# Augmentative and Alternative Communication

lostvoiceguy.com

# Where we are in the course

- Post-spring break 🏁👀
- Some cool topics coming up:
  - Tactile interaction, collaborative user interfaces, cognitive accessibility

# Today

- Some thoughts on communication tech
- Mini-design activity

- Wednesday
  - Talking about *Gleason*
  - More design practice
  - Project 3

# Grades

- Very late :(
- Sorry :(

# AAC technology and design

# AAC

- **A**ugmentative and **A**lternative **C**ommunication
- Covers a very wide range of techniques and abilities
- More than most assistive technology, there is no one size fits all for AAC

# Why AAC is interesting to HCI

- Many different types of interaction challenges (physical, cognitive, linguistic)
- Natural human communication is fast, complex, multi-modal
- Communication skills reflect upon self image, interpersonal relations
- Communication is very contextual—may be able to leverage sensing, linguistics

# Understanding AAC

- Who uses AAC?
- Types of AAC
- Input methods
- Output modes
- Form factors
- Design considerations / evaluation

# Who uses AAC?

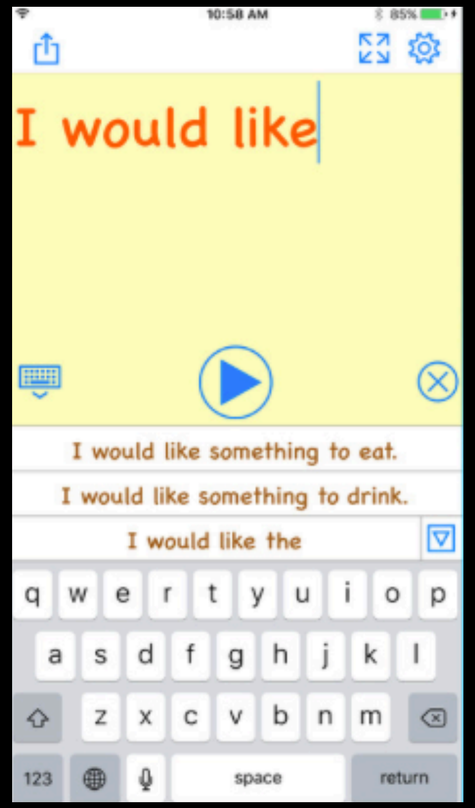
# Who uses AAC

- Cognitive impairment (congenital or acquired, as in traumatic brain injury)
- Autism spectrum
- Aphasia
- Physically unable to speak (ALS, other severe physical impairments)
- Unable to speak clearly: dysarthric speech
- **Very often involves comorbid disabilities**

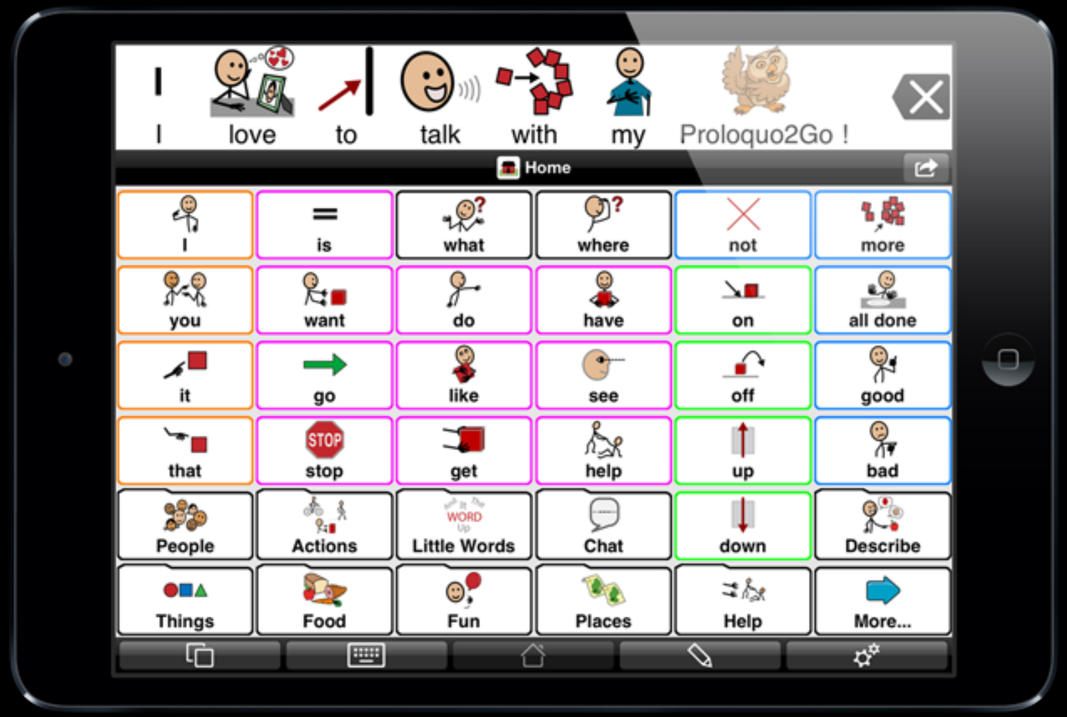
# Many interaction challenges

- Articulating spoken words
- Remembering the appropriate words (for written and/or spoken text)
- Recognizing others' words
- Using appropriate grammar
- Selecting the words you want to say
  - By typing it out
  - By recognizing it on a screen
- All of this is compounded by difficulties in using a graphical user interface

