Emerging AAC technologies and interventions to increase access and participation
RERC on AAC

Janice Light, Susan Fager, Erik Jakobs, Heidi Koester, David McNaughton
Jon Brumberg, David Chapple, Jessica Gormley,
Christine Holyfield & Tracy Rackensperger

Presentation at ISAAC Connect, August 9, 2021

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The need

- More than 97 million people worldwide have severe disabilities resulting in complex communication needs
  - Developmental disabilities
  - Acquired conditions
  - Degenerative disabilities

2

The challenge

- Without access to spoken, written, & digital communication, these individuals are severely restricted in their participation in society
  - Education
  - Employment
  - Health care
  - Family
  - Community living

3

Augmentative and Alternative Communication

- AAC technologies offer the potential to
  - Enhance communication &
  - Increase participation
- Substantial advances in AAC over the past 40 years
  - But the potential has not been fully realized for many individuals with complex disabilities

4

Barriers for individuals who require AAC

Many individuals with complex needs

- have only minimal movement and cannot reliably control technology
- are not literate and are excluded from the use of many technologies
- are overwhelmed by the substantial learning demands of many AAC technologies and abandon their use
- face significant societal barriers, especially when communication partners are unfamiliar and untrained in AAC

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Our vision

- Ensure that all individuals, including those with the most complex needs, have access to effective AAC technologies & interventions to realize
  - the basic human need,
  - the basic human right, and
  - the basic human power of communication

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RERC on AAC Team

- Individuals who rely on AAC & their families
  - Anthony Arnold, Dave Chapple, Chris Klein, Godfrey Nazareth, & Tracy Rackensperger
- Rehabilitation engineering team
  - Erik Jakobs, Heidi Koester, & Jon Brumberg
- Rehabilitation scientists & clinicians
  - Susan Fager, Jessica Gormley, Christine Holyfield, Janice Light, & David McNaughton

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RERC on AAC activities

- The **RERC on AAC** conducts
  - **Research** to advance knowledge & enhance participation
  - **Development** to improve AAC technology solutions
  - **Training** to increase the knowledge of consumers, families, service providers, researchers, technology developers & policy makers
  - **Dissemination** to reach all stakeholder groups and bridge the gap between research and practice

    - To expand "what is possible"
    - To ensure "what is possible" becomes "what is probable"

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Research & Development Projects

- **Enhance communication & participation**
  - R1 Video VSD Intervention
  - R2 AAC Literacy Decoding Technology
  - D3 Partner mTraining
- **Improve access to AAC technologies**
  - D1 Access Assistant
  - D2 Smart Predict
  - R3 Motion in AAC User Interface Displays

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Training & Dissemination

- **Training Projects to build capacity**
  - T1 Mentored R&D Lab Experiences
  - T2 Rehab Engineering Student Capstone Projects
  - T3 Student Research & Design Competition
  - T4 Doctoral Student AAC R&D Think Tank
  - T5 AAC Webcasts and Instructional Materials
- **Dissemination**
  - Website, webcasts, e-Blasts, presentations, publications, social media, etc.
  - AAC Consumer & Technology Forum
  - State of the Science conference

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R1 Video Visual Scene Display (VSD) Intervention

David McNaughton, Janice Light, Erik Jakobs

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Communication

- Speech will not meet communication needs of
  - 40% of adults with autism spectrum disorders
  - 50% of adults with Down syndrome
- Less than 10% of adults with developmental disabilities who **need** communication supports **receive** communication supports

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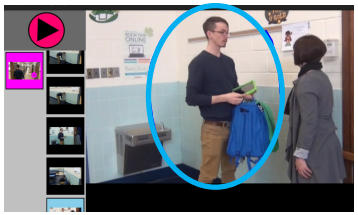
Video visual scene display (VSDs)

- Capture video of events/ interests
- Pause at key moments
  - Create visual scene at these junctures
  - Add hotspots with speech output



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Sean

- 21-years old
- Down syndrome
- Complex communication needs
  - intelligibility <10%
- Independent shopping
  - Taco shells, bananas, cheese at deli counter
  - **Yogurt, apples, sliced turkey at deli counter**
  - **Frozen pizza, potato chips, soft drinks**
- Large grocery store

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Video visual scene display (VSDs)

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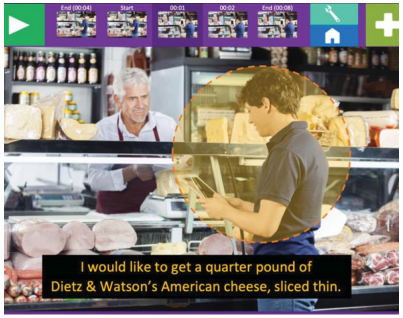

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Research to date

- Single-case studies
- Improved outcomes in
  - Shopping
  - Riding public transportation
  - Working in a foodbank
  - Working in a library

