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Session Code: AAC-006 Integrating Speech Recognition into AAC Technology

Susan Koch Fager, PhD, CCC-SLP
Institute for Rehabilitation Science and Engineering
Madonna Rehabilitation Hospital, Lincoln, NE
Tom Jakobs, PE,Invotek, Inc.. Alma, AK

January 29, 2015; 9:20-10:20

Handouts are available at: www.atia.org/orlandohandouts

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Learning Objectives

- **Attendees will be able to identify 3 challenges individuals who rely on AAC face in communicative interactions using current technology.**
- **Attendees will describe the impact of integrating natural speech in AAC interactions.**
- **Attendees will describe 2 strategies and/or modifications to current AAC technology to promote natural communicative interaction.**

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Institute for Rehabilitation Science and Engineering

Developing technologies and treatments to help eliminate barriers and solve rehabilitation challenges

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Collaborative Research

- Invotek, Madonna
  - Long history of SBIR projects
  - www.invotek.org/research/

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- Penn State, OHSU, Invotek, Madonna

RERC on AAC

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Grant funding support

- National Institutes of Health
  - NIDCD
  - Effective Self Expression for People with Severe Speech Disorders
  - 1R43DC012734-01

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Disclosures

- Madonna Rehabilitation Hospital does not have a financial relationship with the sale of the technology presented in the project
- Invotek, Inc. is the developer of the prototype technology presented today. Invotek, Inc. sells the speech recognition software (SSR) that the prototype is based upon. The prototype described in the presentation is not currently a commercially available product.

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Background/Rationale

- Desire to use natural speech is innate
  - Automatic
  - Source of identity
  - Allow for more natural timing in interaction
  - Able to "hold the floor" compared to device-mediated interactions
- AAC technology tends to serve as a "replacement" for speech

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Prototype description

- Speech recognition based on models of dysarthric speech
  - SSR (Supplemented Speech Recognition)
  - Incorporates speech, first letters of spoken words are typed, word prediction
- Fager, S., Beukelman, D., Jakobs, T., & Hosom, J.P. (2010). Evaluation of a Speech Recognition Prototype for Speakers with Moderate and Severe Dysarthria: A Preliminary Report. *Augmentative and Alternative Communication, 18*, 48-55.

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- Forward facing monitor
  - User essentially has subtitles, can turn on or off
- Synthesized speech output if desired/needed

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How the prototype works

- User types the first letter of the target word
- They speak the word
- The SSR attempts to recognize the word
  - If recognized it is inserted in the line of text
  - If not, the word may appear in the word prediction list and the user can select if from there
  - Or user can spell the word out letter-by-letter
- What is written is displayed on the forward-facing monitor to the listener

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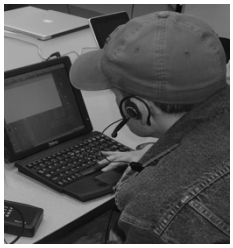
Supplemented Speech Recognition



1. Automatic speech recognition based on models of dysarthric speech
   - System is further customized by individual user
2. First letter identification (alphabet supplementation)
3. Word prediction

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Alphabet Supplementation
(Sentence: "The nurse will bring my snack")

A B C D E
F G H I J K
L M N O P
Q R S T U
V W X Y Z

REPEAT
START AGAIN
END OF WORD
END OF SENTENCE
1 2 3 4 5
6 7 8 9 0

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How SSR functions

- User types the first letter of the target word
- User says the word
- Word shows up in line of text (most probable) OR
- Word is available on one of 6 word prediction buttons (next 6 probable word options) OR
- User has to type the word

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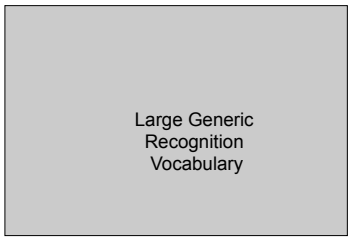
Traditional Vocabulary



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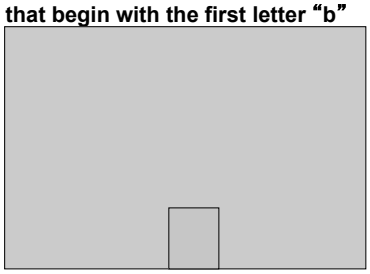
Words that begin with the first letter "b"



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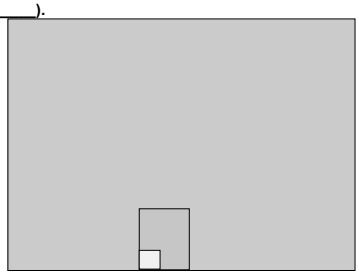
Words that begin with a given letter of the alphabet "b" and occur following a specific word (The "b"_____).



