ICAN™ Talk With My Eyes

EVALUATING EYE GAZE ACCESS

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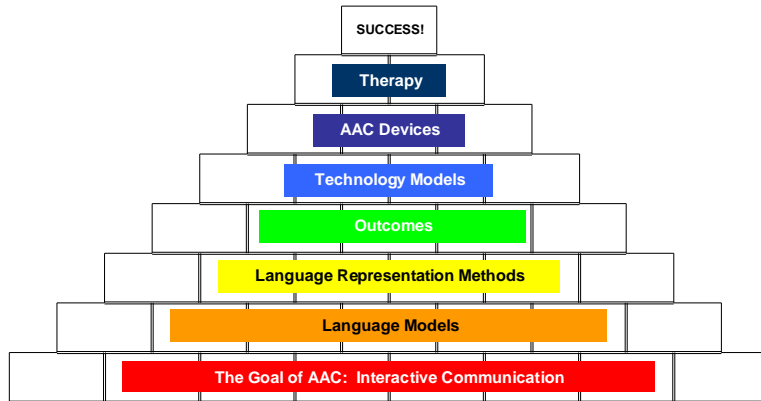AAC Institute

What is Eye Gaze?

- Vision-controlled direct selection technique

- Two methods of tracking: bright and dark pupil tracking (High tech Systems)

- Using our eyes for target selection

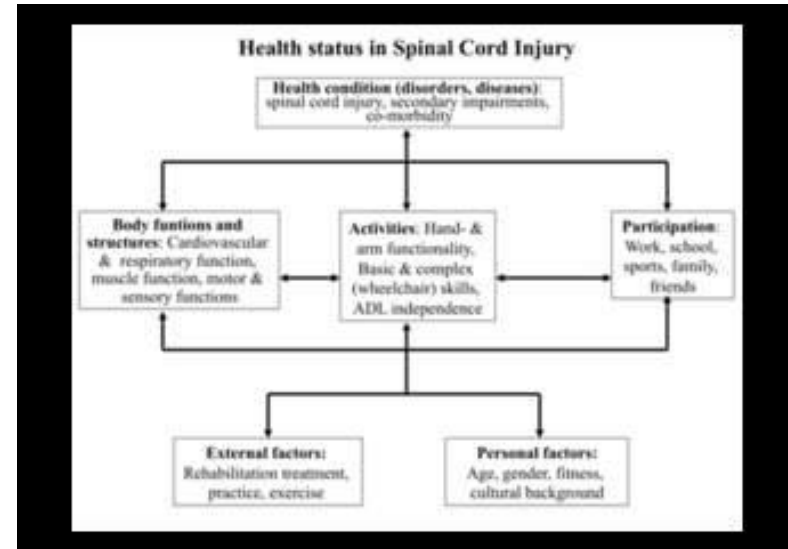AAC
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Eye Gaze Assessment

Theoretically-driven Assessment

AAC LANGUAGE-BASE MODEL

ICF MODEL (WHO, 2001)

Eye Gaze Assessment Principles

o No prerequisites for initial trial and evaluation

o No hierarchy of access methods

o Language first, technology second - ALWAYS

o Apply evidence-based practice for best outcomes

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Clinical Populations

o Traumatic Brain Injury (TBI)

o **Cerebral Palsy**

o **Rett Syndrome**

o **Amyotrophic Lateral Sclerosis (ALS)**

o Multiple Sclerosis

o Muscular Dystrophy, spinal atrophy, Werdnig-Hoffman Syndrome

o Spinal cord injuries

o Strokes (typically brain stem)

o Locked in Syndrome

Speech-Generating Device Funding Report

Primary Components

1. Medical History
2. **Vision**
3. **Expressive Language**
4. **Receptive Language**
5. **Pragmatic Language**
6. **Cognition**
7. **Physical**
8. **Device Trials**
9. Goals

REMEMBER!