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Video VSD - Planned Activities

- 3 large scale studies
- 72 participants
  - Intervention delivered by RERC on AAC team
    - 24 adults with IDD (Study 1)
    - 24 adults with ASD (Study 2)
  - Intervention delivered by family/caregivers, community professionals
    - 24 adults with ASD or IDD (Study 3)

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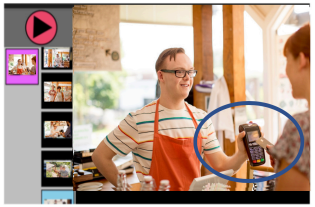
Video visual scene display (VSD)

Expected outcomes

- Supports for development and delivery of Video VSD interventions
  - Evidence-based protocol
  - Evidence-based online training module
- Tech transfer to manufacturers to support iterative development of Video VSD app



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R2 - AAC Literacy Decoding Technology

Janice Light, Christine Holyfield, Erik Jakobs, & David McNaughton

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AAC Literacy Decoding Technology

The problem

- Literacy skills are essential to communication & participation in society
  - Especially for individuals who rely on AAC
- More than 90% of adults with complex communication needs enter adulthood without functional literacy skills
- Current AAC technologies do not support the transition from picture symbols to literacy

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AAC Literacy Technology Prior R&D

- The transition to literacy (T2L) *sight word* feature was developed under the prior RERC on AAC
  - Individual selects a picture symbol from the AAC display
    - Supports understanding
  - Written text appears on screen using smooth animation to capture attention
    - Supports orthographic processing
  - Word is spoken out
    - Supports phonological processing

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Demonstration of the T2L Sight Word Feature

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AAC Literacy Technology Prior R&D

- Evaluated T2L *sight word* technology in a series of studies
  - 56 children & adults
    - Different ages and disabilities
  - 89% of participants demonstrated significant increases in literacy skills
  - Required only minimal exposure to T2L feature to acquire new sight words
  - Easy to use
- BUT limited to sight word learning
  - Require decoding skills for functional literacy

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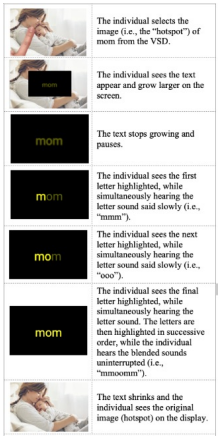
AAC Literacy Decoding Technology

Proposed solution

- AAC T2L *decoding* technology
- Individual selects a picture symbol
- Text appears dynamically
  - Motion drives visual attention to text
- Each letter highlighted in turn
  - Luminance drives visual attention to letter
- Letter sound is spoken slowly as letter is highlighted
  - Speech output supports phonological processing



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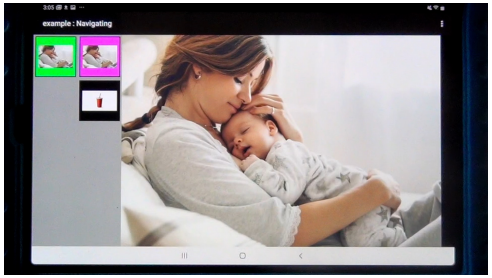
Demonstration of T2L Decoding Technology



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AAC Literacy Decoding Technology Evaluation

- Series of single case experimental design studies
- 48 individuals with complex communication needs who are nonliterate
  - Different ages & disabilities (ASD, IDD, CP)
- Independent variable
  - T2L decoding technology (VSD or grid)
- Dependent variables
  - Percent accuracy decoding (reading) words – novel words
  - Frequency of words communicated accurately using text-only AAC display

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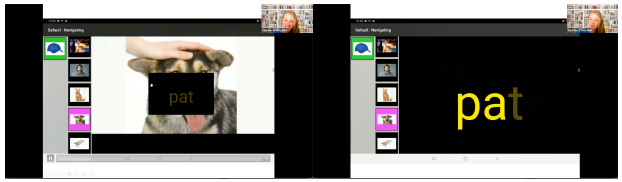
AAC Literacy Decoding Technology
Research in progress

- 7 adolescents & adults with IDD have participated to date
- Participants used the VSD T2L decoding technology during interactions with researchers that occurred remotely



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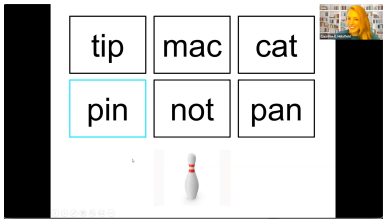
AAC Literacy Decoding Technology
Research in progress

Results to date

- All participants have increased accuracy in at least one of the following skills:
  - Decoding novel CVC words,
  - Decoding more complex, novel words
  - Encoding novel words

(Holyfield, Pope, Light, Jakobs, McNaughton, Laubscher, & Pfaff)



