

Designing for Humans

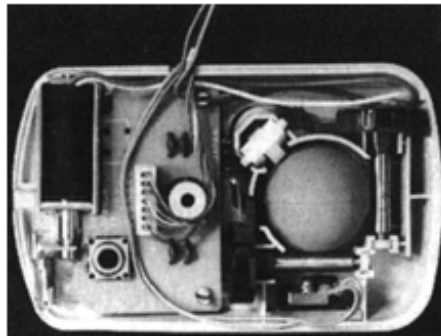
Control-Display Relationships

Controls and Displays

- “Control”
 - An input device actuated/manipulated by a human
 - Examples: keyboard, mouse, joystick, button, microphone, etc
- “Display”
 - An output device stimulating a human sense
 - Visual display (e.g., CRT, LCD, any light)
 - Aural display (e.g., speaker)
 - Tactile display (e.g., a solenoid-driven pin)
 - Smell display (?)

Tactile Displays

- Not as common as visual or aural displays; so, here's an example...
 - Mouse with tactile feedback using a pin embedded in a mouse button



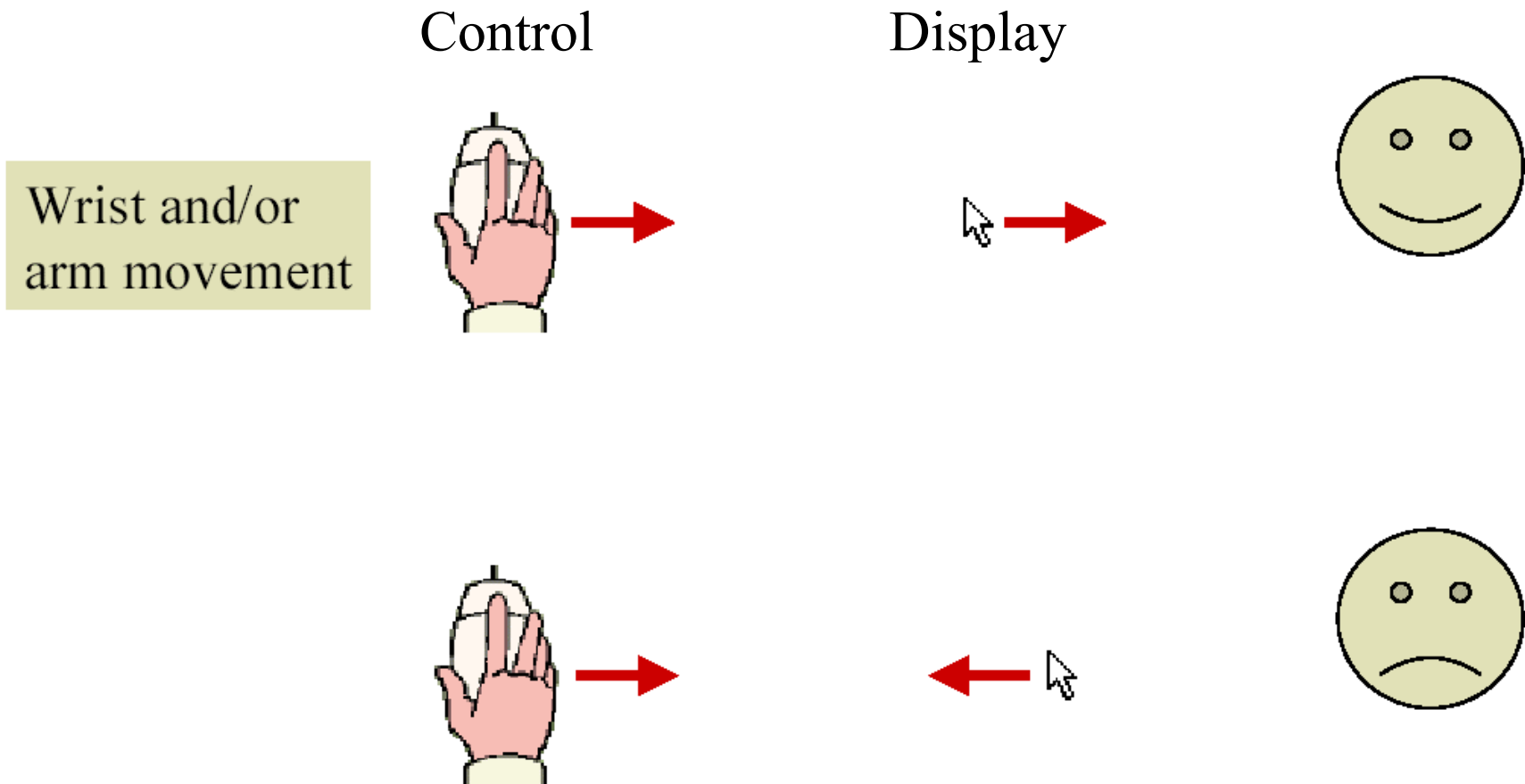
Control-Display Compatibility

- Compatibility refers to the “correctness” of the relationship between the way the control is manipulated and the way the display responds
