



Rehabilitation Engineering Research Center on Augmentative and Alternative Communication RERC on AAC






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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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- **Session Feedback Evaluation**
 - Your feedback is very important to us. Please be sure to complete the session evaluation through the ATIA mobile app
- **Learning Objectives**
 - Describe 2 research projects of the RERC on AAC
 - Describe 2 development projects of the RERC on AAC
 - Describe 2 webcasts from the AAC Learning Center
 - pink157



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The need

- More than 5 million Americans have severe disabilities resulting in complex communication needs
 - Developmental disabilities
 - Acquired conditions
 - Degenerative disabilities
- More than 97 million people worldwide

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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



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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



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Barriers for individuals who require AAC

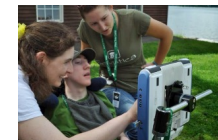
- Many individuals with complex needs
- have only minimal movement and cannot reliably control technology
 - are not literate and are excluded from the use of many technologies
 - are overwhelmed by the substantial learning demands of many AAC technologies and abandon their use
 - face significant societal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



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NIDILRR-funded RERC on AAC

- The RERC on AAC conducts
 - **Research** to advance knowledge & enhance participation
 - **Development** to improve AAC technology solutions
 - **Training** to increase the knowledge of consumers, 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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RERC on AAC Team

- Individuals who rely on AAC & their families
- Rehabilitation engineers
- Rehabilitation scientists & clinicians




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RERC on AAC Research and Development Projects

- Research Projects
 - R1 Video VSD Intervention
 - R2 AAC Literacy Decoding Technology
 - R3 Motion in AAC User Interface Displays
- Development Projects
 - D1 Access Navigator
 - D2 Smart Predict
 - D3 Partner mTraining






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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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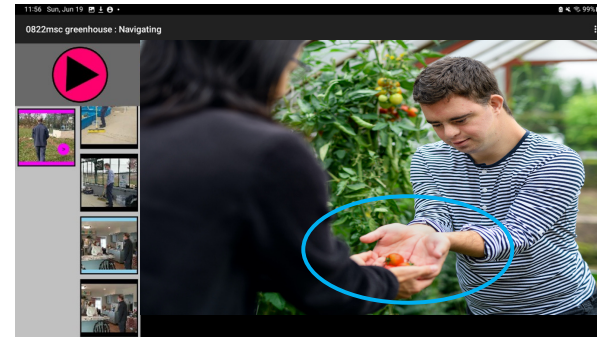
Video visual scene display (VSDs)

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



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Video VSD - Greenhouse (19 steps)



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Key Features of Video VSD as a Participation Support

- Support **independent performance** of complex, multi-step skills in community settings
- **Easily learned and used** by autistic persons and persons with IDD
- Provide **communication assistance** as needed
- Make use of **highly portable, commonly available** technology
- Easily developed for **individually selected goals** by typical support providers
 - family members, group home workers



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Research to date

- Series of single-case experimental studies
 - Improved outcomes in
 - Shopping (*Babb et al, 2021*)
 - Riding public transportation (*O'Neill et al, 2017*)
 - Working in a foodbank (*Babb et al, 2020*)
 - Working in a library (*Babb et al, 2019*)
- RCT study (in progress)
 - 24 adults with IDD (Study 1)
 - 24 autistic adults (Study 2)
 - Intervention developed by family/caregivers, community professionals
 - 24 adults with IDD or on autism spectrum (Study 3)



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Video visual scene display (VSD)

Expected outcomes


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



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D1 Access Navigator Software to Improve Alternative Access Services

Heidi Koester, Susan Fager, Erik Jakobs, Tabatha Sorenson

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Access Navigator – 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.

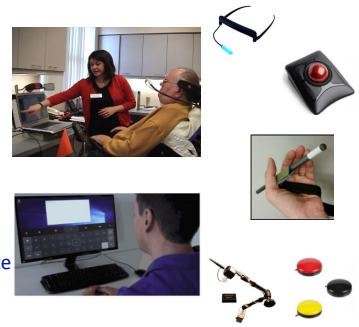
Jim and his SLP needed support to make appropriate access decisions and ensure his full access to communication.

