Humans and the Technology Interface
aka: Access

Review Course for Assistive Technology Practitioners & Suppliers

Learning Objective

• Understand the characteristics of a human technology interface.
• Recognize functional limitations that prevent use of typical interfaces.
• Apply this knowledge in guiding the selection of the best interface for a particular client.

Where do you start?

• A control interface: Where the human user meets the technology! The access method.
• Usual control interfaces are based on study of how humans typically take in information, process it and act upon it.
• Thinking about "typical" will help guide choice of modifications or substitutions required by sensory, cognitive or motor problems.
• The human’s goal drives how he/she proceeds and provides the context for interacting with the technology.
Who or What Determines the Interface?

- What is the "norm?" i.e. using a joystick to control the power wheelchair.
- What prevents success with the norm? i.e. the client doesn't have the strength to use the joystick effectively.
- Modify with an adaptive interface i.e. try a mini joystick.
- Occupational Therapists are interface specialists.

What is a Good Human/Technology Interface?

- The selection set is compatible with the user and the technology to be controlled.
  - Matches the motor, sensory and cognitive skill and ability level of the client
  - Learnable within reasonable time limits
  - Has the potential to become automatic or performed without thinking
  - Can become highly skilled and effortless

The concepts apply...

To control of all forms of AT
  - Wheeled Mobility
  - Computer
  - Augmentative & Alternative Communication
  - Electronic Aids to Daily Living

- This issue is especially important in presence of severe impairment.
  - Integrated control of AT devices is needed, interfacing the electronics
Special Human User Problems

- Influence of primitive reflexes, abnormal muscle tone: high, low, athetoid.
- Weakness, paralysis, low endurance, limited range of motion (ROM), pain.
- Lack of coordination, tremor, problems with accuracy or timing.
- Low vision, no vision, hard of hearing, deafness, perceptual problems.
- Absence of limbs or fingers or deformity of limbs, trunk, pelvis, etc.
- Cognitive processing and/or learning.

The Human Technology Interface

- **Interfaces**
  - How the input method controls the AT
    - Direct Selection
    - Indirect Selection
    - Static vs. Dynamic Display
    - Integrated Controls

- **Feedback**
  - Visual
  - Auditory
  - Device response
  - Movement and reaction to forces generated

- **Input/Selection/Access Method**
  - Switches or buttons
  - Joysticks
  - Voice Recognition
  - Keyboard or Mouse
  - Speech Generating Device

Interfaces

- How the input method controls the AT
  - Direct Selection
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Interface: Direct Selection

- **Direct Selection** - all possible choices are present at one time, e.g., keyboard, keypad
  - Use a body part: finger, palm, foot, toe, or head to make the selection.
  - Can make use of a control enhancer: typing aid, head pointer, mouth stick, optical pointer and arm support.
  - Preferred!!

Interface: Indirect Selection

- **Indirect Selection** - only a subset of choices are available at any time. The user must wait until the desired choice within the set is presented.
  - Scanning
    - Directed Scanning
  - Coded input - there are a number of intermediate steps required in order to arrive at a final selection
    - Morse code

(Cook and Hussey, P. 214 - 215)

Indirect Selection: Scanning

- **Types of Scanning:**
  - Linear
  - Row-Column
  - Group-Row-Column
- Cursor Advancement is based on user preference or motor skill
  - Automatic
  - Inverse
  - Step

Refer to Chapter 7
Indirect Selection: Scanning

- Scanning can be modified by:
  - Customizing the scanning layout
  - Changing advancement strategy
  - Modifying the pace of the cursor
  - Selecting an optimal or specialized switch
  - Use of efficiency strategies
    - Order by frequency of use
    - Group, row, column, item
    - Progressing to directed scanning

Indirect Selection: Scanning

- **Directed Scanning** - a hybrid type of indirect selection in which a joystick is used to steer to a section of the scan.
  - Then user scans the selected section.

Indirect Selection: Scanning

- **Coded Access** - a type of indirect selection in which a distinct sequence of movements is used to input a code.
  - A single or dual switch is used to send code.
  - Morse code - a combination of dits & dahs to send letters, numbers, functions, etc.
    - ••• --- ••• = SOS
Interface: Dynamic and Static Displays

- **Dynamic interfaces**
  - Change what the user sees based on his/her input.
  - Typically require a computer monitor or an LCD screen
  - E.g., Scanning Director and Vanguard
- **Static interfaces**
  - Don’t change
  - Example: TV Remote

Interface: Integrated Controls

- **Integrated Controls**: Essential when the client has limited motor capacities.
- Also referred to as Interfacing
- Maximize the output
- Example:
  - Use the wheelchair joystick to drive the mouse on the computer or move between the appliance options on an environmental control unit — also called Electronic Aid to Daily Living (EADL).