- “Correct” example:
 - Move a mouse right, cursor moves right
- “Incorrect” example:
 - Move a mouse right, cursor moves left

An orange arrow pointing to the right, containing the text "Next slide".

Next slide

Example – Cursor Control (1D)



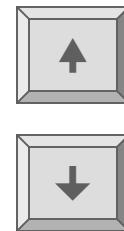
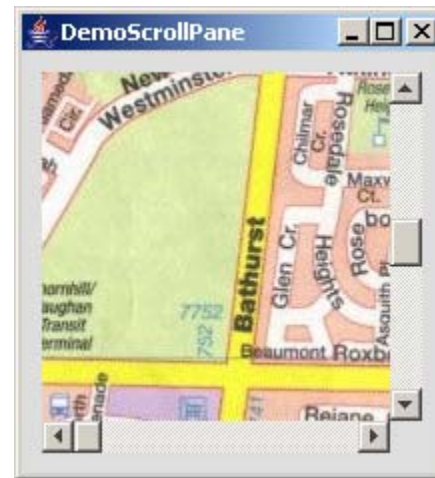
Compatibility

- Compatibility is (arguably) not inherent
- It is a learned relationship
- “Learned” examples:

Move mouse forward,
cursor moves up

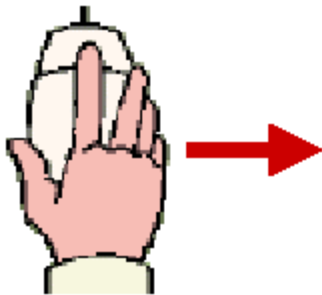


Press down key,
image moves up

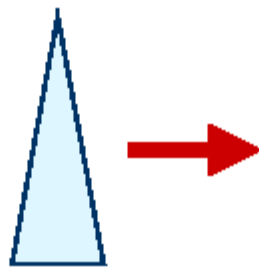


Example – Object Manipulation (1D)

Control

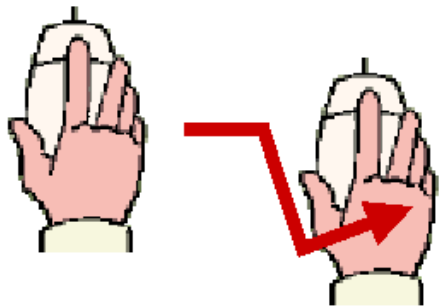


Display

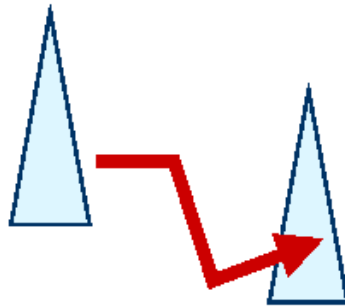


Example – Object Manipulation (2D)

