RERC on AAC

Using Communication Supports to
Enhance Communication Effectiveness of
People with Severely Dysarthric Speech

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ISAAC Conference 2016

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Disclosure
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- NIDILRR is a Center within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). The contents of this presentation do not necessarily represent the policy of NIDILRR, ACL, HHS, and you should not assume endorsement by the Federal Government.

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Disclosures

1. Partner in the Rehabilitation Engineering and
      Research Center for AAC

2. Senior Researcher in the Institute for
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3. Emeritus Faculty at University of
      Nebraska, Lincoln

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Visual Supplementation

- **Understandable speakers** provide the story-line through speech and enhance detail through visual supports

- **Speakers who are difficult to understand** (Provide story-line through supplemented speech and enhance visual detail information through visual supports)
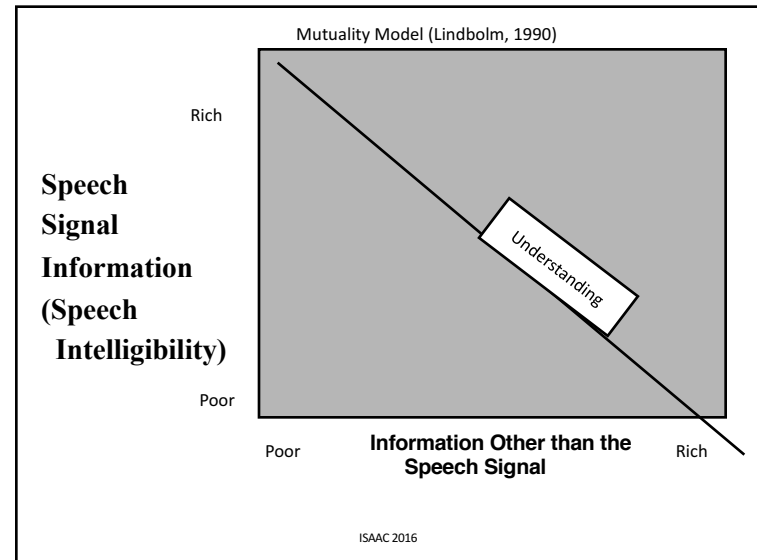
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Illustrate Visual Detail
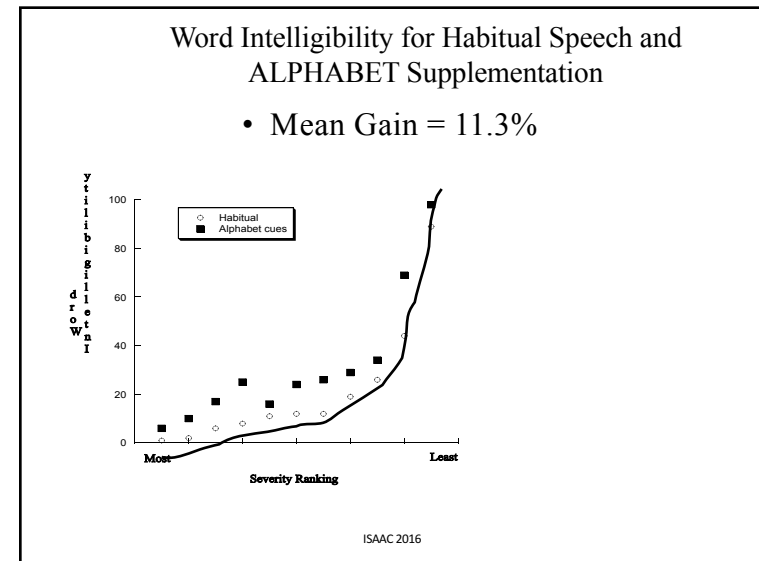

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Illustrate an Activity

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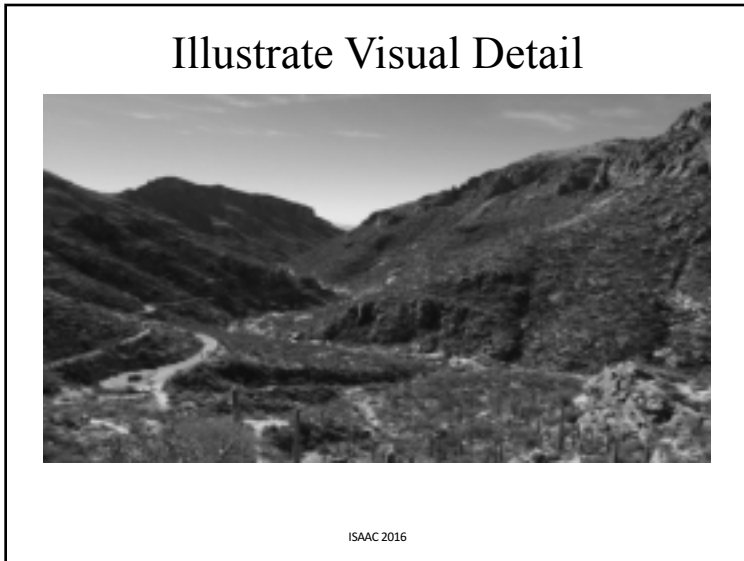
Intervention Goals

