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

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NATIONAL INSTITUTE ON DISABILITY, INDEPENDENT LIVING, AND REHABILITATION RESEARCH
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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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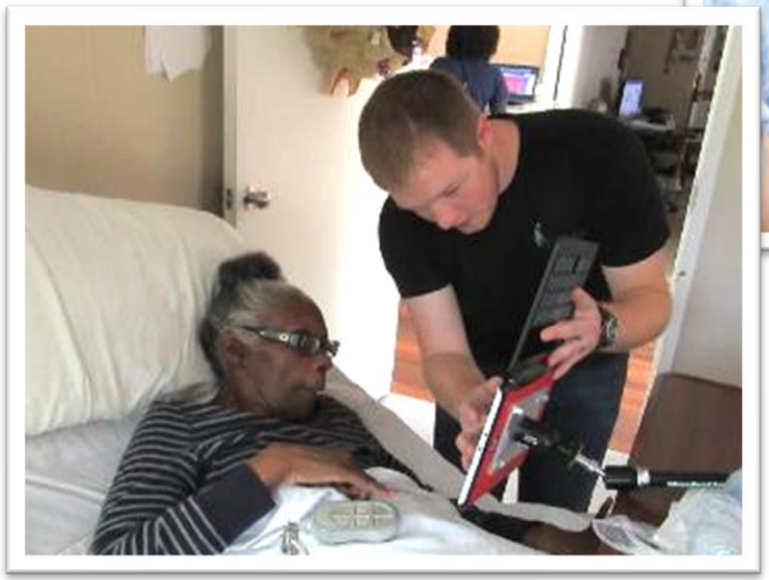
- Session Feedback Evaluation
  - Your feedback is very important to us. Please be sure to complete the session evaluation through the ATIA mobile app

- 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

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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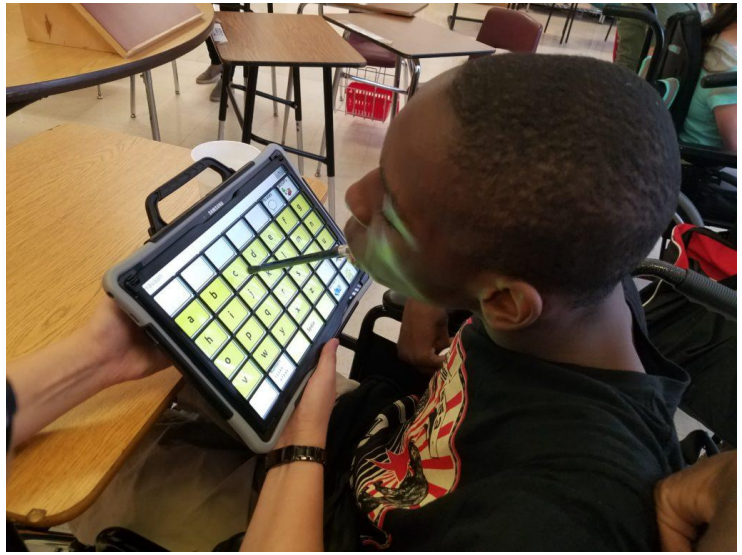
Augmentative and Alternative Communication

- 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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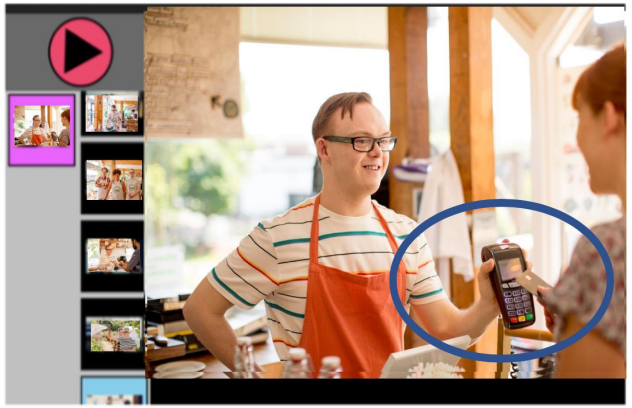
Research and Development Projects

- 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, Becca Stroschein, Christine Holyfield, Salena Babb, Courtney Dobrzynski , Sharon Redmon, Zhigao Liang, Emily Laubscher

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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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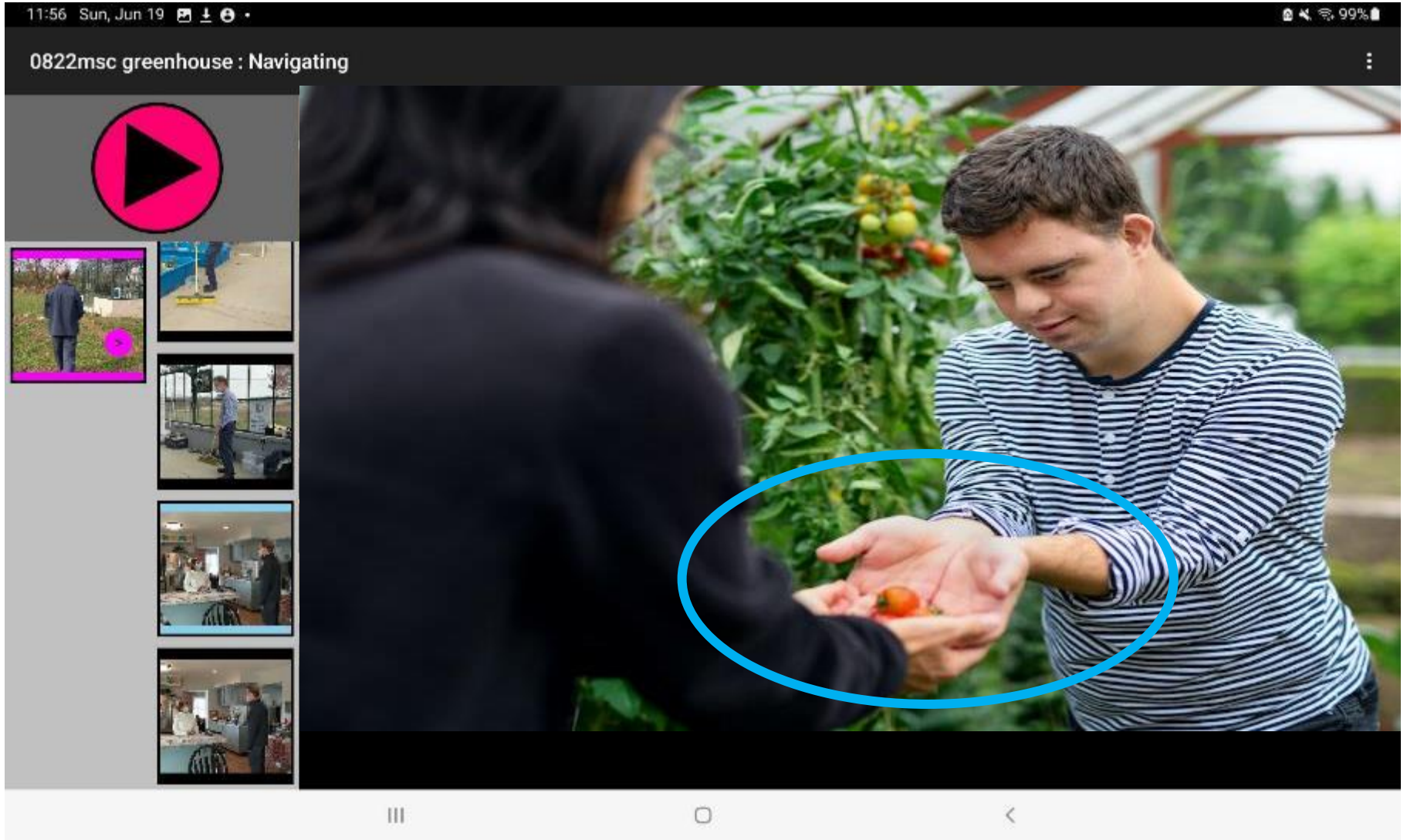
Video VSD - Greenhouse (19 steps)



Wide variety of activities

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)

