Fitt's Law and Hick's Law

Fitts' Law

- Fitts' Law predicts that the time to point at an object using a device is a function of the distance from the target object & the object's size.

- The further away & the smaller the object, the longer the time to locate it & point to it.

- Fitts' Law is useful for evaluating systems for which the time to locate an object is important, e.g., a cell phone,
a handheld devices.

Fitts' Law

- Models movement time for selection
- Movement time for a rehearsed task
  - Increases with distance to target (d)
  - Decreases with width of target (s)
- Depends only on relative precision (d/s), assuming target is within arms reach
- First demonstrated for tapping with finger (Fitts 1954), later extrapolated to mouse and other input devices
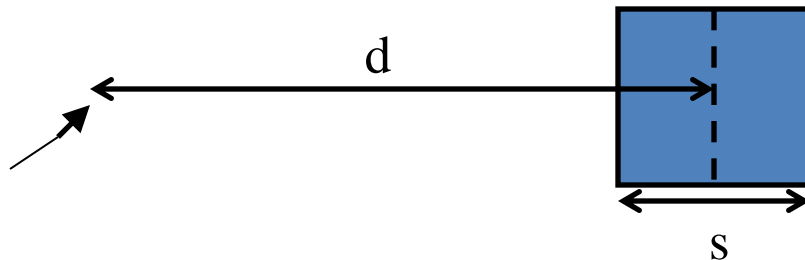
Fitts' Law Equation

$$T_{msec} = a + b \log_2 (d/s + 1)$$

a, b = empirically-derived constants

d = distance, s = width of target

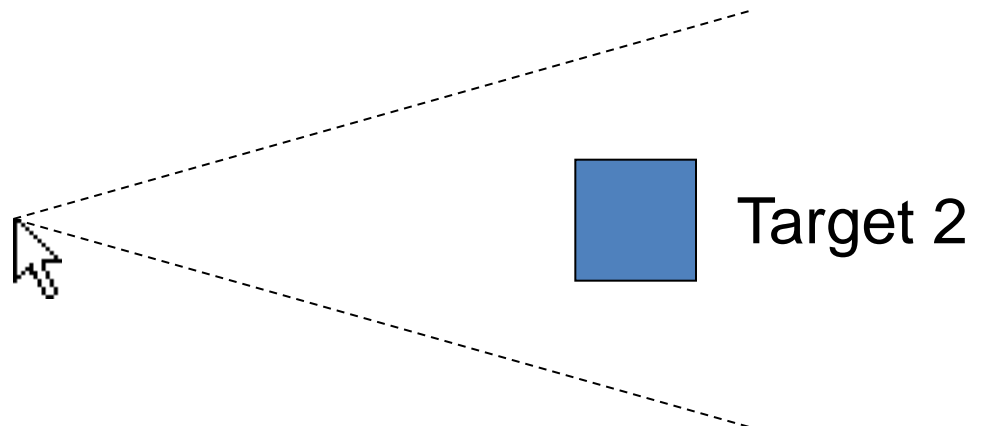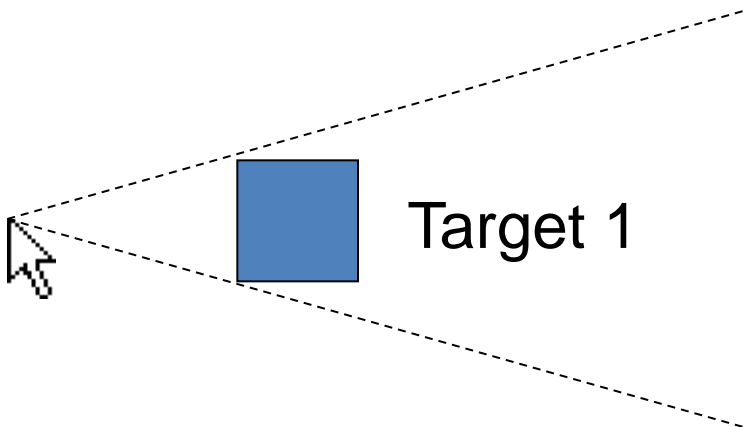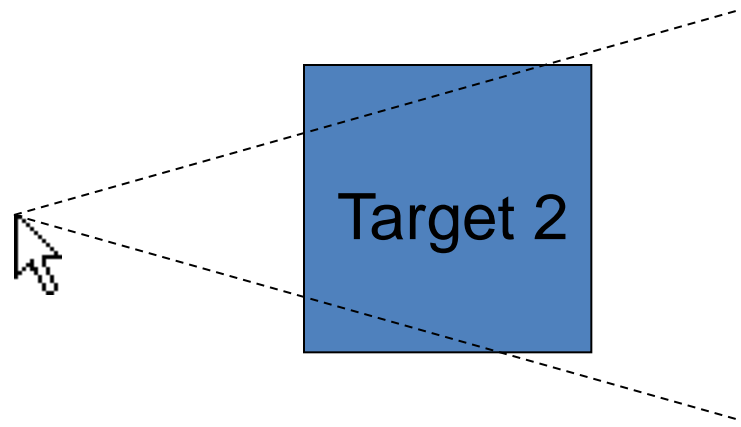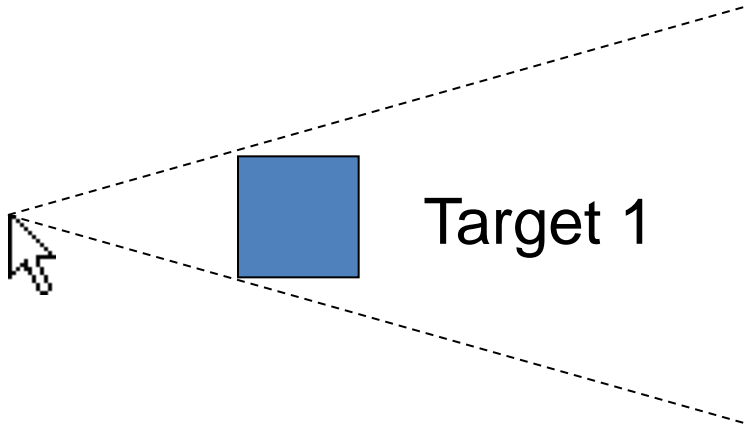ID (Index of Difficulty) = log2 (d/s + 1)