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SSR video

- http://www.invotek.org/products/speech-recognition/

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Evaluation

- The goal of the evaluation is to assess how this new method of supporting an AAC interaction impacts the listeners behavior.
- Hypotheses:
  - Listeners engagement as measured by on-task behavior and eye-gaze will increase during the RealTalk condition compared to traditional AAC condition

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Conditions

- Traditional AAC (no speech, just text to speech with word prediction)
- RealTalk (prototype AAC system that incorporates supplemented speech recognition)

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Participant

- Speaker with dysarthria
  - Female with CP, 74% sentence intelligibility, research assistant
- 5 listeners
  - 1 male, 4 females
  - 2 students in speech pathology, 1 accounting professional at rehab hospital, 1 IT manager at rehab hospital, 1 administrative assistant at rehab hospital

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Tasks

- Unstructured conversation (introduction, hobbies, pets/ vacations)
- Structured barrier tasks
- Tasks randomized per condition, per listener

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Analysis

- Qualitative analysis of gaze behavior of listener
  - All interactions video-recorded, transcribed, timed and coded for gaze behavior (on topic vs. off topic)
  - On topic- focused on speaker or task
  - Off topic- looking around room, focusing gaze on other objects in environment, engaging in conversation with 3rd party
- Proportion of words per participant (unstructured conversation)
- Qualitative feedback on comfort and preference of technology being used in a communicative interaction with the speaker

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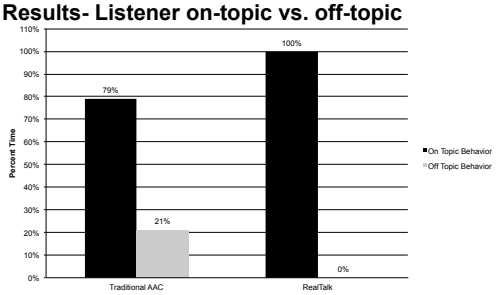
Results- Listener on-topic vs. off-topic



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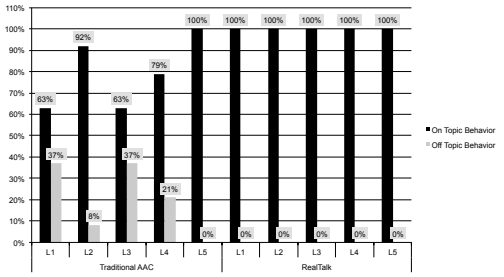

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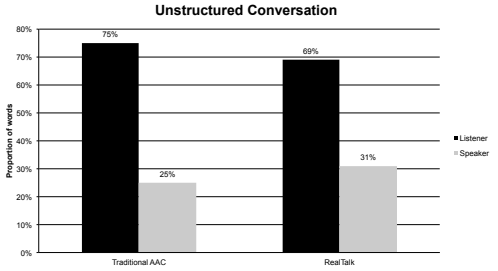
Proportion of words used in unstructured conversation



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Usage Statistics

Traditional AAC

- Keystrokes: 377
- Corrections: 108
- Word Prediction: 118
- Keystroke Savings: 13.41%
- Communication Rate: 7.2

RealTalk

- Keystrokes: 267
- Corrections: 4
- Word Prediction: 28
- Keystroke Savings: 61.2%
- Communication Rate: 11.22

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Preference and qualitative comments

- All listeners preferred RealTalk to the traditional AAC condition for day-to-day communication with a communication partner
- Comments:
  - L5: "When she wasn't talking the technology seemed in the way. When she was talking it seemed more helpful during the conversation."
  - L3: "I didn't know what to do or look at during the [traditional AAC] part. I felt uncomfortable."
  - L4: "I was able to focus and pay attention when she was talking."
  - L4: "I felt like I knew more what was going on when I could hear her talk."
  - L1: "The time delay in the traditional AAC condition felt unnatural. It felt more natural to be able to listen to her speech during the interaction."

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Video

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Future Directions

- Wider range of participants with dysarthria
  - New participant= 17% on sentence intelligibility
- Analysis of familiar vs. unfamiliar listeners
- Use of video clips across a wide range of listeners for more qualitative information on perceived level of comfort and preference, etc.

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Acknowledgements

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