FITTS' LAW

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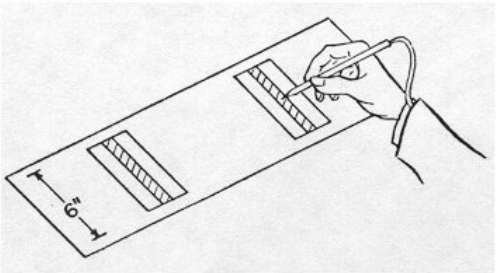
Fitts' Law

- Fitts' Law or Fitts's Law (never call it Fitt's Law)
- Named after Paul Fitts, for his 1954 study of pointing. His original study was on pointing with a stylus, but his work is applicable to pointing with a mouse, using touch screens, and the range of pointing devices for 2D displays.

http://usabilist.com.ua/wp-content/uploads/2009/01/paul-fitts-copy.png

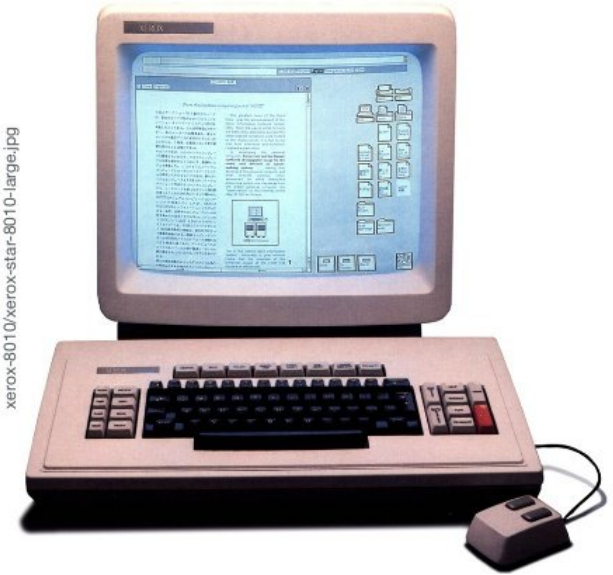
Paul Fitts (1912-65)



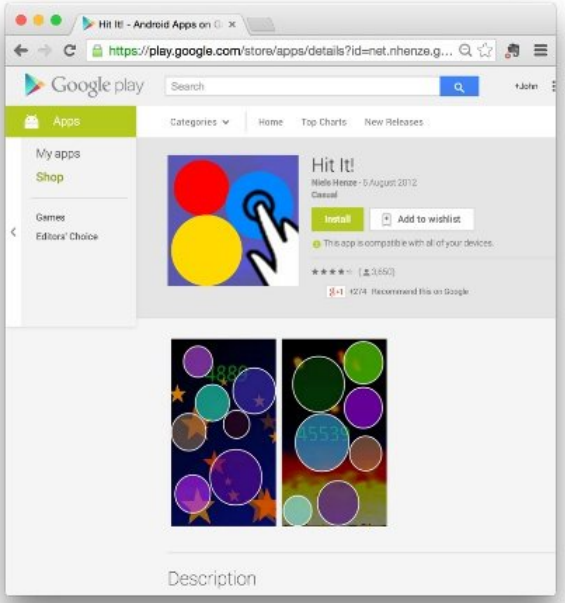
http://automation.berkeley.edu/fitts/tapping.gif

