Fitts's Law (1954)

- Psychologist Paul Fitts developed mathematical description to measure difficulty of hand to object acquisition
- Models time to acquire targets in aimed movement
  - Reaching for control in a cockpit
  - Moving across a dashboard
  - Pulling defective items from a conveyor belt
  - Clicking on icons using a mouse

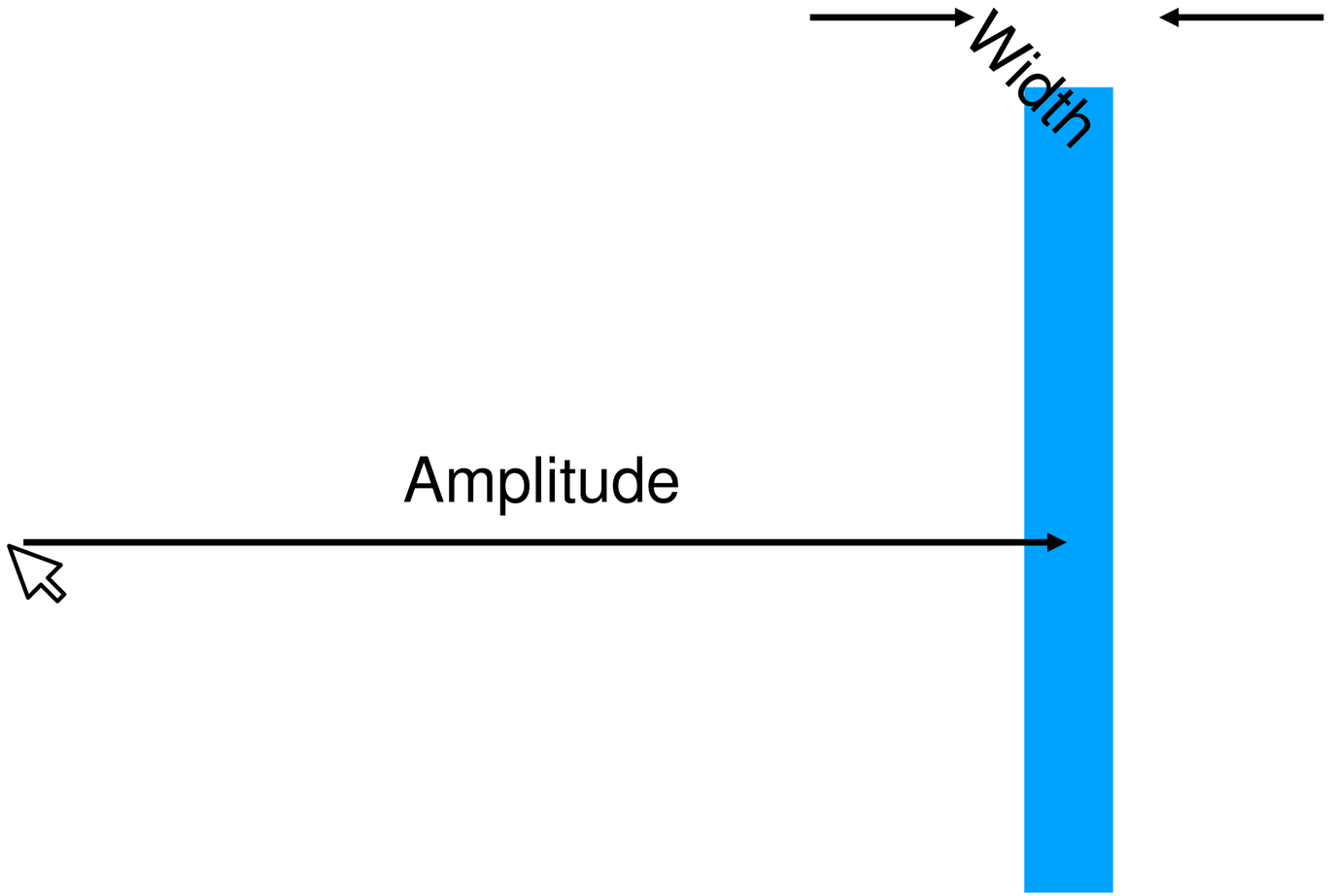
https://en.wikipedia.org/wiki/Fitts%27s_law

Fitts's Law (1954)

- Very powerful, widely used
  - Holds for many circumstances (e.g., under water)
  - Allows for comparison among different experiments
  - Used both to measure and predict

https://en.wikipedia.org/wiki/Fitts%27s_law

Point-select task



Fitts's Law

- $MT = a + b \log_2(A / W + 1)$
  - What kind of equation does this look like?