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AAC Literacy Decoding Technology
Expected outcomes

- New research-based AAC technology feature to support the acquisition of **decoding** literacy skills
  - Grid-based app
  - VSD-based app
- Evidence-based protocols for intervention using T2L decoding technology
  - Different ages and disabilities

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R3 Motion to improve AAC user interface displays

Janice Light, Krista Wilkinson, & Erik Jakobs

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R3: Motion to improve AAC displays
The problem

- Most AAC displays are complex
  - Impose significant visual, cognitive, & linguistic processing demands
- Many individuals who require AAC experience
  - Difficulty attending to key components of AAC displays
  - Difficulty learning new AAC symbols
  - Difficulty using AAC displays to communicate in real world contexts

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Motion to improve AAC displays

Proposed solution

- Motion is a powerful attractor of visual attention
- Can we harness motion to improve AAC user interface displays?
  - Increase visual attention to key components of the display
  - Reduce visual distractions
  - Increase learning of target symbols

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Motion to improve AAC displays

Hypotheses

- When motion is used with target symbols in AAC displays, individuals with complex communication needs will demonstrate
  - Increased visual attention to target symbols
  - Increased accuracy learning & identifying target symbols
  - Increased accuracy using target symbols when communicating compared to static displays (i.e., the current state of practice)

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Motion to improve AAC displays: Research methods

- 4 studies of effect of motion on visual attention, learning, & use of AAC symbols
  - 2 studies of grid displays with picture symbols
  - 2 studies of grid displays with written text
- Design
  - Within-subjects experimental design with repeated measures
  - 60 individuals with developmental disabilities (ASD, IDD)
- Independent variables
  - Type of AAC Display (static display vs. targeted motion)
  - Session (session 1-5)
- Dependent variables
  - Visual attention, symbol identification, communicative use

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Motion to improve AAC displays

Materials

- Prototype displays of 12 new AAC symbols (picture symbols or text)
  - Static display (current state of practice)
  - Display with motion of symbol upon selection

Procedures

- In each condition, participant selects target AAC symbol
  - In static condition, no change to target AAC symbol upon selection
    - Speech output
  - In motion condition, smooth animation of target symbol
    - Speech output

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Motion to improve AAC displays - Measures

- Visual attention
  - Measured using eye tracking research technology that rapidly samples position of eye in relation to areas within AAC display
    - Latency
    - Duration
    - Sequence of visual fixations
- Symbol learning
  - Accuracy of identification
  - Rate of learning

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Motion to improve AAC displays - Pilot study

- Pilot study
  - 18-year-old with Down syndrome
  - Remote data collection via zoom due to COVID 19
  - Participant's face & eyes video recorded while looking at AAC displays
    - Static
    - Motion
  - Onset /offset and location of eye gaze coded by two graduate students
    - blind to display conditions

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Pilot study results
Visual attention to target symbol with static and motion displays

- Participant attended visually to target symbols for much longer with motion vs static display
  - Mean of 2.84 sec per symbol in motion condition
  - Mean of 1.28 sec per symbol with static display
- Participant was more easily distracted with static display
  - Looked elsewhere 71% of the time

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Pilot study
Accuracy identifying text symbols with static & motion displays

- Participant learned text symbols more quickly with the motion compared to the static display
- Participant was more accurate identifying text symbols with the motion than the static display
- These are only preliminary results; further investigation is required

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Motion to improve AAC displays
Expected outcomes

- Scientifically-based design specifications for using motion in AAC displays
  - Maximize visual attention to key components of display
  - Minimize attention to distractors
  - Maximize learning of new symbols
    - Picture symbols
    - Written text
  - Enhance communication performance

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Major Theme: Access

- Increasing access to AAC technology through the development of new supports to alternative access assessment activities and alternative access approaches
- Projects:
  - Access Assistant
  - Smart Select
  - Targeted Motion and Displays

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D1 Access Assistant Software to Improve Alternative Access Services

Heidi Koester, Susan Fager, Erik Jakobs, Tabatha Sorenson

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Access Assistant – Problem statement

Jim is a farmer in a rural Midwestern state, diagnosed with ALS. Living 400 miles from an AAC assessment center, he relied on his local speech-language pathologist (SLP) to support his needs as his disease progressed. Trying to provide Jim with a sophisticated, high-tech access method, he eventually received an eye-tracking device but struggled to use it successfully. His SLP was frustrated with the lack of support she had to select, implement, and monitor this complicated access method with Jim and often wondered if she had made the right access decision.

Jim and his SLP needed support to make appropriate access decisions and ensure his full access to communication.