MEDICAL NECESSITY VS EDUCATIONAL NECESSITY

Matching Persons with Technology

AAC Primary Components		
Language Representation Methods	Vocabulary	Methods of Utterance Generation
Single Meaning Pictures Alphabet-Based Methods Semantic Compaction	Core – high frequency words Extended – low or topic specific words Both vocabulary categories	SNUG (spontaneous novel utterance generation) Pre-stored sentences Multiple methods to generate messages

Secondary Components		
User Interface	Control Interface – Selection Methods	Outputs
Symbols (types/set) Display size # locations on display Color coding Navigation/# pages/displays Automaticity Human Factors	Direct Selection *Keyboard, head pointing, eye gaze* Scanning *Switches* *Physiological (EMG, BCI, etc.)* Morse Code	Speech Display Electronic/Infrared/Radio Frequency Data logging

Tertiary Components		
Peripheral and Integrated Features	Manufacturer/Vendor Resources	Clinical Service Delivery
Computer access/internet Phone access Switches & mounting systems (multiple; wheelchair) Electrode peripherals	Training (face-to-face; webinars) Technical support Repair support & loaner programs Warranties	Trained & experienced AAC professionals Evaluation & Treatment Telerehabilitation capabilities

Hill & Scherer, 2008; Hill, 2010

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Questions or Comments

User Factors: *Body, Function & Structure*

o **Language Ability**

o Vision

o Physical Status

o Cognition

User Factors: Vision

Inclusionary
- ◦ Good control of at least one eye
- ◦ Adequate vision
- ◦ Correction with glasses
- ◦ Absence of side effects from medication

Exclusionary (may interfere with eye gaze success)
- ◦ Inadequate visual acuity
- ◦ Blurred vision
- ◦ Cataracts
- ◦ Hard contacts
- ◦ Common eye movement problems
- ◦ Medications: anti-depressants, anti-convulsants, Baclofin

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Common Vision/Eye Problems

Diplopia
- ◦ Double vision

Nystagmus
- ◦ Constant involuntary movement of eyeball
- ◦ Limits ability to focus and make selection
- ◦ Better prognosis if rate of movement is less than 3 per second

Alternating Strabismus
- ◦ Inability of the two eyes to maintain proper alignment
- ◦ Use of nasal side, partial eye patch on affected eye may help improve and maintain alignment

Ptosis
- ◦ Eye droop

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How our eyes work while reading

- Eye movement while reading
  - Fixations and Saccades
- Visual perception and language processing
- Reading Errors
- Poor readers: language skills versus eye movement control
- Eye Fatigue
- Eye Strain

Fixations and Saccades

o   Fixations: The pause of the eye movement on a specific area of the visual field

o   Saccades: The eye's ability to quickly and accurately shift from one target to the another between fixations.

Errors While Reading

- Reading requires specific voluntary eye movements

- May not adequately process visual information

- Eye must track left to right and sweep back to left after completing a line.

- If errors in voluntary fixation and saccades occur comprehension becomes difficult.

  - Skill does not fully develop until 17 years old.

Eye Movements While Reading
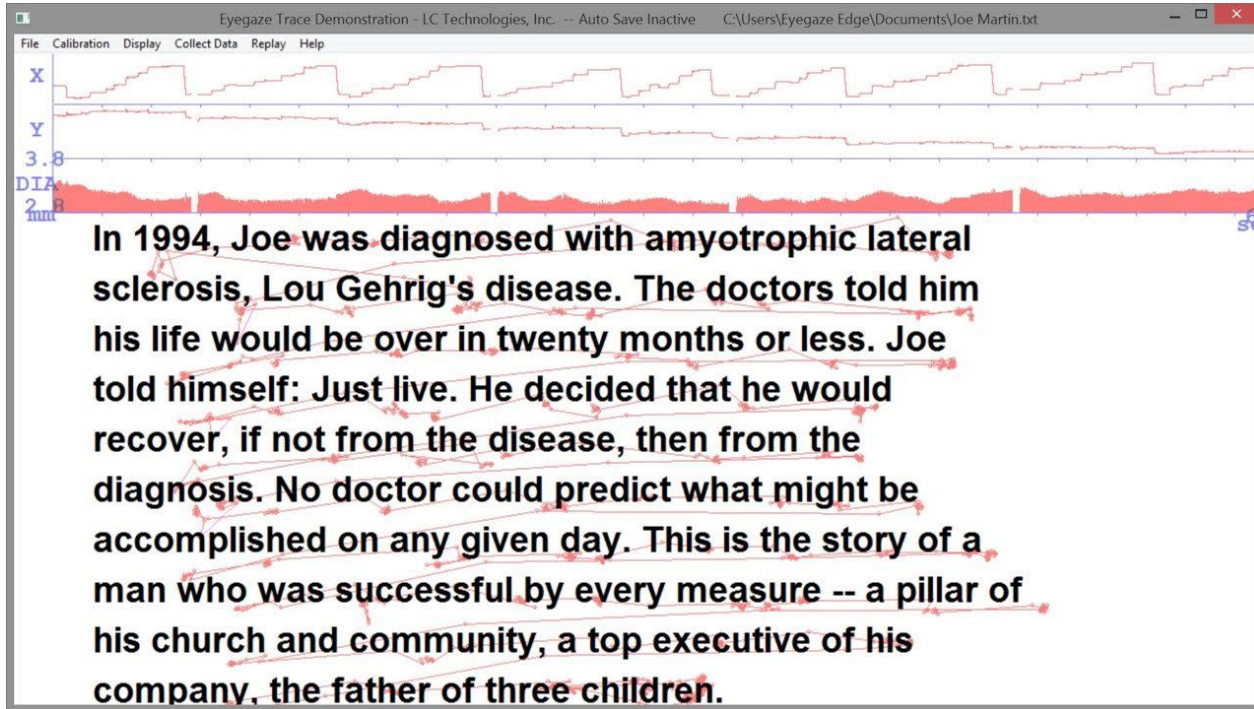
Technology: How it tracks

