out. Again, this is taken from [1]

THE INFORMATION SUPER HIGHWAY
THANK YOU FOR YOUR HELP
VIDEO CAMERA WITH ZOOM LENS
THE FOUR SEASONS OF THE YEAR
OUR FAX NUMBER HAS CHANGED

Note: This example is based on Mayzner's original corpus, and not Norvig's modernized version.

The reason why we are using 14 participants is because 7 of the participants will start off with Qwerty keyboard and the other half will start with the Qwirky keyboard. Since we are using the same phrase for both keyboards, if all of them start off with Qwerty, then they'll have practice with the words and know the words to type.

When we meet with our participants for the first time, we will give them a quick introduction of our project and then give them a consent form to fill out. Participants will be given some time to try out the keyboard before we start testing them. This might range from typing out a few sentences to a phrase. After this 1-2 minute trial, the experiment begins. Each participant shouldn't take more than 30 minutes. The volunteers will start typing the prompoted phrase whenever they feel comfortable, and once they are done, the number of errors and the time they took to type the phrase will appear on the screen. After they are done typing the phrase using one of the keyboards, they will then switch over to the other keyboard and type the same phrase. This will be the end of our experiment. By the end of the last session in this experiment, we will ask for subjective input from the participants. We will be doing this using the NASA Task Load Index format.

Measures

The first dependent variable that we plan to collect data from is time. We will measure the time it takes each participant to completely type the word sample we provide. We will also be calculating the words per minute (WPM) that each participant types at.
Time will be the most crucial dependent variable that we collect data from. This is because one of the most basic determinants for the efficiency of a keyboard is how quickly one can type on it. The purpose of this research project is to design a more optimal keyboard, and having high participant WPM will demonstrate the viability of our new keyboard. By measuring whether participants are able to achieve a high WPM typing speed, as well as complete their word sample in a relatively quick time, we will be able to determine the efficiency of our new design.

The next dependent variable that we will collect data from is typing accuracy. This includes keystroke errors that participants make while typing out their word sample. We will measure the number of keystroke errors that each participant encounters in their sample. Typing accuracy is another basic determinant of the efficiency of a keyboard. A mistype of a key results in incorrect input of text, and if one were to correct their mistake they would have to delete the accidental characters and retype the desired word. Not only is this an annoyance to a keyboard user, but the user will also have to spend an overall greater amount of time typing when they have to correct their mistakes. Therefore, measuring the typing accuracy is important in determining whether our new design is indeed efficient and adaptable.

By measuring these two dependent variables, we will be able to analyze two fundamental determinants of an efficient keyboard between our newly designed keyboard and the classic Qwerty keyboard.

Data collection

To collect data for the time it takes a participant to completely type the phrase, we have implemented a timer function in our app. The timer will start when the user begins typing and will end when they finish (when a space or an appropriate punctuation mark is typed on the last word). By logging the time from the very first touch of the keyboard to the very last letter inputted, we are able to measure the exact time of completion in seconds. Time to complete the word sample will be collected for every session of the experiment.

Also coded into our app, we have implemented a feature that will be able to measure the typing accuracy of our participants. This feature will keep track of the number of errors made throughout the completion of the word sample. When the user enters a keystroke that does not match the word sample, the error will be logged. At the end of each completed word sample, the number of errors made by the participant will be presented.

Furthermore, with the data we have collected regarding time and accuracy, we will also calculate the Net WPM of each participant using the following equation:

$$\text{Net WPM} = \text{Gross WPM} - \left(\frac{\text{Uncorrected Errors}}{\text{Time (min)}}\right)$$
$$= \frac{\left[\left(\frac{\text{All Typed Entries}}{5}\right) - \text{Uncorrected Errors}\right]}{\text{Time (min)}}$$

Equation for Net WPM (http://www.speedtypingonline.com/typing-equations)

This equation will determine the participant's WPM which will reveal the speed at which they type.

Finally, at the end of the experiment, we will collect information from each participant regarding their impression of our newly designed keyboard. Information will be collected in NASA Task Load Index format. Questions regarding the difficulty, efficiency, adaptability, and effectiveness of our keyboard will be presented with a grading scale that participants will fill out based on their experience. This data will serve as important information regarding the overall impression that each participant had with our keyboard.

References

1. I. Scott MacKenzie, Shawn X. Zhang. 1999. The design and evaluation of a high-performance soft keyboard. Retrieved Feb 2, 2016 from http://dl.acm.org.myaccess.library.utoronto.ca/citation.cfm?id=302983&CFID=749110248&CFTOKEN=21122957

2. Peter Norvig. 2012. English Letter Frequency Counts: Mayzner Revisited or ETAOIN SRHLDCU. Retrieved February 23, 2016 from http://norvig.com/mayzner.html