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Challenges with Alternative Access

- Alternative access methods help people with motor impairments control technology
- But people don't always get methods that are the best fit for their needs
- Why not?
  - AT providers may not have needed knowledge and skills
  - Difficulty carrying out systematic, evidence-based assessment process
  - Existing assessment tools may be cumbersome, time-consuming, or incomplete

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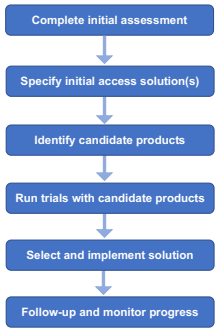
Access Assistant – Proposed solution

- Develop Access Assistant software
- Web-based tool to guide access assessments
- Improves the quality of the assessment process:
  - Leads teams through a repeatable, systematic process
  - Incorporates performance measurements for evidence-based decision-making
- Will be freely available



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Access Assistant – User-centered design timeline

1. Product Definition ✓	2. MVP Initial Design ✓	3. Ready to Code – soon!
How • User interviews • Benchmarking What • List of requirements • Personas • Scenarios • Basic workflow	How • Iterative ideation • Wireframe design What • Refined product definition • User-vetted wireframe UI • Tech stack requirements	How • 2 user studies • Clinical content development What • Refined wireframe UI • Tech stack selection
oct 2020 – jan 2021	feb 2021 – apr 2021	may 2021 – sep 2021

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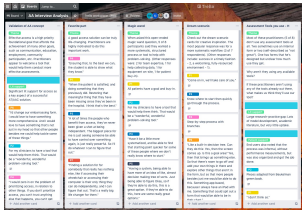
Access Assistant – Key themes from user interviews

- 8 practitioners and 3 end users
- 46 themes and corresponding requirements for the app
- Practitioners want a more systematic approach, but don't use the tools that are already available. A Holy Grail?



- Practitioner anxiety can be intense: *"I should know this, but I don't."* Design AA to take the worry out of assessments – welcoming, reassuring, fun, exploring.
- Speed/accuracy measurements aren't everything (but they still have value)
- Need option for self-defined test-drive tasks that are meaningful to user

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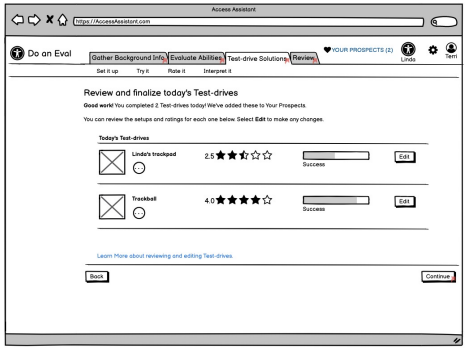
Access Assistant – Wireframe UI design

- Using Balsamiq tool for wireframe creation
- Unstyled, monochrome to keep the focus on content and workflow
- Explore workflows for planning ahead for an eval as well as conducting an eval.
- About 60 screens in the design!



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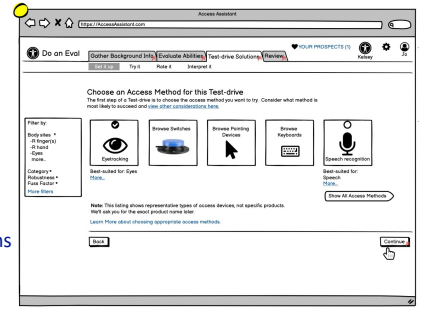
Access Assistant – Wireframe UI design

- User study #1
  - 4 practitioners interacted with early-stage design
  - Positive feedback and opportunities for improvement
- Intense internal review of the workflows and design (2 clinical experts on the team)
- User study #2
  - 8-10 practitioners using refined design
  - Think-aloud protocol + specific questions
  - Slated to begin in August



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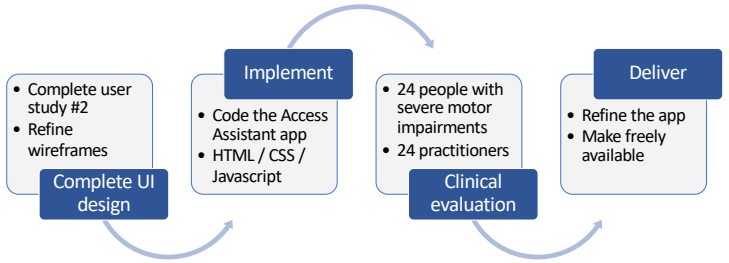
Access Assistant – Future Work



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For more information

Contact Heidi Koester at hhk@kpronline.com

- See short paper and poster on user interviews and thematic analysis at the KPR website (from RESNA 2021 conference):
  - kpronline.com/pubs
  - "Designing an app for computer access assessments: using interviews to uncover and define user needs"
- Thanks for being here!

