Adaptive Access: Key Design Considerations for People with Communication, Motor and Cognitive Challenges

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Introduction

• Multi-modal / Multi-input
• General Computing
• Social Media
• Mobile Computing
• Natural Language Processing
• Interaction

Themes & Contexts

• Performance & use
• Identity
• Science
• Clinical practice
• Development
• Social and technical forces

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TEMPT ONE
Multi-Modal/Multi-Input Access

- Physical access to technology
  - Focus on best/most reliable movement capability
- AAC “systems” (low and high) typically incorporate variety of physical movements and signals
- Technology—how to harness various physical movements and signals for access

Challenges & Benefits

- Single access strategy
  - Benefits: typically most reliable/consistent movement
  - Challenges: fatigue, potential for over-use, may not be most reliable/consistent throughout day
- Multi-input strategy
  - Benefits: efficiency, access throughout day, health benefits, promoting learning/movement training opportunities, able to use modalities (e.g. speech) that have not had success using alone as access method
  - Challenges: technology limitations, individual differences

Examples- Speech Recognition as part of a multi-input strategy

- Supplemented Speech Recognition (SSR)
  - Speech recognition based on models of dysarthric speech
  - First letter identification
  - Word prediction

- Speech recognition and sEMG
General Computer Navigation and Mouse Control & Writing

• Many individuals today computer savvy
  – Strong emphasis on basic computer use, mouse control and writing amongst SGD consumers

• Current SGDs
  – Limitations of computers that house AAC software
  – Use of new interface required to engage in general computing
  – Focus on f2f communication

• Benefits of access to standard computer interface

• How we now communicate through the computer

• Cognitive and physical demands of learning new interfaces
Social Networking

• Common form of communication
  – Daily (hourly!) communication for some

• Appealing for those with limited access to f2f interaction

• Expression of identity, social interaction without time constraints

Challenges

• Interfacing SGD and communication software with social networking sites
• Social networking changes- how do we adapt our systems to a moving target?
• How do people actually do social networking with their systems?
• Ease of use for texting, instant messaging
• Seamless integration of these “mainstream” functions into AAC technology

Mobile Computing

The Tablets

Microsoft Surface
Google Tablet
iPad
Kindle Fire
State of Mobile Computing

- Disruptive, Destabilizing, Revolutionary Technology
- Rapid Change
- Rise of the individual
- Challenge to existing institutions

Access Challenges

- Improve physical access
- Make use of gestures
- Sophisticated devices beg for sophisticated and transparent access options.
- How to achieve this?

Interoperability, etc.

- Equal access across applications
- Coordinate access across technologies
  - Single source input
  - Between devices
  - The Cloud
- Develop non-touch control (gaze, head movements) for pointing, gesture and selection

app Development

- Include the technology user in the development process
- Utilize clinical best practice, research findings, while developing for out-of-the-box
- Make the research / development relationship work
Natural Language Processing

NLP is concerned with computer algorithms that analyze, modify, augment, or generate human language and methods that range from assigning probabilities to words or sequences of words to full-scale transformation of sentences. (Higginbotham, Lesher, Moulton and Roark, 2012)

NLP & AAC

- Word prediction, spell & grammar checking
- Keyboard layouts
- Speech recognition

Emerging Areas

- Dysarthric Speech Recognition
- Context Leveraging
  - Internet for topic specification
  - Utterance-based communication
  - Geo-positioning
  - Partner talk
- Text Simplification
- Brain Computer Interfaces

Text Simplification

Original
The plane, a twin-engined Cessna owned by XYZ, Inc., crashed into the ocean after striking a flock of seagulls on takeoff.

Simplified
The plane crashed into the ocean. The plane was a twin-engined Cessna. The plane hit birds during takeoff.

Summarized
The plane crashed into the ocean. The plane hit birds during take-off.
State of NLP & AAC

• Keystroke savings for word prediction hasn't changed for a decade or more.
• Linguistic context, web, partner and location remain, utterance-based apps, for the most part, are research interests.
• Speech recognition still doesn't support dysarthric speakers or conversational discourse.

From the Trenches

Stock replies do not have built in recipient design… Pre-formulated turns at talk cannot adapt to the particular words used and to the specific setting of the verbal exchange. These predesigned turns at talk feel like heavy weights, encumbering natural conversation. (Robillard, 2006)

NLP Challenges

• Does the innovation matter?
  – What are the operation requirements?
  – What’s the payoff
• Access to the internet??
• Developing the underlying database
• How do we keep growing the device?
• Integration of real-life information / personal interests

Interaction

Better our understanding regarding communication performance:

  – Not all interaction is face to face
  – Examine talk in authentic interaction tasks and contexts
  – Utilize current research in conversation and interaction analysis, and HCI
**Visual Displays**

The spontaneous use of visual displays by communication partners points out some of the current design problems of SGDs.

- **Design Out** the problems
- **Design In** socially interactive displays

**Voice and Identity**

If people told me if I was going to make it in college...I'd have to master the computer voice. But I hated the damn thing. Nobody knows the real man, not even my mom. I'm worried that people will not talk to me, but to the computer. There is no way in hell a computer voice can express the emotion I have inside of me. (Dan Keplinger, in Whiteford, 2000)

**Portnuff's Hierarchy of Speech Synthesis Requirements**

- Singing
- Talking to Animals
- Multilingual capabilities
- Shouting (get above the din)
- Expressiveness (Intonation)
- Effectiveness (Pitch, speed, timing, stress)
- Intelligibility
- Sapi 5 Voice

**Voice Challenges**

- Individualize the voice
- Emotive speech
- Real-time paralinguistic control
Staying in time: Challenges / Solutions

- Quick utterance generation
- Collaborative technologies
- Manipulating utterances
- Supporting partners

Jenn Seale (2012)*

Advancements in the field can be credited, in part, for the reality that some augmented communicators are employed, college graduates, living independently, and engaged in various other community activities.

But increased opportunities for augmented speakers to express themselves in a predominately speaking culture are perhaps the most important result of AAC developments.

*from 1st Phd research project, University at Buffalo, 2012