Video VSD

Studies 1 & 2

- 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

Study 3

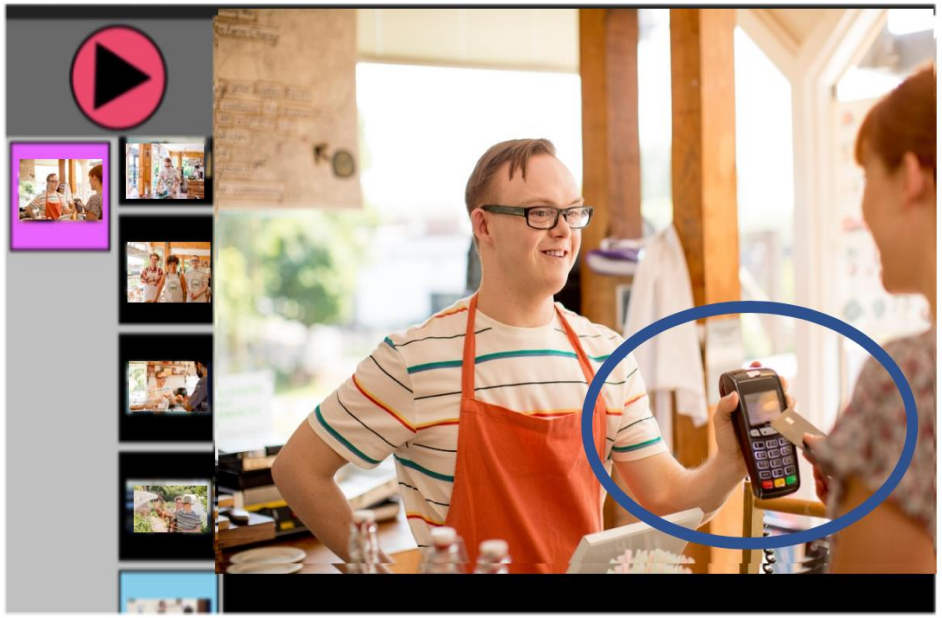
- Investigate development for **individually selected goals** by typical support providers
  - family members, group home workers

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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ATIA 2024: Booth

D1 Access Navigator Software to Improve Alternative Access Services

Heidi Koester, Susan Fager, Erik Jakobs,
Tabatha Sorenson, Jessica Gormley

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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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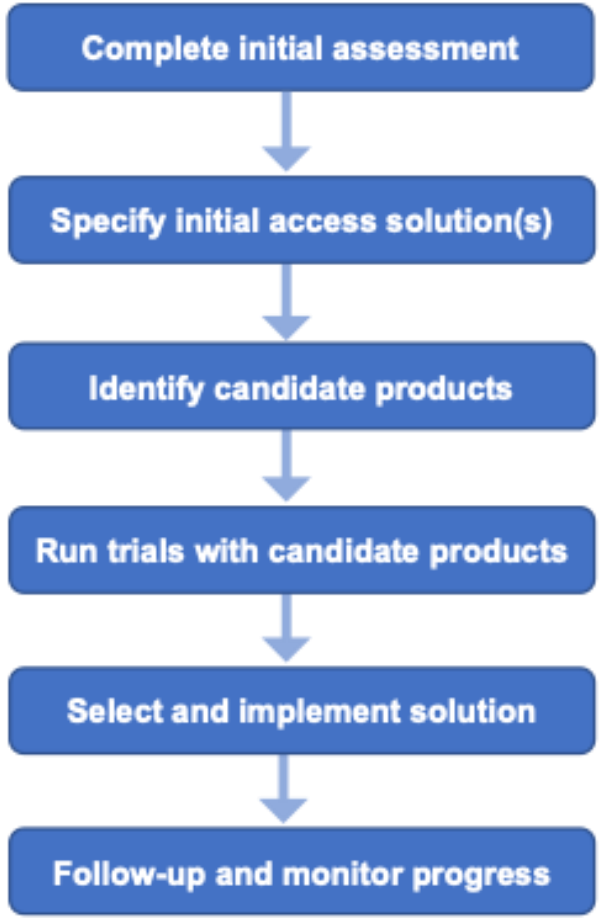
Access Navigator – Proposed solution

- Develop Access Navigator 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 Navigator – User-centered design timeline (Yr 1)

1. Product Definition ✓

How
- User interviews
- Benchmarking

What
- List of requirements
- Personas
- Scenarios
- Basic workflow

oct 2020 – feb 2021

2. MVP Initial Design ✓

How
- Iterative ideation
- Wireframe design

What
- Refined product definition
- User-vetted wireframe UI
- Tech stack requirements

mar – may 2021

3. Refined Design and Content ✓

How
- 2 user studies
- Clinical content development

What
- Refined wireframe UI
- Tech stack selection

jun – nov 2021

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Access Navigator – highlights of user-centered design phase

- Interviews with 11 people
  - 46 themes and corresponding requirements for the app
  - Practitioner anxiety can be intense:
    "I should know this, but I don't."
  - Design the app to take the worry out of assessments – welcoming, reassuring, fun, exploring.

- UI Feedback from 12 practitioners
  - Balsamiq wireframe design
  - High agreement that:
    - They'll use Access Navigator with their clients
    - It's easy to use
    - It covers the important aspects of the assessment process
    - Basic workflow is sound
  - *"Yeah, I would use this. I can't wait to use this!"*

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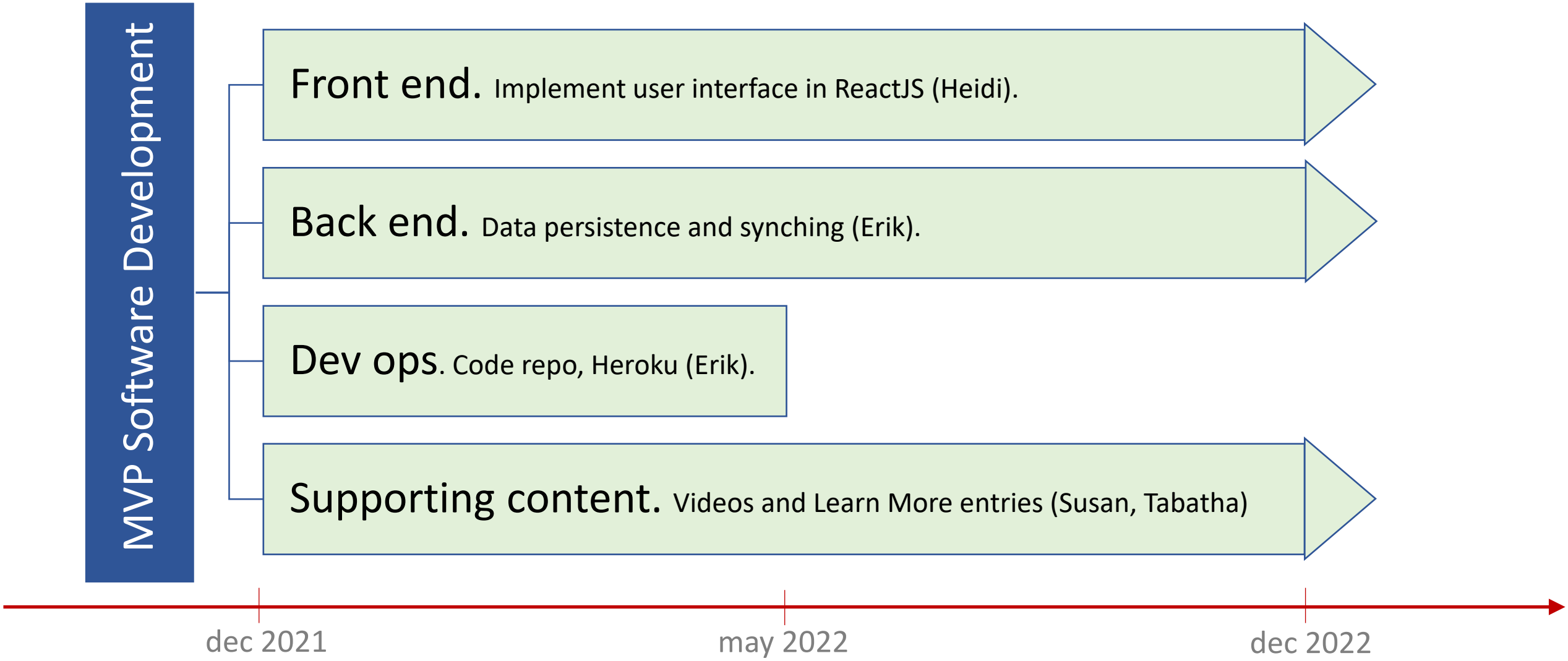
Access Navigator development (Yr 2)