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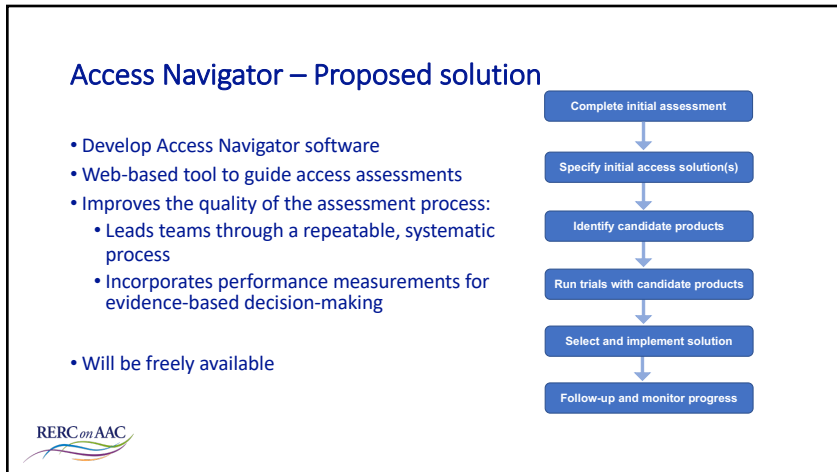
Challenges with Alternative Access