# Types of AAC




Text-based (Proloquo4Text)




Symbol-based (Proloquo2Go)

# Input methods

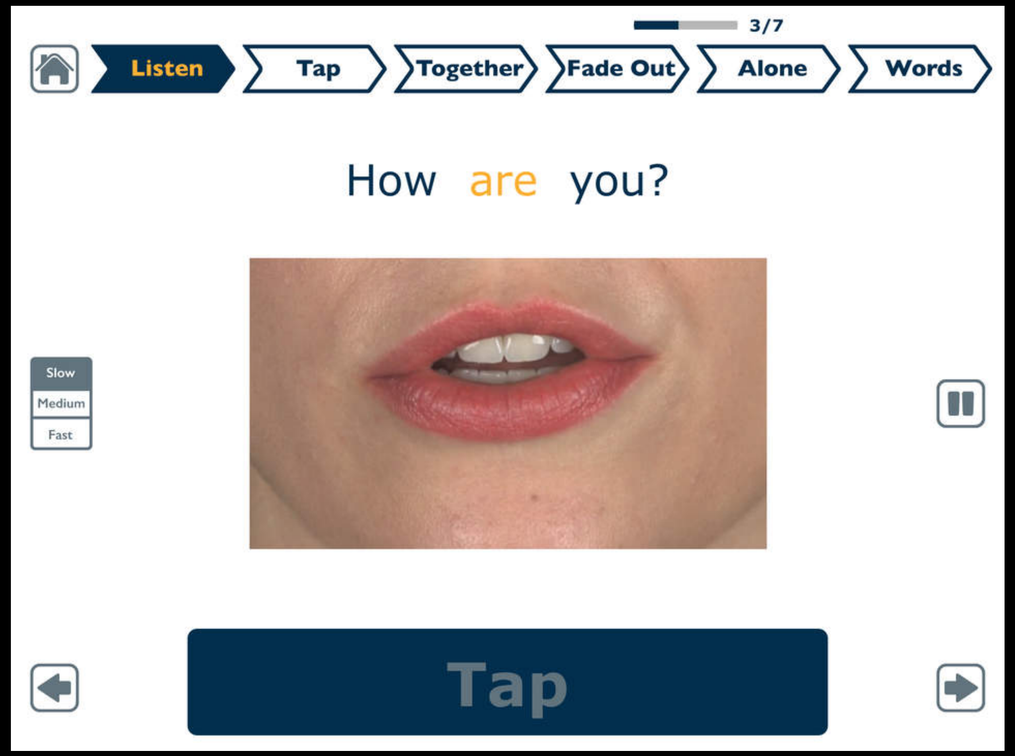
- Touch (probably most popular)
- Switch input
- Head mouse
- Eye gaze
- Low tech (e.g. Becker Board)

# Low-tech methods

- What to do when technology doesn’t work?
  - Battery is dead, too much sun…

# Output modes

- Text-to-Speech (TTS)
  - Customize voice settings
  - Custom voice
- Recordings (voice banking)
- Text only (to share in person or over network)
- Recorded video (for apraxia)



# Form factors

- Phones
- Tablets
- Wearable HMDs
  (Williams et al., ASSETS ’16)
- Textiles

# AAC can be expensive



Intel Buys Mobileye in $15.3 Billion Bid to Lead Self-Driving Car Market
Russian Espionage Piggybacks on a Cybercriminal's Hacking
Miscue Calls Attention to Amazon's Dominance in Cloud Computing
Waymo Asks Court to Block Uber's Self-Driving Car Project
High Above, Dro Watchful Eyes o in Africa

TECHNOLOGY

## *Insurers Fight Speech-Impairment Remedy*

By ASHLEE VANCE SEPT. 14, 2009

152

Kara Lynn, with her 5-year-old son, Aiden, uses an iPhone to run text-to-speech software.
Chester Higgins Jr./The New York Times

SAN FRANCISCO — Kara Lynn has amyotrophic lateral sclerosis, or A.L.S., which has attacked the muscles around her mouth and throat, removing her ability to speak. A couple of years ago, she spent more than $8,000 to buy a computer, approved by Medicare, that turns typed words into speech that her family, friends and doctors can hear.

Under government insurance requirements, the maker of the PC, which ran ordinary Microsoft Windows software, had to block any nonspeech functions, like sending e-mail or browsing the Web.

RELATED COVERAGE

BITS
Text-to-Speech Technology Progresses SEPT. 17, 2009

Expanding Options for the Disabled
SEPT. 10, 2009

RECENT COMMENTS

**AnaSLP** September 15, 2009
Sad to see anyone a) claim all healthcare workers are pirates--some are, but the majority are people who make personal sacrifices to heal...

**djinniz** September 15, 2009
This is something that needs to be fixed about Medicare/Medicaid.The Times did a piece a few years back about Medicare suppliers.This type...

**mfellion** September 15, 2009
This story just illustrates the rip off in the medical device field. I used to audit these thieves. One typical example, medicare pays...

SEE ALL COMMENTS

# Challenges of AAC

- Why is this difficult?
  - Variations in ability (language, cognition, motor abilities)
  - Personalizing - how does it reflect me? my interests, etc
  - Expressing personality
  - Emotion
  - SPEED
  - Researchers / designers can’t get rich feedback often
  - Speed vs. training (aka the tyranny of QWERTY)

# Challenges of AAC

- Input is slow
- Input can be difficult for many users
- Breadth vs. depth in UI
- Supporting situational use
- Lack of expressiveness

# Generalizability?

- Can AAC (and related technology) help a broader audience?