Tracking via Infrared light

- ◦ Near field infrared camera reflects a small bit of light off the cornea and pupil of the eye

- ◦ The reflection is captured by the camera to determine the gaze point or glint

- ◦ The camera calculates the gaze direction from the angle of the reflection
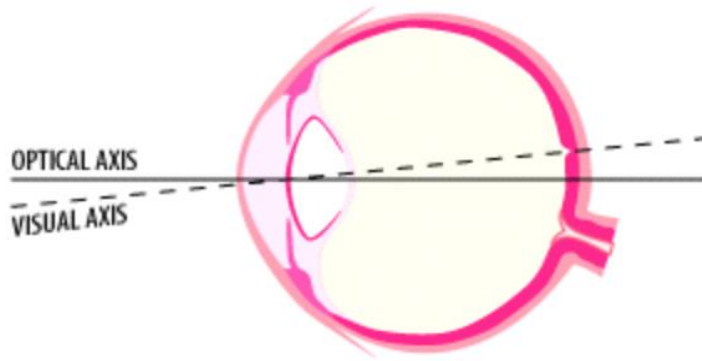

(a) (b) (c)

Bright Pupil Vs Dark Pupil Tracking

o Bright Pupil:

- o Camera light is placed closer to the optical axis of the eye causing the pupil to appear bright. Similar to red eye

o Dark Pupil:

- o Camera light is placed away from optical axis of the eye causing pupil to appear darker than the iris

Factors Influencing Pupil Tracking

- Age and environmental light may impact pupil trackability

- Bright Pupil Method: Works well for most people

- Dark Pupil Method: Difficult for people with darker colored eyes.

- Ask manufacturer which type of camera is in the system

- Amount of infrared light subjected to person's eyes

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Calibration & Calibration Accuracy

o Calibrate the system based on the manufacturer's protocols and recommendations

o Collect necessary data on patient position, distance from device, lighting of room, and eye calibration (left, right, both)

o Visual Pursuit- Eye's natural instinct to follow a moving target.
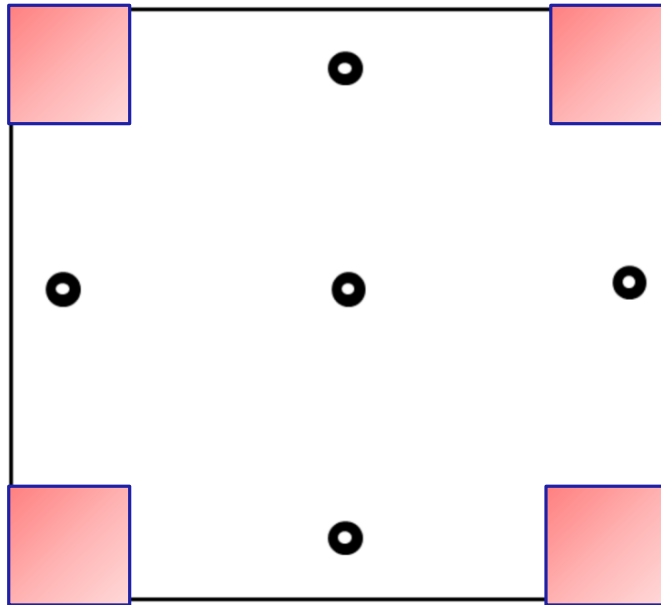
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Calibration