- 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

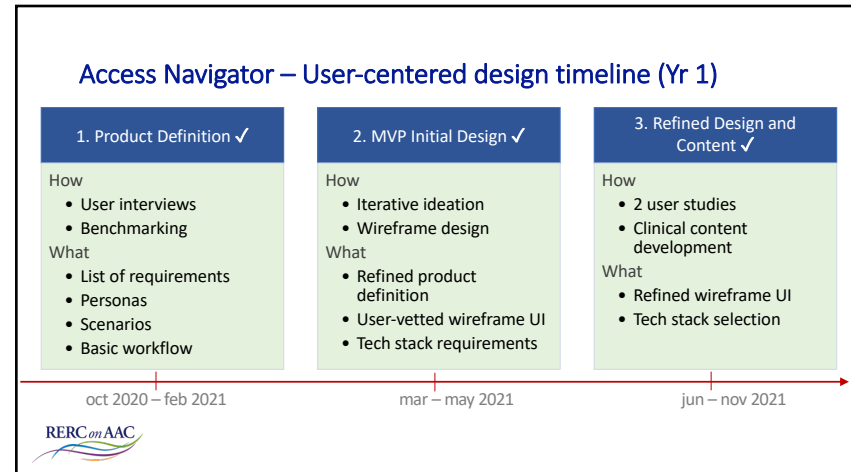


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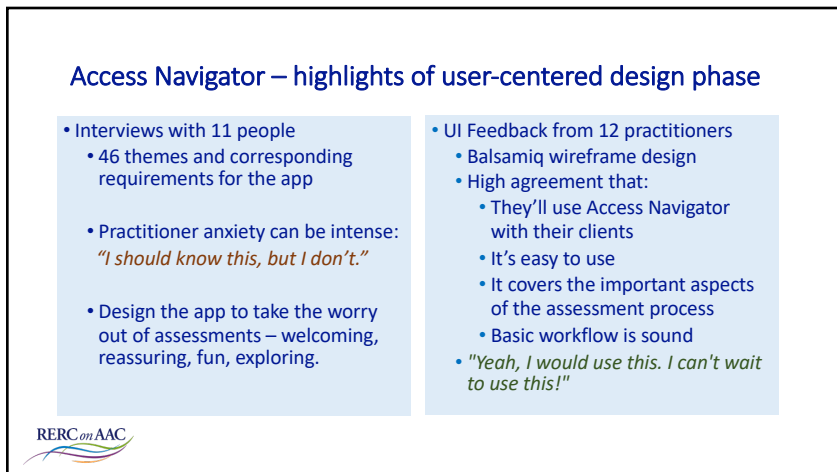
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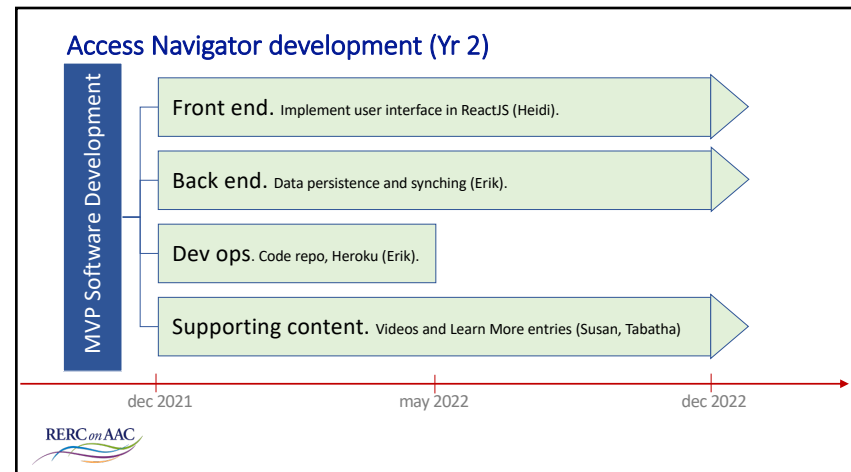
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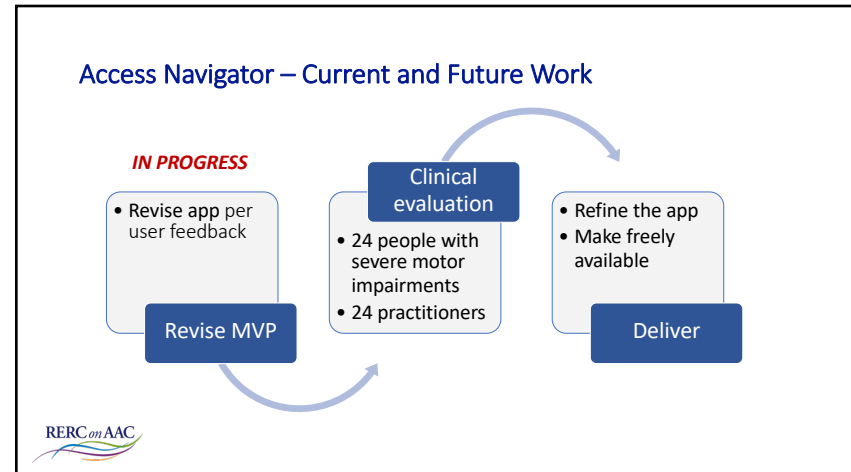
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User feedback study on the MVP

- 5 practitioners in a think-aloud protocol with their chosen use-case scenario
- Data:
 - User think-aloud comments
 - ‘Critical incidents’
 - SUS responses
 - Responses to open-ended questions
- All participants conducted a mock session correctly and successfully (avg 42 minutes)
- Very high usability (avg SUS of 86)
- 6 key issues in the UI accounted for the 21 major usability problems that were observed across all participants
- Revised design will focus on addressing those 6 areas



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If you'd like to try Access Navigator:

Contact Heidi Koester at hkh@kpronline.com



Thanks again for being here!

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D2 Smart Select: A New Switch Access Method

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

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D2 Smart Select: a new switch access method

The Problem

- 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.

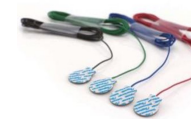


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D2 Smart Select: a new switch access method

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 combine brain EEG and muscle EMG signals.

