A Comparative Study of Text Entry Performance of Low-Profile versus High-Profile Keyboards

Camilla Arntzen
OsloMet
Oslo, Norway
s326162@oslomet.no

Jan F. E. Kopperud
OsloMet
Oslo, Norway
s326288@oslomet.no

Thomas Horn
OsloMet
Oslo, Norway
s315291@oslomet.no

Frode Eika Sandnes
OsloMet
Oslo, Norway
frodes@oslomet.no

ABSTRACT

Users' perceptions on what makes a good computer keyboard varies. Laptop computers are often equipped with low-profile keyboards for improved mobility, while desktop computers often are equipped with traditional high-profile keyboards with longer displacement ranges. This work set out to explore if the keyboard height profile influence text entry performance. A controlled experiment was set up with N = 15 participants. The results show that the low-profile keyboard yielded on average 12% faster text entry rates than the high-profile keyboards. No significant effects could be observed on error rates.

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI) → Interaction devices

KEYWORDS

low-profile keyboards, slim keyboards, chiclet keyboards

1 INTRODUCTION

Some users have strong preferences regarding computer keyboards. Some users prefer keyboards with distinct tactile or audio feedback such as mechanical gaming keyboards, while others prefer silent and/or portable keyboards. Laptop computer keyboards are often referred to as low-profile keyboards since they provide less vertical distance for the keys to travel compared to traditional high-profile desktop keyboards. Low-profile keyboards are also called slim keyboards, chiclet keyboards (after the Chiclet chewing gum) and island keyboards.

This study set out to explore if there are any differences in performance between these two keyboard types. We hypothesized that low-profile keyboard would yield the highest text entry performance since keys will have to be moved at a shorter distance with less energy.

PETRA '20, June 30-July 3, 2020, Corfu, Greece

ACM ISBN 978-1-4503-7773-7/20/06…$15.00
https://doi.org/10.1145/3389189.3393749

2 RELATED WORK

It has been claimed that the research into key design improvement is limited [1]. Issues studied includes the relationship between the point at which a button triggers a signal in relation to its displacement [2]. Keyboards with snap-spring and elastomer key action have been found to be preferred over keyboards with little resistance or linear spring key action [3]. Keyboards with little resistance resulted in more errors than keyboards with higher resistance [4]. Users have been found to typically prefer keyboards with kinesthetic and auditory feedback. Typing with more force may increase the risk of developing upper extremity disorders [5], keyboards that provides cushioning to the fingertips have been designed [6].

Kia et al. [7] studied the effect of ultra-low-profile keyboards (down to 0.5 mm displacement) to regular keyboards (2.0 mm displacement) and was unable to find any notable effect of keyboards on bio-mechanical exposures or typing performance. However, participants preferred the high-profile keyboards.

Hoyle et al. [8] studied the effect on low-profile keyboards by measuring typing tasks on four keyboards with different travel distances ranging from 0 mm (no key displacement) to 2.0 mm. Their results showed that the typing performance was higher with the two keyboards with the largest travelling distance. The error rates were also higher with the 0 mm keyboard compared to the other three keyboards. The 0 mm keyboard also received a lower preference rating than the other three keyboards. Similar conclusions were made by Coppola et al. [9].

3 METHOD

A within-groups controlled experiment was designed with keyboard profile as independent variable and text entry speed and error rates as dependent variables. The in-dependent variable had two levels, namely low-profile keyboard and high-profile keyboard.

A total of 15 participants (7 female) were recruited in the range of 18 to 68 years of age (M = 28.4, SD = 14.6). Of these, 12 participants reported using low-profile keyboards, while 3 used high-profile keyboards. The experimental setup included a laptop computer and two external keyboards. Text entry speeds and error rates were measured with SpeedTypingOnline.

The participants were asked to conduct two text copying tasks suing MacKenzie and Suokoreff's phrases. Each participant was tested individually in a designated meeting room in the authors' university. The presentation orders of the keyboards were randomized to minimize learning effects.

4 RESULTS

Figure 1 shows that the low-profile keyboard resulted in a higher text entry rate in words per minute (M = 46.7, SD = 11.0) compared to the high-profile keyboard (M = 41.5, SD = 10.2). In other words, the mean text entry rate is 12.5% faster with low-profile keys compared to high-profile keys and this difference was highly statistically significant ($t(14) = 7.597$, $p < .001$, d = 1.961).

A Shapiro-Wilk test showed that the distribution of the observed error rates did not satisfy the assumption of normality ($p < .001$) and a Wilcoxon test was therefore used to examine the data. No effect of keyboard types on error rates were detected (W = 28, p = .405). The mean observed error rates were quite similar for the low-profile keyboard (M = 4.2, SD = 4.1) and the high-profile keyboard (M = 4.1, SD = 2.5). However, the spread with the low-profile keyboard was nearly twice as large as with the high-profile keyboard.

