



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

**Christine Holyfield, Lauramarie Pope**  
Janice Light, Susan Fager, Erik Jakobs,  
Heidi Koester, & David McNaughton





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**Acknowledgements and Disclosures**



- 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](http://rerc-aac.psu.edu)**



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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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### 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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### 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

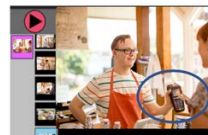
- Individuals who rely on AAC & their families
- Rehabilitation engineers
- Rehabilitation scientists & clinicians



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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 Assistant
  - D2 Smart Predict
  - D3 Partner mTraining




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### RERC on AAC Training & Dissemination

- **Training Projects**
  - 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

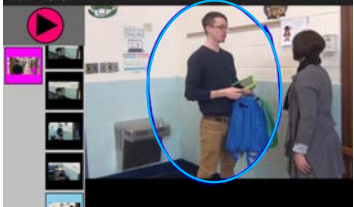

- Speech will not meet communication needs of
  - 40% of adults with autism spectrum disorders
  - 50% of adults with Down syndrome
- Less than 10% of adults with developmental disabilities who **need** communication supports **receive** communication supports




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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)

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



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### Free access on RERC website

#### Personalized AAC to increase participation and communication for an adult with Down syndrome (Babb et al., 2021)

January 12, 2022 by [Emily Hansar Laubscher](#)



Babb, S., Jung, S., Owsley, C., McNaughton, D., & Light, J. (2021). Personalized AAC intervention to increase participation and communication for a young adult with Down syndrome. *Topics in Language Disorders*, 41(3), 232-248. <https://doi.org/10.1097/TLI.0000000000000240>

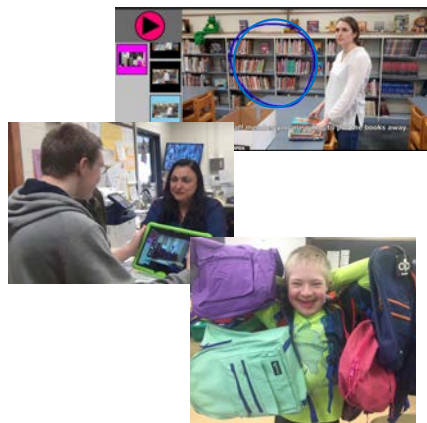
[FREE on PubMed](#)



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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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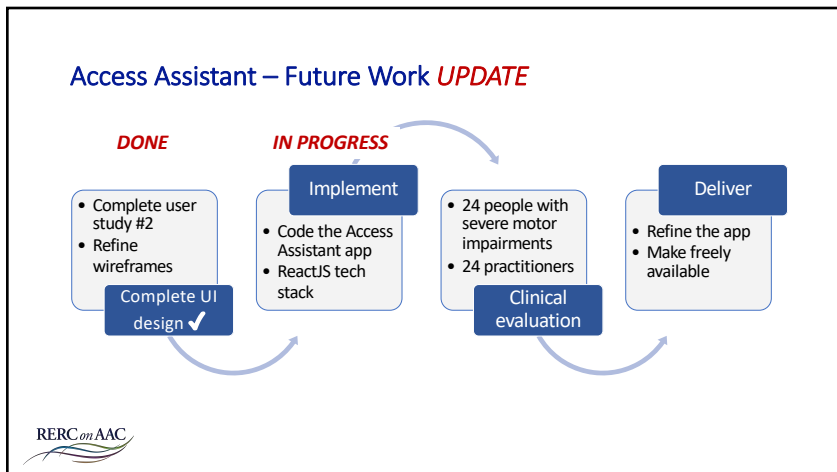
## D1 Access Assistant Software to Improve Alternative Access Services

Heidi Koester, Susan Fager, Erik Jakobs, Tabatha Sorenson

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## Access Assistant – Key results from user study #2

- 8 practitioners provided feedback based on wireframe demo
- High agreement that:
  - They'll use Access Assistant with their clients
  - It's easy to use
  - It covers the important aspects of the assessment process
  - Basic workflow is sound
- About a dozen user interface enhancements identified
- Combined with user study #1, we've had 12 practitioners review our design in detail

*"Yeah, I would use this. I can't wait to use this."*

*"I like how it's setup!"*

*"If I had this when I first started, I wouldn't feel as intimidated going into my first assessment."*

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**If you'd like to try Access Assistant:**

Contact Heidi Koester at [hkh@kpronline.com](mailto:hkh@kpronline.com)

Thanks again for being here!