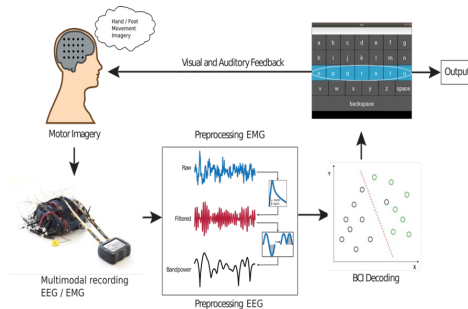


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Smart Select- Prototype

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

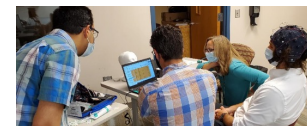


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D2 Smart Select: a new switch access method

Development

- This project will provide the foundational **proof of concept**
- *Smart Select* system will combine motor-based BCI and surface EMG as an access tool
- Development will focus on improving performance and reducing the cumbersome setup and complexity relative to existing technology
- Progress to date: prototype near finalization, data collection on participants with disability starting in 2023



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D3 – mTraining in AAC for Communication Partners

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






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Partner mTraining

The problem

- People who rely on AAC interact with numerous communication partners who lack training in AAC
- Communication partners are often unfamiliar & untrained in AAC
- As a result, people who rely on AAC are unable to communicate and participate successfully
 - Education
 - Employment
 - Healthcare
 - Community

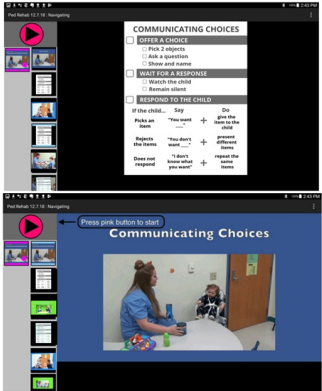



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Partner mTraining

The Proposed Solution

- Develop a user-friendly app to create partner mTrainings that can be deployed “just-in-time” to teach partners AAC strategies
- The app will include step-by-step instructions and video demonstrations of each step
- Components:
 - Checklist of procedural steps
 - Video models of each step
 - Library of “generic” trainings freely available
 - Ability to efficiently develop “personalized” trainings



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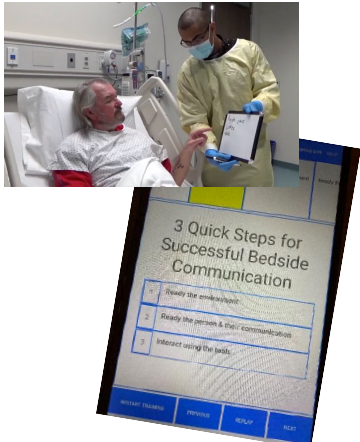
Partner mTraining Evaluation of the App

- **Usability studies**
 - Continuous feedback from end-users through iterative design and testing
- **Effectiveness studies**
 - Healthcare providers using “generic” training
 - Healthcare providers using “personalized” training
 - Educational/community personnel using “generic” training
 - Educational/community personnel using “personalized” training

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Partner mTraining Research in progress

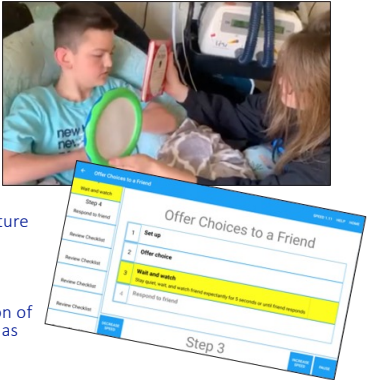
- Pretest/Posttest Control Group Design
 - 11 acute care healthcare workers (nurses, certified nursing assistants)
 - 5 adults with a new onset communication challenge (e.g., aphasia, intubation)
- Partner mTraining: “3 Quick Steps for Successful Bedside Communication”
- Data collection is in progress
 - Pre/post communicative interaction performance
 - Experiences of patients & staff after each interaction
 - Staff feedback on the mTraining app, training content, and use in hospital setting



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Partner mTraining Research in progress

- Pretest/Posttest Control Group Design
 - Students with multiple disabilities and cortical visual impairment who are intentional, presymbolic communicators
 - Peers with typical development
- Partner mTraining to teach peers how to structure opportunities to offer choices
- Data collection is in progress
 - Preliminary results are positive- presentation of choices, commenting on student behaviors as indicative of a choice response
 - Stay tuned for complete results



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Partner mTraining Next Steps