# Generalizability of AAC

- Foreign language learning
- Texting (uses word completion/prediction)
- Many similar challenges to interacting at a distance…

# Mini-talk on social aspects of AAC

*"At times avuncular and cantankerous, with the reflexes of a mongoose":*

# Understanding Self-Expression through Augmentative and Alternative Communication Devices


Shaun Kane[1]

Meredith Ringel Morris[2]

@shaunkane

1 rierm

2 Microsoft Research

“At times avuncular and cantankerous, with the reflexes of a mongoose and a brain like a sieve. A true Renaissance Man, I once grew 17 varieties of green beans.”

# About this talk

- Interview study with 7 People with ALS (**PALS**) and their families
- Understand challenges of expressing **personality** when using Augmentative and Alternative Communication devices (**AAC**)
- Identify goals for understanding and supporting expressive communication through AAC

# Amyotrophic Lateral Sclerosis (ALS)

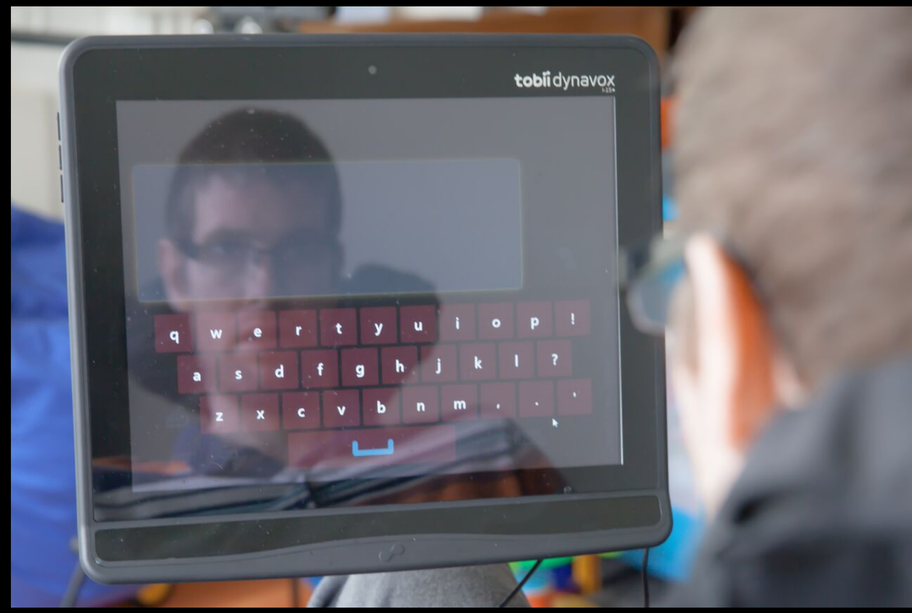
- Affects 1 in 50,000 adults
- Progressive neurodegenerative disease with 2-5 year life expectancy
- Speech and motor movement often isignificantly mpaired, eye gaze primary input method
- Reliant on AAC for most communication

Lou Gehrig

Dr. Stephen Hawking

# Using AAC with eye gaze

- Typical communication rate 10-20 words per minute (wpm)
- Spoken speech approximately 180 wpm
- Error rate can be high, especially in specific locations , including outdoors
- Users typically have low-tech methods as a backup (hand signals or e-tran boards, yes/no gestures)



"…until there is a medical treatment or cure [for ALS], technology can be a cure"

– Steve Gleason

# About the study

- Interviewed 7 PALS (6m, 1f, age range 39-54)
- Most (6) invited a spouse, partner, or caregiver
- Interview topics included: technologies used or tried to support communication, how participant expressed their personality, through conversation and writing, and how the participant has adapted to changing communication ability
- Provided questions to participants ahead of time; encouraged follow-ups by email

| | Gender | Age | Years w/ ALS | Modes of Communication | Intervie |
|---|---|---|---|---|---|
| A1 | M | 49 | 3 | Speech when fatigue is low; EZSpeech on Apple iPad tablet; owns an eye gaze system but has not used it | None |
| A2 | M | 48 | 5 | Tobii Dynavox; e-tran board | Wife (P |
| A3 | M | 48 | 3 | Tobii Dynavox; e-tran board | Domest |
| A4 | M | 53 | 3 | Microsoft Surface tablet with eye tracker; Tobii Dynavox; Apple iPad tablet; hand signals | Wife (P |
| A5 | M | 51 | 4 | Speech when fatigue is low; Microsoft Surface tablet with eye tracker; Tobii Dynavox; Apple iPhone | Wife (P |
| A6 | M | 39 | 5 | Microsoft Surface tablet with eye tracker; e-tran board | Caregive |

# AAC devices used

Gaze-based keyboard AAC (6)

E-tran (eye transfer) board (4)

Commodity phones and tablets (3)

# Findings

1. Challenges to real-time communication

2. Expressing personality using AAC

3. Interactions with the wider world

# Issues with real-time communication

- Pacing
- Volume
- Pronunciation
- Conversational roles

# Conversational pacing

- Slow rate of output commonly affected PALS' ability to keep up with communication; especially with strangers (20 vs. 180 wpm)
  - A2's spouse: "others are a little unnerved, break out the phone [mimics texting] because... of downtime while he's formulating a response..."

