ALS and Augmentative Communication: Seeking Improved Outcomes through Early Engagement in Assessment, System Design and Implementation

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https://www.facebook.com/ACPCHBoston

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Background and Overview of AAC Service
- BCH:
  - 400 beds
  - 4 ICUs
  - Ongoing plans for expansion & increased # of beds
- Established **outpatient** AAC clinic for nearly 40 years
- AAC Service provision in ICU/acute care for 25+ years
- Formal inpatient position for ~10 years
- Current positions
  - 2x 1.0 FTE, 2 SLPs
  - Inpatient grew from Augmentative Communication Program
  - Focus on AAC implementation through the continuum of care
  - Equipment closet with a variety of AAC tools and materials
  - Average caseload: variable; ~30 patients on a given day and rising!
Communication is the thread that connects us all
Hi John,

I just wanted to let you know Mom passed away yesterday afternoon. Dad and I were both able to be with her and although we are terribly sad, our family is glad she is no longer suffering.

I hope to reconnect with you soon to tell you in person how much we really, really appreciate all the kindness and hard work you put into helping Mom. You not only gave her tools to help, but showed compassion and made her feel safe and cared for. Your ability to gently convince her to learn to use the communication boards you developed early on, even though she didn't know why they would be important, was so important. THOSE tools turned out to be our only connection with her in the end. YOU knew that would be the case all along, but we didn't know until it was all we had left. Perhaps most importantly, you gave her her authentic voice when it would have been gone...and now we have it to cherish.

Thank you for all your support.

Melissa

My Ice bucket challenge

A little history

How does a Children’s Hospital end up having a dedicated ALS-AAC Program?
Long history of Proactive Intervention at Boston Children’s that now supports people with ALS
Prepare in advance (you can do this at school or at home)
Sometimes I was tempted to ‘reject’ but I learned a valuable lesson from an 11 year old!
Program Mission:
The mission of the ALS Augmentative Communication Program is to provide comprehensive augmentative communication/assistive technology assessment, trials and training to people with ALS from the time of diagnosis through the lifespan.

Program Goal:
“Our goal is to support communication and daily functional needs, sustain personal control and dignity, facilitate continued social and vocational goals and maintain quality of life through thoughtful implementation of solutions ranging from high technology to quick access/low tech tools and strategies. This is best accomplished by ACP-ALS clinicians constantly communicating and collaborating on how best to support patient-centered functional outcomes in the presence of changing physical abilities while providing support to a person with ALS and his/her family.”

What to expect:
Our team hopes to meet people as early as possible after diagnosis but remains eager to support people with ALS at any time during their journey.
Dear John, Amebaa, and Poppy, I want to thank you for everything you did for my mother. I am so sad for our family. Although she passed before she was able to share full love of the memory, for having all our visitors with her, you were an integral part of her journey. As you know, it is a disease of only being able to hold all of our memories. To be able to have a memory of her, to be able to have her voice, to be able to have her thoughts, is a precious gift of the love and support you gave her. This is the greatest thing she could have. She was able to—
QUICK OVERVIEW OF ALS CLASSIFICATIONS

Types of ALS/MND

• **Sporadic** - the most common form of ALS in the United States - 90 to 95% of all cases.
• **Familial** - occurring more than once in a family lineage (genetic dominant inheritance) accounts for a very small number of cases in the United States - 5 to 10% of all cases.

resource: http://www.alsa.org

Onset

• Bulbar
• Spinal
• Atypical
  – Example: Brachial amyotrophic diplegia (man in the barrel): severe muscle involvement was confined to the upper limbs, predominantly the proximal portion and shoulder girdle, sparing the face and the legs until late in the disease's course or until the terminal stage.
### Bulbar onset

**What is it?**
- Bulbar ALS destroys motor neurons in the corticobulbar area of the brainstem in the early stages of ALS.
- The corticobulbar area controls muscles of the face, head and neck.
- Bulbar ALS usually progresses faster than limb onset.

