King Saud University

College of Engineering

IE – 341: "Human Factors Engineering"

Spring – 2024 (2nd Sem. 1445H)

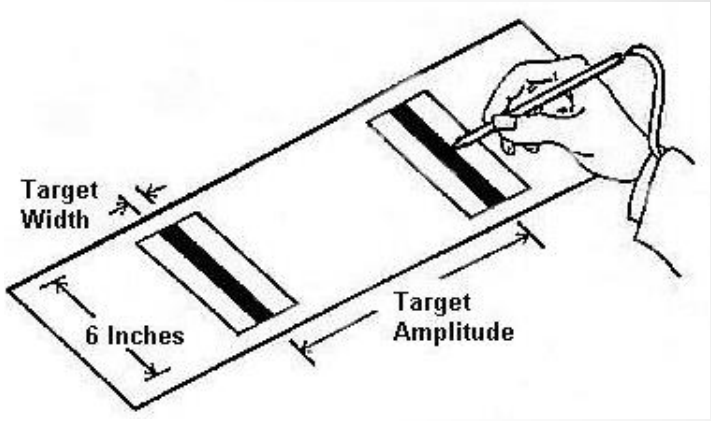
Chapters 3. Information Input and Processing

Part – 2: Fitts's Law (Chapter 9)

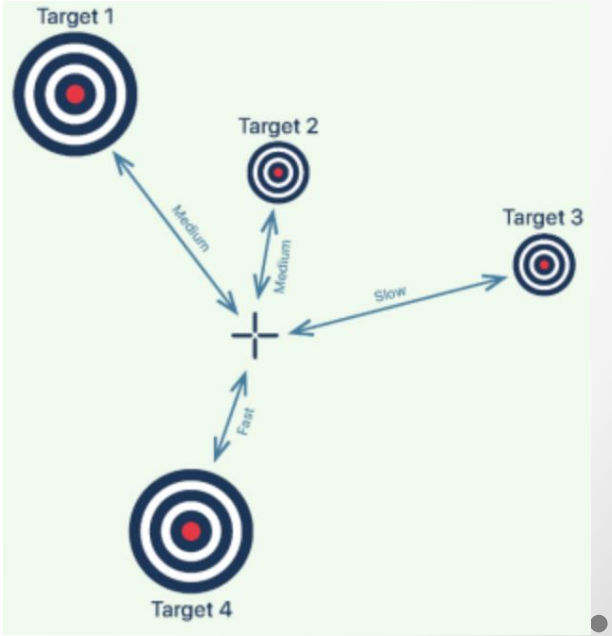
Prepared by: Ahmed M. El-Sherbeeny, PhD

Fitts's Law

- Fitts's Law is used to reach a relation between
  - **size** of, as well as **distance** to target
  - and speed (or **response time**, RT) to reach target