- Lack of awareness of when the AAC user is typing or idle
  - A2 needs to "burst in" to conversations
  - A6 interjects "but" or "also" to indicate a longer sentence is coming

# Phrase-level pacing

- AAC typically provided little control over timing within a sentence or paragraph
  - A1: "when I hit speak, there is no pause between my sentences [where I put a hyphen], and that would piss me off because it becomes a run-on... that forces me to type a sentence, hit speak, delete it, and retype a new one…"
  - A3: "no sense of humor... it [humor] just doesn't come across in the same way... it [the speech rendering] doesn't pause where you would pause, that's a really big one."

# Volume and pronunciation

- Lack of control over volume limited PALS' ability to communicate in public or in groups
  - A1: "I can't go to a restaurant or somewhere with traffic because I can't project my voice [over the ambient noise]. I have a speaker, an amplifier, but it's cumbersome and I never have it when I really need it..."

- AAC often mispronounces words, especially foreign language words, acronyms ("ALS"), and names. PALS learned how to misspell words to achieve correct pronunciation.

# Change in conversational roles

- PALS often struggled with a shift to a more passive role
  - A2's wife: "I think his family as a whole... they're animated people, so I would say the whole sibling engagement was very spontaneous and there was a lot of banter... and I can definitely say that some have not made the adjustment to silence-engagement-silence-engagement ... I think it's uncomfortable [for them]."

- Maintaining an active role often required additional work
  - A3's partner: "if somebody's coming over, he'll write an agenda of questions for them... because otherwise it's really awkward...especially for somebody who doesn't come over very often and is not very comfortable with the pauses."

# Issues with expressing personality

- Controlling tone and expressing emotion
- Humor
- Storytelling
- Communicating concisely

# Tone and emotion

- PALS expressed frustration about their monotone AAC voice, often perceived as emotionless or presenting negative emotions ("condescending" and "less compassionate")
  - A1: "that mood ... when you read a text from someone you don't know well... that now is how I'm starting to feel with everyone."

- PALS felt unable to express their emotions, while feeling emotional could impact the AAC accuracy
  - A6: "I have to write the words 'I'm disappointed', or 'I'm getting frustrated.'"
  - A7: "Strong emotion hinders Tobii usage, tears confuse eyegaze technology and anger prevents focus."

- Recorded speech was valued, but not all were able to voice bank in time

# Humor

- Humor is impaired by the inability to provide quick responses, limited control over pacing, inability to express sarcasm
  - A7: "Each day presents countless frustrations as humor and incisive comments require timing and inflection."

- PALS found new ways to express humor by changing their AAC voice (changing gender, adding a southern drawl), creative cursing, storing and replaying amusing quotes and songs

# Storytelling

- Some PALS had previously been known as great storytellers, and had difficulty telling stories with their AAC

- Some wrote extensive stories, but found that their AAC did not provide control over pacing or voices
  - A5: ”all my voices sound the same.”

- PALS stored favorite quotes, and played videos to spark conversations
  - A6’s caregiver: ”[he] shows off a lot of pictures and videos... that's an easy way for him to show something without having to describe it or talk about it. He's just like, 'look at this.'"

# Communicating concisely

- PALS found that the constraints of their AAC required them to speak more deliberately and concisely
  - A2's wife: "the bluntness is kind of cool, too, because he doesn't have time to beat around the bush," and, "It might be rude if you and I say it, but for him to say it, it's much more ... socially acceptable to say."
  - A5: "Somewhere along the line I think I just stopped thinking about it too much, stopped caring about it too much, just worried about getting the point across."
  - A7: "I think one arena that's improved as a result of AAC use, is my ability to express myself succinctly, when I must."

# Interactions with the wider world

- Communicating in public
- Pets and agents
- Interacting with children
- Interacting online

# Communicating in public

- PALS often have worked out communication strategies with family, but had more difficulty with strangers, who were not used to communicating with AAC users

- PALS experienced difficulty expressing private comments in public, as they can't "whisper"; use IM or facial gestures

# Pets and agents

- **Pets:** One participant (A4) "can no longer call the cat" because the cat did not recognize his AAC output as his speech

- **Agents:** Voice agents like Siri and Alexa typically could not understand PALS' dysarthric speech, but they could use their AAC to speak to these devices

# Interacting with children

- Communicating with children was, as children often could not interpret emotion from context:
  - A6: "It's almost impossible to express frustration when I'm trying to get [my son] to hustle up and get ready... So I have to use words like '[son], you need to hurry.'"

- A5 reads bedtime stories to his children using AAC; A2 used to sing to his children but now plays nostalgic songs