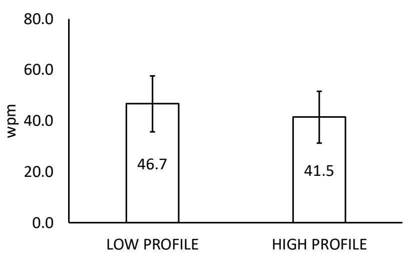

Figure 1: Text entry results. Error bars shows SD.

5 DISCUSSION

It is interesting that the keyboard profile has such a significant effect on text entry performance with such a small number of participants and short text entry experiment. As opinions regarding keyboards range it would be relevant to contrast the effects with gaming keyboards with physical switches to low-profile keyboard. Users of high-profile mechanical keyboards are usually very convinced that this type of keyboards are superior to other keyboards. On the other hand, text entry performance is not the only parameter to consider and comfort is equally important with prolonged use.

The results obtained also do not agree with previous studies that have measured the effect of keyboard height profile [4, 5]. It may be that the upcoming generation who are used to low-profile keyboards with the prevalence of laptop computers (as was the case in our study) may exhibit a different preference to the older generation.

In terms of error rate, the results do not lead to a distinct conclusion. However, there are signs that there may be a difference between the low-profile and high-profile keyboards in terms of error rates where the high-profile keyboard may lead to fewer errors. A non-significant practical higher observation was observed with the low-profile keyboards, while the observations had a smaller spread with the high-profile keyboard. However, a larger sample of measurements are needed in order to clearly assess if there indeed are significant differences in error rates. Such a finding would also agree with the study by Agaki [4] who found that longer key travel distances where associated with fewer errors compared to shorter key travelling distances.

Most of the participants reported being used to the low-profile keyboard. There is thus a risk that this may have resulted in a bias in favor of the low-profile keyboards. Another weakness of the experiment is the different force displacement curves of the two keyboards used. In a strictly controlled experiment, the force response on the keys should be similar such that only the distance travelled is different.

6 CONCLUSIONS

The results of this study show that a higher text entry rate was achieved with the low-profile keyboard compared to high-profile keyboards. No error difference was observed.

REFERENCES

[1] Yi-Chi Liao, Sunjun Kim, and Antti Oulasvirta. 2018. One Button to Rule Them All: Rendering Arbitrary Force-Displacement Curves. In The 31st Annual ACM Symposium on User Interface Software and Technology Adjunct Proceedings (UIST '18 Adjunct). Association for Computing Machinery, New York, NY, USA, 111–113. DOI:https://doi.org/10.1145/3266037.3266118

[2] Sunjun Kim, Byungjoo Lee, and Antti Oulasvirta. 2018. Impact Activation Improves Rapid Button Pressing. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18). Association for Computing Machinery, New York, NY, USA, Paper 571, 1–8. DOI:https://doi.org/10.1145/3173574.3174145

[3] Hans Brunner and Rose Mae Richardson. 1984. Effects of keyboard design and typing skill on user keyboard preferences and throughput performance. In Proceedings of the Human Factors Society Annual Meeting. Sage CA: Los Angeles, CA: SAGE Publications, 267-271.

[4] Kenichi Akagi. 1992. A computer keyboard key feel study in performance and preference. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting. Sage CA: Los Angeles, CA: SAGE Publications, 523-527.

[5] Margaret Hughes and Peter W. Johnson. 2014. Differences in the three-dimensional typing forces between short and long travel keyboards. In Proceedings of the human factors and ergonomics society annual meeting. Sage CA: Los Angeles, CA: SAGE Publications, 1447-1450.

[6] Alec Peery and Dušan Sormaz. 2018. 3D Printed Composite Keyboard Switches. Procedia Manufacturing 17, 357-362.

[7] Kiana, Kia, Jonathan Sisley, and Peter W. Johnson. 2019. Differences in typing forces, muscle activity, wrist posture, typing performance, and self-reported comfort among conventional and ultra-low travel keyboards. Applied ergonomics 74, 10-16.

[8] Wimberly S. Hoyle, Michael C. Bartha, Christy A. Harper, S. Camille Peres. 2013. Low profile keyboard design: the effect of physical key characteristics on typing productivity and user preference. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Sage CA: Los Angeles, CA: SAGE Publications, 1348-1352.

[9] Sarah M. Coppola, Phillipe C. Dixon, Boyi Hu, Michael Y. Lin, and Jack T. Dennerlein. 2019. Going Short: The Effects of Short-Travel Key Switches on Typing Performance, Typing Force, Forearm Muscle Activity, and User Experience. Journal of applied biomechanics 35(2), 149-156.