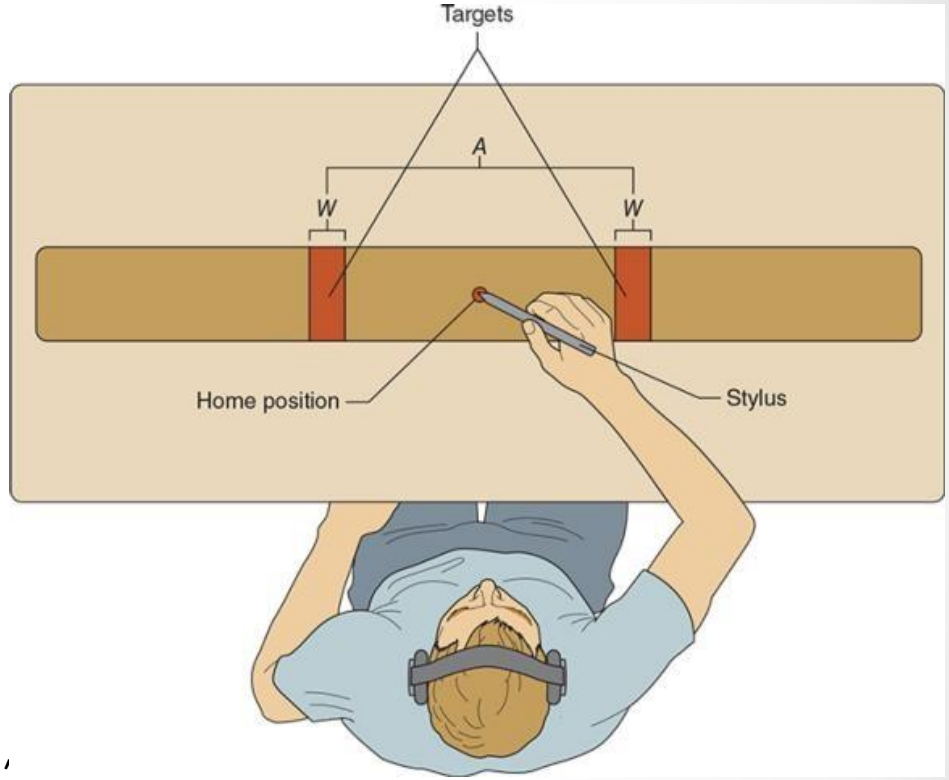


- *Fitts* and *Peterson** found that:
  - the longer the distance (*D*)
  - and/or the smaller the target (*W*)
  - ⇒ the longer the movement will take



Fitts's Law

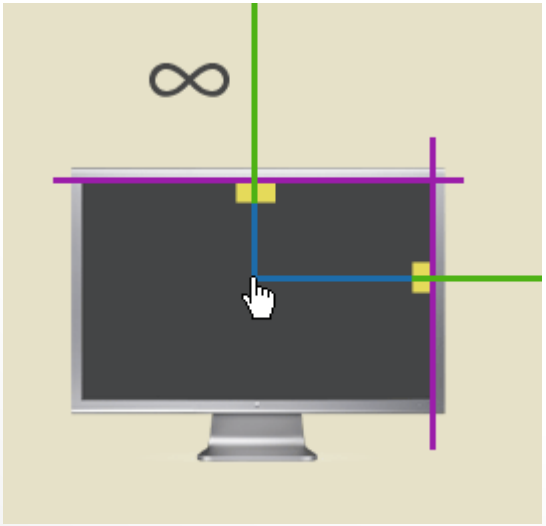
- Fitts's tapping task:
  - participant taps between two targets
  - targets have varying width (*W*),
  - and varying amplitude between them (*A*)
  - participant attempts to move as rapidly as possible between targets,
  - while keeping the number of target misses to a minimum

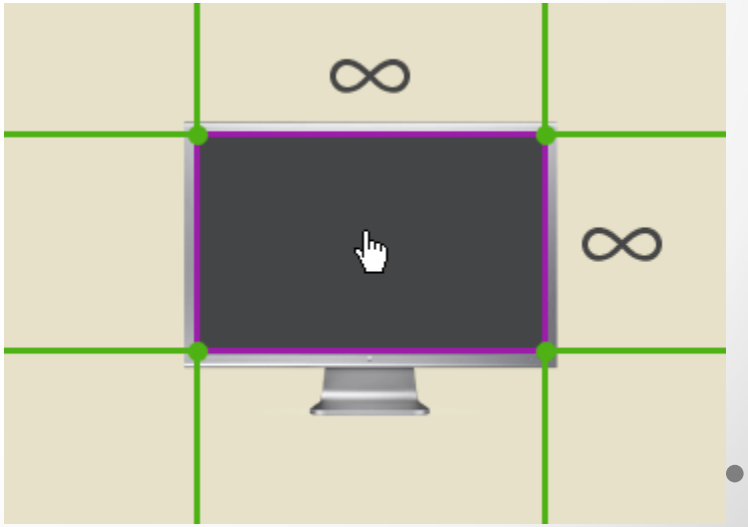


Fitts's Law

- Target can be button on screen or break pedal, etc.

- This has many (increasing) applications in HCI (human-computer interaction)
- The most important finding: edges of a screen are easiest (i.e. shortest time) to reach: can you show how?