# Online interactions

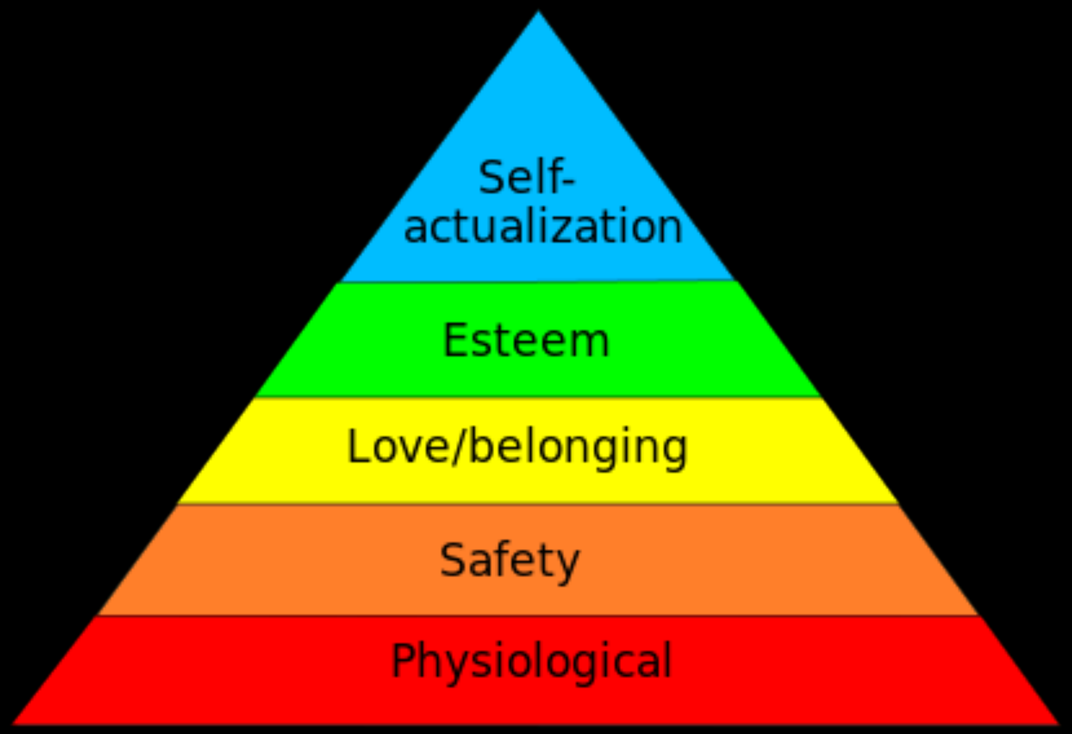
- Writing, journaling, and interacting online took on added significance for many PALS
  - A2: "[I] never wrote before. Now I write like I used to talk."
- A6 writes journal entries for his son; A7 blogs and reviews books
- PALS withdrew from some online communities because they involved activities the PALS could no longer participate in
  - A7: "Prior to ALS taking away the use of my limbs, I spent hours on photography and photography-related applications… Now, I'm unable to access any of it."

# Discussion

# Discussion

- Enhancing the expressiveness of AAC
- Considering metrics for AAC effectiveness

# A hierarchy of expressive AAC




Maslow's Hierarchy of Needs [1943]

| Features |
| --- |
| 1. Sapi 5 compatibility |
| 2. Intelligibility & pronunciation editing |
| 3. Pitch and speed Controls |
| 4. Socially interactive[2] |
| 5. Expressiveness |
| 6. Multilingual Capability |
| 7. Loudness |
| 8. Talk to animals |
| 9. Ability to sing |

Hierarchy of speech synthesis needs from an AAC user [Portnuff, 2006]

# Beyond WPM: New Metrics for AAC

- **Authenticity**: Does AAC communication effectively express the user's personality, communication style, and sense of humor (as it existed before ALS)?
- **Situational Correctness**: Can the user switch between formal/informal communication to match the context? (e.g., punctuation norms, bilingualism, slang, cursing, wordplay)
- **Expressing and Accommodating Emotion**: Can the user control tone and pacing, and dynamically change emotions during a conversation? Can they use the AAC when feeling extreme emotions?
- **Goal-Oriented Speech**: Can the AAC support directed social activities (e.g., negotiating to buy the family car, running a business meeting)?
- **Conversational Metrics**: Does the AAC support equal participation, turn taking, communication with non-native speakers, children, pets/?

# Enhancing AAC expressivity

- Awareness displays representing the current state of the AAC device (see Kiley Sobel et al., CHI 17)
- Support greater control over performance of sentences and stories
- Support smoother integration between pre-recorded and live content

# Conclusion

- Lots of room for improving the performance of AAC
  - Challenges related to physical, environmental, and social factors

- In parallel, we should consider how AAC can improve the user's ability to **express themselves authentically**

- Despite challenges, participants are often able to adapt their use of AAC to express their personality

# Thank you!

Read the paper: [aka.ms/expressiveaac](aka.ms/expressiveaac)

Shaun Kane
(@shaunkane)
**Universirty of Colorado Boulder**
[superhuman.cs.colorado.edu](superhuman.cs.colorado.edu)

Meredith Ringel Morris (@merrierm),
Ann Paradiso, and Jon Campbell
**Microsoft Research**
[aka.ms/msrenable](aka.ms/msrenable)


SUPERHUMAN COMPUTING LAB
University of Colorado Boulder

Microsoft Research

# AAC Research

# Evaluating AAC

- How can we evaluate how well an AAC device works?