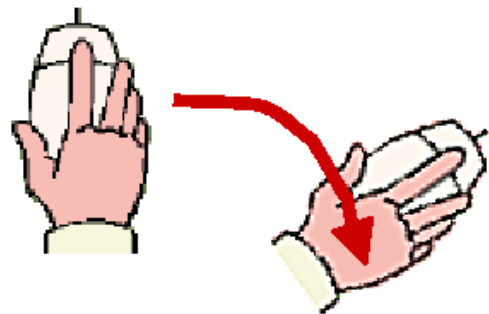
Control



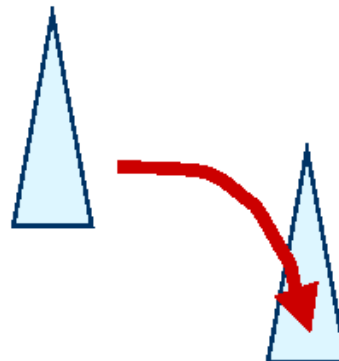
Display



Control



Display

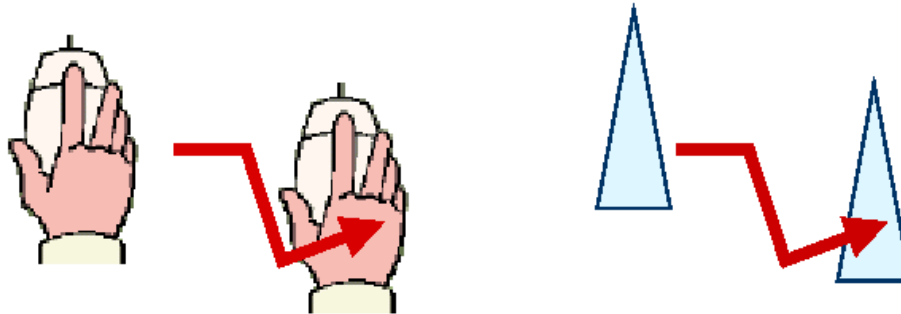


Dimensions vs. Degrees of Freedom

- In 2D there are 3 dof (degrees of freedom)
 - x position or displacement
 - y position or displacement
 - Θ_z – z-axis angle or rotation
- A mouse is a 2 dof device
 - Senses x displacement
 - Senses y displacement
 - Does not sense z-axis rotation
- The problem: generating z-axis rotation data with a mouse

Solution #1 – Rotate Tool

Step #1 – acquire object, move mouse



Step #2 – click on rotate tool (enable rotate mode)

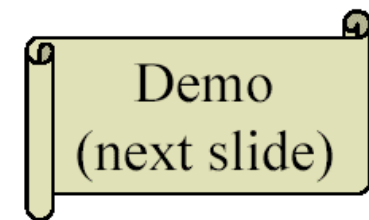
Step #3 – acquire object, move mouse



or

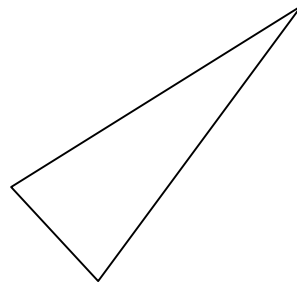
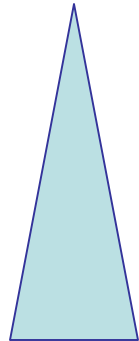


?



