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Entering Text Into Hand-Held Devices: Comparing Two Soft Keyboards

By Michael Bohan

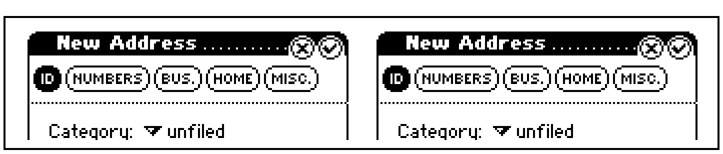
With the increasing demand for smaller more mobile devices (e.g., PDAs, pen tablets, etc.), manufacturers have been forced to consider alternative methods of input (other than a standard keyboard) such as pen-based input via handwriting recognition or on-screen, soft keyboards. However, meeting the need for high-efficiency input in these physically constrained environments has proven to be a challenge for designers and researchers, particularly given the fact that they are designing for a "walk-up" market where consumers want to be able to begin using it without extensive practice.

While handwriting is arguably the most natural fit for text entry on small notepad-sized computer devices, current handwriting recognition walk-up accuracy rates are still reported to be only around 85%-93% (Gibbs, 1993; MacKenzie & Chang, in press), and text entry speeds are around 16-18 wpm (MacKenzie & Chang, in press; MacKenzie, et at., 1994). Consequently, there remains a good deal of interest in on-screen or soft keyboards as a primary means of input for hand-held computing devices. Toward that end, we are exploring a wide variety of soft keyboard designs to determine which is the most effective.

In a recent series of experiments, we investigated text entry performance using two soft-keyboard designs; a standard QWERTY keyboard and the T9 keyboard, developed by Tegic Communication (see Figure 1).

The T-9 keyboard offers a number of unique characteristics that make it a potentially viable alternative to the QWERTY. The layout mirrors that of a touchtone telephone (without the numbers), with individual letters grouped onto a single key (e.g. ABC...DEF...GHI), thus users are offered larger blocked keys to tap instead of the smaller individual lettered-keys. Moreover, users do not need to make multiple taps to identify a single letter, as with some other types of telephone keyboards. Instead, this system uses a disambiguation algorithm, in conjunction with a dictionary, to determine the word intended. Obviously the success of this type of system is dependent upon the ability to accurately differentiate between potential words (e.g., "bat" and "cat"). Nevertheless, this keyboard design is appealing as an alternative to the QWERTY for three reasons.

- First, the natural familiarity with the layout of the letters on the T9 keyboard, due to exposure during telephone use, may allow users to become proficient at entering text with very little training.
- Second, because multiple letters are placed on a single key, the keys are necessarily larger than those on a comparably-sized QWERTY keyboard. The larger keys would be expected to yield faster tapping speed and improved accuracy.
- Third, the multi-letter blocks reduce travel distance, and thus again should yield faster input.