o Number of points on the

   screen
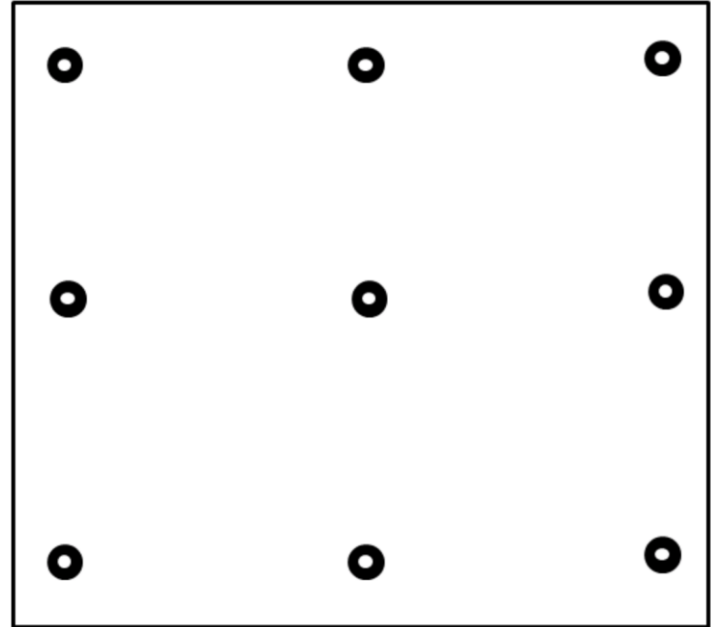
o Dwell time

Calibration

o Can the user access the 4 corners of the screen?

Calibration Data Collection

- Target Practice

- Acceptance/Dwell Time

- Number of Locations

- Display Software

- Accuracy

- Copy spell and core word sentence tasks

Display
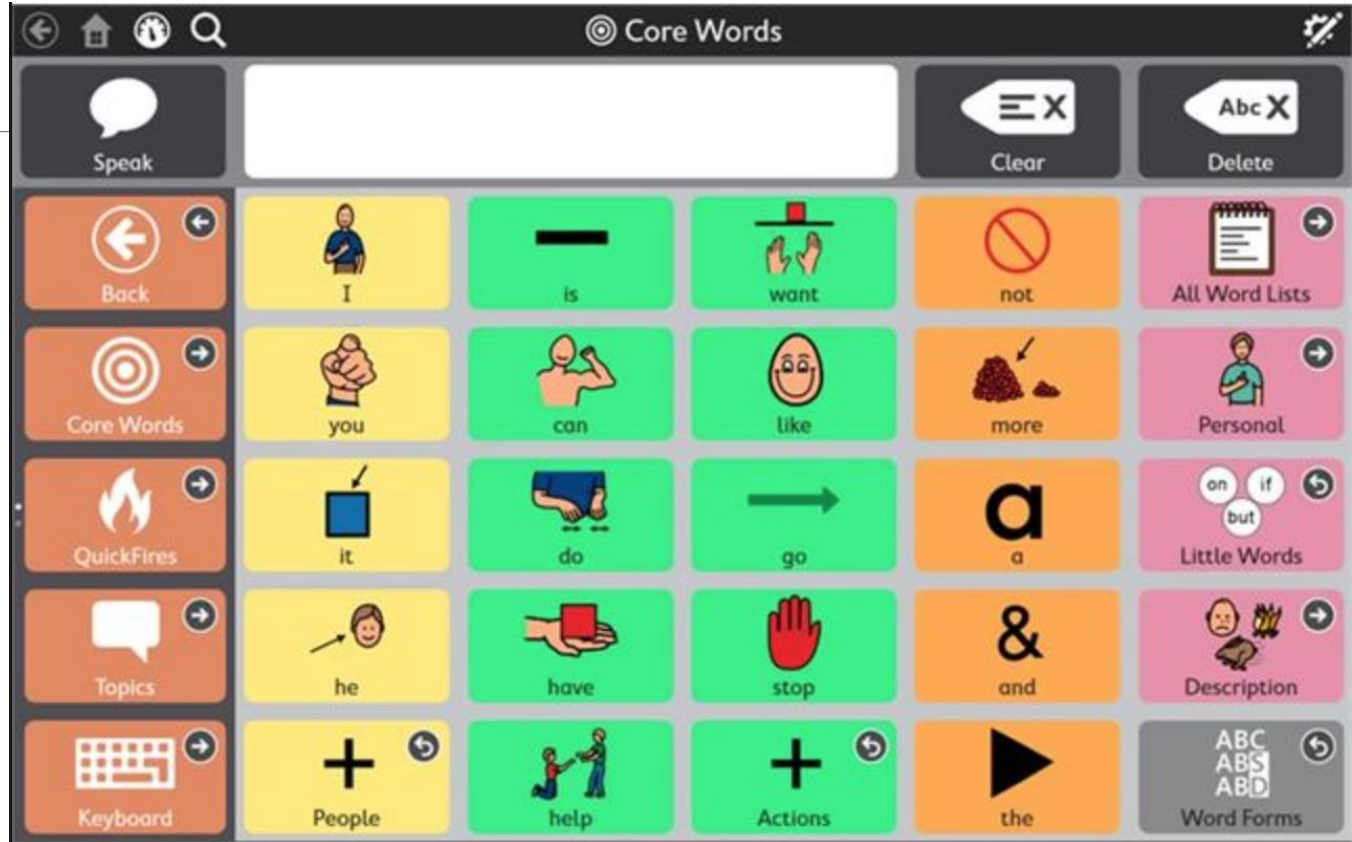
o Set up the display for SUCCESS!
  o Use hide/show features of AAC device
  o Spaces allow improved accuracy