**How Common is Bulbar ALS?**
- Observed in 20-30 percent of people with ALS.
- Almost all people with ALS display bulbar symptoms at later stages.

### Symptoms Affecting Speech
- Changes in voice and speech.
  - Harsh, hoarse or strained voice.
  - Breathy speech pattern.
  - Poor articulation.
  - Decrease in range of pitch and loudness of voice.

### Other Symptoms
- Spasms in muscles of the jaw, face, voice box, throat and tongue.
- Inappropriate excessive laughing and crying.
- Brisk jaw jerks.
- Involuntary twitching in the muscles of the tongue.
- Dysphagia
- Vocal cord spasms causing the sensation that air cannot be moved in or out.

### Spinal onset

- Initial symptoms may affect only one leg or arm.
- Individuals may have awkwardness and stumbling when walking or running. They may have difficulty lifting objects or performing tasks that require manual dexterity (e.g., buttoning a shirt, tying a shoe, turning a key).
- Eventually, the individual will not be able to stand or walk, get in and out of bed without help, or use hands and arms to perform activities of daily living, such as washing and dressing.
- 70-80% of patients, symptoms begin with limb involvement.
- Eventually develop bulbar symptoms.
Spinal onset (cont’d)

• Upper motor neuron involvement include spasticity and exaggerated reflexes
• Patients with upper limb onset have twice the likelihood for onset in the dominant arm, compared with the non-dominant arm
• Symptoms of lower motor neuron degeneration include muscle weakness and atrophy, muscle cramps, and fasciculations

Fronto-temporal dementia

• Fronto-temporal refers to the forward part of the brain that sits above the eyes and behind the temples. Lowering of the function of this region can lead to impulsive, compulsive, and emotional behavior.

Current research data suggest that up to 50% of people with ALS will never develop significant changes in thinking or behavior, over and beyond normal psychological reaction to diagnosis and symptoms.
• Up to 50% of people with ALS will experience some degree of change in thinking or behavior, with approximately 25% of those people with ALS developing a full blown dementia.

ALS Association fact sheet rev 2014
There have been many clinic-based studies of cognitive and behavioral impairment in ALS, using cross-sectional cohorts of patients. These studies show:

- up to 20% of ALS patients demonstrate dementia,
- roughly 30% of ALS patients develop impairment without dementia, and
- up to half of ALS patients are cognitively normal.


A word about pseudobulbar affect

- Some people with ALS develop an unusual symptom called “pseudobulbar affect.” They may cry or laugh at inappropriate times or discuss how once they start feeling an emotion, it is difficult to shut it off. Sometimes, pseudobulbar affect can be present when a person feels more emotionally reactive in general, with more intensity to the emotion that is experienced than normal. Pseudobulbar affect is common in ALS and is the result of a brain reflex that is no longer working correctly. It does not necessarily mean that a person is feeling anxious, sad, depressed, or emotionally distraught. People with ALS can have pseudobulbar affect and no other cognitive, behavioral, or psychological symptoms.

ALS Association fact sheet rev 2014

As appropriate, Speech-Language Pathology will:

- introduce strategies to minimize fatigue associated with speech including: strategies to enhance intelligibility or preserve energy, and may introduce varied voice amplifiers.
- May introduce our model of Message Banking and/ or options for Voice Banking.
- partner with patient and family to create – over time – custom quick access communication tools
As appropriate, Speech-Language Pathology will (cont’d):

• Introduce and assess various communication technologies to support face to face communication as well as communication through internet/telephone.
• Establish and coordinate evidence based trials
• assess and provide call systems to meet individual needs.
• Provide partner training

Also provide:

• Home-based services may be available when patient can no longer travel to the center.
• Tele-support
• Web based training modules (late 2016)
• Web based downloadable templates (late 2016)
Begin with
THANK YOU
to many extraordinary
people with ALS

Patient photo or video

Opening statement:

“My goal is to
waste your time”
Second statement:

“You are stuck with us”

AAC/Speech Pathology Protocol of Assessment Considerations

- Speech strategies
- Partner training
- Amplification considerations
- Amplification while using bipap
- Call system for emergency and attention
- Quick access encoding strategies (non-electronic)
- Electronic encoding
- Quick access encoding strategies (non-encoding)
- Writing strategies
- Message Banking
- Voice Banking
- Speech Generating Device assessment
- Speech Generating Device trial for Practice Based Evidence
- Training, implementation/integration

Occupational therapy/Assistive Technology Protocol of Assessment Considerations (NOT part of today’s discussion)

- Physical Access Control Site assessment
- Positioning/support
- Access to mobile technology
- Phone access
- Call system/attention signal access
- Environmental control
- Access to books (hardcopy or digital)
- Computer access: keyboard
- Computer Access: mouse
- Computer Access: speech/voice
- Speech Generating Device Access
- Training
Based on assessment of current voluntary motor abilities, Occupational Therapist/AT specialist:

- identify adaptations and tools to facilitate continued physical access to daily activities. A wide spectrum of options exist, ranging from minor modifications to one's computer keyboard and mouse to hands free control of a computer, tablet and smartphone.

- In addition to supporting hand function as much as possible, voluntary movements of one's eyes, head and feet are explored to minimize the overuse of any one muscle group.

Based on assessment of current voluntary motor abilities, Occupational Therapist/AT specialist

- Accommodations to minimize fatigue and facilitate function often include a combination of:
  - positioning mounting adaptations,
  - low and high tech adaptive pointers,
  - alternative computer mice and switches

- In addition to facilitating one's access to written and spoken communication, email, the Internet and social media, options for independent access to reading, television operation and other leisure time activities can also be addressed.
SPEECH STRATEGIES

Speech strategies
- Pacing/segmenting with breath control
- Breathing awareness (diaphragmatic vs. clavicular)
- Reduce gravel with quieter voice (in concert with amplifier)
- Over articulation (without strain)
- Economizing
- Stretching – NOT oral motor exercise/repetitive motion. Discuss issues of muscle recovery.
- Letter cueing
- Topic cueing
- Counsel on positioning/support
- Counsel on speech fatigue/over-use and difficulty with recovery

Letter Cue board
THE WORD BEGINS WITH.....
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M Start again
br cr fr gr tr pl st Next word
bl sl fl gl sw ds tw End
sl sc sk sm sn sp
sw squ spl spr ser
### Topic Cue board

<table>
<thead>
<tr>
<th>People</th>
<th>Food</th>
<th>Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Places</td>
<td>Colors</td>
<td>Questions</td>
</tr>
<tr>
<td>Animals</td>
<td>Entertainment</td>
<td>Body</td>
</tr>
<tr>
<td>School</td>
<td>Home</td>
<td>Community</td>
</tr>
</tbody>
</table>

### Identification/explanation card for car

Every day 15 people in the U.S. are diagnosed with ALS, two-thirds the incidence of multiple sclerosis.

- Educational programs and literature
- Basic science and clinical research
- Support services for patients and families
- Advocacy that supports hospitals and services for people with ALS

http://alsworldwide.org
Many patients now ask about medications and we ALWAYS refer them back to their physician.

While we do not focus on feeding swallowing…

HOW TO SAVE YOUR OWN LIFE: THE SELF-HEIMLICH MANEUVER

We read in newspapers or online every day about someone choking in the presence of another person. The article goes on to share how someone else stepped in and performed the Heimlich. We then wonder how that person knew to perform the maneuver. As you read the article, you think, “I would never know what to do!”

But suppose that other person were not present that day? What would you do if you were choking and no one was there to help? Would you be able to get air into your lungs? Would you be able to breathe? Would you be able to stand upright? Would you be able to walk and talk? Of course not! What would you do?

We know of an eight-year-old boy who had a dislocated shoulder and a broken arm. He had a seizure and was choking. There was no one to help him. All he was able to do was yell for help. The family was not equipped to handle a medical emergency like this and the boy died.