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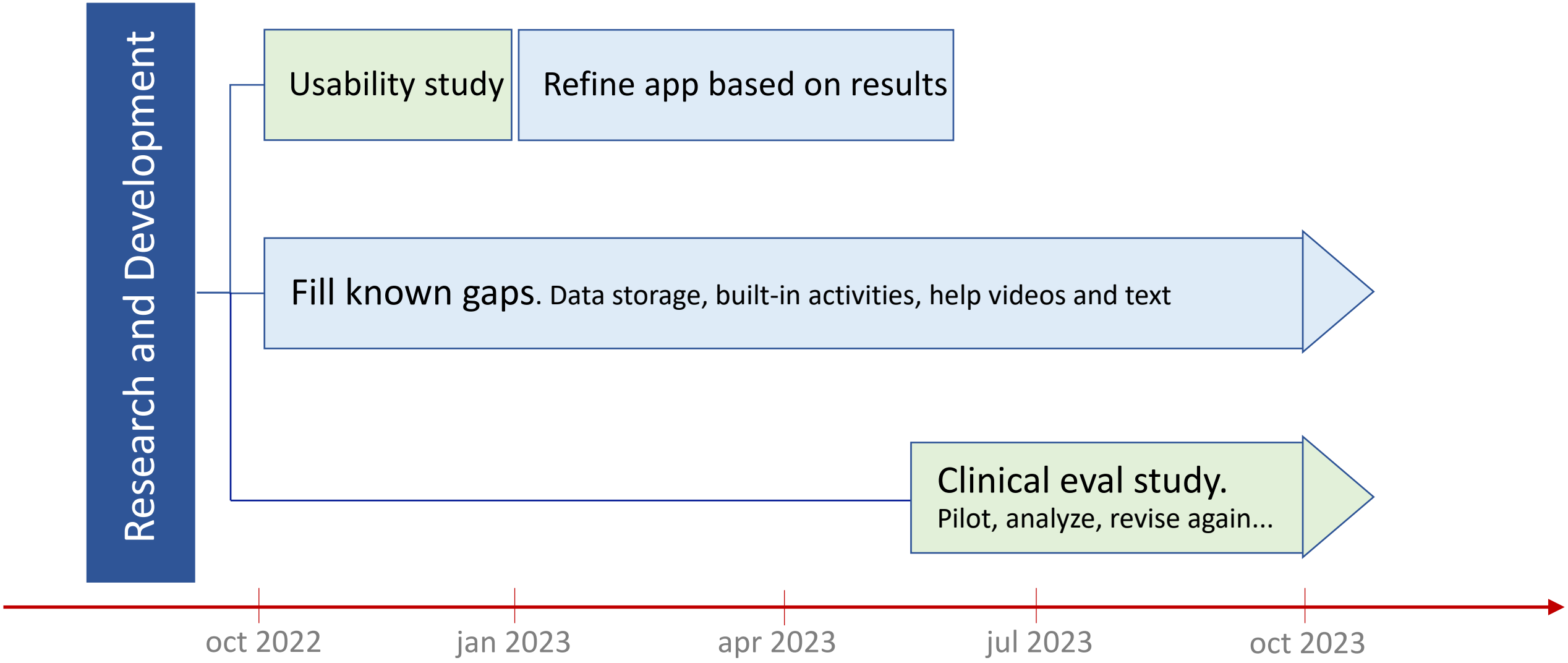
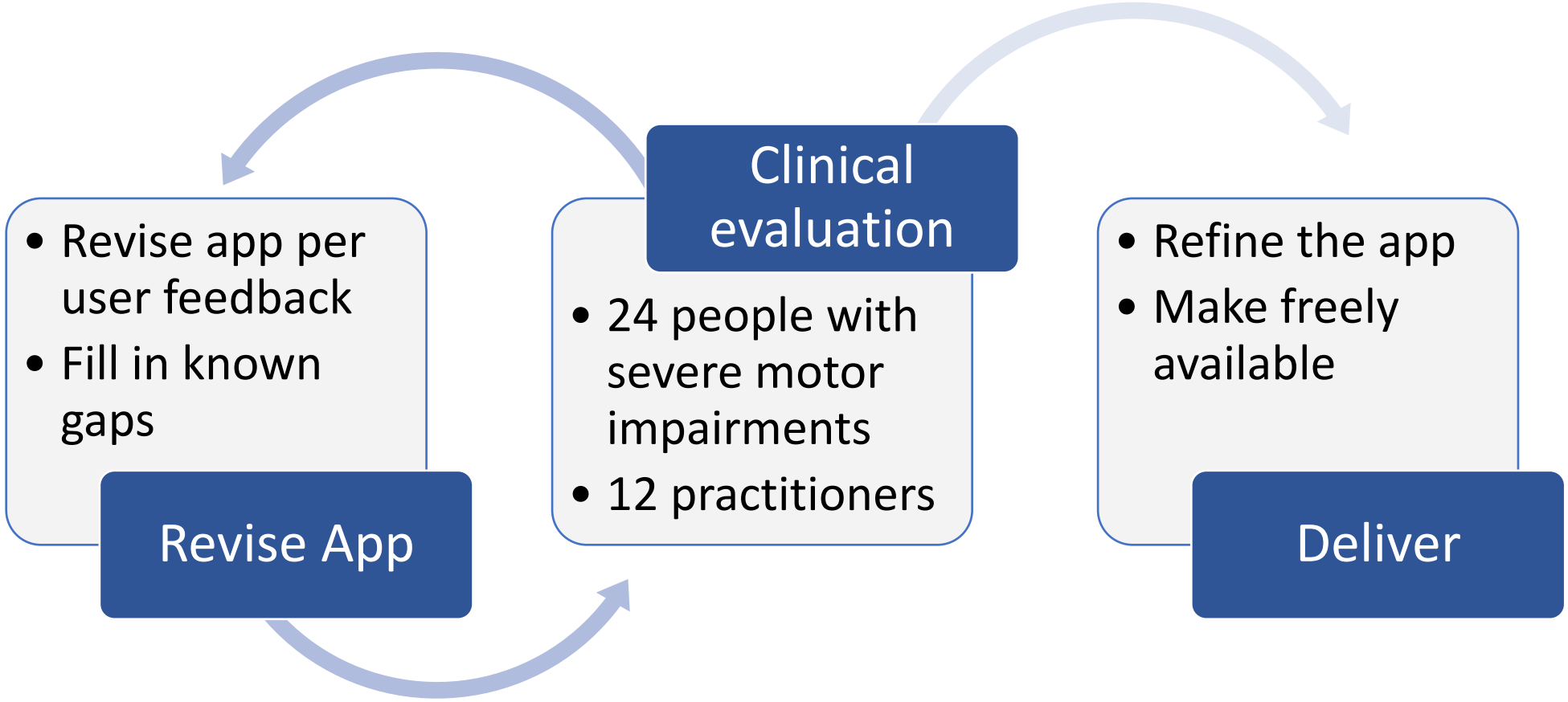
Overview of Year 3

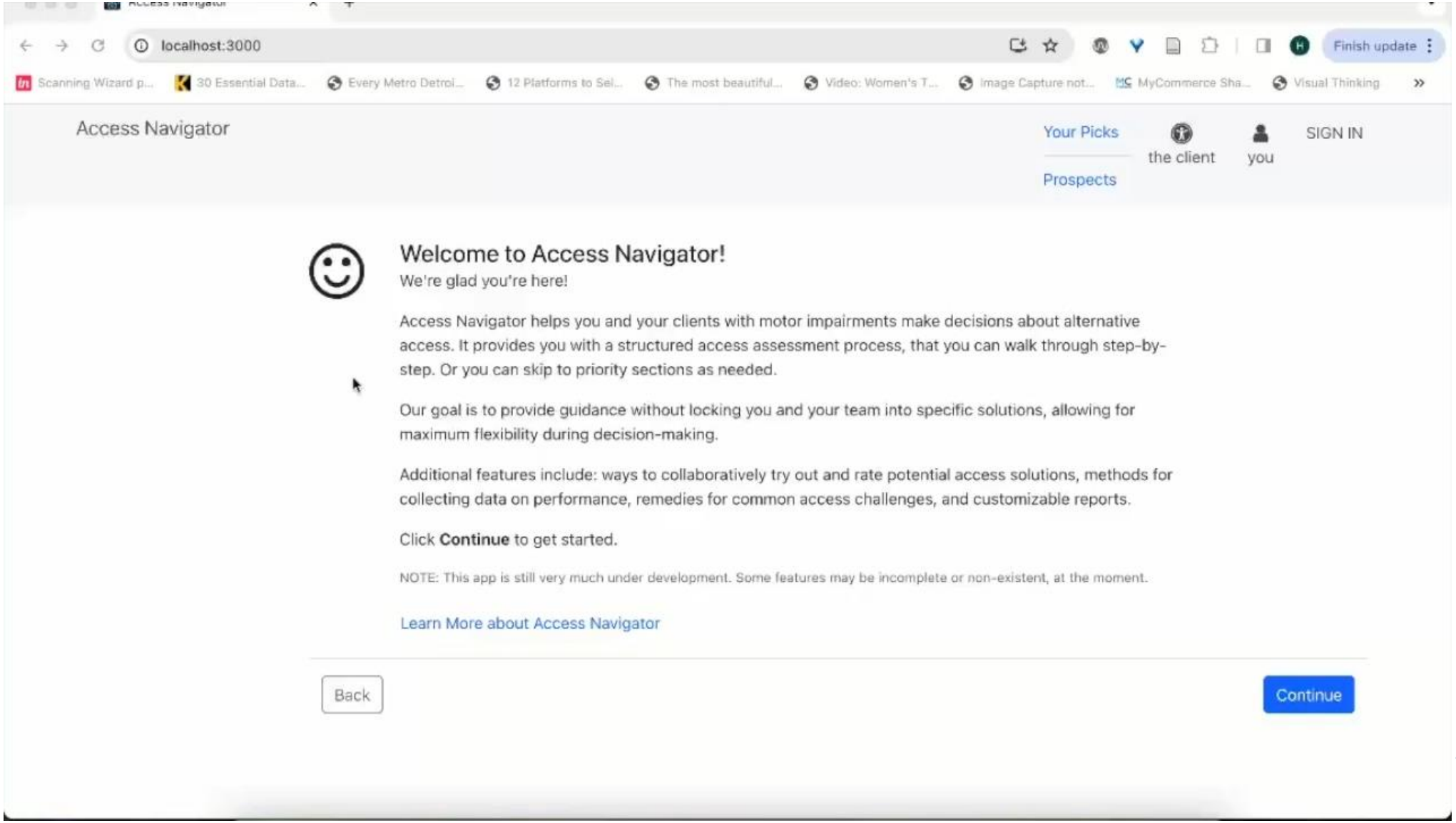


Access Navigator – Current and Future Work



IN PROGRESS

A short demo of Access Navigator



ACCESS NAVIGATOR

If you'd like to try Access Navigator:

Contact Heidi Koester at hhk@kpronline.com

We'd love your feedback!