o Resting Eye Gaze Position

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Display

Position of User & Eye Gaze System

o Position in front of patient at eye level based on the recommended distance.

o Remember!!!! Be aware of resting eye gaze position: patient must know operational features to pause and un-pause system

Physical

Positioning: ability to maintain a position in front of they eye gaze screen and camera

Impact of continuous uncontrolled head movement
- ◦ Makes operation difficult
- ◦ Makes it difficult for communication partner to see where patient is looking (low tech)
- ◦ Camera is required to relocate eye each time the user moves away from the field of view

Device Mounting
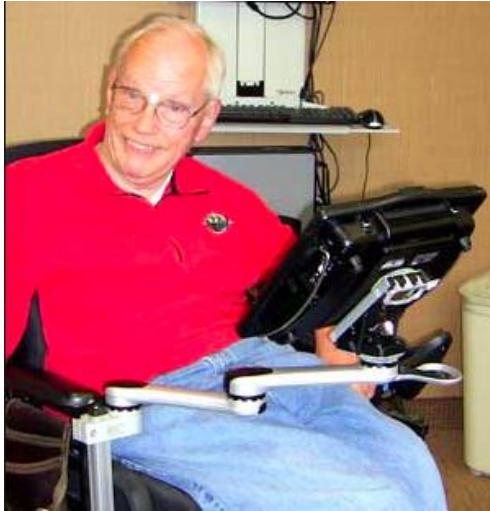
Images from: www.mountnmover.com
www.daessy.com

Questions or Comments

Personal & Environmental Factors

PERSONAL USER FACTORS

- User motivation

- User interests and hobbies

ENVIRONMENTAL FACTORS

Daily communication environments

Access to system

Family Support

School team support

Training

User Satisfaction and Family/Caregiver Support

- o Performance/Rating Scales

  - o AAC Profile

- o Quality of Life Survey

  - o ASHA QCLS

- o Caregiver support, device training, and communication facilitation methods are critical to user success

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User Factors: Language Ability

- Expressive and Receptive Language Skills

- Reading and Literacy Skills

- Daily Communication Needs

- Pragmatic

Evaluating Receptive Language

Assessment Modification

Evaluating Receptive Language ability may be difficult using traditional assessment tools

○ Modifying assessments may distort results. Use caution when making changes.

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Evaluating Expressive Language

Language Representation Methods

- Always consider the 3 Language Representation Methods (LRMs) when deciding on a Eye Gaze System

- LRMs provide the basic building blocks of content & form

    - Single Meaning Pictures

    - Semantic Compaction

    - Spelling/Orthographic Symbols

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LRM Data Collection

o Data to consider when evaluating LRMs:

  o *Rate of Communication*: How long does client take to produce a word, phrase, and sentence?

  o *Level of independent encoding*: is the client independently communicating using his/her AAC device?

LRM Data Collection

Frequency of errors: How many errors does the client make during communication? In which area of AAC do the errors occur?