Restoration—reduce the impairment----normalization

Compensation—reduce the activity limitation through behavioral or prosthetic interventions

Supplementation—provide information in addition to the speech (natural or AAC speech)

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Mutuality Model (Lindbolm, 1990)

Rich

Speech Signal Information (Speech Intelligibility)

Understanding

Poor

Poor   **Information Other than the Speech Signal**   Rich

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Speech Intelligibility

Speech Impairment
&
Compensatory Strategies

Acoustic Signal → Listener Processing → Speech Intelligibility

Language Knowledge
World Knowledge
Disability Knowledge

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Speech Signal Information
Speech Impairment
&
Compensatory Strategies

Signal-Independent Information
  Semantic Context
  Syntactic Context
  Alphabet
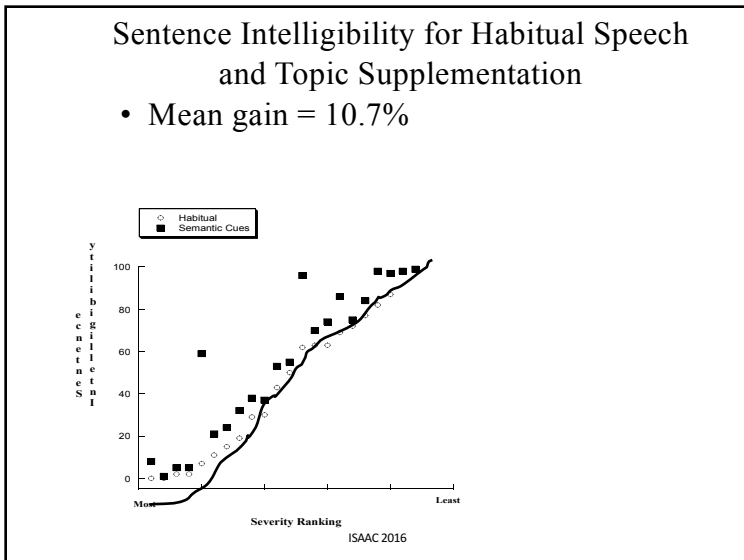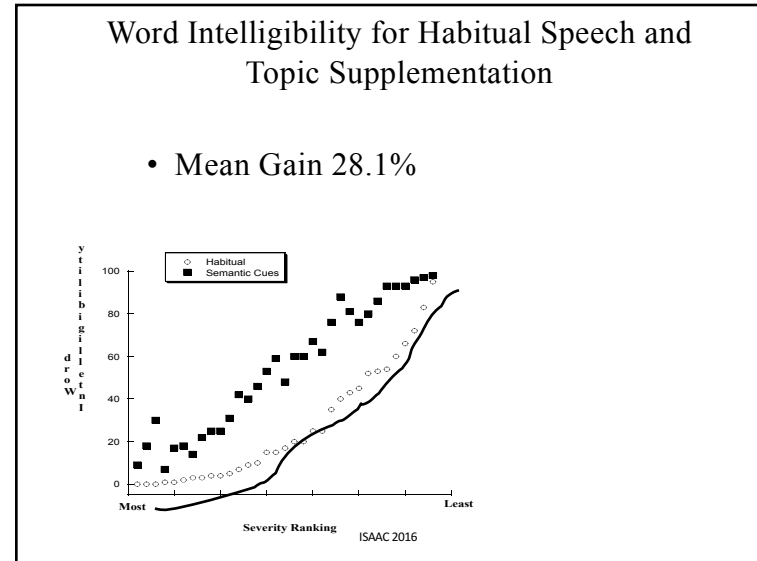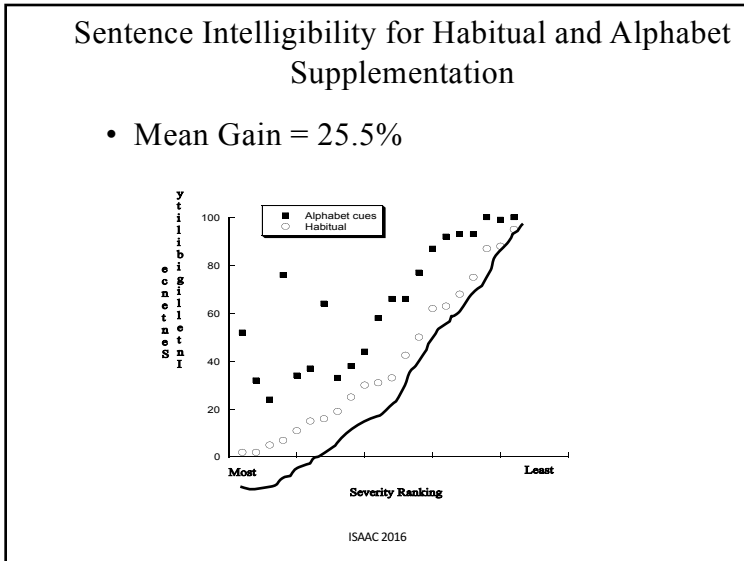 Gesture
  Visual support

