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The Size Effects of Keyboards (Keycaps) on Computer Typing Tasks

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***Abstract*—**Keyboard is the most important equipment for computer tasks. However, improper design of keyboard would cause some symptoms like ulnar and/or radial deviations. The research goal of this study was to investigate the optimal size(s) of keycaps to increase efficiency. As shown in the questionnaire pre-study with 49 participants aged from 20 to 44, the most commonly used keyboards were 101-key standard keyboards. Most of the keycap sizes (W×L) were 1.3×1.5 cm and 1.5×1.5 cm. The fingertip breadths of most participants were 1.2 cm. Therefore, in the main study with 18 participants, a standard keyboard with each set of the 3-sized (1.2×1.4 cm, 1.3×1.5 cm, and 1.5×1.5 cm) keycaps were used to investigate their typing efficiency, respectively. The results revealed that the differences between the operating times for using 1.3×1.5 cm and 1.2×1.4 cm keycaps was insignificant while operating times for using 1.5×1.5cm keycaps were significantly longer than for using 1.2×1.4 cm or 1.3×1.5 cm, respectively. As for typing error rate, there was no significant difference.

***Keywords*—**Keyboard, Keycap size, Typing efficiency.

I. Introduction

NOWADAYS, the conventional QWERTY keyboards are most commonly used but not designed to meet the ergonomic requirements of users. Many studies have revealed the kinematics of users' necks, arms, wrists, hands, and fingers in keyboard tasks (e.g., [1]-[3]). Some researches have indicated that the size, shape, and texture (material), as well as spacing, alignment (layout) and travel distance of the keycap and even the slope of keyboard wedge may affect typing performance (e.g., [4]-[6]). However, little or no existing research explored the effects of keycap sizes on typing efficiency. To further improve design of keyboards, this study investigated the size effects of keycaps on the typing tasks.

II. Materials and Methods

A. Pre-Study

This questionnaire pre-study preliminarily investigated the commonly used keyboard and the alphanumeric keycap size to design the keycaps samples applied in the main study. The subjects were 49 college and graduate students (25 male) from Tatung University in Taipei City. Their ages ranged from 20 to 44 (Mean = 26.21) years. All of them had extensive experience with PCs.

The fingertip breadths of the participants were measured. They ranged from 0.7 to 2.2 cm (mean = 1.31 cm). According to this survey of fingertips breadth, 63% (31 in 49) of the participants' breadths were 1.2 cm.

The result showed that the most commonly used keyboards were 101-key standard keyboards. Most of the keycap sizes (W×L) were 1.3×1.5 cm and 1.5×1.5 cm (see Fig. 1).

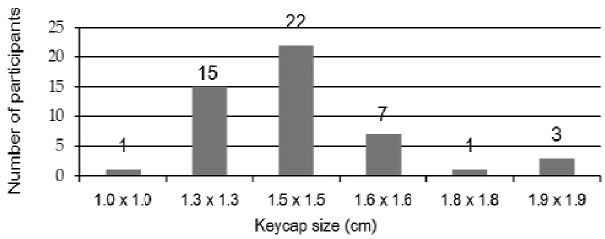

Fig. 1 The sizes of keycaps mostly used by participants

Consequently, 1.2×1.4 cm, 1.3×1.5 cm, and 1.5×1.5 cm keycaps were designed to be the samples to test with standard keyboards, respectively.

B. Man-Study

1. Participants

The unpaid volunteer participants of the study were eighteen college and graduate students (9 male) from Tatung University in Taipei City. They did not participate in or learn about the pre-study. Their ages ranged from 18 to 44 years (M = 27.12; SD = 5.08).All of them had extensive experience with computer typing tasks.

2. Apparatus

A Cherry MX-Board 3.0 (mechanical standard keyboard, see Fig. 2) with three modes of customized alphanumeric keycaps (1.2×1.4 cm, 1.3×1.5 cm, and 1.5×1.5 cm, see Fig. 3) connected to MSI Windtop AP2021 (All-in-One PC). The key activation force was 60±20 gram with vertical displacement of 0.4 cm. The key spacing was 1.9 cm.