# Evaluating AAC

- Speed and accuracy
- Expressive language
- Emotional communication
- Diverse input modes
- Social participation

# Key challenges for research

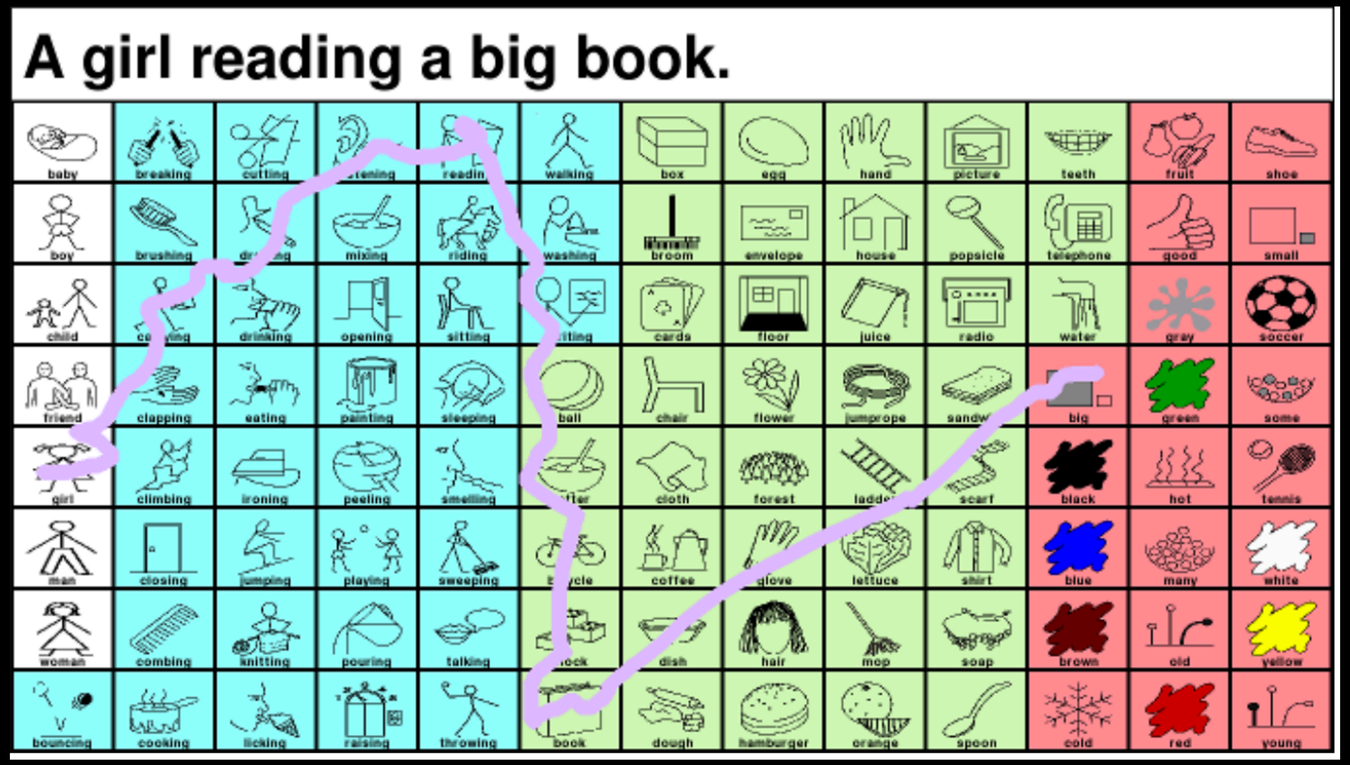
- Improve speed and accuracy
- Reduce errors (which can have social implications)
- Support expressive communication
- Support eye contact, joint attention

# Strategies from prior research

- Private display (GLAAC, Williams et al., ASSETS ’16)
- Support robust input modes
- Leverage conversational partners
- Use context for predictions
- Provide status feedback