- Evaluating how to best create and implement personalized mTrainings
- How?
 - Learning SLPs’ experiences developing personalized training for an adult who relies on AAC in a hospital setting – time taken to create, usability, etc.
 - Pre/post mTraining: communicative interaction performance on range of healthcare providers
 - Experiences and feedback on mTrainings who rely on AAC

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R2 - AAC Literacy Decoding Technology

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

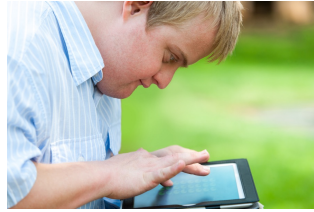


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AAC Literacy Decoding Technology

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



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AAC Literacy Technology Prior R&D

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

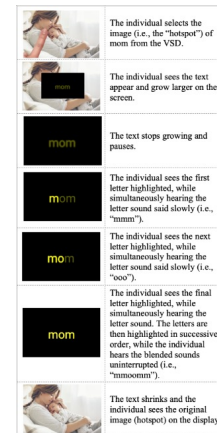


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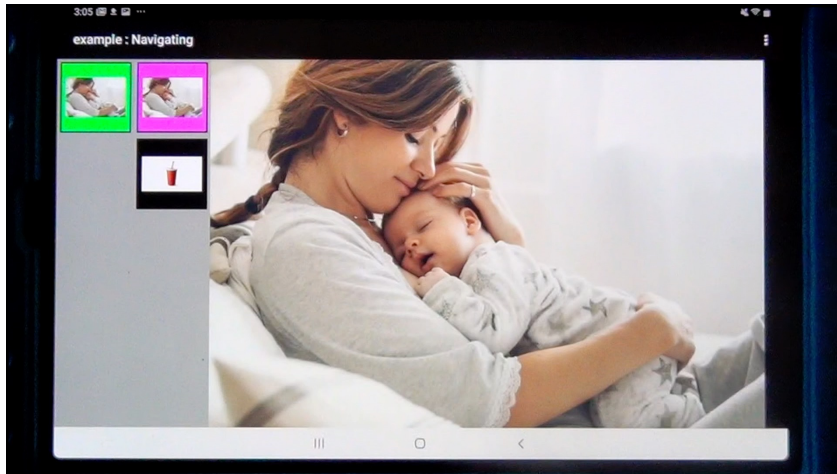
AAC Literacy Decoding Technology

Proposed solution

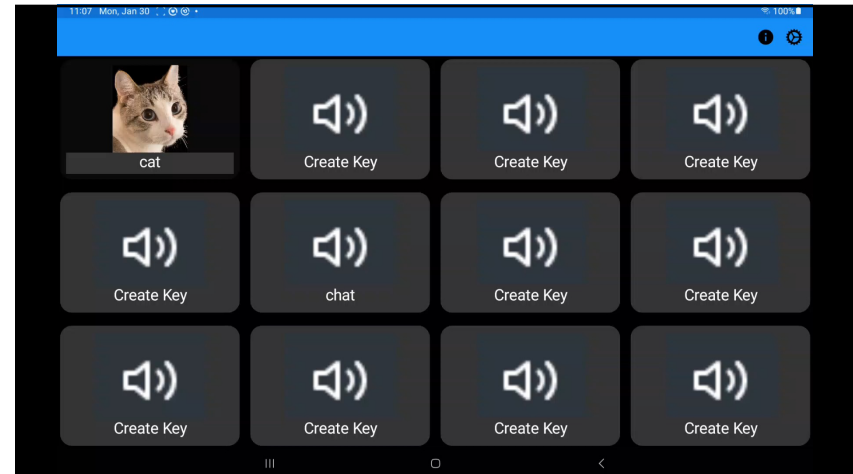
- AAC T2L *decoding* technology
- Individual selects a picture symbol
- Text appears dynamically
 - Motion drives visual attention to text
- Each letter highlighted in turn
 - Luminance drives visual attention to letter
- Letter sound is spoken slowly as letter is highlighted
 - Speech output supports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



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AAC Literacy Decoding Technology Evaluation