- ◦ AAC access
- ◦ Navigation of language system
- ◦ Message formulation

Recall of novel picture locations or semantic codes: Does the client remember the location of newly introduced vocabulary.

Performance Measures

o   Drives device selection, goal and treatment development
o   Should be collected frequently to track progress
o   Language Activity Monitoring
  o   Can be used to monitor language development, communication effectiveness, and frequency of use
  o   Communication Rate
  o   Selection Rate
  o   LRM used
  o   Error percentage
  o   See www.aacinstitute.org for more information

Cognition

- Executive Functioning
- Perception and Attention
  - Visual
  - Auditory
- Scanning & Searching Methods
  - Reading Text
  - Scene Viewing
- Information Processing
- Memory & Learning
- Problem Solving Strategies

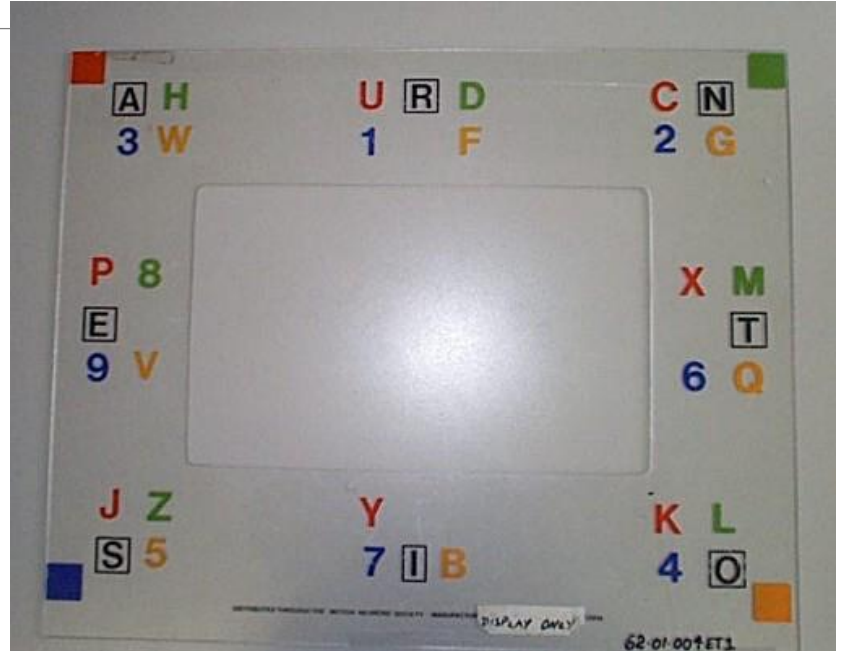# Eye Gaze Device Manufacturers

Manufacturer	Products
LC Technologies, Inc.	Eyegaze Edge Talker
Prentke Romich Company (PRC)	NuEye Tracking System
Tobii-Dynavox	I-Series+ EyeMobile PCEye Explore and Go
FRS	Enable Eyes
Lingraphica	AllTalk with Eye Gaze
myGaze	myGaze Eye Tracker

High Tech Eye Gaze

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Low Tech Eye Gaze

Resources

o   Clinical support: www.icantalkclinic.com

  o   ICAN Talk Clinic AACtion Points

  o   ICAN Talk with My Eyes Assessment forms

o   Sign up on www.aacinstitute.org for AAC Institute announcements and CEU's

o   SIG 12 ASHA Perspectives: Eye Gaze 101: What Speech-Language Pathologists Should Know About Selecting Eye Gaze Augmentative and Alternative Communication Systems

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References

Anson, D., George, S., Galup, R., Shea, B., & Vetter, R. (2001). Efficacy of the Chubon vs. the QWERTY keyboard. *Assist Technol, 13*(1), 40-45.

Anson, D., Moist, P., Przywara, M., Wells, H., Saylor, H., & Maxime, H. (2006). The effects of word completion and word prediction on typing rates using on-screen keyboards. *Assist Technol, 18*, 146-154.

Bates, R. E. A. (2006). *Enhancing the performance of eye and head mice: A validated assessment method and an investigation into the performance of eye and head based assistive technology pointing devices.* Unpublished PhD thesis, DeMontfort University, Leicester, UK.

Biscaldi M, Fischer B, Hartnegg K. (2000). Voluntary saccadic control in dyslexia. *Perception, 29*, 509-521.