Demo

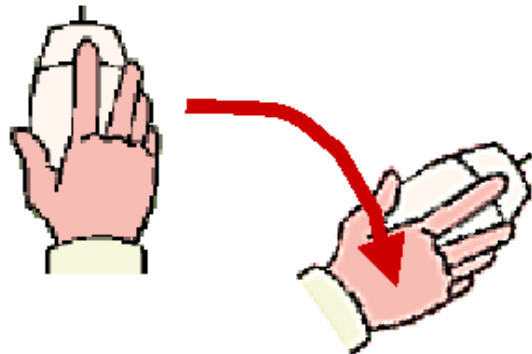
- Move object to new location



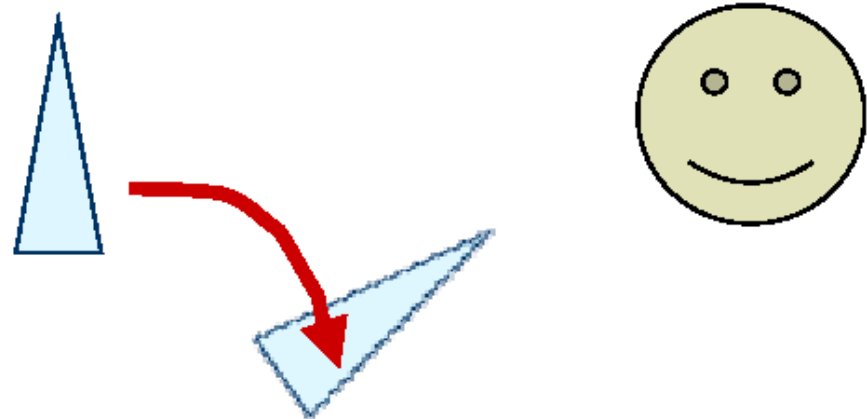
Solution #2 – Build a 3 dof Mouse

Step #1 – acquire object, move mouse

Stimulus

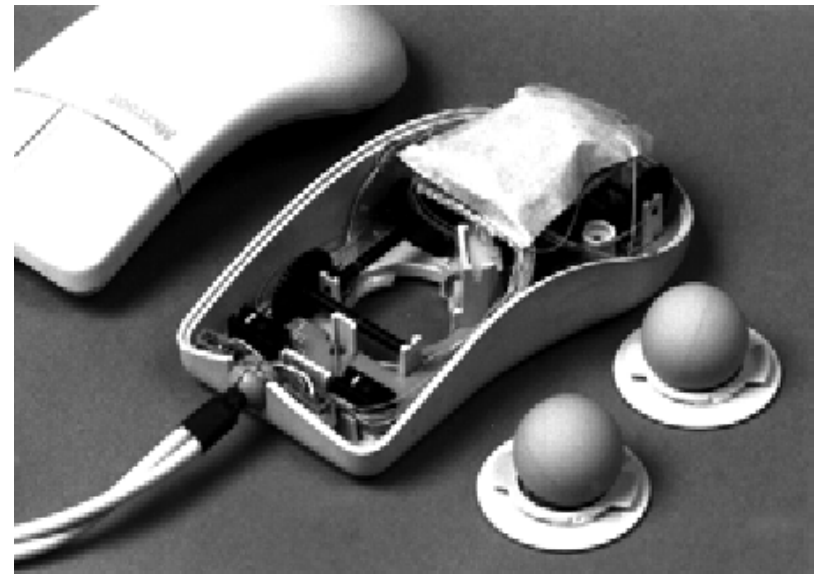
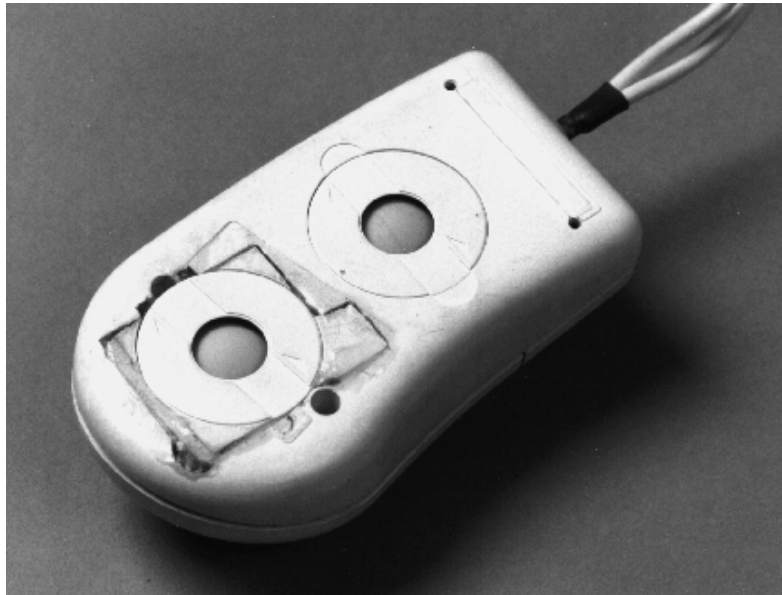


Response



Solution #2 – We did it!