What could have been done to prevent this? The family did not know how to perform the Heimlich maneuver. They did not have the information. To protect the health and safety of our patients, we are providing this training.

PARTNER TRAINING
Partner training

- Identify communication partners/supports
- Share anecdotal feedback from people with ALS and families
- Share handout on “Guidelines to Communication Partners”
- Discuss strengths and major challenges with asking yes/no questions
- Discuss the pros and cons of prediction and permissions that should be in place.
Holly's advice (recorded early in the day when speech was easier to produce)

Patient photo or video

AMPLIFICATION CONSIDERATIONS
**Amplification considerations**

- Counsel regarding impact of speech efforts on fatigue
- Discuss pro-active approach (as appropriate) to preserving energy
- Introduce amplification options
- Identify microphone headset placement considerations with head movement

**Often will be told:**

“I can talk loud enough, I just get worn out by 2 in the afternoon and am too fatigued”

**Speech production requires:**

- Articulation
- Phonation
- Resonation
- Respiration
An often noted symptom is patient taking more frequent and longer pauses between words or word clusters when speaking.

*** many people continue to try to speak as many words as possible on a breath and ‘trail off’

Phonation

Perceptive changes in voice quality and loudness may be first symptoms

Attempts to compensate may exacerbate issue (sound more gravely when trying to speak louder)
Articulation

Highly coordinated movement of lips, tongue and jaw

Resonance

• Velopharyngeal muscle weakness leads to continual opening of velopharyngeal port during speech
When I use the amplifier...
Patient photo or video

AMPLIFICATION WITH BIPAP

Amplification while using bi-pap
Assessment of transdermal microphone options
When using in the same house....

Home alone and calling 911 when speech is difficult

The Silent Call Procedure
If you need to call 9-1-1 and you are unable to speak for any reason, once the call is answered:
Press:
- 9-1-1
- If the 9-1-1 dispatcher asks questions, press
- For ISS
- For the police
- For the fire department

Source: MA State ISS Department and the Executive Office of Public Safety and Security

Phone app for emergency requiring no speech
QUICK ACCESS ENCODING
(NON-ELECTRONIC)

Quick Access **Encoding**

- Standard Etran two-step encoding
- eye gaze and partner assist combination (AEIOU)
- Alpha – color encoding
- EyeSpeak board
Partner Assisted Scanning

- Establish patient’s “yes/no” response
- Scan by row/column to identify target

Patient photo or video
**Etran**

Video courtesy of ALS association (Iowa Chapter)

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**ELECTRONIC ENCODING**

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**Electronic encoding**

- Minimize working memory demands for communicator and partner
- Provide a visual script/reminder of message progress

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Abbreviated expansions with Logical Letter Encoding/Salient Letter Encoding

- A logical relationship exists between the key words of the phrase or sentence and the code selected

- O D  = Please open the door
- J  C  = My name is John Costello
Quick Access (non-electronic continued)

- Personal tabbed flip chart
- Alphacore displays or others with direct selection by:
  - Hand
  - Stylus
  - Safe laser
On our new ALS webpage

Safe laser and core vocabulary
http://lowtechsolutions.org

Amy Roman and Margaret Cotts

Patent photo or video

WRITING

Bostion Children's Hospital
Boogie Board

- Used to write messages
- Can use fingernail
- Lightweight
Writing strategies

• Notepad
• Notebook
• Boogie board
• Ipad/android – note apps
  – Finger
  – Rubber tipped stylus
  – Jot stylus
  – Apple pen

MESSAGE BANKING

Message Banking

• Introduce concept/definitions and idea of ‘technology agnostic’
• Practice recording with a hand held recorder to support high quality recordings ‘in the moment’.
• Share clinical stories and outcomes and provide concrete examples
• Provide full handout with definitions and thousands of examples from people with ALS
• Download, playback, label and store audio files, providing guidance for improving quality if needed.
• Review potential technologies that could accommodate message banking across varied platforms.
• Provide person with ALS with their own recorder to take home and use to functionally record.
Message Banking .wav technology given to people with ALS

- set at 16/44 baud rate
- Must use wind guard
- Hold close to mouth for best quality
- Practice timing of push - speak – push
Message Banking with your own voice digitally record and store words, phrases, sentences, personally meaningful sounds and/or stories using your natural voice, inflection and intonation.