Acoustic Signal → Listener Processing → Supplemented Speech Intelligibility

Supplemented Speech Intelligibility

Language Knowledge
World Knowledge
Disability Knowledge

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Alphabet Supplementation

A B C D E REPEAT
F G H I J K START AGAIN
  END OF WORD
L M N O P END OF SENTENCE
Q R S T U 1 2 3 4 5
V W X Y Z 6 7 8 9 0

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Word Intelligibility for Habitual Speech and ALPHABET Supplementation

- Mean Gain = 11.3%

Word Intelligibility

○ Habitual
■ Alphabet cues

Most — Least
Severity Ranking

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Sentence Intelligibility for Habitual and Alphabet Supplementation

- Mean Gain = 25.5%

Word Intelligibility for Habitual Speech and Topic Supplementation

- Mean Gain 28.1%

Sentence Intelligibility for Habitual Speech and Topic Supplementation

- Mean gain = 10.7%

Supplementation Board with Word/Phrase Dictionary

Integrating Speech Recognition into AAC Technology

Susan Koch Fager, PhD, CCC-SLP

Tom Jakobs, PE

David Beukelman, PhD, CCC-SLP

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Fager & Beukelman--Disclosures

- Employed: Institute for Rehabilitation Research and Technology, Madonna Rehabilitation Hospital
- Funding:
  - National Institutes of Health, NIDCD, Effective Self Expression for People with Severe Speech Disorders,1R43DC012734-01
  - H133E140026 from the NIDLRR, U.S. Department of Health.
- No financial compensation between the researchers and Invotek

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Jakobs - Disclosures

- Owner: Invotek, Inc.
- Funding:
  - National Institutes of Health, NIDCD, Effective Self Expression for People with Severe Speech Disorders,1R43DC012734-01
  - H133E140026 from the NIDLRR, U.S. Department of Health.
- RealTalk is not a commercial product of Invotek, Inc. at this time.

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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).

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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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Listener Display

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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)
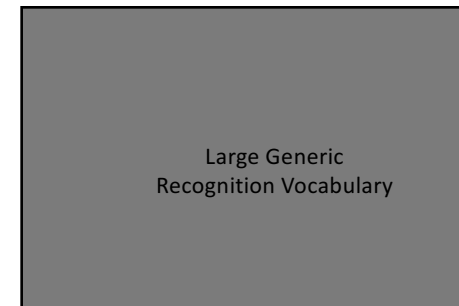3. Word prediction
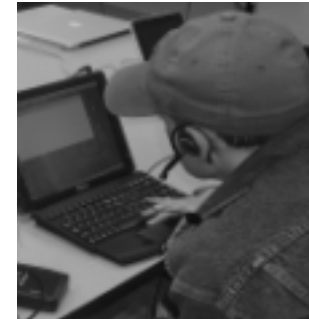
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Alphabet Supplementation
(Sentence: "**T**he **n**urse **w**ill **b**ring **m**y **s**nack")

A B C D E   REPEAT
F G H I J K   START AGAIN
               END OF WORD
L M N O P   END OF SENTENCE
Q R S T U   1 2 3 4 5
V W X Y Z   6 7 8 9 0