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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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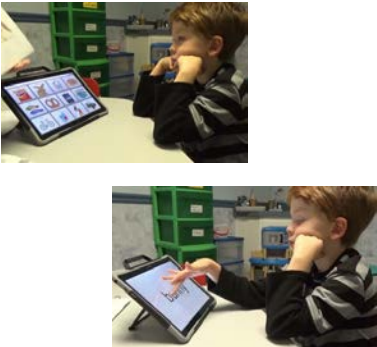
**AAC Literacy Technology  
Prior R&D**



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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 nonliterate
  - 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

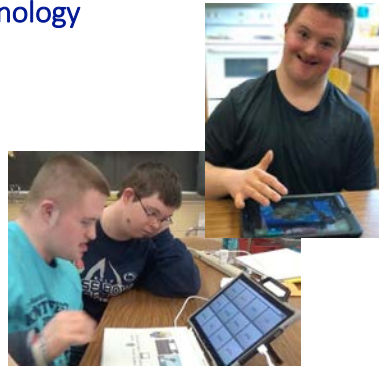


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### AAC Literacy Decoding Technology Research in progress

- 3 single case studies completed with adolescents / adults with Down syndrome
  - Decoding simple cvc words
  - Decoding longer words with digraphs
  - Transfer from decoding to encoding
- Conducted remotely via zoom due to COVID restrictions
- Data collection is in progress
  - Preliminary results are positive
  - Stay tuned for complete results



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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, Chris Klein, Godfrey Nazareth,



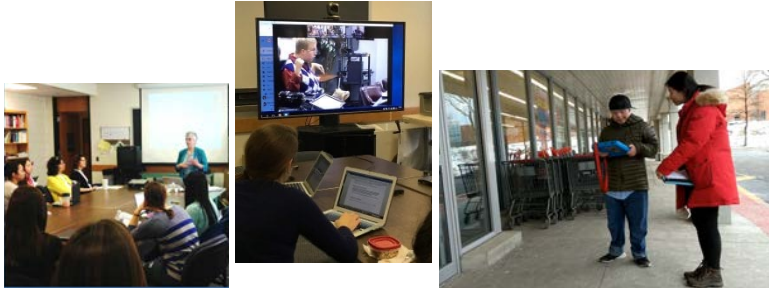
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### Challenge



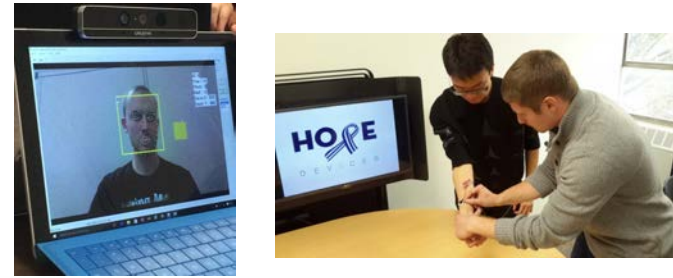
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### T-1 Mentored Research and Lab Experiences



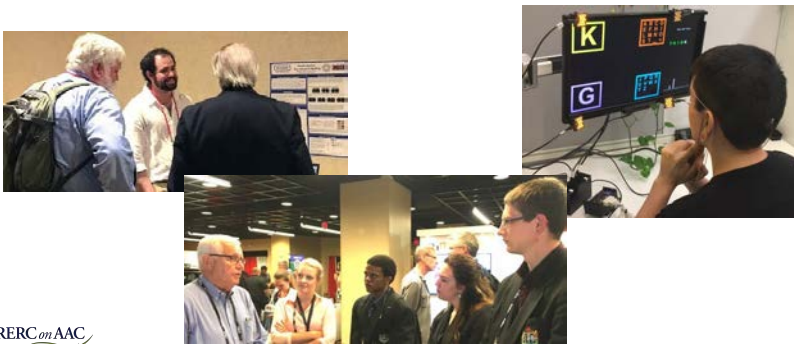
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### T-2 Rehabilitation Engineering Student Capstone Projects