- Series of single case experimental design studies
- Participants
 - 48 individuals with complex communication needs who are preliterate
 - Different ages & disabilities (ASD, IDD, CP)
- Independent variable
 - AAC T2L decoding technology (VSD or grid-based)
- 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

- A series of single case studies have been completed including:
 - 8 school-age children, adolescents, and adults with Down syndrome
 - 3 school-age children and adolescents on the autism spectrum
 - 2 school-age children with multiple disabilities
 - 2 school-age children with cerebral palsy
 - 1 school-age child with IDD
- The feature has shown positive preliminary results in supporting:
 - Letter-sound correspondence
 - Decoding simple cvc words
 - Decoding longer words with digraphs
 - Transfer from decoding to encoding


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AAC Literacy Decoding Technology Expected outcomes

- 2 new research-based AAC apps to support the acquisition of **decoding** literacy skills
 - Grid-based app
 - VSD-based app
- Evidence-based protocol for intervention using T2L decoding technology
 - Different ages and disabilities





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Training and Dissemination

David Chapple, David McNaughton, Tracy Rackensperger,
Anthony Arnold, Lance McClemore, Godfrey Nazareth,

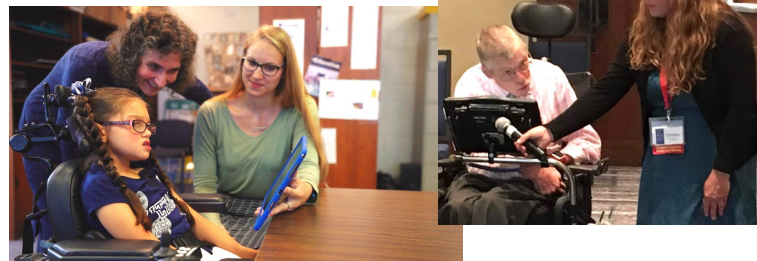
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Challenge



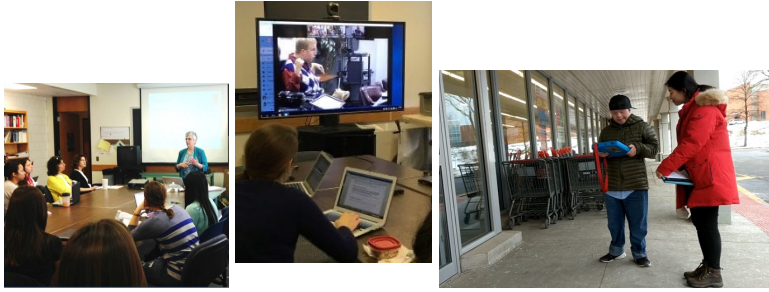
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Challenge



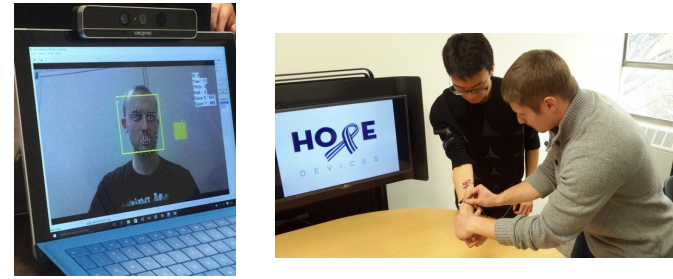
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T-1 Mentored Research and Lab Experiences



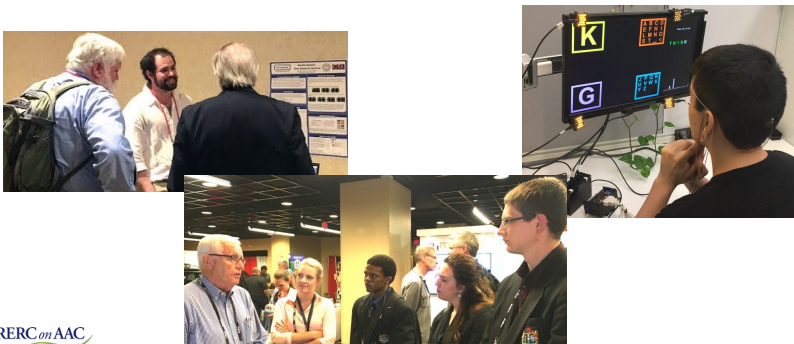
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T-2 Rehabilitation Engineering Student Capstone Projects