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Traditional Vocabulary

Large Generic
Recognition 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"_____).
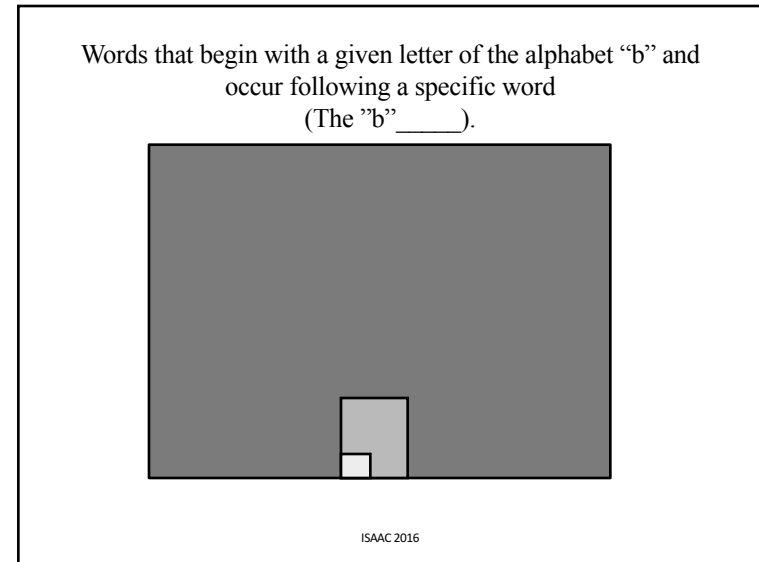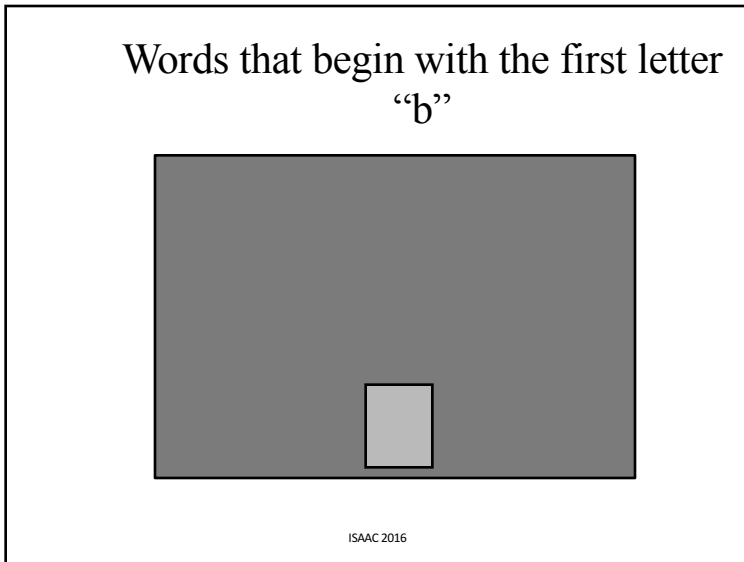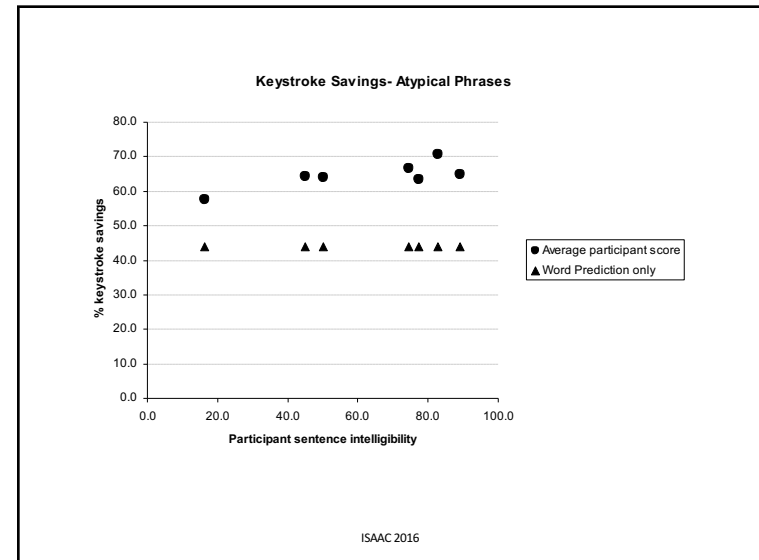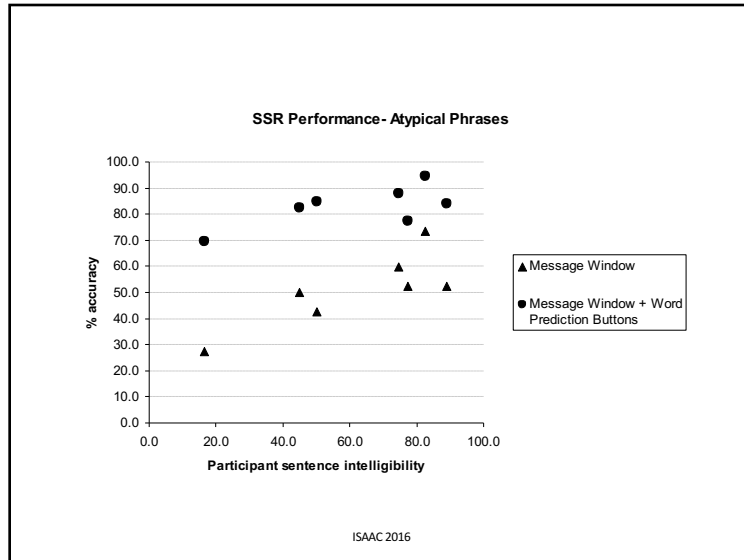