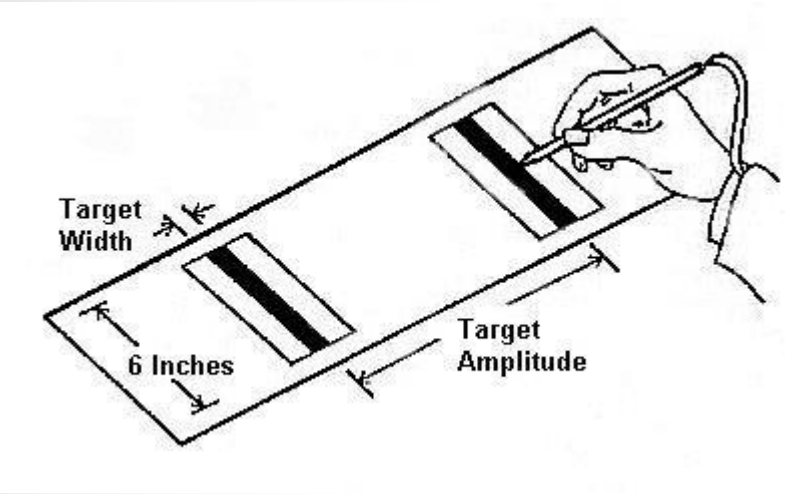




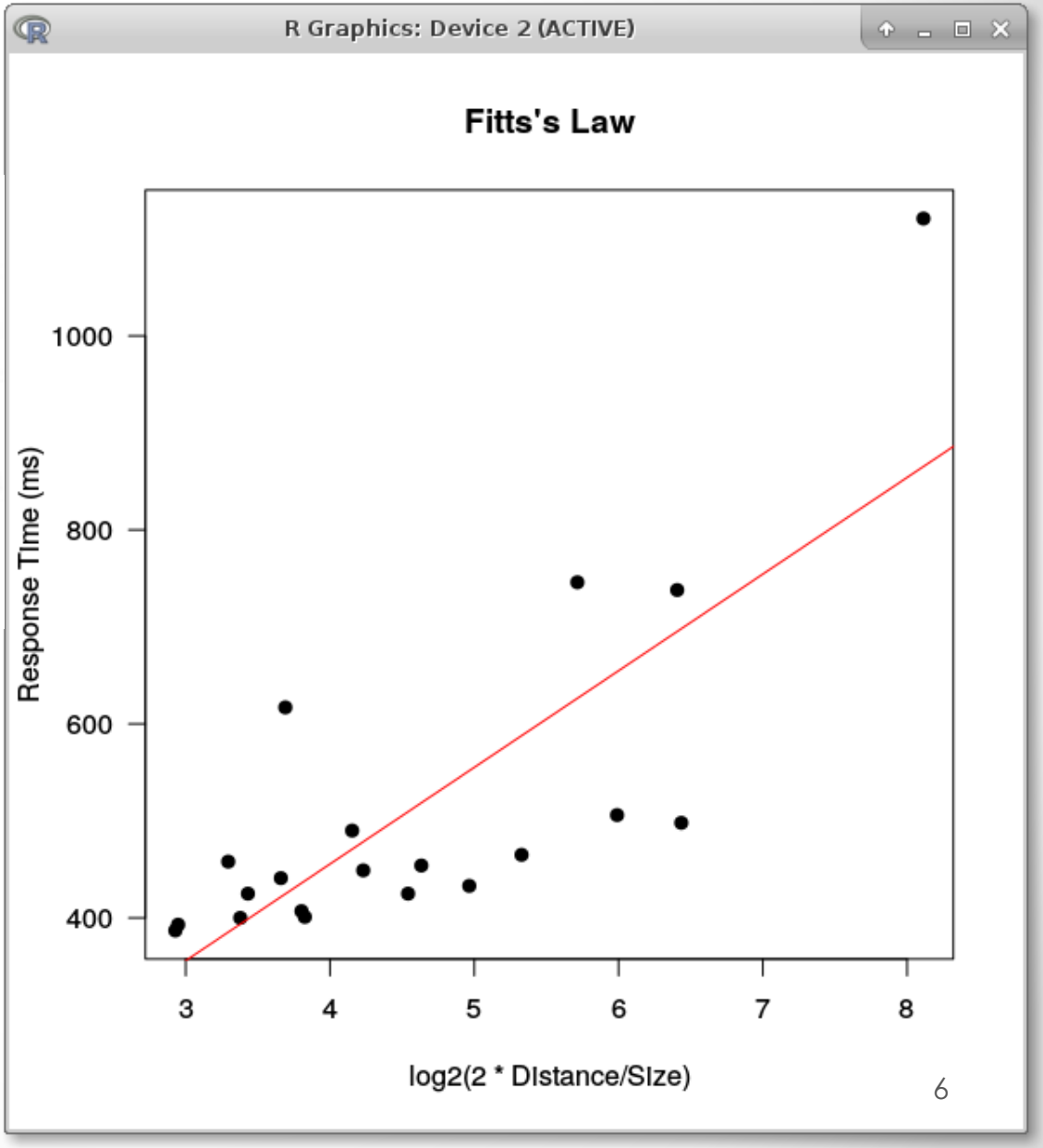
Fitts's Law

- Watch the following video on Fitts' (or Fitts's) Law: https://youtu.be/E3gS9tjACwU

Fitts's Law



- Q: where does the red line cross the y-axis? What do you think this means?*



Fitts's Law

- Fitts's Law:

$$T = a + b \log_2 \left(\frac{2D}{W} + 1 \right)$$

  - T: movement time (aka *MT*)
  - *D*: distance to target (aka amplitude)
  - *W*: width of target (i.e. target size, e.g. button)
  - *a*, *b*: empirically derived constants (depend on the type of movement)
  - Note, there are different versions of Fitts's Law (e.g. *D*/*W* instead of 2*D*/*W*)*

- Q: what happens if $D \approx 0$? or if $W \to \infty$? What does that mean (i.e. any useful implications?)

