Fitts’ Law

Fitts [1] published in 1954 his law that represents a model for human movement to predict the time that it takes for a user to move from an origin to a target. This law establishes the relationship between time, distance and accuracy for aimed movements. He created a function that measures speed and accurary in pointing tasks. This model could be used in the real world or in digital devices because this law applies to actions like pointing and dragging like using a computer mouse or pointing in a touchscreen. This model is used in human-computer interaction investigations to predict user behivour [2].

Scott MacKenzie [12] addapted the formula to be MT= a + blog2(A / W + 1) where MT represents the movement time, and a and b are the empiric constants that are adjusted to the specific device used. A is the amplitude or distance from the initial point to the center of the target. W measures the width of the target and could also represent the accuracy of the pointing task as it sets the limits of the action. Fitts’s ID or index difficulty determines the movement difficulty and has units of bits [13]. The most used formula for ID is Shannon formulation proposed by MacKenzie [14] ID = log2(A / W + 1).

Hick’s Law

Hick’s Law represents a way to predict the time used to make a decision when a multiple choice task is evaluated. This law can measure the capacity for cognitive information. The function to evaluate the required time, T, to choose among n choices is T = b log2(n + 1). This time, known as the rate of gain of information, is logarithmic beause people divide possible options into categories instead of evaluating one by one so that they discard part of them.

Keystroke

The Keystroke-Level model was designed to predict the execution time spent in mouse and keyboard tasks [6]. It evaluates the steps needed to complete a task to improve the process. After evaluating the task, steps could be sorted to facilitate the understanding and even resultant unnecessary steps could be removed. The method contains five operators to categorise and measure task steps, they are: P for pointing, K for key strokes, B for button pushes, H for movement from the mouse to the keyboard or viceversa, R for system waiting and M for mental preparation. Each operation has a constant time obtained from experiments. By adding the constants the times they apply in the task, the needed time to complete the task could be easily estimated.

Gender issues

One study performed in 2007 [4] with Chinese and British university students analyses the sex differences in the use of computers and Internet, and shows (claims) that men start using computers earlier that women, more than five years before for British men students in this study. It also suggests the existance in the past of a stereotype that stated that computers were considered as masculine.

Another study [7] examines the differences between American college students from 1989 to 1997. In 1997 gender differences were reduced and students had more experience than people from previous years. Nevertheless men still had more experience in programming and in computers in general terms, and this could influence the greather feeling of confort in using computers and the Internet.

To analyse the differences in computer attitudes and anxieties, one study [8] was done between 207 British students and 286 from Hong Kong. They found more positive computer attitudes in males and the same anxiety for both genders in British participants. In contrast, Hong Kong male participants showed more anxiety and no gender differences in attitudes were noticed.

One study [9] to meausure gender differences in an online learning course found that male participants had more problems interacting but obtained slightly better results. Nevertheless, no differences in learning were found.

Another experiment [10] with 36 men and 36 women who were asked to perform a computer task shows that men achieved better results than women as they spent 50% less time in average to complete the task. These participants also completed a survey where one question asked whether they thought that computers were easy to use, for this topic 72% of men answered affirmatively in contrast to women proportion, 36%.

Cultural issues

The cultural differences from the point of view of the user of an interface play a remarkable role in reception satisfaction. The process of interface designing should consider those cultural differences, since they influence user perception [11].

Laterality issues

Eye movements are faster than hand movements [5].

When the mouse movement is analysed the dominant hand of a person accomplishes fast non-accurate reactions and the non-dominant hand reacts accurately and slowly. It is also known that small target elements are difficult to reach and big elements are easy [3].

In an experiment [15] accomplished by a group of 26 men and 26 women, all right-handed students, accuracy and response times were examined. The study reports that male participants were more lateralized than female ones. It also shows the dominance of the right hemispheric of the brain for men.

In another study [16] based on two response-time experiments, a group of right-hand male participants were asked to complete two tasks: a pointing exercise and a visual detection one. For both tasks the left hand obtained shorter response-times, which shows that the right hemisphere is dominant for movement planning, and takes less time to plan a movement. Thus, manual asymmetries in aiming movements are related to the dominance of the right hemisphere for visual attention.

One experiment [17] done with 100 young male participants demonstrated that right-handed participants’ reaction times were faster for right hand movements than those completed with the left hand. It also states that the differences between both hands for left-handed people were not relevant.

To examine the difference between right and left hand response times in spatial movements a group of people participated in an investigation [18] that consisted in the performance of a pointing task and a questionnaire fulfillment to determine the hand preference. The results show that for left-handers the left hand behaves better when the target is in the left side as the right hand does for the right side, so there was no difference when the target was spatially located in the same side of the hand. Nevertheless, right-handers achieved better results in ipsilateral movements done with their left hand.

Age issues

An experiment [20] with a group of people of different ages measured how age could affect the reaction time when performing a step. The oldest people, with a mean age of 78, executed the task 10% slower than the group of people with a mean age of 67.3, and this last group performed the step 23% slower than the youngest group, whose mean age was 20.

Men and women start losing power and strength at the age of 40. [21]

The speed in performing tasks decreases as people get older. A experiment [22] with old and young adult participants consisting in moving a cursor with a mouse to a target revealed that older volunteers spent more time to do the asked task. The difference in time was not related to the lack of force enough to complete the task as participants unconciously preferred slower movements. It also states that older people produce a greater number of fast sub-movements to compensate their lower accuracy.

This strategy of compensation motor efficiency perceived in older individuals was also reflected in a typing performance study [23] ran with 34 professional female typists. This research exposes that older women had slower tapping rate and reaction times but their speed of typing was similar to younger participants’. This is related to the fact that older typists compensate their age-related loss of motor efficiency anticipating the characters in advance.

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Towards a standard for pointing device evaluation, perspectives on 27 years of Fitts’ law research in HCI

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Abstract

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Fitts's Law Studies of Directional Mouse Movement

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Gender and cultural differences in Internet use: A study of China and the UK

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EVALUATION AND ANALYSIS OF EYE GAZE INTERACTION

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Using the Keystroke-Level Model for Designing User Interface  
on Middle-Sized Touch Screens

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Gender, Internet and computer attitudes and experiences

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A Cross-Cultural Comparison of Gender Differences in Computer Attitudes and Anxieties: The United Kingdom and Hong Kong

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An Exploratory Study of the Effects of Gender on Student Learning and Class Participation in an Internet-Based MBA Course

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Cultural Issues and Their Relevance in Designing Usable Websites

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