These messages are catalogued as WAV files and may then be linked to messages in a variety of augmentative communication technologies or sound storage files. This will allow you to ‘retrieve’ a message and speak it in your own voice but does not allow you to create novel messages by spelling. If you have recorded individual words, you may combine these words to create unique messages, although the output will sound more staccato than your natural speaking.

TERMINOLOGY:

Legacy Messages are those messages, often delivered with unique intonation and prosody that are unique or particular to you. It may be a ‘trademark’ message you say or it may be a trademark delivery of a message that many people say. A legacy message does not need to be meaningful to the general population instead it may have unique and personal meaning to only you and a loved one. Further, a legacy message does not need to be real words to be meaningful. It may be the way you clear your throat in a sarcastic manner to communicate “I wish you so!” or it might be the invented pet name you have for a loved one delivered with your unique voice, intonation and prosody. Similarly, legacy message may be that stereotypical thing you say after your favorite sports team scores or it may be a unique greeting you deliver to friends. Those close to you may be helpful with identifying these Legacy Messages because sometimes they are so naturally part of socially relating with others, you may not even be aware you are “known” for them.
64 page handout will be on new ALS website but can be found now at:

• http://www.childrenshospital.org/~media/messagebankdefinitionsandvocab201613.ashx?la=en
Charlie, age 42
Diagnosed with ALS at age 41

My voice Messages that reflect 'you'

July, 2011, having a little fun with messages

May 2011

Patient photo or video
Need to bank more, body is changing
Has been banking messages in many formats for children

Patient photo or video

Vocabulary

• Vocal play with children
• Many loving messages to children
• Many messages to wife
• Vacation/quality family time messages
• Anger
• Defending self dignity anticipating severe disability
• Directives to anticipated staff
• Changes in physical state
• Refusal of medical treatment
Bob - ipad
Patient photo or video

Wants to know the options

Patient photo or video
Bob – first time with 'message bank' messages

VOICE BANKING

Voice Banking

• Provide definition and description of process
• Provide examples of voices created
**Voice Banking** is a process of recording a large inventory of your speech that is then used to create a synthetic voice that approximates your natural voice.

Done successfully, this would allow one to spell and create unique messages and then speak them through a synthesizer that approximates one's natural speech. The science behind this process continues to be in development with beta-versions of available software. The ModelTalker is one such project from the University of Delaware Speech Research Lab. The website is: [www.asel.udel.edu/speech/ModelTalker.html](http://www.asel.udel.edu/speech/ModelTalker.html)

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**ModelTalker**

[http://www.modeltalker.com](http://www.modeltalker.com)

The ModelTalker System was developed by the Nemours Speech Research Laboratory located at the Alfred I. duPont Hospital for Children with support from The National Institute for Disability and Rehabilitation Research, the National Institutes of Health, and Nemours Biomedical Research.

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[http://www.modeltalker.com/comparison.html](http://www.modeltalker.com/comparison.html)

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[https://www.modeltalker.org/build-your-voice/](https://www.modeltalker.org/build-your-voice/)

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Custom voice created by Scottish company ‘Cereproc’
http://www.cereproc.com/en/home

Dr. Rupal Patel, VOCALiD
with Samantha Grimaldo
http://www.vocalid.co/how
SPEECH GENERATING DEVICE ASSESSMENT
Speech Generating Device Assessment and trial(s)

**Language Features:**
- core vocabulary + phrase
- single words + Alphabet
- message organization (grid, list, taxonomic, contextual, etc.)