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Measurement
SSR Performance
(Word Recognition Accuracy)

- % of time the target word was either

1) immediately predicted (placed in message window) or

2) available on one of the word prediction buttons

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Keystroke Savings- Atypical Phrases

- Average participant score
- Word Prediction only

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SSR Performance- Atypical Phrases

Message Window

Message Window + Word Prediction Buttons

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Discussion

- Comparable results regardless of intelligibility level
- Significant keystroke savings benefit when compares to word prediction alone
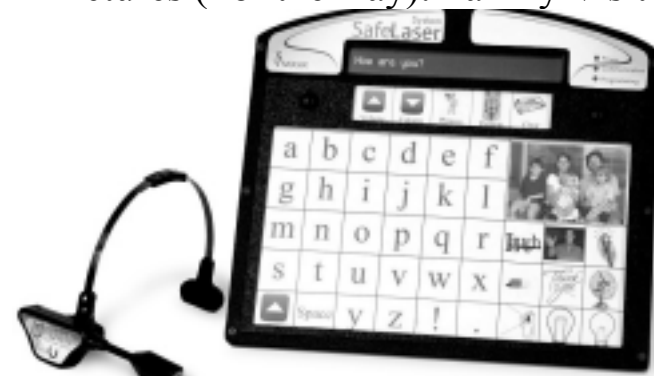- SSR performance- significant benefit to using hybrid approach (versus ASR only)