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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

- 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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### Doctoral Student AAC Think Tank 2022


- Planned for May 9-11, 2022
- 3 days of presentations and discussion
- [tinyurl.com/AACthinktank2022](https://tinyurl.com/AACthinktank2022)



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### T-5 AAC Webcasts and Instructional Materials







Available courses

<p><b>AAC for Children - An Introduction</b></p> <p>Augmentative and Alternative Communication (AAC) supports communication for children who have difficulty with speech.</p>	<p><b>Alternative Access</b></p> <p>Alternative access provides methods and strategies to enable people with disabilities to access technology.</p>	<p><b>Developing AAC Systems for Children</b></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><b>Family-Centered Skills: Active Listening for SLPs</b></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

*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 tends to be 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.*

*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**

Chris: So Steve, tell me what you're experiencing communicating with m

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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.

Self-Determination



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### Personalized AAC to increase participation and communication for an adult with Down syndrome (Babb et al., 2021)

January 13, 2022 by [Emily Hansen Laubacher](#)

Emily S. Arg, S. Dickey, C. McWhorter, D. B. Light, & D. B. Light (2021). Personalized AAC: How to use it. In *Journal of Rehabilitation and Communication*. doi:10.1080/15432545.2021.1911144

FREE on PubMed

### Child-parent-provider interactions in an inpatient rehabilitation facility (Gormley & Light, 2021)

Feb 10, 2022 by [David McNaughton](#)

Gormley, J., & Light, J. (2021). Child-parent-provider interactions of a child with complex communication needs in an inpatient rehabilitation facility: A pilot study. *American Journal of Speech-Language Pathology*, 30(1), 105-116. <https://doi.org/10.1044/2020-AJSP-20-00093>

FREE on PubMed

### Supporting communication and participation shared storybook reading using VSDs (Bhat et al., 2020)

June 1, 2021 by [David McNaughton](#)

Bhat, N., Bhat, J., Bhat, D., Tulkoff, L., Jones, C. (2020). Supporting communication and participation in shared storybook reading using visual supports. In *Journal of Rehabilitation and Communication*. doi:10.1080/15432545.2020.1811144

FREE on PubMed



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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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### 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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### Survey Findings

- 33 adults with cerebral palsy who make use of AAC
- In the past 3 years...
  - 100% communicated with doctor
  - 57% communicated with emergency room staff and/or ambulance drivers
  - 35% communicated with a mental health services provider



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### In what situations do you typically have the most **positive** communication experience?

- Appointment with a FAMILIAR medical provider (87%)
- Emergency room/Emergency personnel (5%)
- Overnight stay in a hospital (5%)
- Appointment with a NEW medical provider (3%)



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### In what situations do you typically have the most **negative** communication experience?

- Overnight stay in a hospital (35%)
- Emergency room/Emergency personnel (33%)
- Appointment with a NEW medical provider (25%)
- Appointment with a FAMILIAR medical provider (5%)



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If you could "go back in time", what would the current "you" say to the younger "you" about increasing successful communication with medical professionals?

Brainstorm some questions and phrases for programming into an appointment page on my speech device and practice it before the appointment

I allowed my parents to talk for me instead of me talking for myself. I should have learned better at a younger age to self advocate for myself.

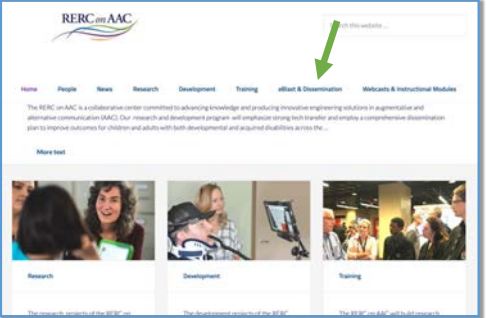

Add a button that says "I understand you, look at and talk to me."

Make them see you as a person



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RERC-AAC.PSU.EDU

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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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### 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.
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- For more information, **please visit our website at [rerc-aac.psu.edu](https://rerc-aac.psu.edu)**



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Questions?

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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](mailto:dbm2@psu.edu)
- <https://aackids.psu.edu/>
- <https://aacliteracy.psu.edu/>



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