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How Important is Visual Feedback When Using a Touch Screen?

By Michael Deron

From check station point-of-sale devices (restaurants, grocery stores, etc.) to information kiosks, to the cars we drive (navigation systems), touch screens have become the input device of choice. While the versatility of the touch screen is highly desired, the poor performance it achieves relative to the mechanical keyboard has been something that users have been forced to deal with. Empirical research studies have found that touch screens consistently produced slower and less accurate performance when compared with keyboards (Barrett & Krueger, 1994; Wilson, Inderrieden, & Liu, 1995). Schneiderman (1998) outlines the many advantages and disadvantages to using a touch screen (see Table 1).

Table 1. Advantages and Disadvantages of Touch Screens

Advantages	Disadvantages
Programmable interface allows for greater diversity	Slower alphanumeric data entry
Utilizes natural abilities of user	Less accuracy (more errors)
requires no additional desk space	Finger may obstruct view of object on screen
Durability	Fatigue
Direct manipulation of objects or cursor	

For the most part, touch screen developers have relied upon the abundant research dealing with mechanical keyboard layouts and their functionality when designing touch screens. With mechanical keys, users are able to rest their fingers on a "home row" and with practice, learn to navigate the keyboard with very little visual or auditory feedback (i.e., they do not need to look at the keyboard when typing or hear the keys depress). Sufficient knowledge as to the accuracy with which they are typing is achieved through feeling the keys depress (proprioceptive feedback); it is this knowledge that leads to very fast input times.

Proprioceptive feedback for the touch screen user, however, is very limited. In most cases, users cannot feel the keys they depress and hence must look at the display while entering information. As a result, users are much more reliant on auditory and visual feedback from the touch screen application when self-monitoring input accuracy. Bender (1999) examined the effects of auditory feedback alone (with no visual feedback) on touch screen data entry performance that are typically found with point-of-sale applications. He found that users were both significantly faster and made fewer errors when an auditory "beep" was presented upon touch than when it was not.

In the present study, we were interested in determining the impact that visual feedback (by itself) has on touch screen performance. Here, users were given a series of four-digit numbers to input on a touch screen. Each user went through four different variations of visual feedback, in random order. For some

of the trials, users received no visual feedback (they had no knowledge as to whether the digits were entered correctly). For another set of trials, a text-field above the ten-key pad presented the numbers as they were pressed (similar to a display on a calculator). A third set of trials provided users with the appearance of a three-dimensional button depression on the ten-key pad when a key was selected. In a final set of trials, participants received both the text field and the visual depression as feedback. User movement time and error rate were used as the dependent measures.

Results of this study were similar to those of Bender (1999) for error rates. Any type of visual feedback resulted in significantly lower error rates than the no feedback condition where error rates averaged 40% (see Figure 1).

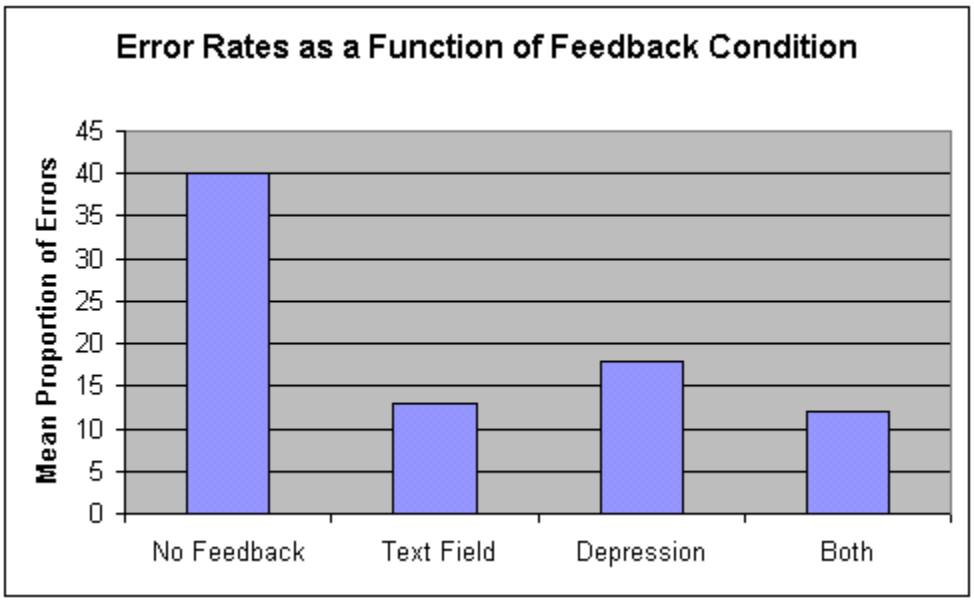

Figure 1. Error rates across the four visual feedback conditions.

No significant difference across conditions was found for movement time indicating that the presence or absence of either kind of visual feedback affected data entry speed. Subjective comments from the users verified that the visual information gave them assurances that the correct key had been selected, thereby preventing them from selecting again when they were in doubt.

It is interesting that although both visual and auditory feedback are not really required for mechanical keyboard use, they do provide much-needed insight into the improvement of touch screen use. Designers of touch screen applications must consider the visual and auditory feedback provided to the user. This is especially true in the case of point-of-sale applications where, error rates of 40% could be disastrous. Of course, this study only looked at two types of visual feedback. Further studies need to be done to determine the optimal types of visual feedback, as well as what impact the combination of visual and auditory feedback has on performance and user satisfaction.

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