Fitts' Law Intuition

- Time depends on relative precision (d/s)

- Time is not limited by motor activity of moving your arm / hand, but rather by the cognitive activity of keeping on track

- Below, time will be the same because the ratio d/s is the same

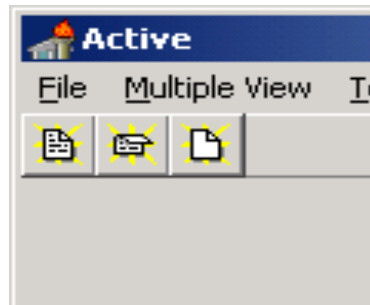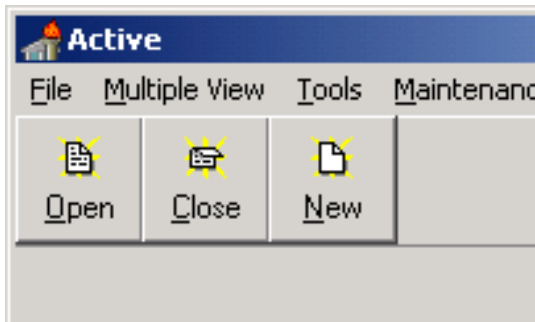Target 1

Target 2

Fitts' Law Examples

Target 1

Target 2

Target 1

Target 2
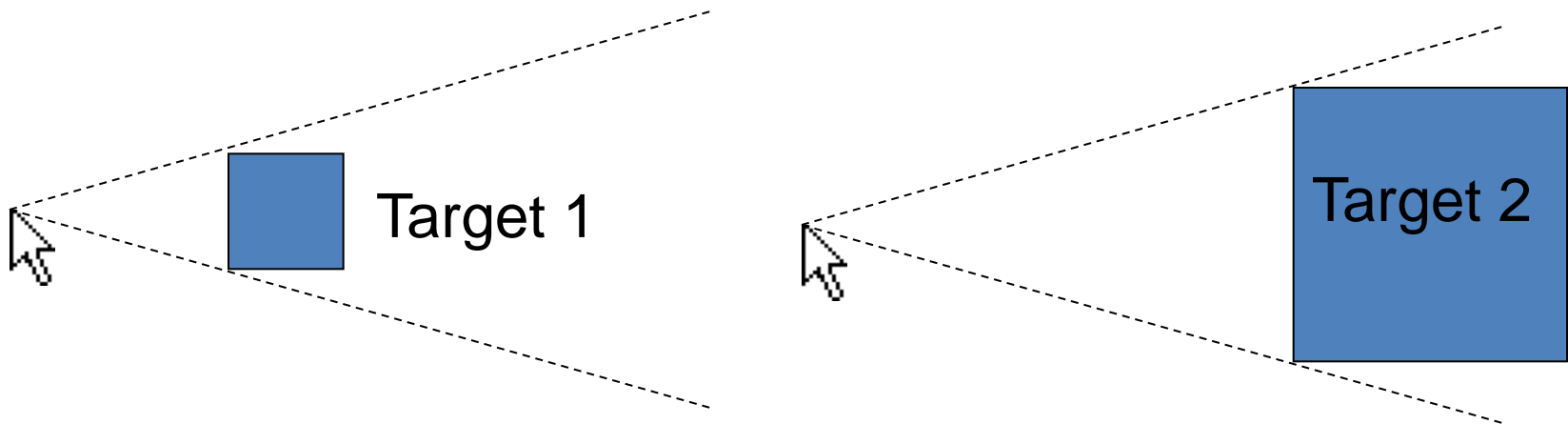
Fitts in Practice

- Microsoft Toolbars allow you to either keep or remove the labels under Toolbar buttons

- According to Fitts' Law, which is more efficient?

Fitts in Practice

- You have a toolbar with 16 icons, each with dimensions of 16x16

- Without moving the array from the left edge of the screen, or changing the size of the icons, how can you make this more efficient?
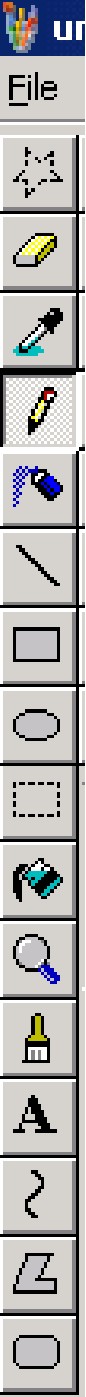
Fitts in Practice

- Answer: Line up all 16 icons on the left hand edge of the screen

- Make sure that each button can be activated up the last pixel on the left hand edge

- Why? Because you cannot move your mouse off of the screen, the effective width s is infinite

Impact in HCI

- Reduce ID
- Bigger icons, more space
- Put things in edges and corners

Hick's Law

- The time it takes to make a decision increases as the number of alternatives increases

- It is used to estimate how long it will take for people to make a decision when presented with multiple choices

- Hick's Law has implications for the design of any system or process that requires simple decisions to be made based on multiple options

Hick's Law

- The law does not apply to decisions that involve significant levels of searching, reading, or complex problem solving.

- Hick's Law is most applicable for simple decision-making tasks in which there is a unique response to each stimulus.

- For example, if A happens, then push button 1, If B happens, then push button 2. The law is decreasingly applicable as the complexity of tasks increases.3

Hick's Law

$$RT = a + b \log_2 (n)$$

RT = response time

a = the total time that is not involved with decision making

b = an empirically derived constant based on the cognitive processing time for each option

n = number of equally probable alternatives

Hick's Law

- For example, assume
  - It takes 2 seconds to detect an alarm and understand it's meaning
  - Pressing one of five buttons will solve the problem caused by the alarm.
  - Cognitive processing time for each option is 0.155 seconds
  - What is the response time?