Applied to Wheeled Mobility

- **Direct**: Proportional
  - Joystick simultaneously controls steering & speed
  - Modify the joystick: size, shape, placement, throw, resistance, templates
- **Direct**: Switches
  - Directions are separated and activated by switch, speed is preset.
  - Digital joystick or switch array mounted in head rest or tray, sip n’ puff, etc.
- **Indirect: Switches**
  - Directions are offered in scanning array, switch activation selects direction, speed may be latched
- **Integrated controls**
  - Input Method in ECU mode activates SGD or computer
Applied to Computer Access

- **Interface**: Direct selection
  - Mousing
    - Substitute: trackball, joystick, head mouse
  - Keyboarding
    - Substitute: membrane, chording, on-screen, eye-gaze, voice recognition
    - Alternative: use a single or dual switch to send Morse code
- **Interface**: Indirect selection
  - Scanning, directed scanning or coded input
- **Integrated Controls**
  - Send EADL signals or run communication software

Applied to Speech Generating Devices

- **Direct selection**
  - Static and dynamic keyboards, touch screens, joystick, mouse, light pointers, eye gaze
- **Indirect selection**
  - Scanning
  - Directed scanning with a joystick
  - Coded input
- **Integrated controls**
  - Device sends IR signals for device control or serves as computer keyboard

Applied to Electronic Aids to Daily Living (EADL)

- **Direct selection**
  - Voice control, X-10 control box, audiovisual remote controls
- **Indirect selection**
  - Scanning on EADL or switch operated phone.
- **Integrated controls**
  - A few EADL systems send signals to a computer
Interfaces, Input & Feedback

- **Interfaces**
  - Direct Selection
  - Indirect Selection
  - Static vs. Dynamic Displays
  - Integrated Controls

- **Input or Selection Method**
  - Switches or buttons
  - Joysticks
  - Voice Recognition
  - Keyboard or Mouse
  - SGD Device

- **Feedback**
  - Visual
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Input or Selection Method

- Switches or buttons
- Joysticks
- Voice Recognition
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- SGD Device

Input: Switches

- Choose switch or control site with care
  - Use the body part that is most reliable
  - Hand, foot, elbow, chin, head, eyelid, eyebrow, tongue
  - Use your imagination...
- Switch use is NOT intuitive... Training is needed!
  - Cause and effect
  - Timing
  - Learning a sequence
Input: Switches

- Many types of switches
- Use knowledge of person to choose a switch based on:
  - How it will be used: direct or indirect control.
  - User movement skills
  - Durability
  - Amount of force required.
  - The body part that will activate it.
  - The context for use

Rocker Switch

Pneumatic: Sip n’ Puff

Star Switch

Input: Switches

- Target size
- Space between switches
- Activation force
- Activation type:
  - Momentary
  - Latched
- Throw
- User feedback
**Input: Joystick**

- **Proportional**
  - Speed is related to % of throw
  - Direction is related to direction of throw
  - Typical of powered mobility
- **Switched**
  - 4 to 5 switches.
  - Speed is preset

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**Input: Voice Recognition**

- Static vs. learning
- Recognition accuracy is dependent on user training
- Wake-up/sleep command
- Nested menus
- Used in computer access and EADLs
- Not as reliable for mobility

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**Input: Keyboard and Mouse**

- **Keyboard:** Original input method for computers
  - Control of OS
  - Text entry
- **Mouse:** Controls the graphical user interface
  - Pull down menus or choose from pallet
  - Click, move and organize icons
  - Produce graphics, design, simulate
- Many alternatives exist.
Input: Speech Generating Devices (SGD)

- High end SGDs have built in interface for control of computer and devices in the environment.
- Language stored in SGDs can be used for writing.
- The selection method has already been optimized... Why re-create for computer access or EADLs?

Interfaces, Input & Feedback

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Feedback

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- Auditory
- Device response
- Movement and reaction to forces generated
Feedback: Auditory and Visual Device Response

- EADLs - light goes on, channel changes, phone is answered,
- Computer - monitor and printer give visible results; CPU uses sound to give audible error messages
- Mobility - display shows battery power level, status of controller, auditory beeps
- SGD - display builds a sentence, shows choices of vocabulary or provides auditory scanning, speech output

Feedback: Kinesthetic & Vestibular

- In response to joystick control of wheelchair motors, the body feels:
  - Change in pressure within joints, spine.
  - Vestibular stimulation in the inner ear
  - Centrifugal force
  - Acceleration and deceleration
- Not true with driving simulators!

Resources