# Support robust input modes

- Wiegand and Patel, SymbolPath, ASSETS ’12



# Leverage conversation partners

- Fiannaca et al., AACrobat, CSCW ‘17

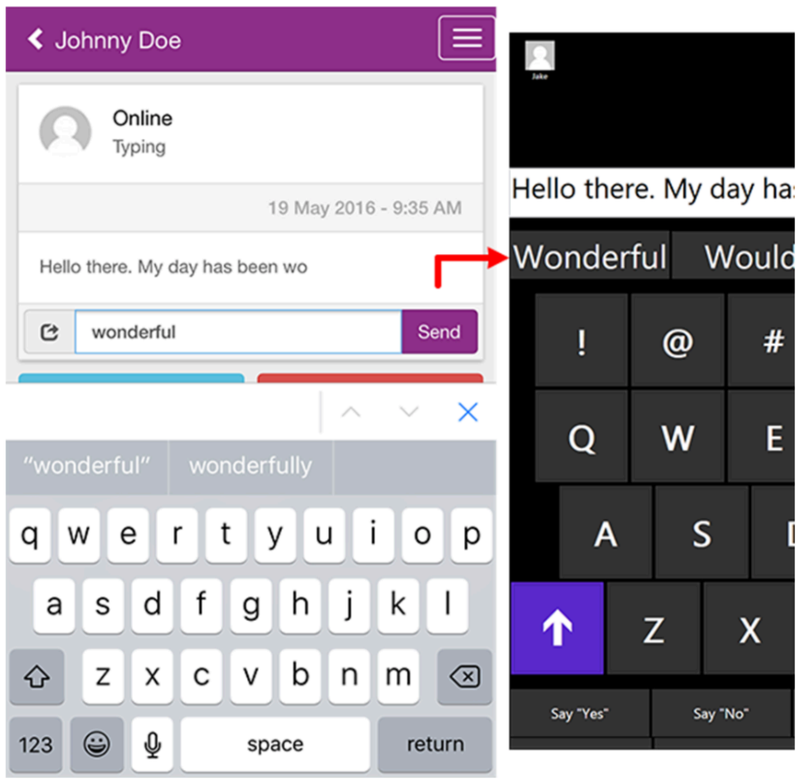
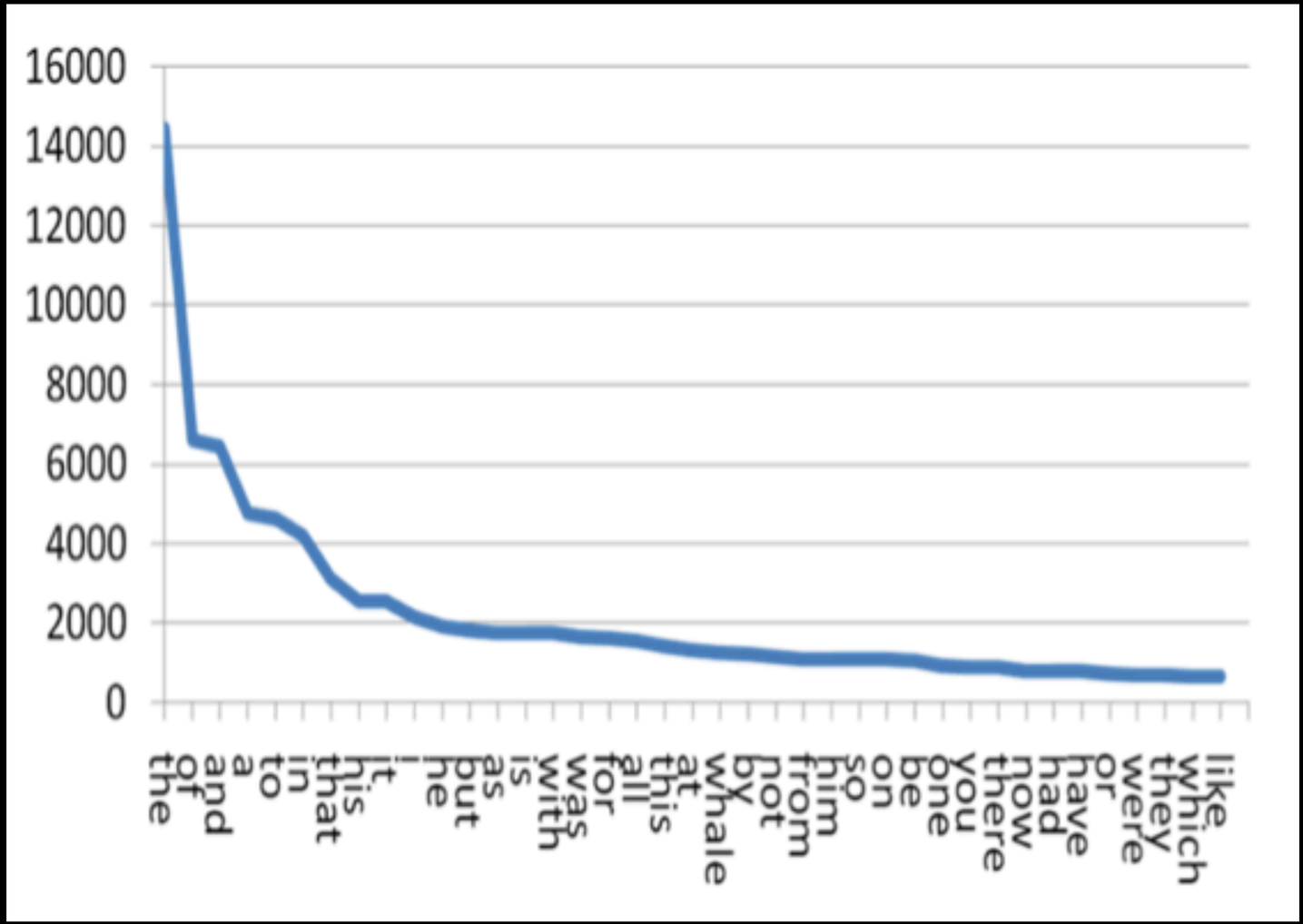



**Figure 4. Example of co-construction functionality in the companion app inserting a suggestion into the prediction bar of the AAC application. When the communication partner sends a word or phrase suggestion, it appears in the AAC application’s prediction bar among the system-generated predictions.**

