Supporting Communication of Individuals with Minimal Movement

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Minimal Movement

- Etiology
  - Brainstem stroke
  - Guillain Barre
  - Amyotrophic Lateral Sclerosis (ALS)
  - Severe Traumatic Brain Injury

Challenges

- Medical instability
- Fatigue/endurance
- Limited movement capabilities
- Positioning
- Technology training/on-going support

AAC Decision-Making Brainstem Impairment

(Culp, Beukelman, & Fager, 2007)

- Initial Assessment
  - Establishment of yes/no response mode
  - Nurse call system
  - Consistent/reliable response modality

- Early Intervention
  - Low tech communication systems
    - Eye gaze, eye linking, partner-dependent scanning
  - Probe use of high tech AAC
    - Challenges: fatigue, medical instability
  - Education
    - Impact of fatigue on performance
    - Altering intervention schedules (brief interventions with rest periods)

- Formal Assessment
  - Funding considerations
    - Long-term placement significantly impact SGD funding options
  - Technology to accommodate minimal movement
  - Maintenance and care of technology
    - SNF- challenges with staff turn-over, technology training
    - Establishment of communication advocate

- Ongoing Assessment
  - Customization of technology
  - Training staff, caregivers, comunication advocates
  - Educate for modifications over time
    - Increases in motor function
    - Changes in speech
  - Establish long-term support system

Direct Access Methods to Support AAC

- Safe-laser technology
- Absolute head tracking technology
- Eye gaze technology

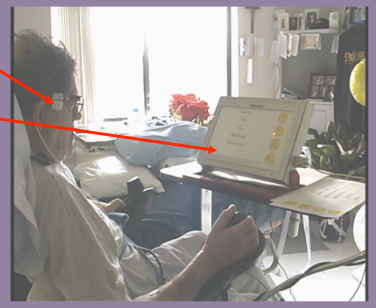
Safe-laser Access System

Safe Laser Access System

- Components:
  - Laser pointer
  - Laser sensing module
- Features:
  - Eye-safe laser
  - Low power except when pointing at a laser sensing surface

Initial Prototype (phase I prototype)

- Laser pointer
- Laser sensing surface
- Low tech pointing



3 Areas of Exploration

- Primary Communication System
- Head Movement Training
- Transitional System

Initial case study
(head training and primary communication system)

- Merle
  - Sustained brainstem stroke
  - Locked-In Syndrome
  - Introduced Safe-laser Access System 2.5 months post onset
  - Used as low tech pointing system

Safe-Laser Vertical Message Alignment

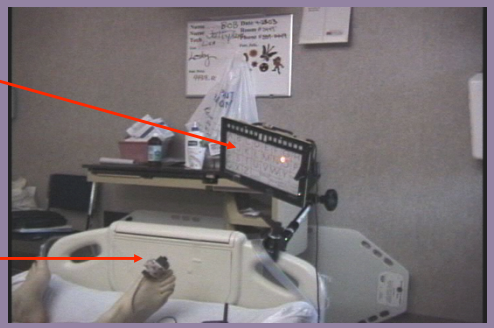
Safe Laser- Alphabet Spelling

Safe-laser Access System as Primary Communication Device

- Bob
  - Acute exacerbation of Myasthenia Gravis
  - ICU transitioned to acute hospital rehab setting
  - Able to utilize Safe Laser Access System mounted on foot to communicate all needs until natural speech recovered (6 weeks)

Macaw Laser Prototype

Laser pointer mounted to toe



Safe-laser and Head Movement Training

Participants

- 7 individuals with a diagnosis of LIS due to brainstem stroke
- 1 female, 6 males
- Age 30-66 years
- 4 weeks to 18 years post onset
- 1 lived at home, 6 lived in long-term care facilities

Evaluation Protocol

- Interface displays for the safe laser system consisted of 2, 4, 8 and 32 cells
- Data collected on the following
  - Movement range and accuracy across the interface
  - Consistency of laser movement
  - Estimates (family and staff) of laser use for communication
  - Health status throughout evaluation