Video also at:
https://www.youtube.com/watch?v=ZWatRhHL-Xk

Thanks again for being here!

ACCESS NAVIGATOR

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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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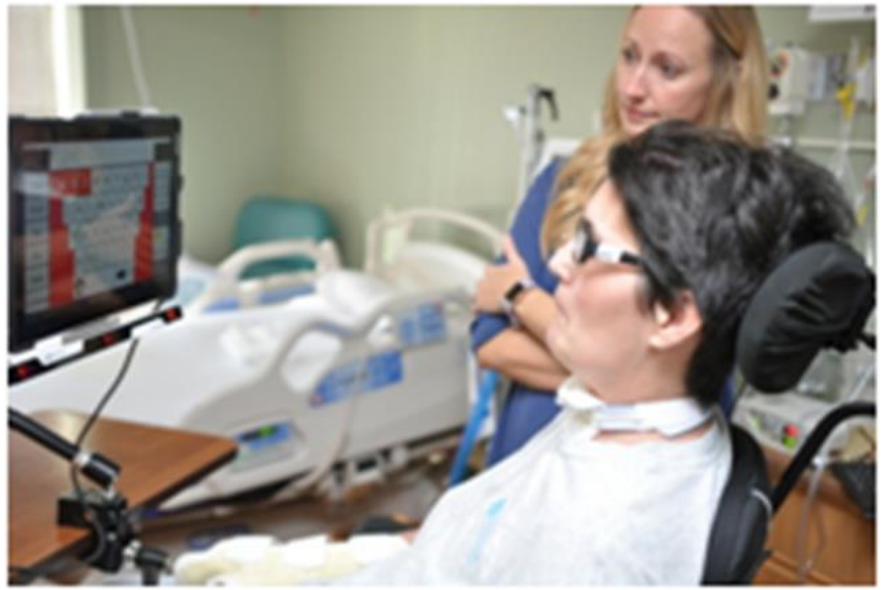
D2 *Smart Select*: a new switch access method

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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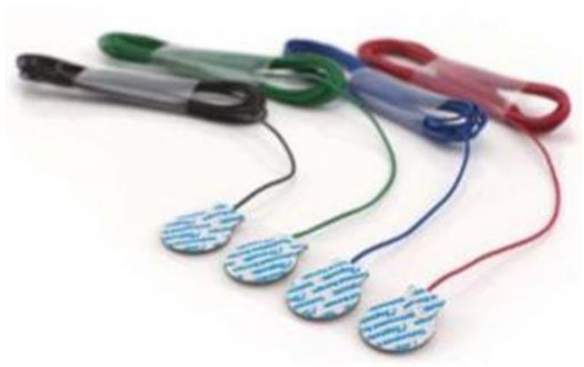
D2 *Smart Select*: a new switch access method

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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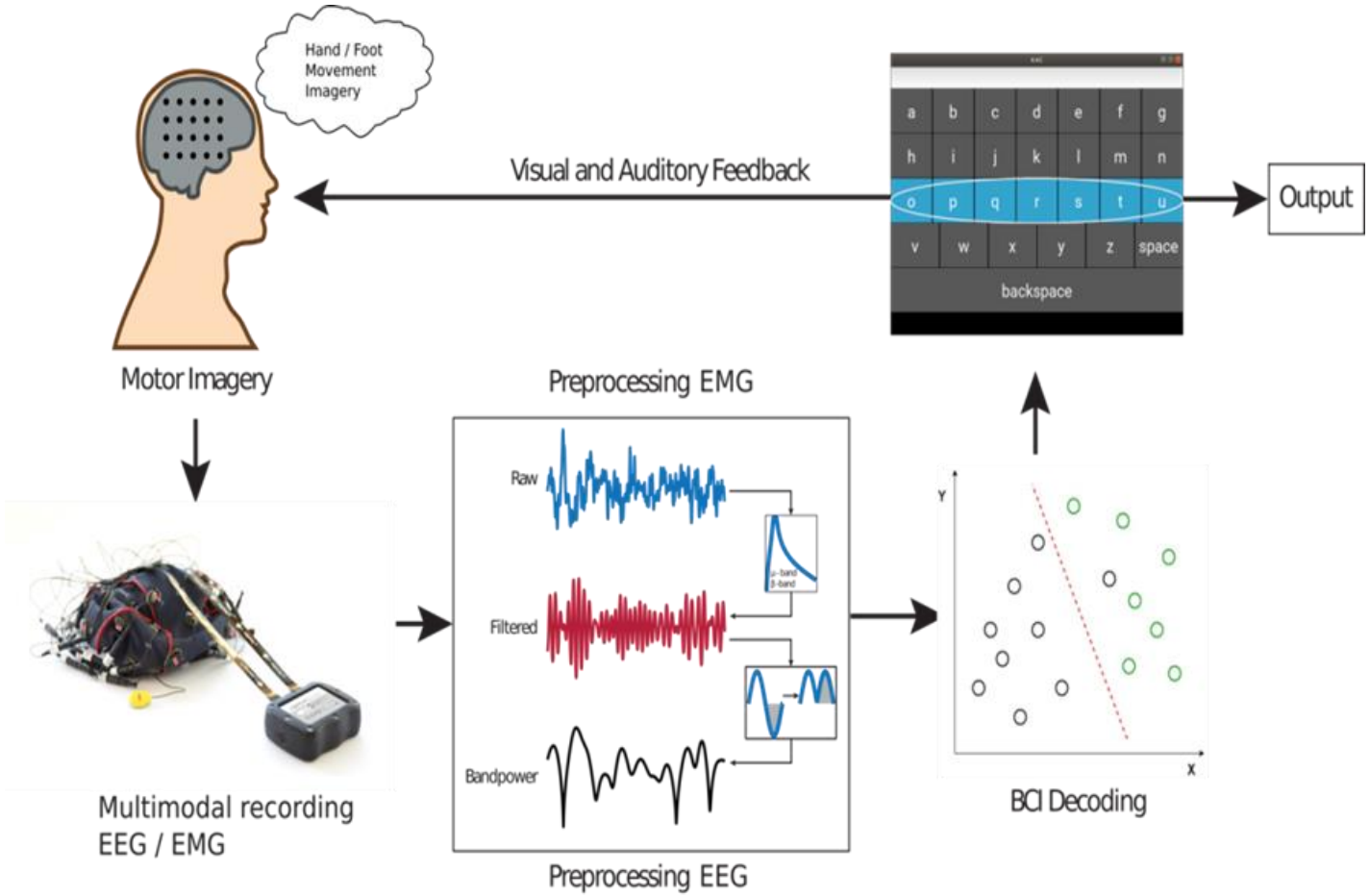
Smart Select- Prototype