Calvo, A., Chio, A., Castellina, E., Corno, F., Farinetti, L., Ghiglione, P., et al. (2008). *Eye tracking impact on quality of life of ALS patients.* Paper presented at the Computers Helping People with Special Needs, Berlin.

Cooper, R., Hill, K., Koester, H., & Spaeth, D. (2004) *Advances in data logging across assistive technology platforms*. Paper presented at the 2004 RESNA Annual Conference. Atlanta, GA. June, 2004.

Day, H., & Jutai, J. (1996). Measuring the psychosocial impact of assistive devices: The PIADS. *Canadian Journal of Rehabilitation, 9*(2), 159-168.

Demers, L., Weiss-Lambrou, R., & Ska, B. (1996). Development of the Quebec user evaluation of satisfaction with assistive technology (QUEST). *Assist Technol, 8*(1), 1-13.

Doll, T.J. (1993). Preattentive Processing In Visual Search. In Proceeding of the Human Factors and ergonomics Society, 37th annual meeting (p. 1291-1294). Santa Monica, CA.

Feng, J., Karat, C.-M., & Sears, A. (2005). How productivity improves in hands-free continuous dictation tasks: lessons learned from a longitudinal study. *Interacting With Computers, 17*(3), 265-289.

Fischer B,Hartnegg K. Auditory, Visual, and Optomotor Develomental Deficits, and Training in Dyslexia. In: Trends in Dyslexia Research, 2005 Chapter 1, pp 1-33.

References, cont.

Hansen, J. P., Torning, K., Johansen, A. S., Itoh, K., & Aoki, H. (2004). *Gaze typing compared with input by head and hand.* Paper presented at the ACM Symposium on Eye Tracking Research and Applications, San Antonio, TX.

Hill, K. (2004). AAC evidence-based practice and language activity monitoring. *Topics in Language Disorders: Language and Augmented Communication, 24*, 18-30.

Hill, K., & Romich, B. (2001). A language activity monitor for supporting AAC evidence-based clinical practice. *Assistive Technology, 13*, 12-22.

Hill, K., Romich, B., & Spaeth, D. (2000). AAC selection rate measurement: Tools and methods for clinical use. In *Proceedings of the RESNA '00 Annual Conference.* Orlando, FL. July. pp 61-63

Itoh, K., Aoki, H., & Hansen, J. P. (2006). *A comparative study of two Japanese gaze typing systems.* Paper presented at the ACM Symposium on Eye Tracking Research and Applications, ETRA 2006, San Diego, CA.

Koester, H.H. and McMillan, W.W. (1998). Usability Testing of Software for Assessing Computer Usage Skills, *Proceedings of the RESNA '98 Annual Conference*, Minneapolis, Arlington, VA: RESNA Press.

Lin, A., Weaver, J., Aedo, L. (2009). *Eye tracking technology: Overview of current systems*. Presentation at the annual CSUN conference. Los Angeles, CA: March 16-21, 2009.

MacKenzie, I. S., & Soukoreff, R. W. (2002). *Text entry for mobile computing: Models and methods*, theory and practice. Human-Computer Interaction, 17, 147-198.

References, cont.

Majaranta, P. & Räihä, K. (2007). Text entry by gaze: Utilizing eye tracking. In I. S. Mackenzie & K. Tanaka-Ishii (Eds.), Text entry systems: Mobility, accessibility, universality (pp. 175-187). New York: Morgan Kaufmann Publishers.

Pannasch, S., Helmert, J. R., Malischke, S., Storch, A., & Velichkovsky, B. M. (2008). Eye typing in application: A comparison of two systems in ALS patients. *J. Eye Movement Research, 2*(4), 1-8.

Rayner, K. & Pollatsek, A. (1992). Eye Movements and Scene Perception. *Canadian Journal of Psychology,* 46(3), 342-376.

Rayner, K. (1998). Eye Movements in Reading and Information Processing: 20 years of Research. *Psychological Bulletin*, 124(3), 372-422.

Stein JF. (2000). Monocular occlusion can improve binocular control and reading in dyslexics. *Brain, 123,* 164-170.

Wobbrock, J. O., Rubinstein, J., Sawyer, M. W., & Duchowski, A. T. (2008). *Longitudinal evaluation of discrete consecutive gaze gestures for text entry.* Paper presented at the ACM Symposium on Eye Tracking Research and Applications, ETRA 2008, Savannah, GA.