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D2 *Smart Select*: A New Switch Access Method

Jon Brumberg, Susan Fager, Heidi Koester, Erik Jakobs,
Tabatha Sorenson, Arash Gonabadi

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Smart Select- Problem statement

- *Annie sustained a severe brainstem stroke that left her with severe eye motor control issues. Her subsequent use of eye tracking technology was inconsistent and extremely fatiguing. Trials of switches were inconsistent and frustrating. Annie's only way to communicate was using yes/no eye signals and low-tech partner dependent scanning. How can we use technology to leverage her minimal movements and account for the inconsistencies she exhibits?*

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Smart Select- Challenge

- Some individuals with severe motor impairment have no or very limited access to AAC technology impacting their ability to pursue participation in family life, communication, work, and community.
- Access technologies for individuals with severe motor impairment are emerging (e.g., BCI) but thus far have had limited clinical use due to challenges associated with signal capture and acquisition.

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Smart Select- Previous work

- Despite advances in technology, most access solutions rely on a single signal or tool.
  - Previous RERC on AAC: Eye-tracking + Switch-scanning prototype
  - Leveraged both methods to improve access
    - 1st- Eye-tracking to narrow location of target in interface
    - 2nd-Switch-scanning to target of smaller group of items (versus full interface)
  - New project: Smart Select
    - Examine use of multiple signals to enhance access
    - Examine simultaneous use of access signals (EEG + EMG)

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Smart Select- Proposed solution

- This project will address the access needs of people who are unable to effectively use current alternative access methods, by developing and evaluating a new switch access method called *Smart Select* that uses machine learning to simultaneously combine brain EEG and muscle EMG signals.

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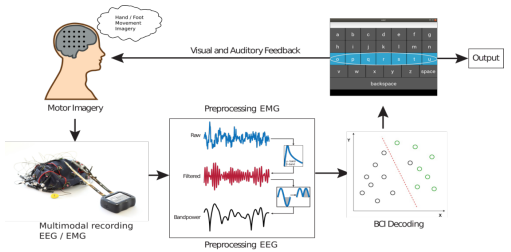
Smart Select- Prototype

***Smart Select* prototype**

- The main components are signal acquisition of EEG and EMG signals, pre-processing of EEG and EMG prior to decoder model fitting and prediction, followed by output to the AAC device



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Smart Select- Prototype development and testing

- Proof of concept development project
- Ready wireless prototype for clinical lab setting for testing
- Examine user-interface design to enhance BCI/EMG access learning
- Determine how to weight signals to optimize performance
- Iterative refinement/design phases
  - Participants- individuals with high level (cervical) spinal cord injury, brainstem impairment and amyotrophic lateral sclerosis
  - Refine/design process will examine and iteratively implement changes to user interface, calibration procedures, and signal processing

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Smart Select- Outputs

- Prototype feasibility/proof of concept
- Development of prototype ready for clinical and home settings
- Development of algorithms to enhance calibration and automatically weight signals based upon performance
- Develop user interfaces based on individual feedback and to enhance learning

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D3: Mobile training in AAC for communication partners

Erik Jakobs, Susan Fager, Jessica Gormley,
Christine Holyfield, Janice Light, & David McNaughton

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Partner mTraining
The problem

- Individuals who rely on AAC encounter numerous communication partners who lack training in AAC
  - These communication partners frequently preempt opportunities for communication
- As a result, individuals who rely on AAC are unable to communicate and participate successfully
  - Education
  - Employment
  - Healthcare
  - Community

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Partner mTraining - Proposed solution

- AAC technology that
  - Supports stakeholders in quickly & easily creating mTrainings to teach partners AAC procedures for successful communication
  - Empowers individuals who rely on AAC and facilitators to deliver these mTrainings "just in time" as required to train communication partners
    - Pop-up within AAC technologies
    - Local computers
      - Password protected
    - Secure URL
      - Pushed to partner's phone

3

Partner mTraining - Development

- Prototype to enable stakeholders to quickly & easily create & deploy mTrainings for communication partners

- Partner mTrainings
  - Checklist of procedural steps
  - Video models of each step
  - Generic or personalized trainings
  - Library of mTrainings freely available to stakeholders

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Partner mTraining - Evaluation

- Evaluation
  - Usability of app to create partner trainings
  - Effectiveness of partner mTrainings
- 4 studies
  - 2 studies to train healthcare professionals who interact with adults with acquired conditions
  - 2 studies to train educational & community personnel who interact with individuals with developmental disabilities

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Partner mTraining – Study #1 (Gormley & Fager)

- **Training healthcare professionals in acute care settings** to interact with patients with acquired conditions
- **Setting up successful patient interactions**
  - ✓Ready the environment (e.g., turn on lights, turn off TV)
  - ✓Ready the patient (e.g., provide hearing aids, glasses)
  - ✓Ready the communication supports (e.g., note how the patient communicates)
  - ✓Interact using the communication supports (e.g., use short sentences, wait)