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

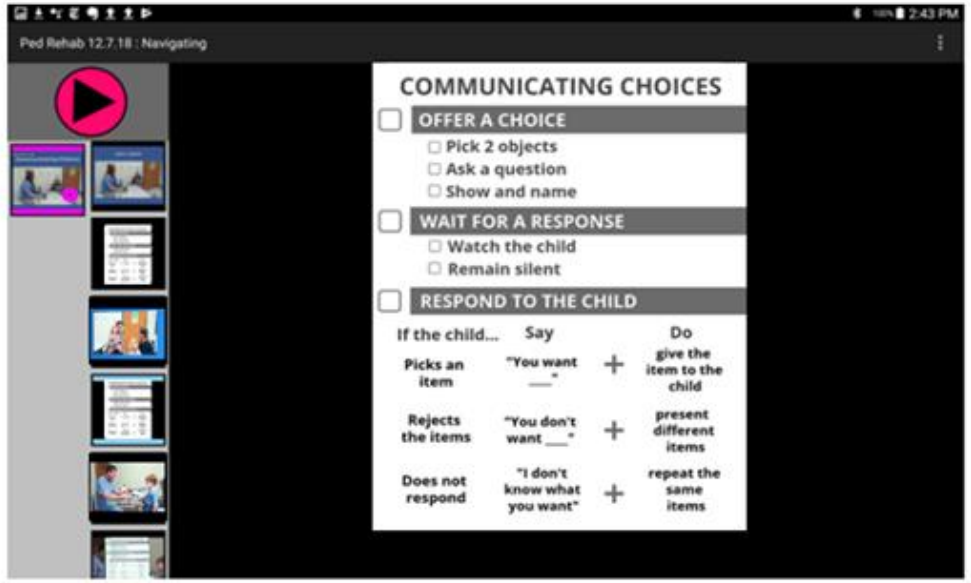
The problem

- 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

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



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

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

Partner mTraining
Research in preparation for publication

- Pretest/Posttest Control Group Design
  - Students with multiple disabilities and cortical visual impairment who are intentional, presymbolic communicators
  - Peers with typical development (3rd & 4th gr)

- Partner mTraining taught peers how to structure opportunities to offer choices

- Data collection complete
  - Gain score of +4.9 sub steps from a 10-step checklist for trained peers
  - Peers were 83% independent in completing the training (app and role play)

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

R2 - AAC Literacy Decoding Technology

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

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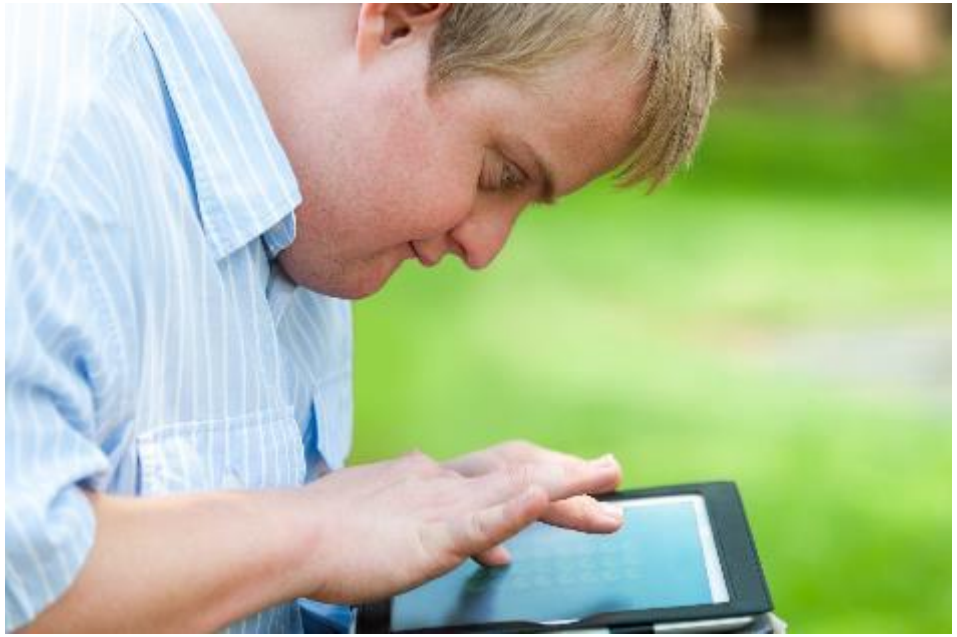
The Problem

- 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



AAC Literacy Technology
T2L *Sight Word* Feature

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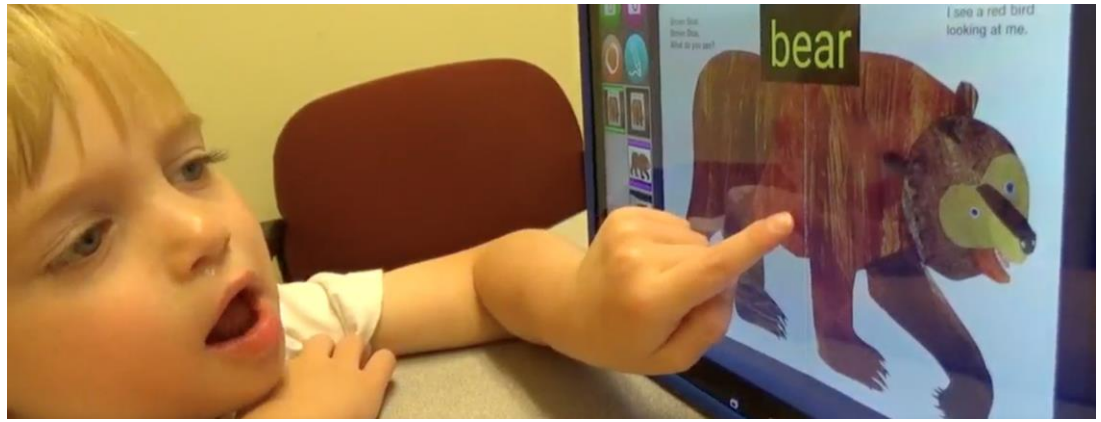
Prior research evaluating the T2L *sight word* feature

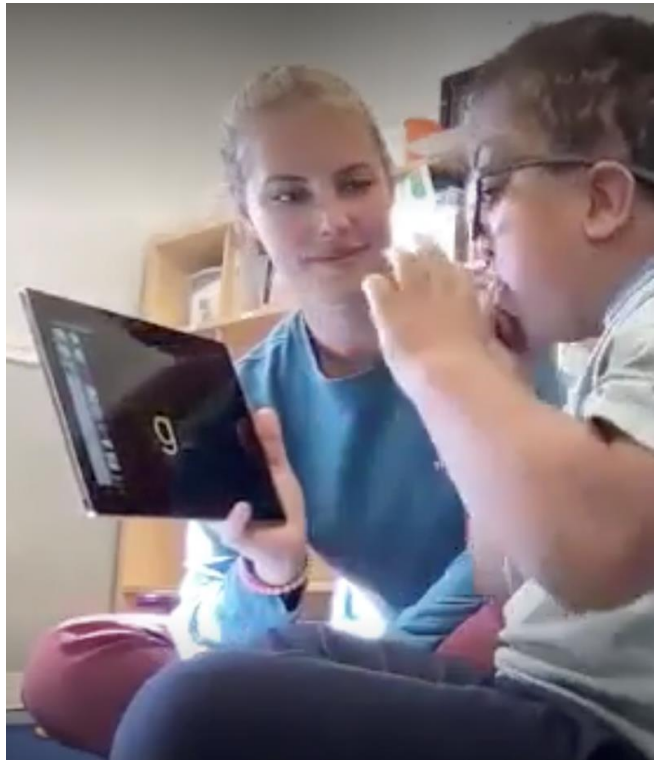
- Evaluated T2L *sight word* technology in a series of studies
  - 56 children & adults with disabilities
  - 89% of participants demonstrated significant increases in literacy skills
  - Required only minimal exposure to acquire new sight words
  - Easy to use
- BUT limited to sight word learning
 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



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



blanket

bubbles

brushes

bear

AAC Literacy Decoding Technology Research in Progress

- A series of single case research design studies
- 26 participants across a range of ages and diagnoses have completed their participation, including:
  - Preschool-age children, school-age children, adolescents, and adults
  - Individuals with Down syndrome, autism, cerebral palsy, multiple disabilities
- Measures have included:
  - Percent accuracy decoding novel words
  - Percent accuracy with other foundational literacy skills (e.g., letter-sound correspondence)
  - Participation and engagement in literacy activities

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AAC Literacy Decoding Technology Research in Progress

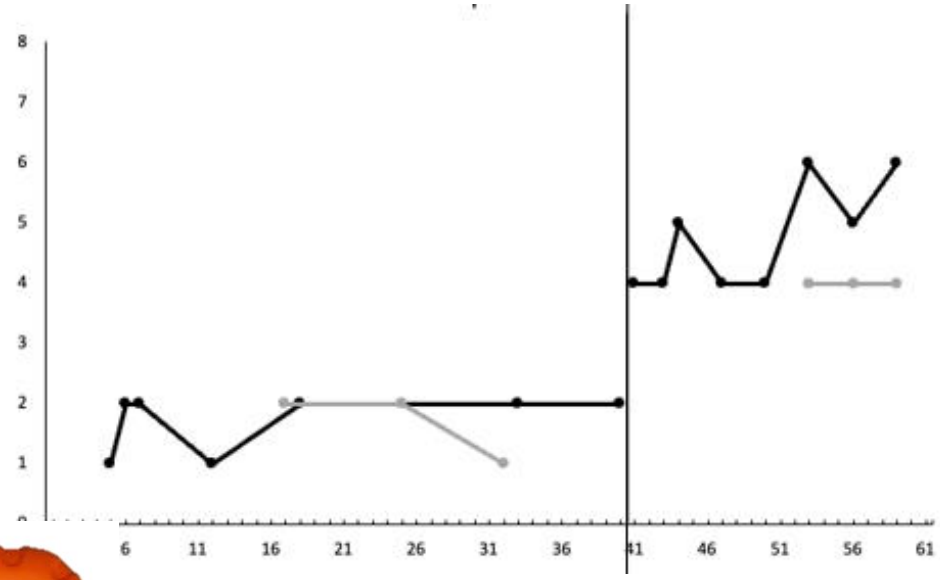
- The feature has shown positive preliminary results in supporting:
  - Decoding novel cvc words
  - Decoding longer novel words with digraphs
  - Letter-sound correspondence
  - Initial phoneme segmentation
  - Encoding (typing) novel words