Fitts' stylus experiment

http://www.digibarn.com/collections/systems/xerox-8010/xerox-star-8010-large.jpg

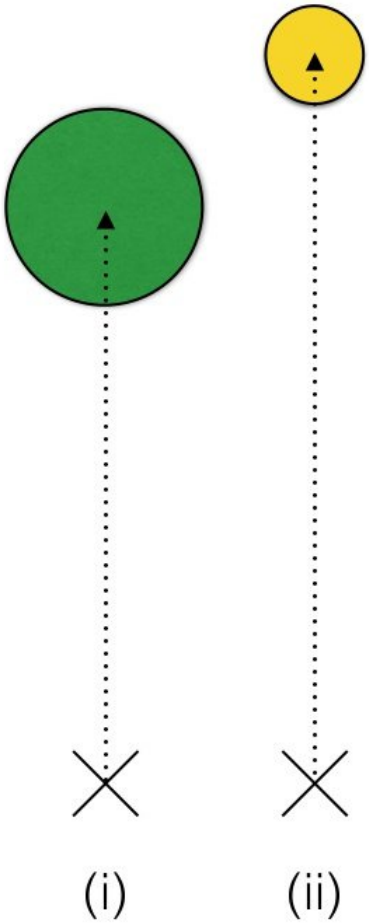


Fitts' law influenced the development of the first WIMP (Windows Interface, Mouse Pointer) computer - The Xerox Star

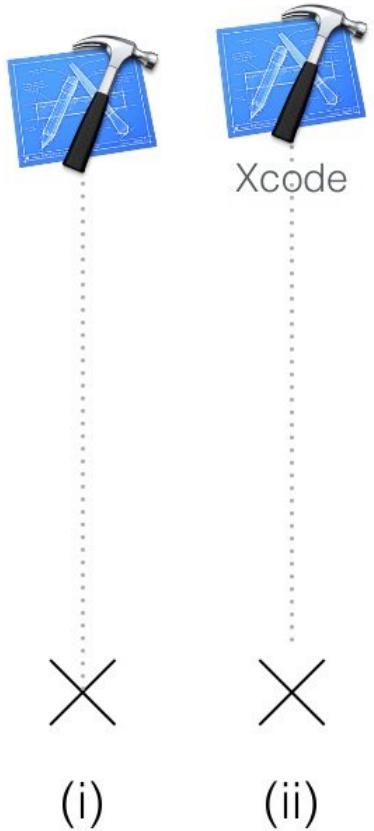


Fitts' law is applicable to touch screen devices. The game Hit It! is a mass scale experiment in Fitts' law

- Fitts' law tells us how long it will take to move a pointer from a specific position to hit different targets.
- Targets that are larger and closer are easier to hit than ones that are smaller and further away.
- We can use Fitts' law to *predict* how long it will take to hit a target (or series of targets)
- We can also use Fitts' law to *compare* different input devices.

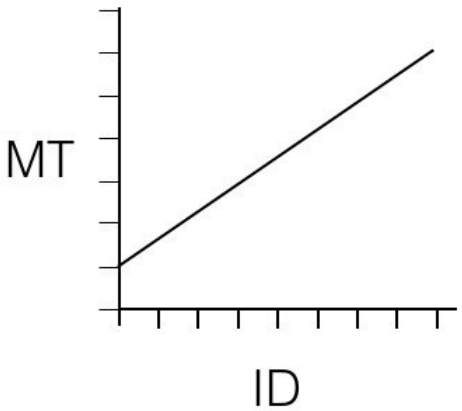


- Icon (ii) is bigger because it has text below it.
- Icon (ii) will therefore be slightly quicker to hit.
- However, icon (ii) is only larger on a vertical axis. It will not be any quicker to hit than icon (i) when moving horizontally.



That's why this widget draws such large icons:
Apple engineers know all about Fitts' Law!

Fitts' Law



$$MT = a + b * ID$$

MT = Movement Time (*typically in milliseconds*)

a = intercept (*MT* where *ID* = 0)

b = slope

ID = Index of Difficulty

There is a linear relationship between MT (Movement Time) and the ID (Index of Difficulty)

When comparing different pointing devices a and b can be experimentally determined.

When predicting how quickly a target can be hit, a and b can be assigned a value.