- Two-ball mouse with 3 degrees of freedom

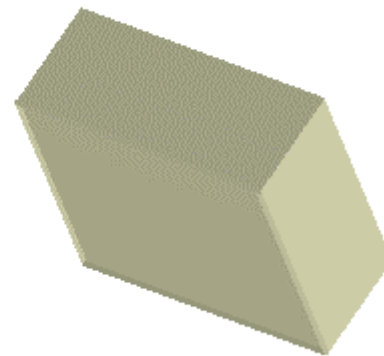
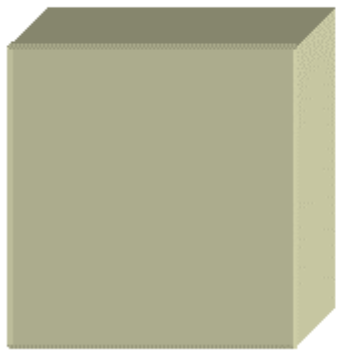




Design Issues for 3 dof Mouse

- Switching between 2 dof and 3 dof modes
 - Solution: use a modifier key (e.g., SHIFT) to enable 3 dof mode
- Yielding 360° of rotation from limited wrist movement
 - Solution: use a modifier key (e.g., CTRL) to “amplify” rotational mapping

3D Interaction (6 dof)

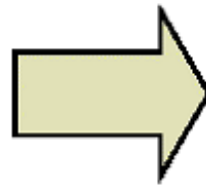


CD Compatibility & Cultural Bias

Control (switch)



Display (light)



Question:

- Is the light on or off?

Answer:

- Off (in England)
- On (in Canada)

Control-Display Relationships

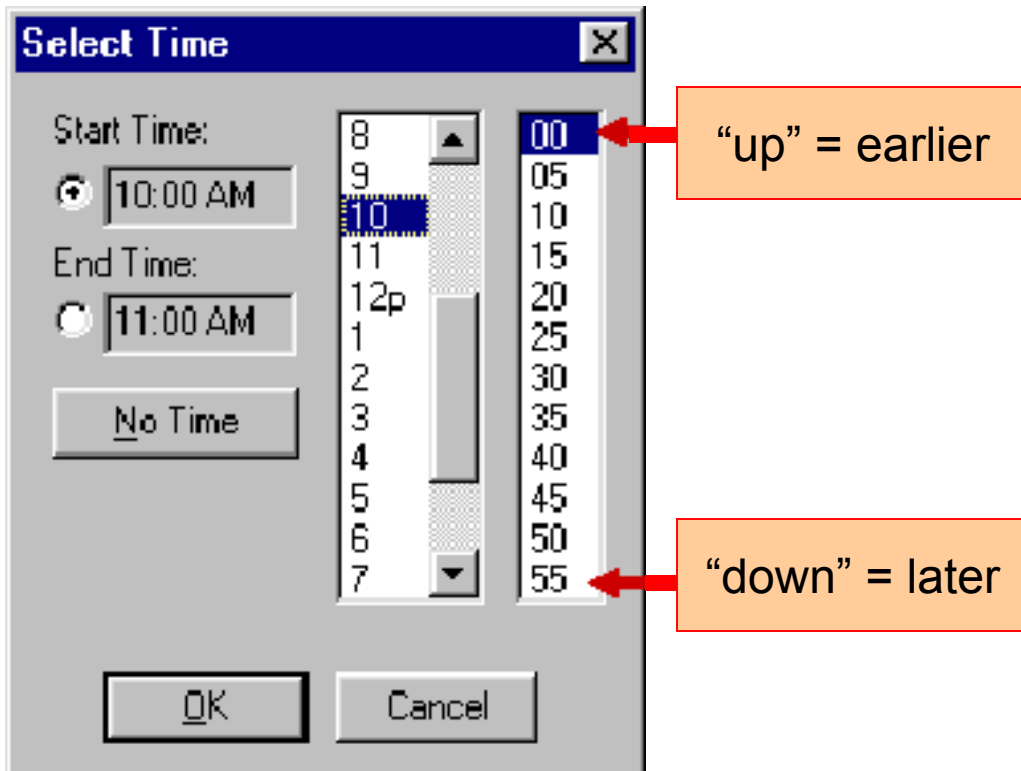


What does this button do?

Answer:

- moves the selected field “backward” in time.

Yes, but...



Thank you