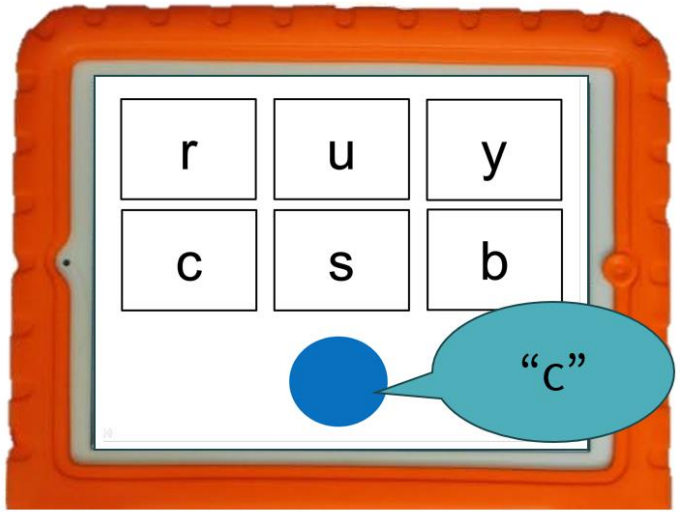
Research Case Example: Ollie

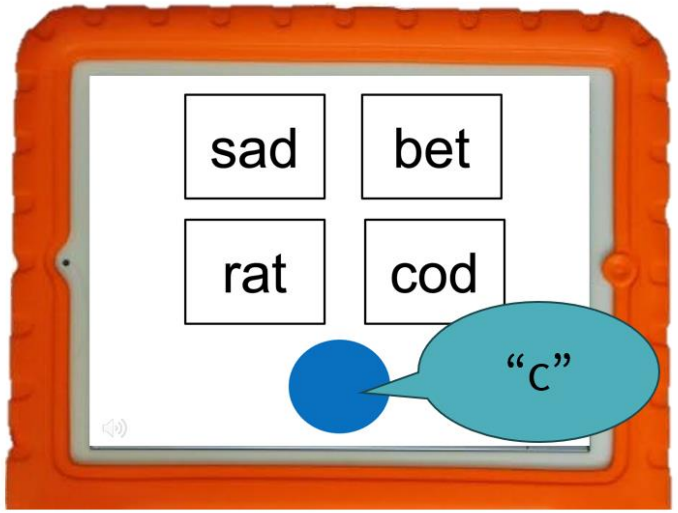
- Preschooler on the autism spectrum
- Interested in watching train videos and playing with trains
- Approximates or speaks about 20 words, but communicates mostly using prelinguistic gestures and other behaviors
- Enjoys looking at particular books, including the Clifford books, but has no formal literacy instruction
- Often demonstrates limited engagement in educational activities
- Prior to participating in the study, demonstrated no consistent letter-sound correspondence knowledge

Research Case Example: Ollie

- Increased accuracy identifying letters based on their sounds and generalized learning to initial phoneme segmentation







AAC Literacy Decoding Technology Outcomes To Date

- Holyfield, C., Pope, L., Light, J., Jakobs, E., Laubscher, E., McNaughton, D., & Pfaff, O. (2023). Effects of an Augmentative and Alternative Communication Technology Decoding Feature on Single-Word Reading by Individuals With Down Syndrome and Limited Functional Speech. *American journal of speech-language pathology*, *32*(3), 1195-1211.
- Holyfield, C., Pope, L., Light, J., Jakobs, E., Laubscher, E., McNaughton, D., & Pfaff, O. (2023). Effects of an AAC feature on decoding and encoding skills of adults with Down syndrome. *Augmentative and Alternative Communication*, 1-15.

AAC Literacy Decoding Technology Outcomes To Date

	Go Visual (Attainment Company)	Dedicated Devices (Saltillo)	Snap Scene (Tobii Dynavox)	Scene and Heard Pro (Therapy Box)
Single Word Recognition	Yes	Yes	Yes	Yes
Initial Phoneme Segmentation				Yes
CVC Word Decoding				Yes
Advanced Decoding				Yes

Training and Dissemination

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

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Challenge

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T-1 Mentored Research and Lab Experiences

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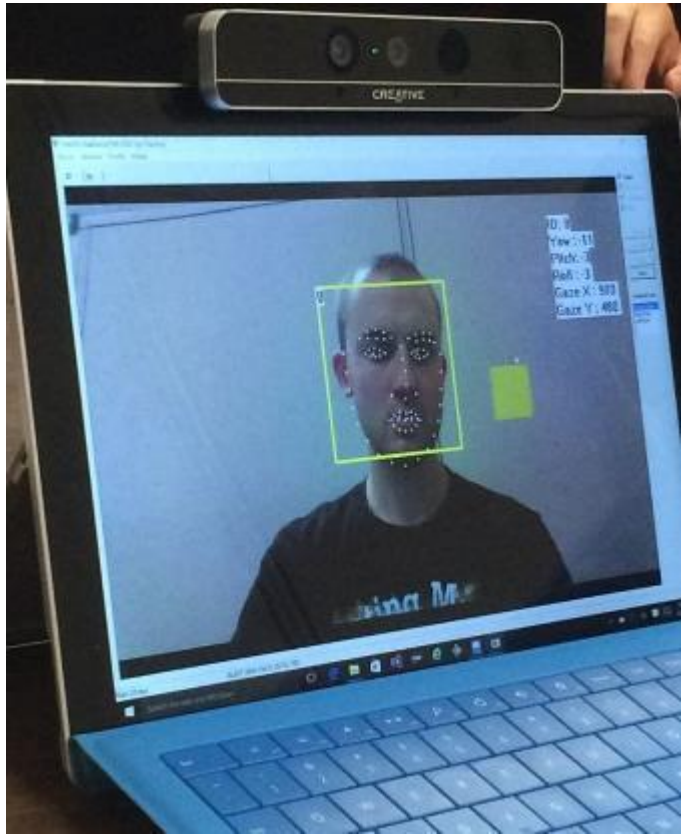
T-2 Rehabilitation Engineering Student Capstone Projects



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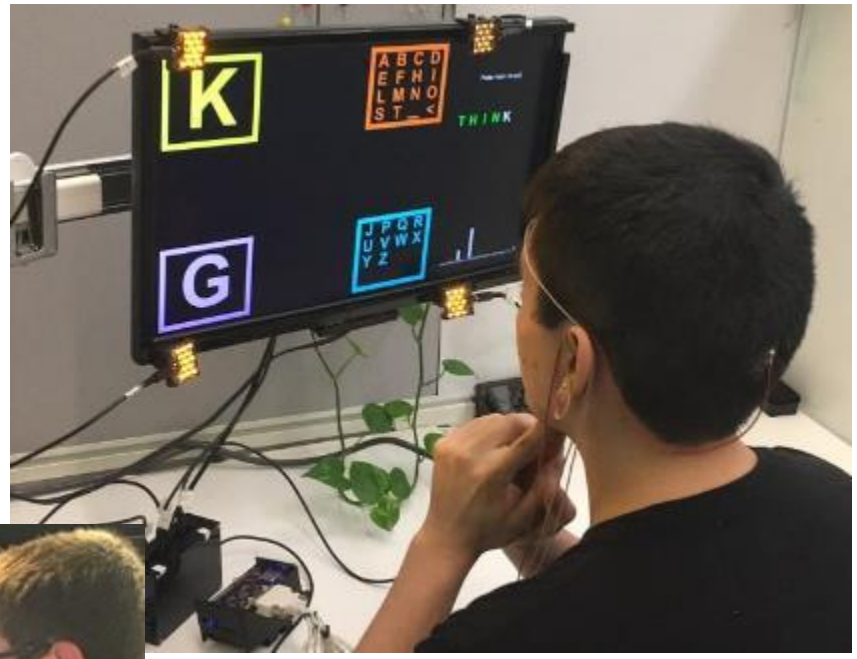
T-3 Student Research and Design Challenges