Participants	Pre-laser AAC strategy	Length of training	Movement outcomes	Impact on AAC
1	Up/down eye movement for yes/no Eye-linking to spell	1 month	2 cells to spelling messages on 32 cell overlay	Low-tech pointing to spell messages with laser Computer access with laser
2	Eye gaze (low tech) Facial Expressions Limited speech	1 month	2 cells to 32 cells	Transitioned to using HeadMouse to access DV4
3	Up/down eye movement for yes/no	3 months	2 cells to 32 cells	Transitioned to using HeadMouse to access DV4
4	Eye movements for yes/no Eye gaze (low tech) Partner-dependent scanning	6 months (repeated hospitalizations)	2 to 4 cells inconsistently	Relies on low tech AAC strategies Continues to use Safe-laser for head training
5	Eye movement for yes/no Facial expressions Partner-dependent scanning	3 months	2 cells to 8 cells	Used Safe-laser to communicate yes/no Discontinued due to depression and health issues
6	Eye gaze (low tech)	4 months (medical set- backs)	Inconsistent	Discontinued due to medical problems
7	Eye gaze (low tech)	3 months	Inconsistent due to medical set-backs	Discontinued due to medical problems

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Absolute Head Tracking

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Absolute Head Tracking Preliminary Case Study

Participant

- 60 year-old male chronic Guillain Barré
- Initial onset locked-in syndrome
- 4 months post onset- used minimal head movement to activate light-touch switch
- 6 months post onset- increased activity tolerance and head movement to trial head tracking technology

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Challenges

- Required head tracking for minimal head movement
- Unable to use head tracking that required frequent recalibration
- Required access to computer while in various positions throughout the day (up in wheelchair, supine, etc.)
- Required simple technological set-up in skilled nursing environment

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AccuPoint Prototype

- Two infra-red digital cameras
- Three reflective dots on forehead
- Conventional computer monitor
- Conventional computer to compute head location and align it with the computer cursor

Results

- **Calibration**
  - Full computer access with scaling of 10:1
  - Minimal head excursion (measured from tip of nose) was ¼ in left/right and up and 1/8 in down
- **Positioning**
  - Successful with calibration and use regardless of position (wheelchair, bed, supine, side-lying)
- **Communication Functions**
  - Written communication throughout the day when one-way valve in use
  - Email communication
  - Internet use
  - Face-to-face communication at night when one-way valve not in use

Results

- **Set-up/Staff Training**
  - One training session with patient and staff
  - Patient trained all other staff independently on set-up
- **Duration of Use**
  - Email/internet 2 hours/day
  - Face-to-face communication 8-10 hours in evening and over-night

Eye gaze technology and ALS-preliminary follow-up study

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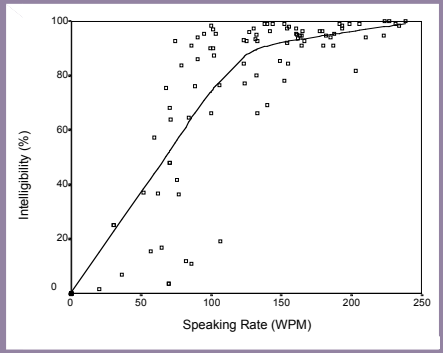
AAC Decision Making in ALS

(Ball, Beukelman, & Bardach, 2007)

- Phase I: monitor speech performance, preserve natural speech effectiveness, and educate about AAC
  - Energy conservation
  - Environmental modifications
  - Voice amplification
  - Ongoing monitoring/assessment of speaking rate

Speaking Rate



- Phase II: Formal AAC Assessment
  - Assessing specific communication needs
  - Cognitive issues (frontotemporal dementia)
  - Support and environment
  - Including information regarding life plans (e.g., decisions regarding artificial ventilation)

- Phase III: Finalization of AAC Recommendations
  - Device trials, preparation of necessary paperwork, funding requests, prescriptions, etc.
  - High and low tech AAC options recommended and implemented

Eye Gaze Technology

- The purpose of this study is report on 15 persons with ALS who selected eye - tracking (ERICA SGD) as their means of augmentative communication.