Fitts's Law

To show effect of constants *a*, *b*:

- Figure 9-10: data from movements of the
  - arm
  - wrist (hand), and
  - finger (Q: why?)
- slope of line decreases from arm to finger*
- as slope ↓
  ⇒ effect of (*D*/*W*) ratio ↓
- Note, Fitts' law also applies:
  - movements of the head
  - movements of the feet
  - movements made underwater
  - remotely manipulated movements

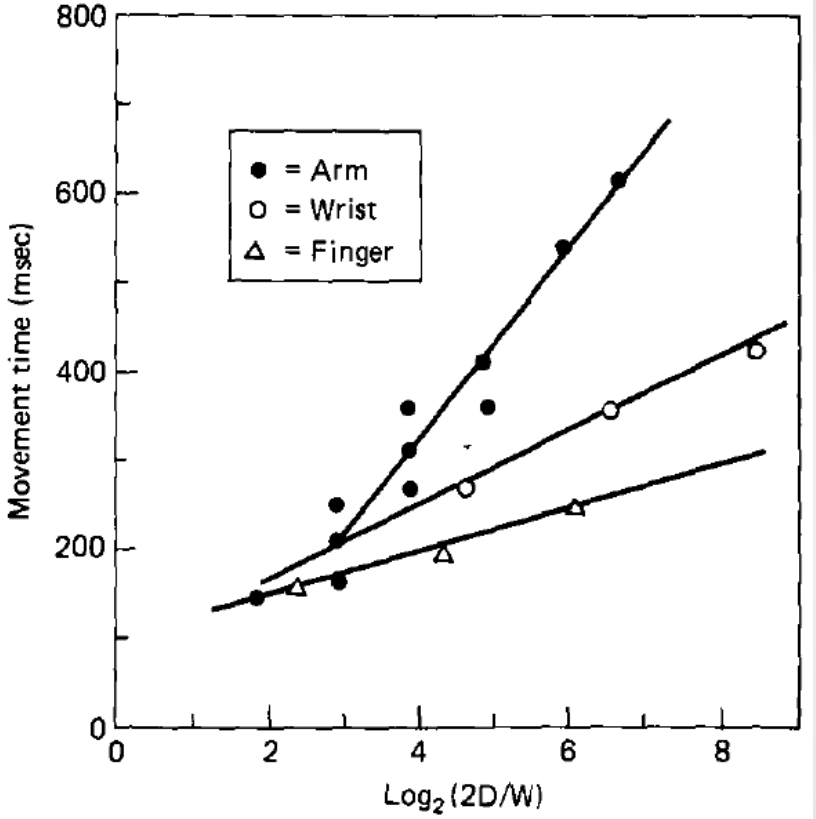


FIGURE 9-10
Example of Fitts' law for arm, wrist, and finger movements. The slopes of the functions are: for arm, 105 ms; for wrist, 43 ms; and for finger, 26 ms. (*Source: Based on data from Langolf, Chaffin, and Foulkes, 1976.*

Fitts's Law

- Interactive Exercise on *Fitts's Law*
  http://fww.few.vu.nl/hci/interactive/fitts/

- Another interactive exercise and further explanation:
  http://www.psytoolkit.org/lessons/fitts.html

- Another interactive exercise:
  http://simonwallner.at/ext/fitts/

References

- ***Human Factors in Engineering and Design***. Mark S. Sanders, Ernest J. McCormick. 7th Ed. McGraw: New York, 1993. ISBN: 0-07-112826-3.
- ***Movement time prediction in human-computer interfaces***. MacKenzie, I. S. (1995). In R. M. Baecker, W. A. S. Buxton, J. Grudin, & S. Greenberg (Eds.), Readings in human-computer interaction (2nd ed.) (pp. 483-493). Los Altos, CA: Kaufmann. [reprint of MacKenzie, 1992]