**Encoding strategies**
- Abbreviation expansion
- prediction (word, grammar, morphology) + letter stream prediction (Dasher)

**Access features (in concert with OT):**
- Direct selection (unaided)
- Direct selection (aided)
  - headmouse
  - eye tracking
- dwell, switch, blink
- Scanning
  - Single switch
  - Two switch
  - Use of switch interface for technologies
  - Software vs. tech access options within tech (accessibility features)

Speech Generating Device Assessment and trial(s) continued

**Integration features:**
- Internet
- Telephone
- television
- text
- custom software
- system mirroring (Splashtop, Team Viewer, etc.)

**Other:**
- Language
- Text
- Symbols
- Synthesizer (and integration with environment such as ‘Alexa’)

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Predictable (Therapy Box):

Import audio in Predictable

NOTE: You will not be able to hear the essential voice until the end of the process.

1. Open therapy.
2. Click on the speaker.
3. Choose the "Therapy".
4. Click on the "Play audio".
5. Stop the audio in the therapy.
6. Stop the audio in the therapy.
7. End and select the audio you will import into Predictable.
8. You can select a group of recordings.
9. Format can be "Real or others.
10. From the app go to phone.
11. From the app, add the phone.
12. From the app, add the phone.
13. From the app, add the phone.
14. From the app, add the phone.
15. Stop and it will pair with the app.
16. End and make to hear the recording.

Ion Clipster blue tooth speaker
Wearable amplifier

Occupational therapy/Assistive Technology Protocol of Assessment

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<th>Considerations (Overview as I am NOT an OT)</th>
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<td>Physical Access Control Site assessment</td>
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<tr>
<td>Speech Generating Device Access</td>
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<tr>
<td>Training</td>
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Physical Access Control Site assessment

- Direct selection
- Non-direct selection
- Best control site (S) *don’t over fatigue one control site:
  - Head, eyes, mouth, tongue, respiratory (sip/puff), voice, chin, shoulder, trunk, arm/hand, leg, knee, foot.
  - Pressure, excursion, range
- Neural access (neural switch), BCI
General considerations for access selection:

(1) the range and control of movement
(2) the amount of training and practice required to use and
(3) the short and long-term costs/benefits of using access method

Phone Access

• Landline options
• Speaker phone options
• Smartphone use
• Hands-free cell phone use
• Switch scanning on iPhone
• Siri
• Mounting options

Call system/attention signal

• Commercial wireless doorbell
• Switch-adapted attendant alarm
• Baby monitor
• Portable speech output device with or without switch
Environmental control

- Enlarged TV remote controllers
- Switch access to TV functions, lights, fan
- Voice control for TV functions, lights, fan
- Control through SGD

Access to books (hardcopy or digital)

- Kindle/iBooks
- Hardcopy books/ book holders
- Page turners
- Audio books

Computer access: keyboard

- Built in accessibility features
- Keyboard/key size
- Ergonomic keyboards
- Forearm supports
- Typing aids
- Word prediction software
- Onscreen keyboard software
Computer Access: speech

- Speech recognition software
- Dictation strategies to improve software recognition
- Built in commands
- Custom commands
- Voice mouse controls

Speech Generating Device Access

- Touch screen
- Stylus and stylus holders
- Keyboard
- Different computer mice
- And/or trackball
- Mouse
- Headtracking access (head mouse, gyro mouse, etc.)
- Adapted mouse
- Switch scanning
- Eyetracking access

Physical Access Control Site assessment (access method, access site, access settings)

- Direct selection
  - Preferred method – if possible
  - Positioning/mounting
  - Adaptive stylus
  - Computer adjustments
- Indirect selection

- Best control site(s)
  - Head, eyes, mouth, tongue, respiratory (sip/puff), voice, chin, shoulder, trunk, arm/hand, leg, knee, foot.
  - Pressure, excursion, range
Considerations for access selection:

- Motor control that is reliable and repeatable
- Motor control that is fine-tuned
- Include eye control and voice production
- Exploit the strengths and circumvent the weakness

(1) the range and control of movement
(2) the amount of training and practice required to use and
(3) the short and long-term costs/benefits of using access method

Baker’s formula....