Hick's Law

$$RT = (2 \text{ sec}) + (0.155 \text{ sec})(\log_2 (5)) = 2.36 \text{ sec}$$
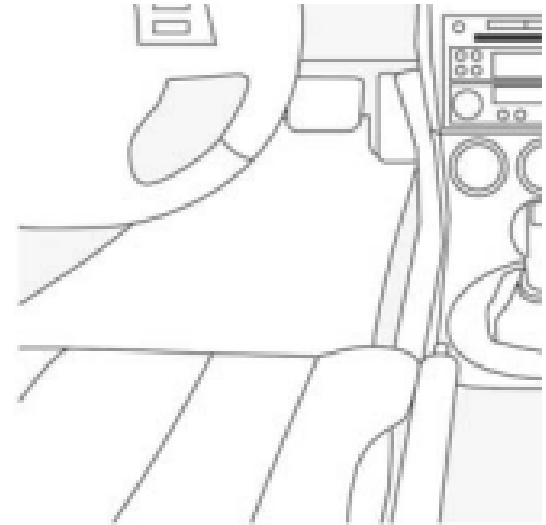
Menus

- The time for a person to select an item from a simple software menu increases with the number of items.

- However, this may not be the case for more complex menus involving a lot of text or submenus.
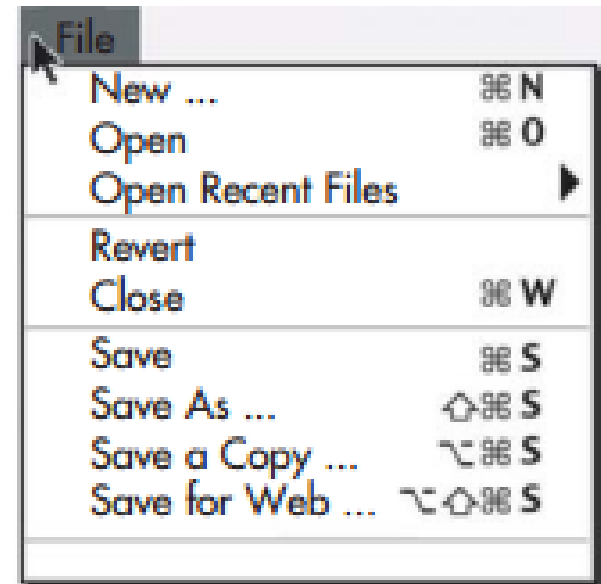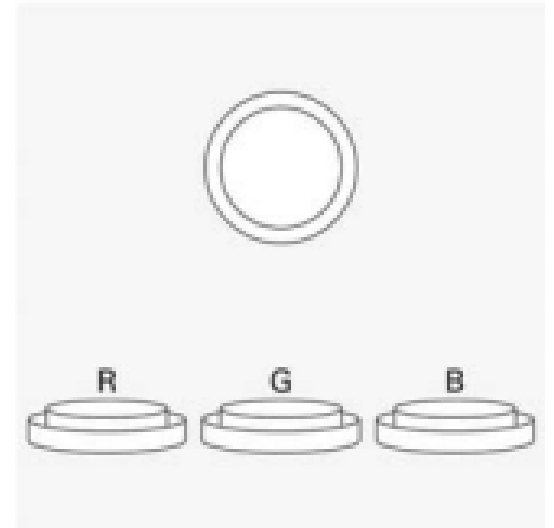
Braking

- The time for a driver to press the brake to avoid hitting an unexpected obstacle increases if there is a clear opportunity to steer around the obstacle.

Simple Tasks

- The time for a person to press the correct button (R, G, or B) depending on the colour of the light (red, green, or blue) increases with the number of possible colours

Task

- Create a paper prototype for a TV director's control application, which allows the director to:
  - Switch between 6 different shots
  - Change the audio levels
  - Change the lighting levels
  - Go to commercial break
  - Type on the auto-cue
  - Change the scrolling text on the bottom of the sreeen
  - Send an audio message to the presenter