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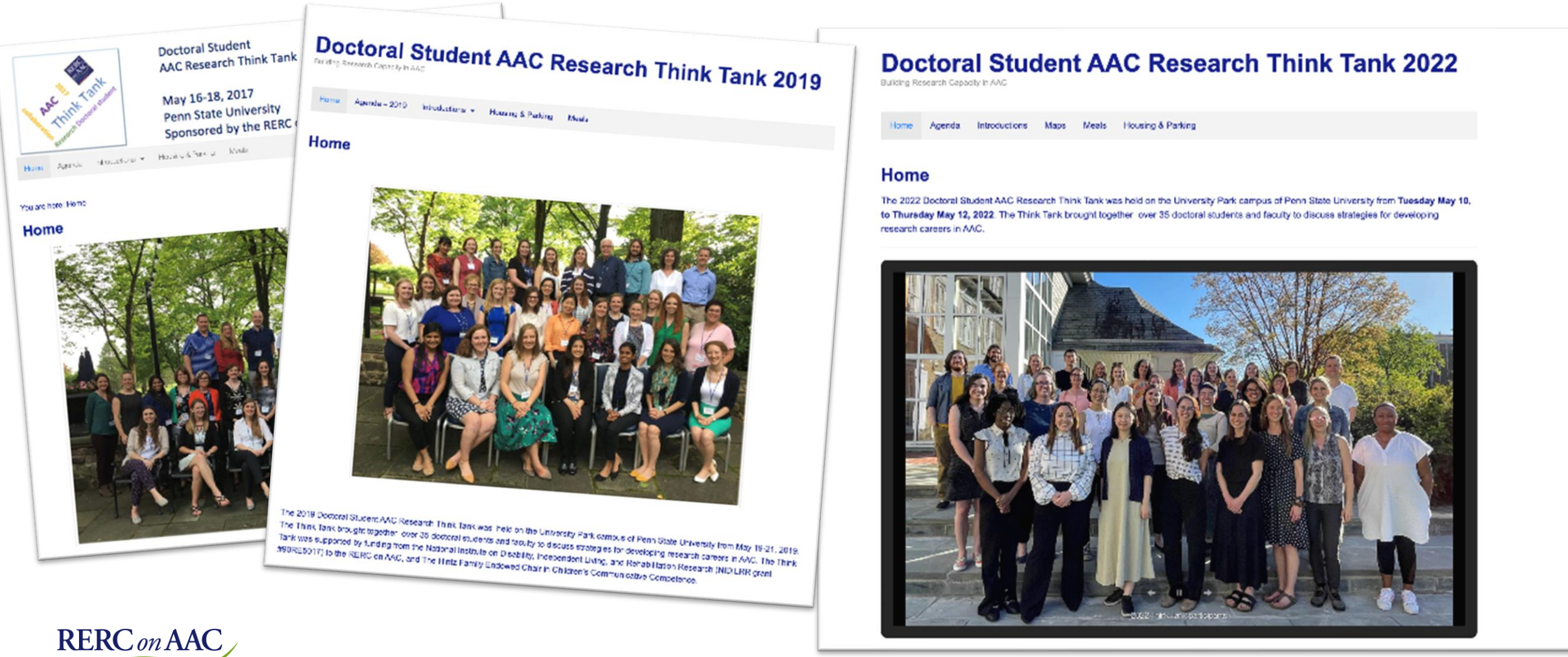
T-4 Doctoral Student AAC R&D Think Tank



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Planned topics (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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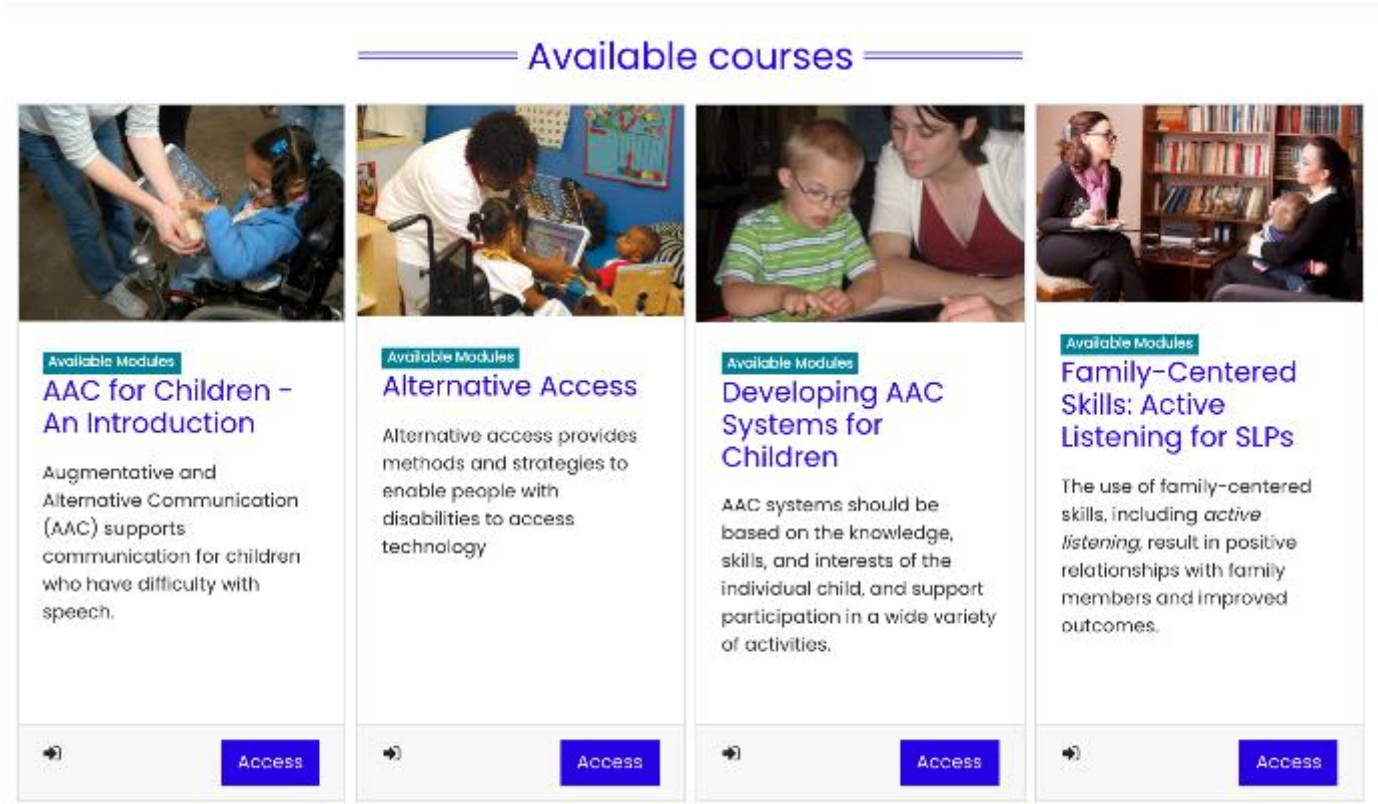
T-5 AAC Webcasts and Instructional Materials

AAC Learning Center Moodle



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Chris Klein: Building Relationships through the Tools of Communication

