Assistive Technology For Cognition (ATC)

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What is ATC?

- ATC are devices and services that compensate for deficits in cognitive functioning.
What is ATC?

- A field whose growth is supported by the maturation of other fields
  - Computer science, artificial intelligence
  - Mobile, wireless electronics
  - Neuropsychology, rehabilitation medicine
- Devices are sometimes referred to as ‘cognitive prosthetics’ or ‘cognitive orthotics.’
Two Approaches

- Replace lost function
  - Substituting audio input for vision to navigate
- Augment diminished function
  - Provide memory prompts
  - Reduce vigilance necessary for memory to increase available cognitive resources
Who Benefits From ATC?

- Individuals with
  - Traumatic Brain Injury
  - Mental Retardation
  - Dementia/Alzheimer’s
  - Cerebrovascular Accident (Stroke)
  - Multiple Sclerosis
  - Autism Spectrum Disorders
Functional Areas

- ATC devices can provide accommodation in the following areas:
  - Memory
  - Executive functions
  - Sensory processing
  - Social and behavioral issues
How Can We Use ATC?

- Memory aid
- Organizational aid
- Psychosocial prompts
- Aided community navigation
- Supports in employment
- Supports in independent living
- Personal safety
Low Tech Memory Aids

- Lists
- Calendars
- Sticky Notes
- Picture boards
- Caregiver prompting
Memory Aids: Pill Organizers
Memory Aids: Pill Organizers
Memory Aids: Reminder Devices
Memory Aids: Reminder Devices
Memory & Organizational Aids on the PC

- Emailing yourself
- Organizing your messages
  - Color coding
  - Sorting into messages
- Using calendars
- Using task lists
Pager Systems

- Well-researched and effective as a memory aid
  - Neuropage
- Devices can be set up to page an individual at a certain time to remind him/her to do something specific – e.g., AT&T Wireless
- Some models can have two way communication, so the individual can acknowledge the instructions have been received.
Personal Digital Assistants

- Used as both memory and organizational aid
- Capable of more sophisticated support
- But more cognitively demanding
Some Problems With Existing Devices

- Limitations in amount of information stored
- Limitations in modes of presentation
- Some devices cannot provide cues and therefore require self-initiation by consumer
- Some devices provide cues but no information about the task to be performed
- Can combine these types of devices, but that increases the cognitive load.
What We Need

- Devices that are multifunctional and multimodal
- Capable of providing complex cognitive support
- Customizable and adaptable
Yoda of Borg
"Futile is resistance. Assimilated you will be, yes. Yoda of Borg I am."

www.theory.org/~strthrwr/pictures/yoda.html
Assisted Cognition systems are proactive memory and problem solving aids that help an individual perform the tasks of day-to-day life.

- “Intelligent”
- Contextually aware
Devices in Development

• At the University of Washington
  • Activity Compass
  • ADL Prompter

• Some other development activities
  • The Aware Home (Georgia Institute of Tech)
  • Caregiver’s Assistant (Intel)
  • Nursebot (University of Michigan)
Device Development at UW

- These devices:
  - Sense **aspects of an individual's location and environment** relying on a wide range of sensors such as GPS, active badges, motion detectors, and other ubiquitous computing infrastructure;
  - Learn **to interpret patterns of everyday behavior, and recognize signs of distress, disorientation, or confusion**, using techniques from state estimation, plan recognition, and machine learning;
Device Development at UW

- Offer help to patients through various kinds of verbal and physical interventions; and
- Can alert human caregivers in case of danger
Activity Compass

- The purpose of the Activity Compass is to:
  - detect when a user is likely to be lost or wandering, and
  - to guide the user back to home or another place of safety when necessary.
Activity Compass

- Over time, the device.
  - learns a user’s typical daily routines (including locations of activities),
  - monitors for variations in the individual’s typical day-to-day activities then.
  - decides whether a prompt is necessary if the routine is unexpectedly changed.
Activity Compass

- Uses software which indirectly monitors your activity and offers proactive advice to aid in successfully accomplishing inferred plans.
- Merges technologies—cell phone, GPS receiver.
Activity Compass
Goal Prediction & Route Change
Activity Compass
Activity Compass
• The ADL Prompter
  • Monitors data collected by sensors embedded in a living or work environment.
  • Using artificial intelligence software, the data from these sensors is interpreted and decisions are made based upon the needs of the user.
ADL Prompter Example

- Joe enters bathroom at 9:00 am.
- He turns on water, and picks up toothbrush. Nothing happens for 30 seconds. ADL Prompter recognizes “tooth brushing” activity has stalled.
- Prompts Joe to pick up toothpaste. Joe does so and completes task.
- Joe leaves bathroom with water still running. ADL Prompter gently encourages Joe to go back and turn it off.
Implications of ATC for Rehabilitation

- Increased independence of individuals with disabilities
- Reduced demand on caregivers and rehabilitation specialists
Specific Benefits for Individuals With Disabilities

- Improved functioning
- Improved self-confidence
- Less stressed/more relaxed
Human-technology Interface Challenges

- **Universal Design**
  - Devices need to be adaptable
    - Functional deficits
      - Physical and sensory abilities
  - Environment
  - User priorities
What Is Left to Do?

- Continued development of new devices and utilization of existing devices in new ways.
  - In particular in the social/behavioral arena.
- Develop training protocols & supports needed by consumers and support professionals.
- Investigate usability over time.
What Is Left to Do?

- Investigate generalizability across home & community settings.
- Investigate devices as rehabilitative tool versus compensatory replacement of function.