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T-3 Student Research and Design Challenges



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T-4 Doctoral Student AAC R&D Think Tank



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Planned topics (2025)

- Developing research partnerships with people with complex communication needs
- Establishing and maintaining collaborations with other researchers and community partners
- Balancing the demands of a successful career



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T-5 AAC Webcasts and Instructional Materials



Available courses

<p>Available courses</p> <p>AAC for Children - An Introduction</p> <p>Augmentative and Alternative Communication (AAC) supports communication for children who have difficulty with speech.</p>	<p>Available courses</p> <p>Alternative Access</p> <p>Alternative access provides methods and strategies to enable people with disabilities to access technology.</p>	<p>Available courses</p> <p>Developing AAC Systems for Children</p> <p>AAC systems should be based on the knowledge, skills, and interests of the individual child, and support participation in a wide variety of activities.</p>	<p>Available courses</p> <p>Family-Centered Skills: Active Listening for SLPs</p> <p>The use of family-centered skills, including active listening, result in positive relationships with family members and improved outcomes.</p>
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Chris Klein: Building Relationships through the Tools of Communication

June 19, 2019 by [David Schumaker](#)



Chris: So Steve, tell me what you first thought after experiencing communicating with me for the first time?



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Chris Klein: Building Relationships through the Tools of Communication

June 19, 2019 by [David Schumaker](#)



Chris: So Steve, tell me what you first thought after experiencing communicating with m

AAC changed everything because no amount of me saying she's smart, and funny, and clever and driven, is as powerful as 30 seconds of watching Maya speak for herself.

maya's mom **dana nieder**



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Chris Klein: Building Relationships through the Tools of Communication
April 19, 2022 | David McNaughton

I go surfing, water tubing, kayaking, snow skiing, snow tubing, water skiing, and basically participate in any sport I can try. Also, I go off roading a lot. This leads me to one of the challenges I face using AAC. There is no really good way for me to use my device outdoors in the sunlight. This has been an issue since dynamic displays became standard. I would like us to really try to come up with creative solutions to this issue of using devices in different lighting situations.

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Chris Klein: Building Relationships through the Tools of Communication
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I go surfing, water tubing, kayaking, snow skiing, snow tubing, water skiing, and basically participate in any sport I can try. Also, I go off roading a lot. This leads me to one of the challenges I face using AAC. There is no really good way for me to use my device outdoors in the sunlight. This has been an issue since dynamic displays became standard. I would like us to really try to come up with creative solutions to this issue of using devices in different lighting situations.

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Anthony Arnold: Four key goals of adult life: The role of AAC in supporting self-determination

And the vocabulary that comes in a device, or is added to a device by someone else, will never be enough - it is important to learn to read and spell.

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Personalized AAC to increase participation and communication for an adult with Down syndrome (Babb et al., 2021)
January 15, 2022 | Emily Hansar Laubacher

Child-parent-provider interactions in an inpatient rehabilitation facility (Gormley & Light, 2021)
April 30, 2021 | David McNaughton

Supporting communication and participatory shared storybook reading using VSDs (Babb et al., 2020)
June 4, 2020 | David McNaughton

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State of the Science in AAC – scheduled for 2024