Background

- Eye gaze access SGDs are particularly attractive to persons who have severe physical impairments (ALS, LIS) that limit other access options.
- Eye tracking technology in SGDs most commonly employs infrared illumination of the pupil or cornea with digital camera tracking integrated into a computer.

Clinician-reported issues with early models of eye gaze technology

- physical abilities (head movement, ventilators)
- eyes (e.g., ptosis, visual apraxia, dry eyes)
- environment (e.g., home vs. community)
- positioning (e.g., head position, distance)
- glasses use (e.g., frame reflection, soiled contacts)
- lighting (e.g., dark room, window proximity)

Participants

- 15 selected eye- tracking (ERICA)

Gender	10 ♂, 5 ♀
Age	52.9 (39-71)years
Length of Use @ Survey	7.6 (1-26) months
Ventilator Use	6 (40%)
Predominant Muscle Tone	53% spastic, 47% flaccid

Participants

- Received personal AAC device
- Received instruction until they could operate devices to communicate
- Were provided with trouble-shooting as needed

Interview Survey

- Participants were interviewed by the SLP who completed the AAC evaluation and assisted in setup and instruction of the ERICA.
- Interview survey was completed in one session, and required approximately 1 hour of the participant's time.

Results

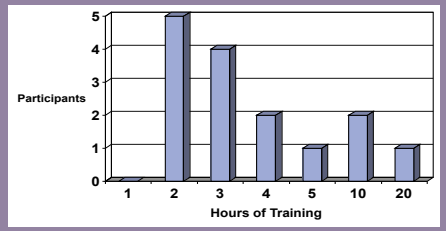
- Successful Use
  - 14 became successful ERICA communicators.
  - 1 discontinued use because of difficulty controlling eye lids.
- Light Compensations were required for most participants, with 14/15 using low light:
  - 10 = dim lights/lower shades
  - 4 = switched to fluorescent bulbs at home
  - 3 = used overhead lighting

- Glasses
  - 53% wore prescription glasses
  - 3 of these had reflective lenses.
  - Of these, 2 indicated that glasses interfere with ERICA use, and 1 uses without glasses.

- Reasons for Technology Selection
  - 58% - eye gaze access only,
  - 27% - multiple access,
  - 13% - unable to scan,
- 7% - wanted eye + head access.
- Funding
  - 7 - Medicare,
  - 4 - Medicaid, 3 Private Insurance
  - 1 - Veterans Administration.

Instruction

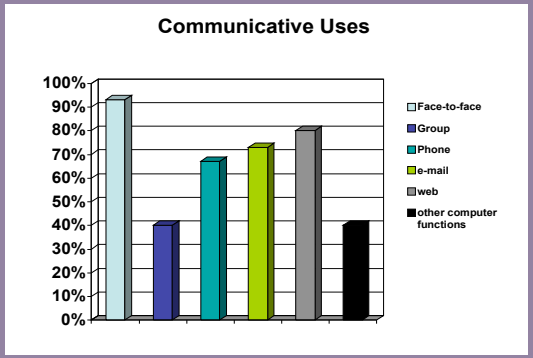
- Mean training received from SLP = 5.67 hrs (2-20).



- Increased instruction needed when primary facilitator was not a family member.
- Increased instruction/practice needed with ocular apraxia

- Troubleshooting Issues
  - Lighting
  - Positioning
  - Care facilities vs. home
- Home use sites:
  - 5 - recliner/lift chair only
  - 4 - everywhere
  - 4 - bed only
  - 1 - wheelchair only
  - 1 - table only

Use Patterns



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