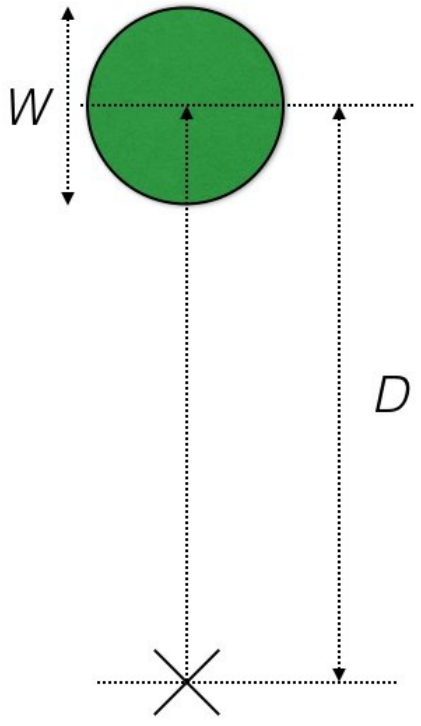
ID (Index of Difficulty)

- The ID can be expressed in several ways.
- The following is an ISO standard (ISO 9241-9) for the ID. It is known as the "Shannon formulation"

$$ID = \log_2 \left(\frac{D}{W} + 1 \right)$$

D = distance to midpoint of target

W = width of target



(i)

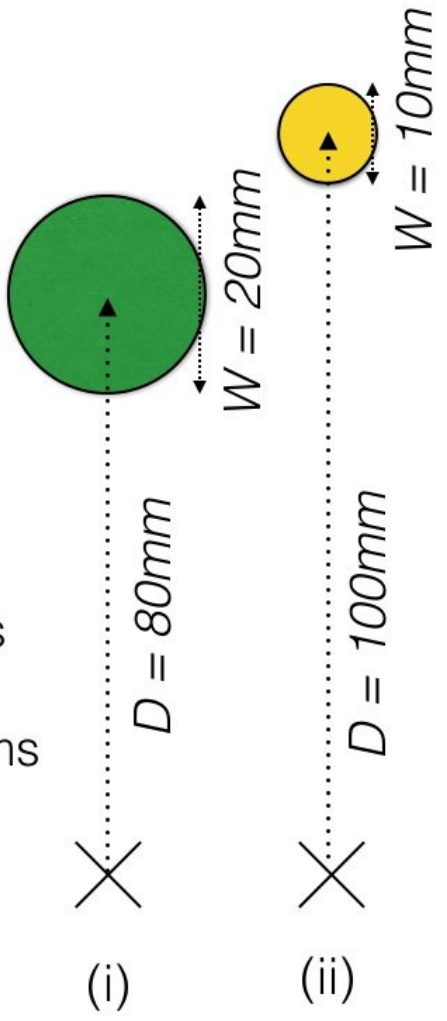
Putting it all together

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

Assume a = 50ms, and b = 150ms

$MT_i = 50 + 150 \log_2 (80/20 + 1) = 398$ ms

$MT_{ii} = 50 + 150 \log_2 (100/10 + 1) = 569$ ms



Summary

- Fitts' law can be applied to interface design to predict the time it will take users to move to a target (or series of targets).
  - The bigger and closer the target, the easier it is to hit.
  - Targets at the edges of a screen can be considered to have an infinite size, and are relatively easy to hit.
- Fitts' law can also be used to compare pointing devices.

Reading

- **Read pages 66 to 70 of this textbook (eBook available via library website):** Ritter F., Baxter, G., Churchill, E. Foundations for Designing User Centred Systems. Springer, 2014.

- **Paul Fitts' original study:** Fitts, P. M. The information capacity of the human motor system in controlling the amplitude of movement. Journal of Experimental Psychology, 47 (1954), 381-391.

- **Fitts' law and the Hit It! app on Android:** N. Henze. Hit It! – An Apparatus for Upscaling Mobile HCI Studies. Proc CHI'12, 1333-1338.

- **In depth discussion of Fitts' law, and how to conduct Fitts law experiments:** W. Soukoreff & I.S. MacKenzie. *Towards a standard for pointing device evaluation, perspectives on 27 years of Fitts' law research in HCI.* Int. J. Human-Computer Studies 61 (2004) 751–789.