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Physical</th>
<th>Cognitive</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effort</td>
<td>Effort</td>
<td></td>
</tr>
</tbody>
</table>

...
Access to iPad/Android tablets

- Position of device
- Use of finger and/or stylus
- Voice typing
- Siri
- Mounting options
**Computer Access: mouse**

- Customizing computer mouse settings
- Adaptive/alternative cursor control options
- Hand-based
- Head-based
- Foot-based
- Eye-based
- Auto click software
- Switch click options

Example: Origin Head Mouse

Quha Zono Gyroscopic Air Mouse
Foot Mouse
- Foot time mouse
- Trackball

Head Mice
- Origin Instruments
- Quah Zono
- Natural Point
- Tracker Pro
Switch selection

Video game style

- Dasher
  - Streaming letters
  - Attack of the alphabet
  - Minimal movement
  - Word and phrase prediction
Voice input

- (Hey) Siri
- OK Google
- Alexa
- Not intended as an accommodation for a disability. Will have difficulty with soft or dysarthric speech. Limited Functionality
  - Siri cannot voice answer an incoming call
  - Hey Siri may require the iPhone to be plugged in

Voice input - computer

- Dragon Naturally Speaking
- Microsoft built in voice recognition software
- Not intended as an accommodation for a disability. Will have difficulty with soft or dysarthric speech.
  - Best for word processing
  - Custom commands available (Dragon)
  - Plan for a learning curve

Eye Gaze Interface –
The eyes have it
Brain Computer Interface (BCI)

• Projects with which we are currently affiliated:
• Oregon Health Science Project RSVP
• National Center for Adapted Neurotechnologies Wadsworth Ctr. in NY

Brain Computer Interface

• Projects with which we are currently affiliated:
• Oregon Health Science Project RSVP
• National Ctr for Adapted Neurotechnologies Wadsworth Ctr.
Feb 16, 2016

Dear John,

Thank you for our meeting last Tues. As we move forward slowly, I appreciate your intent to truly understand Eric and his desires. As you have surmised he is slowly processing what he wants, and "forcing" decisions does not work. I also greatly appreciate your passion and resulting offer to always be available, even to doing home visits. I later realized what relief I felt, knowing we would not somehow be abandoned because we could not resolve the next step in a timely manner. Truly...I was relieved of an anxiety I had not realized I had.

Amelia
Mounting/positioning

Wearable eye speak technology

Introducing eye tracking to children: A developmental approach
Very early Eye development:

<p>| Eye tracking a slow moving object with jerky muscle movements | Infant |
| Eye coordination and tracking (track a slow moving object with smooth eye movement) | By three months |
| Depth perception develops: Binocularity allows for development of three dimensional perception | Three to five months |
| Seeing color: difficult to determine and likely infants are distinguishing brightness and contrast | By two to six weeks |
| Object and face recognition: At birth can see facial features at arm’s length BUT is attracted to borders so will gaze at edge of face or hairline | Infant |
| Baby notices facial features such as the nose and mouth | Two to three months |
| Differentiate between mother’s face and a stranger’s face | Three to five months |</p>
<table>
<thead>
<tr>
<th>Eye FX from Tobii</th>
<th>Developmental considerations</th>
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<tbody>
<tr>
<td>Blank screen engagement (exploring with cause and effect) make something happen by looking anywhere</td>
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<td>Object displacement (learning to target, track and dwell) select to balloon to pop, spat, etc.</td>
<td>Perhaps black and white, high contrast edges,</td>
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<td>Zoned focusing (developing control and accuracy) turn on all the light bulbs</td>
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<td>Active exploration (enhancing precision and timing)</td>
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<td>Controlled targeting (look and dwell)</td>
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