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Partner mTraining – Study #2 (Laubscher, Light, Holyfield, & McNaughton)

- **Training education professionals** to use aided AAC modeling to support children with developmental disabilities
- **Aided AAC modeling**
  - ✓Provide a choice or introduce the activity
  - ✓Interact with the student modeling the use of AAC symbols
  - ✓Wait and provide the student with time to communicate
  - ✓Respond to the student's communication attempts, modeling the use of AAC symbols

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Partner mTraining – Expected outcomes

- New technology that supports
  - Stakeholders in quickly & easily creating mobile trainings for communication partners
  - Individuals who rely on AAC & facilitators in delivering mTrainings to partners just in time as required
    - Resulting in improved communication & increased participation

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Training and Dissemination

David Chapple, David McNaughton, Tracy Rackensperger,
Anthony Arnold, Chris Klein, Godfrey Nazareth,

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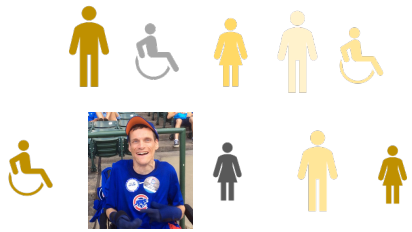
David Chapple

- Co-Leader of Training and Dissemination Team for the RERC on AAC
- Vice-President of Accessible Housing (Austin, Texas)
- Employee of "Training 4 Transformation"

2

Challenge



Less than 1 in 10 adults with developmental disabilities have access to AAC

3

Building Capacity in AAC

(McNaughton, Light, Beukelman, Klein, Nieder, & Nazareth, 2019)

1. Spread awareness of AAC and assisting people with complex communication needs in obtaining needed services;
2. Enhance the knowledge, skills, and attitudes of professionals;
3. Provide appropriate instruction for people with complex communication needs and their communication partners;
4. Develop communication supports in society;
5. Build the research base to help drive continued improvement in AAC practice

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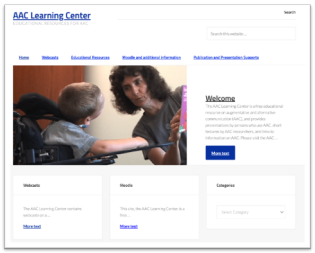
Spread awareness of AAC

- General public
- Broad range of pre-service professionals



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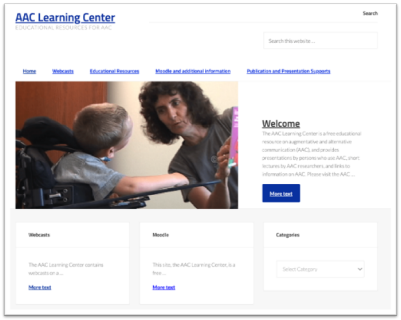
https://aac-learning-center.psu.edu



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Presentations by people who use AAC available at the AAC Learning Center

- Independent living
- Inclusion
- Early intervention with AAC
- Community participation
- Employment

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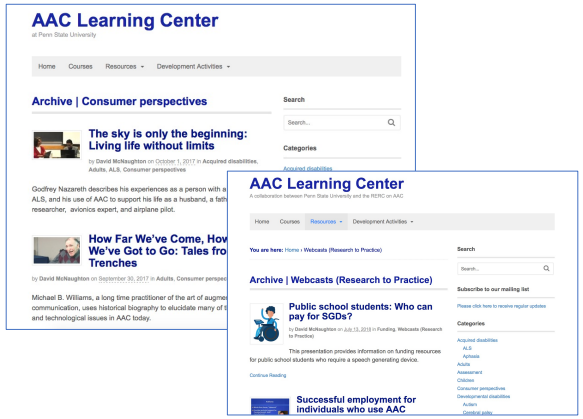

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https://aac-learning-center.psu.edu

- All webcasts, readings, factsheets, "AAC ads"
  - Free
  - Searchable
  - No quizzes
  - No registration

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Building Capacity in AAC

(McNaughton, Light, Beukelman, Klein, Nieder, & Nazareth, 2019)

1. Spread awareness of AAC and assisting people with complex communication needs in obtaining needed services;
2. Enhance the knowledge, skills, and attitudes of professionals;
3. Provide appropriate instruction for people with complex communication needs and their communication partners;
4. Develop communication supports in society;
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Shortage of SLPs with competencies in AAC

- ~55% of SLPs in the schools serve children who have limited speech (ASHA, 2010)
- ~85% of practicing SLPs did not complete a single course focused on the needs of children with CCN (Costigan & Light, 2010)
- SLPs report that lack of training in AAC /AT & services for English language learners are their "greatest professional challenge" (ASHA, 2010)

  - Light et al (2014)