# Word predictions

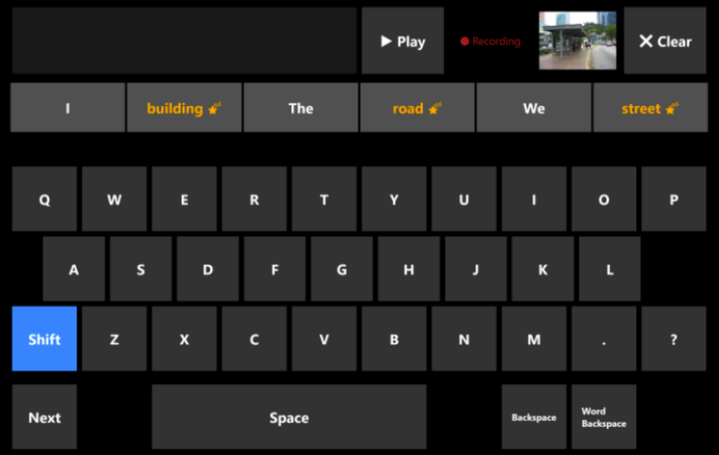


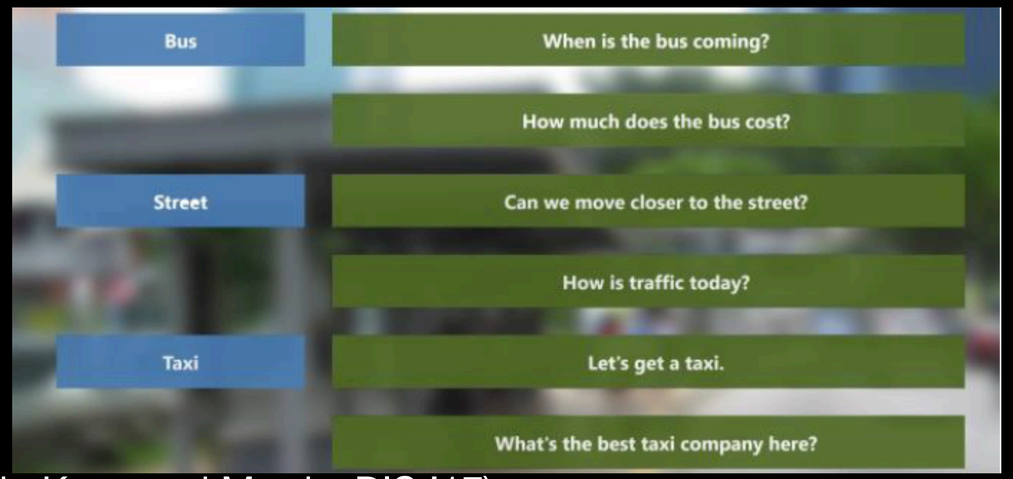
# Use context for predictions

- What information can we leverage for predicting words better?
  - Linguistic analysis (newspapers, etc)
  - Most recently used
  - Other side of the conversation
  - Who is conversation partner?
  - Location

# Use context for predictions

- Location, task (Kane et al., ASSETS ’12)

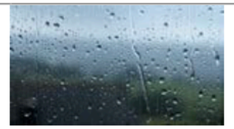



- Nearby objects (SceneTalk, Kane and Morris, DIS ’17)

# Provide feedback on conversation status & emotional state

- Sobel et al., CHI ’17

| *Conversational flow* | *Emotion* | *Awareness display type* |
|---|---|---|
| I’m listening. | sarcastic | **Text (left: *listening*; right: *sarcastic*):** The exact meanings in plain text. For conversational flow, they are presented in sentences. The emotions are individual words. |
| (^o^)<<< | :) | **Emoticon (left: *talking*; right: *happy*):** Pictorial representations using ASCII punctuation marks, numbers, and letters (i.e., emoticons). For emoticons that did not have Western style representations (e.g., *happy*), we used or created Japanese style emoticons (e.g., *talking*). |
| | | **Emoji (left: *hold on*; right: *laughing*):** Static expressive symbols, currently popularly used in text and online communication. Here, the emoji are from Windows 10. The majority of emotions are face-based, while the conversational cues are other types of ideograms. |
| | | **Avatar (left: *Pardon me?*; right: *angry*):** An animated Xbox Live Avatar, available through Windows. Animations last from anywhere between 1-15 seconds. The animations repeat until the corresponding key is released or the action (i.e., *typing*) stops. |
| |  | **Skins (left: *talking*; right: *sad*):** Animated thematic videos; in our case, nature scenes retrieved from Creative Commons. Animations lasted from between 1-12 seconds and repeated as necessary. (Left by Always Shooting / CC BY 2.0; right by Frank Vincentz / CC BY-SA 3.0.) |
| | | **Colored LED cluster (left: *typing*; right: *caring*):** Brightly colored LEDs animate within a circle, and repeat as necessary. Some emotions are modeled after faces/emoticons, while conversational cues are abstract symbols and movement. |

# Wearable AAC (Halley Profita)

- Designed for equine therapy
  - Can’t easily hold a tablet
  - Need simple interface
- Textile-based wearable wraps around the leg
- Prerecorded sounds: Go, Stop, Giddy Up

# Balancing priorities

- Ease of use
- Responsiveness
- Expressivity
- General purpose vs. specific
- Not too many options / too much navigation

# Weekly activity

- Design an AAC interface for a specific context (game, hobby, sport) or a particular user
- Consider, and write down, what is particularly **challenging** about this context? What is important in this context?
- Add interesting sensing or interaction techniques as appropriate
- Design your interface and demonstrate it via a storyboard, video, or web demo

# Let’s brainstorm contexts

- Retorts / GIF / memes
- Bar / restaurant / coffee
- Board games
- Card games
- Navigating
- Rock climbing

# Let’s brainstorm contexts

- Dating
- Classroom
- Video games online
- Talking about the big sports game
- Political rally / discussion
- Talking about recent media
- Small talk
- Playing with a child
- Making / Listening to music
- Family gatherings
- Grocery store
- Talking to medical professionals

- Dungeons & Dragons
- Sci Fi convention
- On a boat
- Reading the tabloids
-

# AAC for dating

- Specific language?
  - Flirtatious, friendly joking, coy
- Scripts to follow?
  - Interview. Food/dinner. Deescalation.
- What is important to express?
  - Sarcasm. Interest/excitement. Listening. Eye contact.
  - Facial expressions as an avatar?
- Does context affect design of the interface?
  - Supporting backchannel. Make it look good / match your outfit.

# AAC for comedy!

lostvoiceguy.com