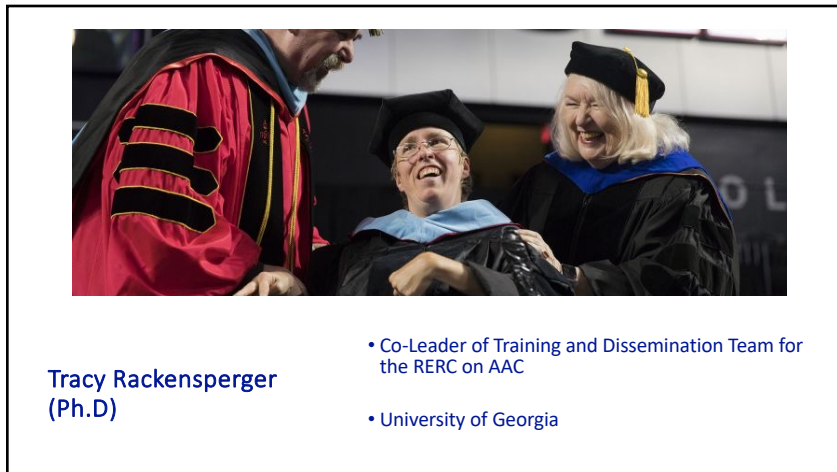
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AAC Consumer & Technology Forums (2021-2025)

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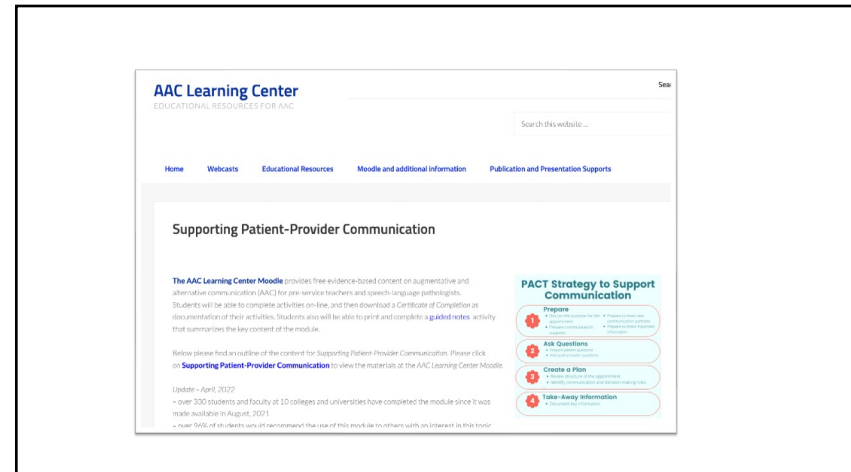
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Tracy Rackensperger
(Ph.D)

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

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Experience as expertise:
Supporting the participation of people who use AAC
in pre-service training for SLPs and teachers
using video teleconference technology

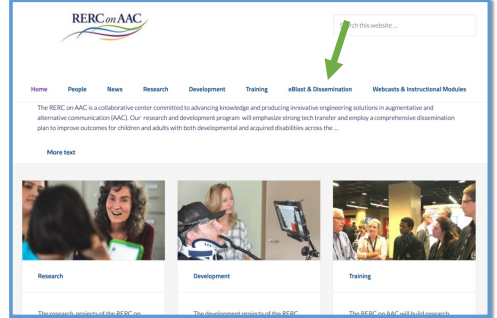

David Chapple, Lance McLemore, David McNaughton, Tracy Rackensperger

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RERC on AAC - Anticipated Outcomes

- 6 R&D projects to advance knowledge & improve AAC technology solutions
- 13 new research-based AAC technologies and interventions
- 5 training projects to increase capacity in the AAC field



- **Improved physical access to AAC technologies for those with significant motor impairments**
 - Improved access assessment (D1)
 - New multimodal access technique that combines BCI & EMG (D2)

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Anticipated Outcomes

- **Reduced learning demands & increased usability of AAC technologies**
 - Video VSD technology to increase participation in vocational / community activities (R1)
 - AAC decoding technology to increase literacy skills & enhance communication (R2)
 - Targeted motion to improve AAC user interface displays (R3)
- **Increased successful participation in society**
 - mTrainings in AAC for partners to reduce barriers (D3)
- **Increased awareness & competencies in AAC for stakeholders**
 - Training & dissemination activities

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Having the power to speak one's heart and mind changes the disability equation dramatically. In fact, it is the only thing I know that can take a sledgehammer to the age-old myths and stereotypes and begin to shatter the silence that looms so large in many people's lives (Williams, 2000; p. 249).



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Questions?

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