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Preservice training

- 18-35% of preservice programs do not offer any coursework at all in AAC
- Many of the programs that offer training in AAC, do so on a limited basis
  - 1-4 hours of AAC content
- Only a small percentage of programs offer full courses in AAC
  - ~half of these are not required courses
- 64% of programs report that faculty who are not experts in AAC typically teach the AAC courses
  - Light et al (2014)

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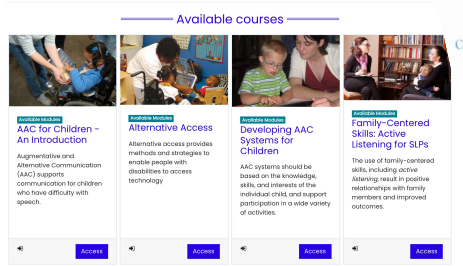
Free AAC Webcasts and Instructional Materials



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https://aac-learning-center-moodle.psu.edu

Modules contain

- Videos of evidence-based practices
- Web-based practice activities
- Guided notes
- Certificates of Completion
- Classroom extension activities

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Available topics

- AAC for Children – An Introduction,
- Alternative Access,
- Developing AAC Systems for Children,
- Family Centered Skills: Active Listening for SLPs,
- Funding for AAC for Children, and
- Literacy and AAC: Letter-Sound Correspondences
- Literacy Intervention for Learners with Complex Communication Needs
  - ➢ Supporting Patient-Provider Communication

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https://aac-learning-center-moodle.psu.edu

- In use at more then 35 colleges and universities
- Over 5,600 Certificates of Completion awarded
- More than 96% of students would "recommend" or "strongly recommend" the use of the modules to others

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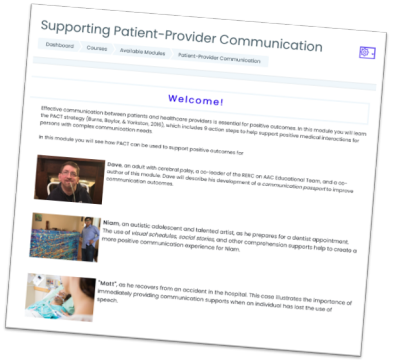
Supporting Patient-Provider Communication



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David Chapple's Blog

Speaking with Professionals - Alternatively

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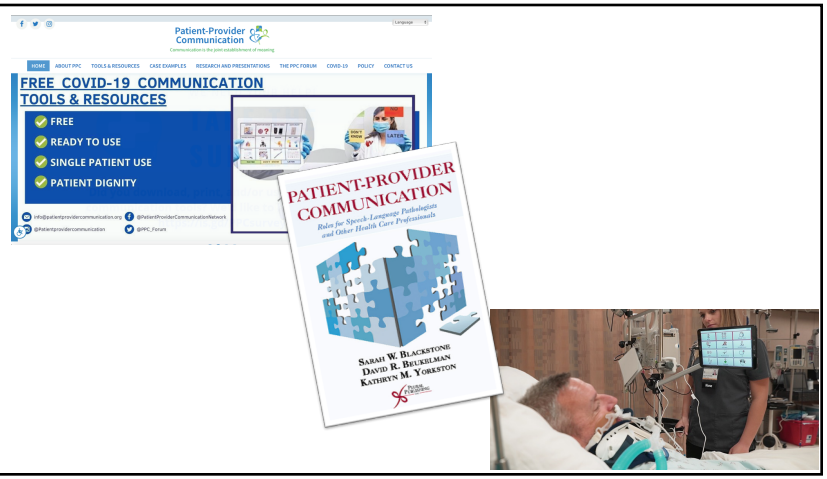

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Interacting with Healthcare Professionals

- Almost 20% of admissions result in harm
  - Over 60% were preventable
- Patients with communication challenges are 3x more likely to experience an adverse event

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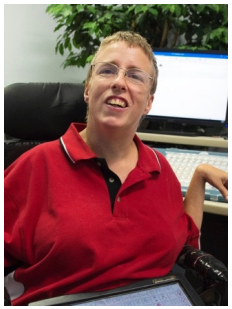
Tracy Rackensperger (Ph.D)

- Co-Leader of Training and Dissemination Team for the RERC on AAC
- University of Georgia



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AAC Consumer and Technology Forums

- Four consumer-led research projects to identify challenges and solutions to communication
  - Community participation
  - Access to healthcare
  - Employment
  - Education
  - Independent living
- Focus group and survey methods
  - current barriers
  - needed features of AAC technology solutions

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AAC Consumer and Technology Forum

- Bring key stakeholders together
  - AAC consumers and their families
  - AAC researchers and developers
  - AAC and mainstream manufacturers
  - AAC service providers and students
- Review survey/focus group findings
- Discuss opportunities and drawbacks both with current and newly emerging AAC technologies, and
- Identify supports and barriers to the development of new AAC technologies