Fitts's Law

- $MT = a + b \log_2(A / W + 1)$
  - What kind of equation does this look like?
  - Slope Intercept: $y = mx + b$
- $MT = a + bx$, where $x = \log_2(A / W + 1)$
  - x is called the Index of Difficulty (ID)
  - As "A" goes up, ID goes up
  - As "W" goes up, ID goes down

Movement Time (MT)

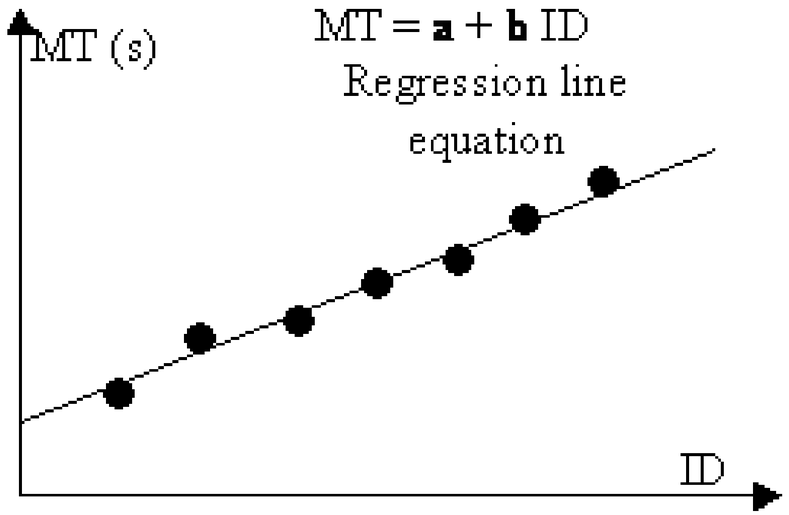
- $MT = a + b \log_2(A / W + 1)$
- Time, in seconds, to acquire the target (e.g., click on the button)

Index of Difficulty (ID)

- $\log_2(A / W + 1)$
  - Fitts's Law claims that the time to acquire a target increases linearly with the log of the ratio of the movement distance or amplitude (A) to target width (W)
- Why is it significant that it is a ratio?
  - Units of A and W don't matter
  - Allows comparison across experiments
- ID units typically in "bits"
  - Because of association with information capacity and somewhat arbitrary use of base-2 logarithm

Index of Performance (IP)

- $MT = a + b \log_2(A / W + 1)$
  - b is slope
  - a is y-intercept
- 1/b is called Index of Performance (IP)
  - If MT is in seconds, IP is in bits/second
- Also called “throughput” or “bandwidth”
- a and b are empirically determined constants (e.g., constant time required to press a mouse button)
- **a and b depend on the input device**



[Fitts’s law demo]

https://www.psytoolkit.org/experiment-library/fitts.html

“Beating” Fitts’s law

- It is the law, right?
  - $MT = a + b \log_2(A/W + 1)$
- So how can we reduce movement time?
  - Reduce amplitude (A)
  - Increase width (W)

Activity

“Beating” Fitts’s law

- Put targets closer together
- Make targets bigger
- Make cursor bigger
- Make impenetrable edges

Fitts's Law in windowing

- Windows 95: missed by a pixel
- Windows XP: good to the end
- Corners and edges make great targets
  - Do not have to move precisely to trigger them
  - They have "infinite" width

Fitts’s Law in other domains

- How would Fitts’s Law apply to using touch input on a phone?
  - Shorter distances (smaller screen)
- All things being equal, movement times *should* be lower
  - Shorter distances, faster to move your finger than a mouse

Fitts’s Law in other domains

- But in practice, touchscreens on mobile tend not to be much faster
  - Buttons are smaller
  - People tend to be slower near the edges of touchscreens