June 14, 2018 by David McNaughton

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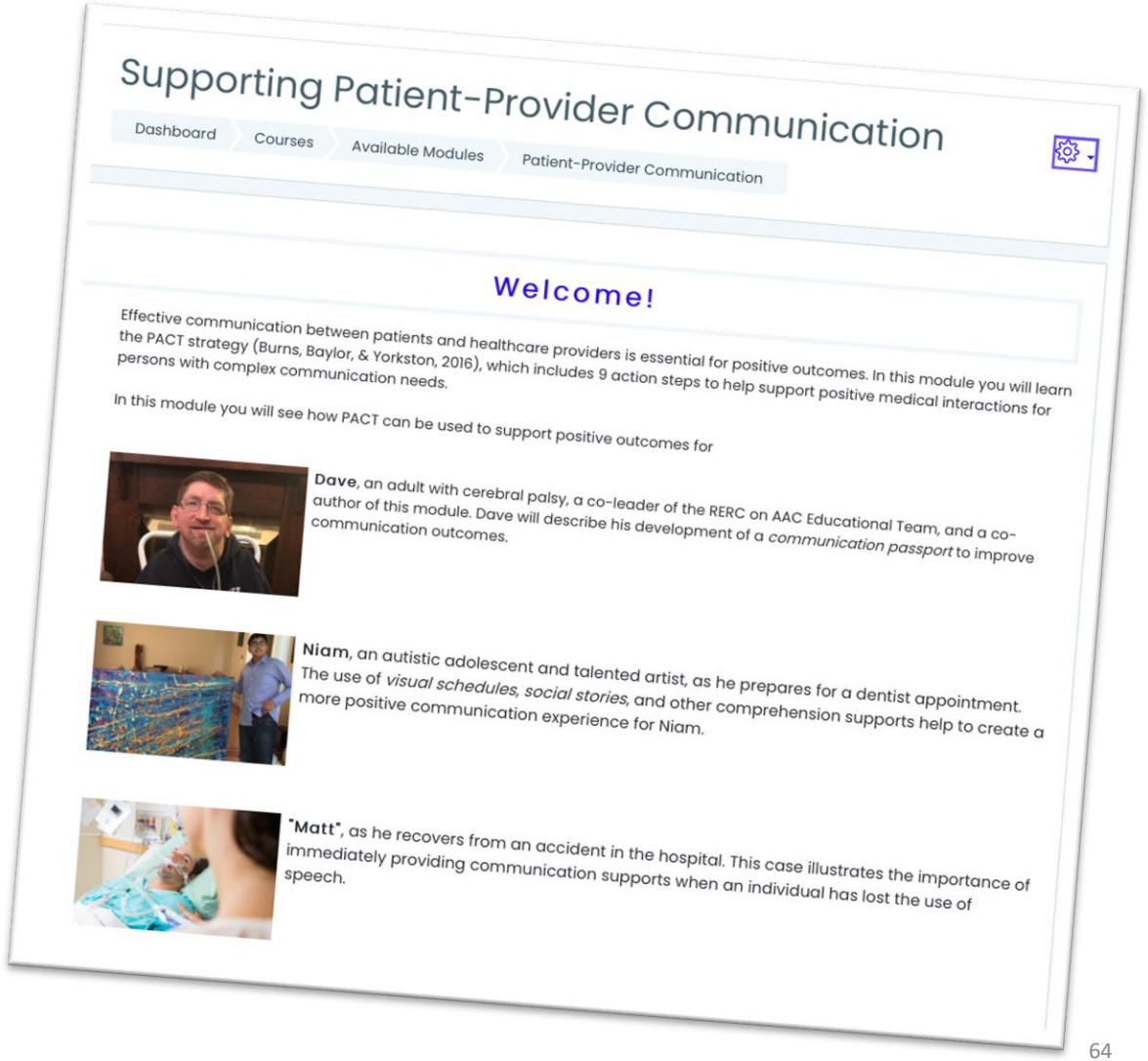
Supporting Patient-Provider Communication (Stroschein et al, 2021)

P	Prepare for the visit
A	Ask questions
C	Create a plan
T	Take away material



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., Ousley, 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/TLD.0000000000000240

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Supporting communication and participatio shared storybook reading using VSDs (Bhar 2020)

June 4, 2020 by **David McNaughton**

Billy shares with Abby

Bhana, N., McNaughton, D., Raulston, T., Ousley, C. (2020). Supporting communication and participation in shared storybook reading using visual scene displays. *TEACHING Exceptional Children*. Advanced Online Publication. https://doi.org/10.1177%2F0040059920918609

FREE on PubMed

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

April 30, 2021 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), 105–118. https://doi.org/10.1044/2020_AJSLP-20-00031

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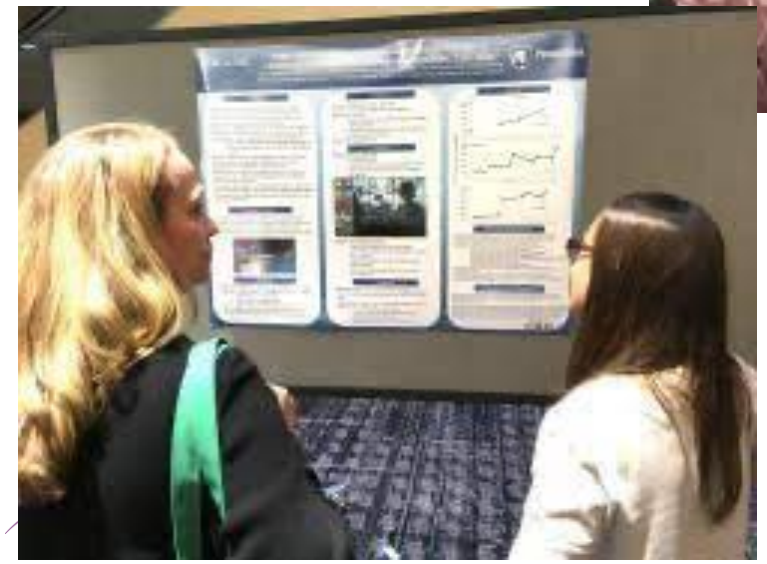
RERC on AAC

State of the Science in AAC – scheduled for 2024



AAC Consumer & Technology Forums (2021-2025)

RERC on AAC

Tracy Rackensperger (Ph.D)

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

Direct Support Management and Community Participation For AAC Users

Tracy Rackensperger, Lance McLemore, David McNaughton, Hannah Springfield

NATIONAL INSTITUTE ON DISABILITY, INDEPENDENT LIVING, AND REHABILITATION RESEARCH
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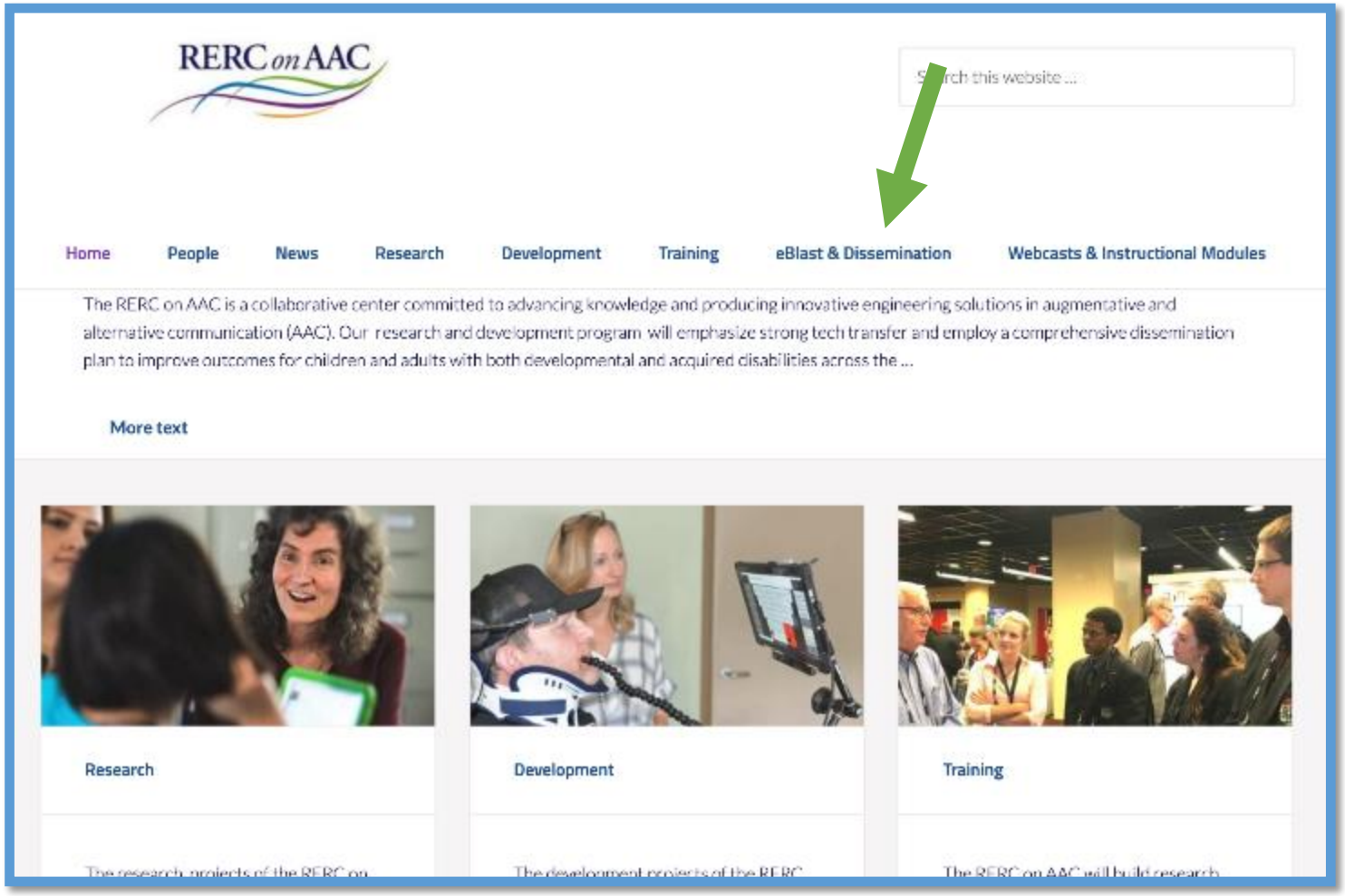

RERC on AAC

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)

RERC on AAC

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

RERC on AAC

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).

RERC on AAC