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Building Capacity in AAC

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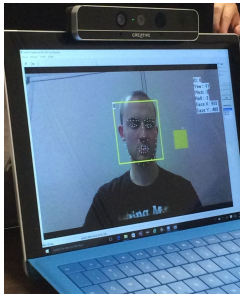
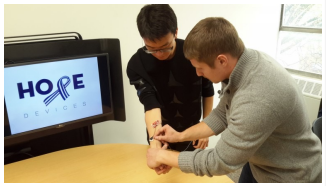
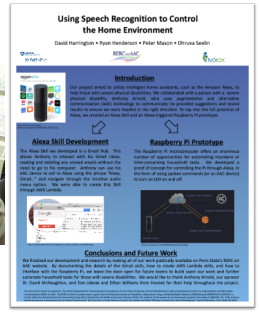
Inspire a new generation of AAC developers
Rehabilitation engineering student capstone projects







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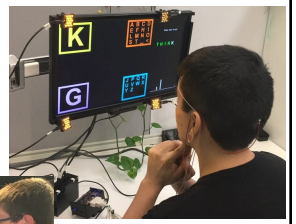
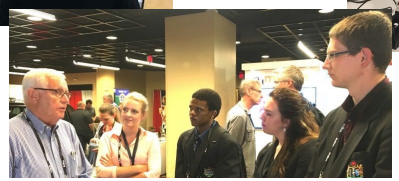
Inspire a new generation of AAC developers:
Student research and design challenges





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Inspire a new generation of AAC developers:
Student design challenge website

https://sites.psu.edu/resnasdc/

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Inspire a new generation of AAC researchers

Doctoral Student AAC R&D Think Tank

Next AAC ThinkTank scheduled for Summer 2022

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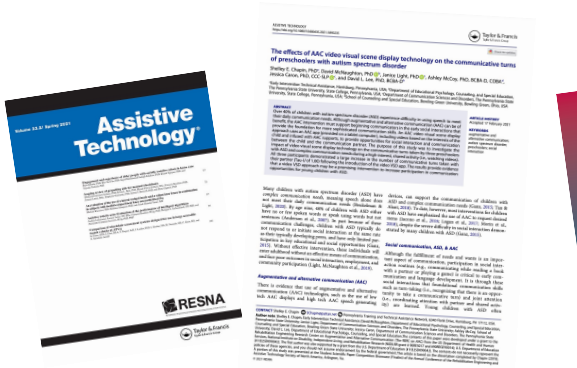

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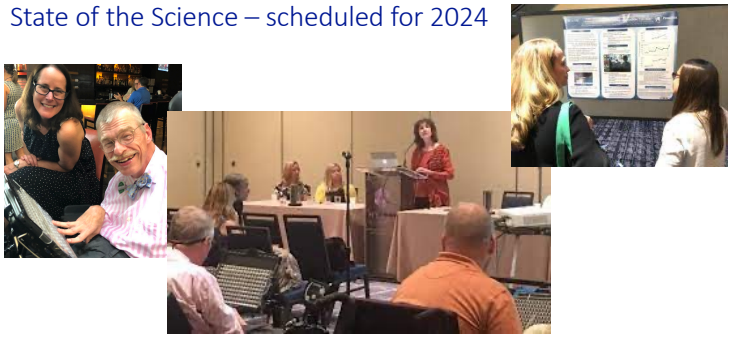
State of the Science – scheduled for 2024



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Resources

- https://aac-learning-center.psu.edu/
- https://aac-learning-center-moodle.psu.edu

- https://rerc-aac.psu.edu/

- Doctoral Student AAC Research Think Tank
  - https://sites.psu.edu/aacthinktank/
  - https://sites.psu.edu/aacthinktank2019/
    - dbm2@psu.edu

- https://aackids.psu.edu/
- https://aacliteracy.psu.edu/

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Acknowledgements

- We are grateful to the individuals who rely on AAC and their families who have allowed us to be part of their lives and have inspired our work.
- This research was supported by grant #90REGE0014 to the Rehabilitation Engineering Research Center on Augmentative and Alternative Communication (The RERC on AAC) from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR). NIDILRR is a Center within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). This research does not necessarily represent the policy of NIDILRR, ACL, HHS, and you should not assume endorsement by the Federal Government.
- For more information, **please visit our website at rerc-aac.psu.edu**

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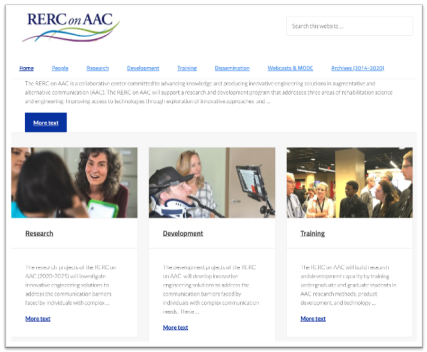

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