Fig. 2 Cherry MX-Board 3.0

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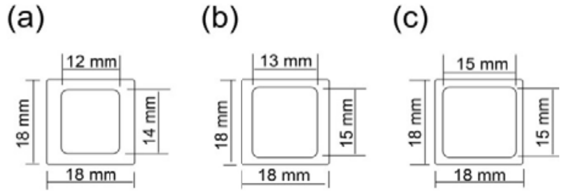

Fig. 3 Dimensions of tested keycaps:
(a)1.2×1.4 cm (b) 1.3×1.5 cm (c) 1.5×1.5 cm

3. Experimental Design

There was one parameter in this study. The mode of the keycap sizes (3 levels) was independent variable. Each task consisted of 1 testing and 2 training sets of trials in advance of the experimental trials. Dependent measures consisted of operating time and error rate.

Operating time was recorded for 3 passages and measured in words per minute (WPM). Errors gathered from all three passages then combined for each keycap. Any error was not allowed to be corrected and an error rate was defined as the ratio of the total errors (typing mistakes) to the total words typed in a testing trial.

4. Procedures

To minimize the learning effect, the keycap size conditions for all participants and the experiments were conducted over two days, with at least a one-day interval between tests. The order of the keycap size conditions were counterbalanced across participants. Participants conducted tests on different keycap sizes and passages in different orders.

Before starting the experiment, the participants were standardized instructed about the processes of the study, the devices and tasks. For each keycap size condition, participants conducted two 5-minute training sets of trials with a 1-minute break, and then typed 3 of 9 possible passages in a 5-minute block (three 1-minute trials and two 1-minute breaks in between) as one set of testing trials. All participants typed all 9 passages. Each participant performed 9 trials per task (3 sizes of keycaps×3 typing trials).

They were asked to proceed with the tasks as quickly and correctly as they could and to complete all the tasks.

The experimental environment was set up as shown in Fig. 4. The chair height and angle as well as the screen panel of the All-in-One PC were adjusted to suitable positions by the participants.

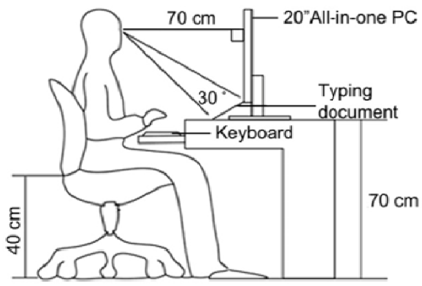

Fig. 4 Experimental environment

III. Statistical Analysis

Operating times and error rates were analyzed with one-way repeated measures analyses of variance (RMANOVA) for the within-subject factor ‘keycap size’ (3 levels). ‘Least significant difference (LSD)’ was used for post-hoc pair wise comparisons and the level of significance was set at 5%.

IV. Results and Discussion

Operating times were significantly faster for 1.2 × 1.4 cm or for 1.3×1.5 cm than for 1.5 × 1.5 cm, respectively (see Table I). It was comparable to the results of previous researches (e.g., [7]). The reason might be that most the fingertip breadths of participants were smaller than 1.5 cm but between 1.3 and 1.2 cm. The differences between the error percentages were not significant. It might be because the participants executed rather correctly with a mean error percentage below 5%. This phenomenon was in accordance with the results of other researches for typing tasks (e.g., [8], [9]).

V. Conclusion

In terms of operating times, the standard keyboards with 1.2×1.4 and 1.3×1.5 cm keycaps might be more suitable than with 1.5×1.5 cm ones for the typists with fingertip breadths not larger than 1.5 cm.

TABLE I
Mean Operating Times (s) and Error Rates (%) for Keycaps (Standard Deviations in Parentheses) (N = 18)

Keycap size (W× L) [cm]	Variables			Effects		
	1.2×1.4 (a)	1.3×1.5 (b)	1.5×1.5 (c)			
	Mean (SD)	*Mean (SD)*	*Mean (SD)*	$F_{2,51}$	*p*-Value	*Post Hoc*
Operating time [WPM]	61 (392)	56 (540)	42 (206)	4.18	0.021*	a = b > c
Error rate [%]	3.09 (0.16)	2.02 (0.09)	1.98 (0.07)	0.66	0.517	N/A

* $p < 0.05$

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