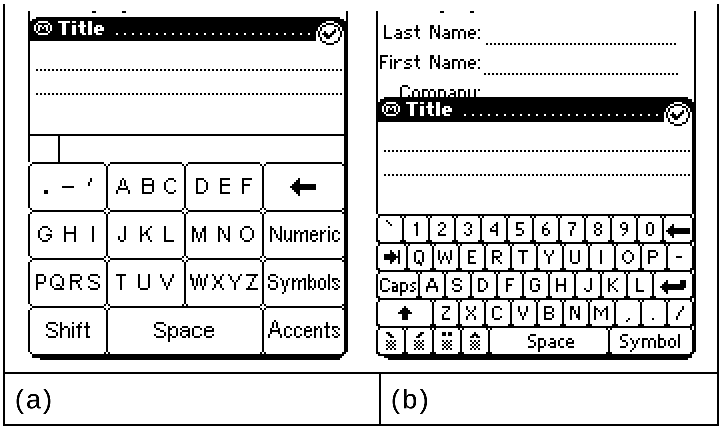
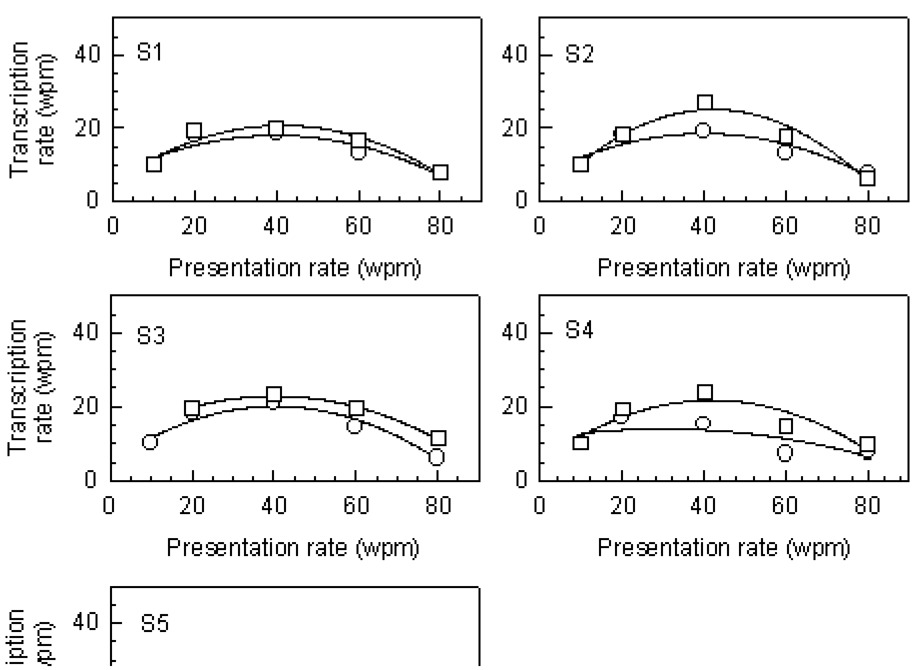


Figure 1. Pictorial representation of the (a) T9 and (b) QWERTY keyboards.

In our first experiment (Bohan et al., 1999), we presented words on a computer monitor at systematically varying rates and measured the speed at which participants were able to transcribe the words onto a PDA with these two keyboards. As demonstrated in Figure 2, despite the apparent physical superiority of the T-9 keyboard, transcription rates (in words per minute) were significantly higher for the QWERTY keyboard (on average 26 wpm and 19 wpm for the QWERTY and T-9 respectively). This finding suggested that perhaps grouping the letters together on a single key created a, "can't see the trees for the forest" effect (see Palmer, 1992), in which a greater amount of visual scan time was required to individuate the letters from the group (Eriksen, & Eriksen, 1974). This is also referred to as the perceptual grouping hypothesis. We tested this hypothesis in a second experiment by grouping the letters of a QWERTY keyboard in a similar fashion to the T-9 (e.g., "QWE") and then compared text entry performance on this modified QWERTY to the standard one. Consistent with the predictions of the perceptual grouping hypothesis, text entry was significantly slower in the modified version (M = 12 wpm vs. M = 26 wpm for the standard QWERTY). In a third experiment, we again modified a QWERTY keyboard, but this time manipulated the number of letters within a key (1-3). Again, consistent with the perceptual grouping hypothesis text entry speed decreased with an increase in the number of elements within a key (M = 22 wpm, 16 wpm, and 15 wpm for one, two and three letters respectively).

We are currently investigating ways to break this perceptual grouping effect so that it is possible to take advantage of potential benefits gained from grouping multiple letters on a single key (e.g. larger targets, smaller travel time, etc.). However, as it stands now, our results suggest that the QWERTY keyboard allows faster and more accurate input than the T-9 without the need for extensive practice.



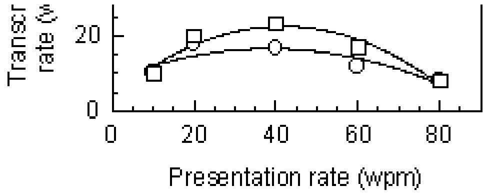


Figure 2. Transcription rate as a function of text presentation rate for the two keyboards. Circle and square symbols represent data obtained for the T-9 and QWERTY keyboards (From Bohan et al., 1999).

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