

Evaluation of fitts law for touch screen human-computer interface: one and two dimensions

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Abstract: Recently, touchscreen technology has increased dramatically in the medical field. This study evaluates the suitability of human-computer interaction through two tasks in terms of gender differences using a Microsoft Office touchscreen laptop. Fitts's law pointing was employed to study the effect of 1-dimension and 2-dimensions in terms of gender differences on the three task parameters. Although there was no significant difference in the index of difficulty, the statistically significant differences between the movement time and throughput were particularly evident in the 1D task. Using a two-dimensional touchscreen reduces the gender gap. Training of females on one-dimensional touch screens is recommended.

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I. Introduction

Many medical products contain an LCD module of one type or another. This is nothing new, but what is surprising is the increase in the number of medical devices that incorporate some sort of touchscreen technology [1]. One of the most important reasons for moving to touch screens in medical devices is to reduce chaos by eliminating extra devices such as mouse or keyboard and also phasing out buttons and switches. Nowadays, designs have influenced how people and computers are related. The technician to communicate with machines or in other words computers is important to every individual to use whether in their daily lives or in work-life. Since the invention of computers, almost every aspect of humans depends on technology, and in every design nowadays the user has a unique experience, style, and quality depending on the priorities of life. The unique style and device of the user experiences are impacted by how each design of the human-computer interaction interface is and which has a significant impact on how easy and practical machines and computer equipment can be used. The design of human-machine interfaces is more precise and demanding in the medical and healthcare industries. Medical monitoring equipment requires more precise and accurate time expression, therefore, the interface design for medical monitoring equipment is important in terms of human-computer interaction [2]. According to Fitts's law, human movement can be modeled by analogy to the transmission of information. Fitts's popular model has been widely adopted in numerous research areas, including kinematics, human factors, and more recently human-computer interactions. Many researchers investigate Fitts's law on one-dimensional (1D) and two-dimensional (2D) pointing tasks [3]. Factors that may have an impact on the model, such as gender differences, were also studied [4]. However, pointing tasks were not considered with respect to gender differences in these studies. This study evaluates and compares the fitness for human-computer interaction of two tasks:

one (1D) and two dimensions (2D), in terms of gender differences using a Microsoft Office Touch-Screen Laptop.

II. Material and methods

Fitts's Law was used on the basis for operating 1D and 2D by touch-screen laptop taking into account gender differences. The participants were 120 students from the University of Duhok, 60 male and 60 female. All participants were between 18 and 22 years old. They all had a correct vision and all gave their informed consent to participate in accordance with the regulations of the Institutional Review Board of the University of Duhok. The environment for this experiment is a Java-based software program that will be used to measure the movement, time, and as well as all record independent variables. The experiment was between either two vertical boxes (one dimension) or between multiple circles (two-dimension). One Microsoft Surface touch-screen Laptop was used in the experiment and Java software was loaded into it. Each student was asked 7 trials and 9 complete sequences using both vertical boxes and circle tests. The independent task parameters were the width/diameter between boxes/circles, and the distance between boxes/circles respectively. Whereas the dependent task parameters are the index of difficulty (ID) which was measured in bits, and throughput (TP) which was measured in bits/s, and the movement time (MT) was measured in milliseconds. Data were analyzed using SPSS. Differences between male and female groups in one and two-dimensional tasks were investigated using the Mann-Whitney test for the task parameters (ID, MT, and TP).

III. Results and discussion

Males showed lower movement times than females for the one-dimensional and two-dimensional tasks with a difference of 11.45 % and with a difference of 6.24 % respectively as shown in figure 1 (A and B). The difference was statistically significant ($p < 0.05$) for both tasks between the males and females. This may be due to the fact that males

and females use different cognitive strategies for dealing with spatial tasks [5], and that females use their cognitive skills less than males even within the same occupation [6]. Furthermore, the results for throughput in the one-dimensional task showed that the males yielded a throughput of 6.16 bits/sec, which was 10.17 % higher than the average of 5.57 bits/sec for the females. While for the two-dimensional tasks, the Male throughput of 4.45 bits/sec was 5.93 % higher than the average of 4.19 bits/sec for the females as shown in figure 2 (A and B). This is also consistent with the central idea in Fitts's work that throughput is independent of the amplitude (A) of movement and target width (W), as implied by ID. In other words, as ID changes (due to changes in A or W), MT changes in an opposite manner and TP remains less affected [7]. In the gender comparison, the difference was statistically significant ($p < 0.05$) for throughput only in the one-dimensional task which is fully consistent with what has been reported by Mackenzie [3].

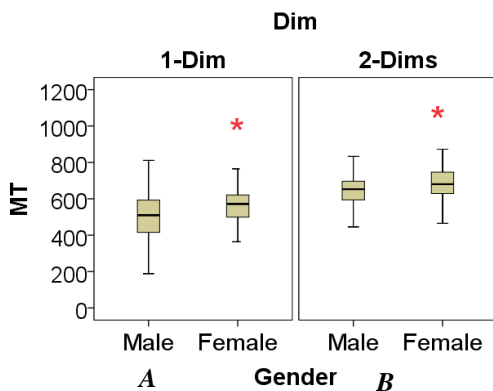


Figure 1 Movement time for males and females in (A) 1D and (B) 2D Fitts's law tasks.

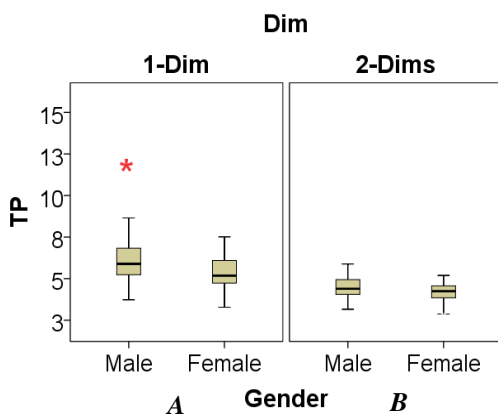


Figure 2 Throughput for males and females in (A) 1D and (B) 2D Fitts's law tasks

This result may be explained by the fact that faster environmental learning in males compared to females in particular for one dimension [8]. Furthermore, it is suggested that the insignificant difference in 2-D throughput between males and females indicates that longer cognitive-motor tasks reduce the gender gap. The Index of Difficulty score was fairly constant for both tasks and with less than a 2 % change in terms of gender difference. Thus, no breakdown of the results by the index of difficulty was given. Finally,

the findings are likely to have reasonable generalizability to similar individuals and populations.

IV. Conclusions

For devices with a two-dimensional operational interface, the differences between the genders are almost non-existent in terms of both MT and TP. The fact that males are superior to females in the use of input interfaces for a one-dimensional touchscreen device doesn't mean that females pose a risk in operating such equipment. However, it is preferable to train users of female input interfaces for one-dimensional touchscreen devices in order to reduce MT and increase TP.

AUTHOR'S STATEMENT

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