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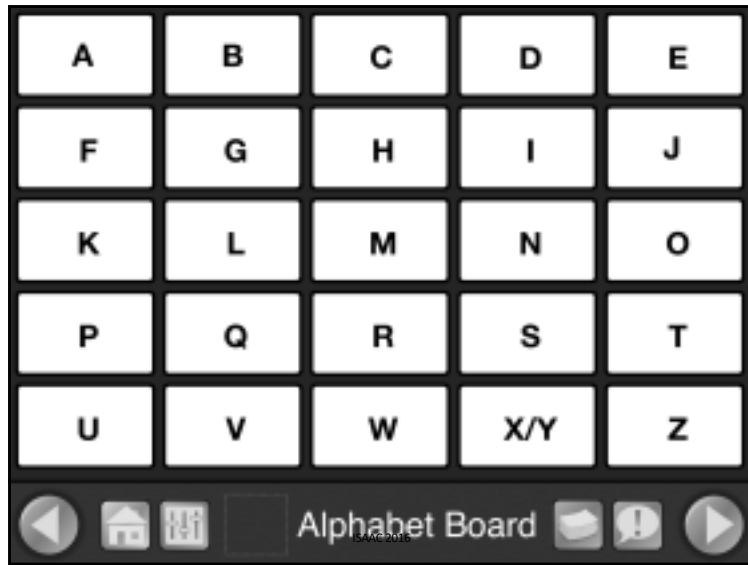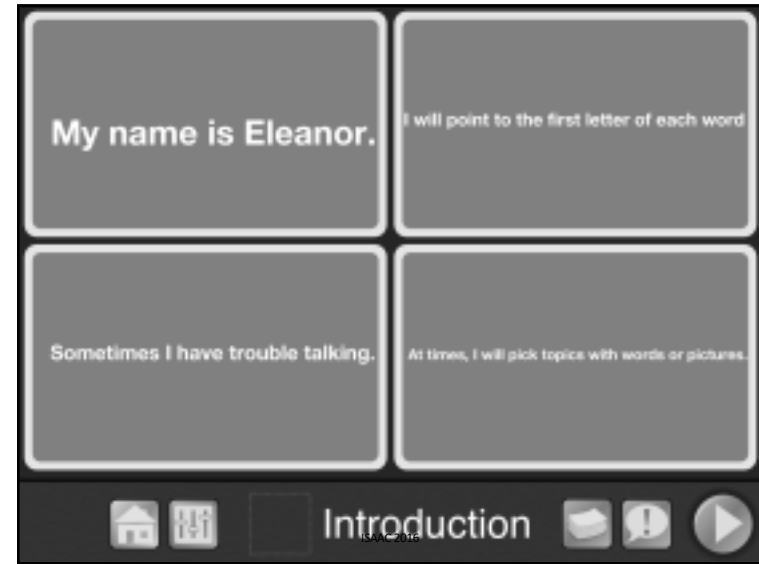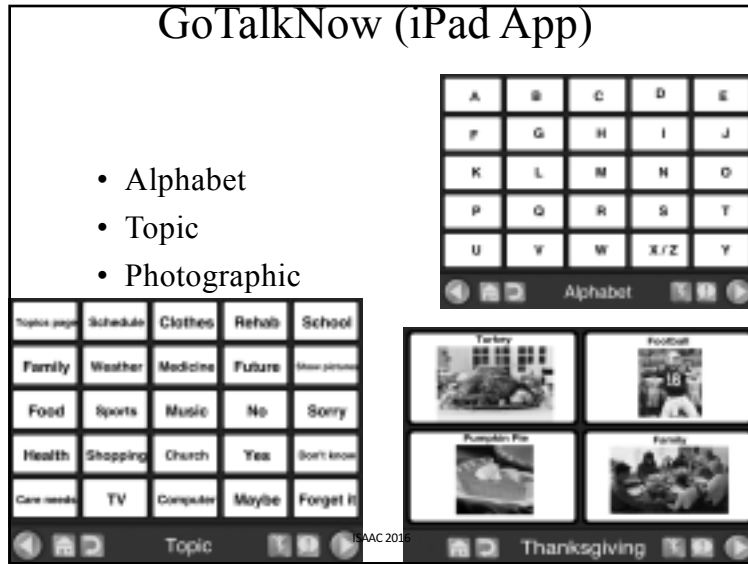## Multi-modal Supplemented Communication

- Residual Natural Speech
- Alphabet Supplementation
- Topic Supplementation
- Photographic Supplementation
- Communication Partner Information & Instruction For Supplementattion

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SafeLaser—With Topic Setting Pictures (For the Day): Family Visit

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GoTalkNow (iPad App)

- Alphabet
- Topic
- Photographic

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

Alphabet

Topics page	Schedule	Clothes	Rehab	School
Family	Weather	Medicine	Future	More pictures
Food	Sports	Music	No	Sorry
Health	Shopping	Church	Yes	Don't know
Care needs	TV	Computer	Maybe	Forget it

Topic

Turkey Football
Pumpkin Pie Family

Thanksgiving

| My name is Eleanor. | I will point to the first letter of each word |
| Sometimes I have trouble talking. | At times, I will pick topics with words or pictures. |

Introduction

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

Alphabet Board

Photographic Supplementation

- Creating a shared communication space
- Provide information about event, episode, activity
- Provide information about the role of people in an event
- Provide information about visual details
- Control topic during conversations
  – Topic Setter
  – Topic Keeper

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Quick Talk Instructional Messages for Listener

F	G	H	I	Explain
K	L	M	N	Repeat words
P	Q	R	S	Start over
U	V	W	X /	Spell word

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Photographic Supplementation

- 1. Establish and maintain the topic
    - --Episode
    - --Event
    - --Location
  2. Provide visual details
    - --People
    - --Places
    - --Objects (antique cars, art, clothes, etc.
    - --Complex scenes or actions

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- Beukelman, D. & Mirenda, P. (2013). *Augmentative and alternative communication for children and adults (Fourth Edition).* Baltimore, MD: Paul H. Brookes Publishing Co.
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- Hanson, E., Beukelman, D., & Yorkston, K. (2013). Communication support through multimodal supplementation: A scoping review. *Augmentative and Alternative Communication,29, 310-321*
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