AAC Research at PSU

AAC Program at Penn State

- Mission
  - To enhance communication, increase participation, and improve the quality of life for individuals with complex communication needs who require AAC and their families

Research focus

- AAC research at PSU focuses on needs of
  - Individuals with CCN across the life span
    - Infants, toddlers, preschoolers, school-aged children, adolescents, young adults, older adults with CCN
  - Families and other partners
  - Professionals who work with them
- AAC research focuses on the needs of
  - Individuals with developmental disabilities
    - ASD, CP, Down syndrome, IDD, etc
  - Individuals with acquired /degenerative disabilities
    - ALS, etc

Nothing about us without us

- Research responds to needs of individuals with CCN & families
  - Individuals who require AAC / family members are integrally involved in all aspects of all major grants
  - Conceptualization, implementation, dissemination

External funding support

- Very active research program supported by significant external funding
  - 27+ years of continuous funding support
  - More than 40 externally funded grants
  - More than $20 million dollars of external funding secured
  - More than $8.5 million in external funding currently

AAC Research at PSU

Research collaborations

- University of Nebraska-Lincoln / Madonna Rehab
  - Dr. David Beukelman & Dr. Susan Fager
- Oregon Health Sciences University
  - Dr. Melanie Fried-Oken
- Northeastern University
  - Dr. Deniz Erdogmus
- Hershey Medical Center /Vista school
  - Dr. Michael Murray
- Shriver Center on Developmental Disabilities
  - Dr. Bill McIlvane
- AT manufacturers /developers
  - InvoTek, Tobii Dynavox, Saltillo/ PRC, etc
- Wide range of schools and agencies

RERC on AAC

- Penn State is the lead agency for the Rehabilitation Engineering Research Center (RERC) on AAC
  - virtual center for AAC research, development, training, & dissemination
  - funded through a 5 year, $5 million grant
  - funded by the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR)

Vision of the RERC on AAC

- Ensure that all individuals, including those with the most complex needs, have access to effective communication
- Seven R & D projects to
  - Advance knowledge in AAC
  - Improve AAC engineering solutions
  - Improve AAC practice

RERC on AAC Projects
Research Projects
- Access R1: Brain-computer interface (BCI)
- ***LangTech R2: Technologies to support the transition from graphic symbols to literacy**
- ***HCI R3: Visual cognitive processing demands of AAC interfaces**

Development Projects
- ***Access D1: Multimodal technologies to improve access**
- ***LangTech D2: AAC technology to support interactive video visual scene displays**
- LangTech D3: AAC technology with smart prediction
- HCI D4: Cognitive demands checklist for AAC technologies and apps

AAC Research at PSU

RERC on AAC
Training & Dissemination projects

- *MOOC to enhance training in AAC & improve AAC services (PSU)
  - Leaders in the AAC field
- *Collaborative projects with the Penn State Learning Factory (PSU)
  - Focus groups of individuals with CCN /families to identify unmet needs and priorities
  - Student capstone engineering projects
- Doctoral student think tank (PSU)
  - Summer 2017 and Summer 2019
- State of the Science in AAC conference
  - Summer 2018, Washington DC

Overview of research themes

- The Penn State AAC research program targets three urgent unmet needs
  - Research to improve the design of AAC systems to reduce learning demands, increase appeal, & enhance the power of communication
  - Intervention research with individuals who require AAC to increase participation and enhance language, literacy, & communication skills
  - Research on partner / professional training to increase EBPs & improve outcomes for individuals with CCN

Improving the design of
AAC systems

- Cuts across various stages of development
  - Beginning communicators to more advanced communicators
- Includes both basic & applied research to investigate the effects of various system variables on learning & use
  - Ultimately the goal is to design AAC systems to
    - Reduce learning & processing demands
    - Facilitate automaticity /fluency
    - Increase appeal
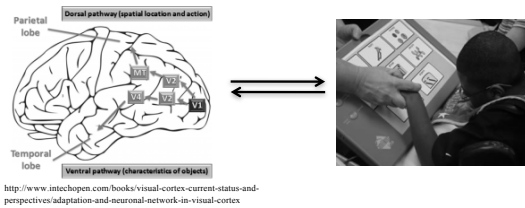   - Enhance communication power

Improving the design of
AAC systems

- Research focused on investigating
  - Representations
  - Organization
  - Layout
  - Selection techniques
  - Navigation
  - Output
- Research is focused on reducing
  - Motor, visual, cognitive & linguistic processing demands to enhance performance

AAC Research at PSU

It seems important to understand principles of visual processing when putting together a visually-based aided AAC intervention

http://www.intechopen.com/books/visual-cortex-current-status-and-perspectives/adaptation-and-neuronal-network-in-visual-cortex

Knowing how children perceive, process, and respond to visual information is necessary to help to optimize visual aided AAC interventions


Research to examine how individuals with ID/DD attend to visual communication displays that might be used on AAC systems. (Krista)

For most studies, we have used a standing research eye tracker, that works like this:
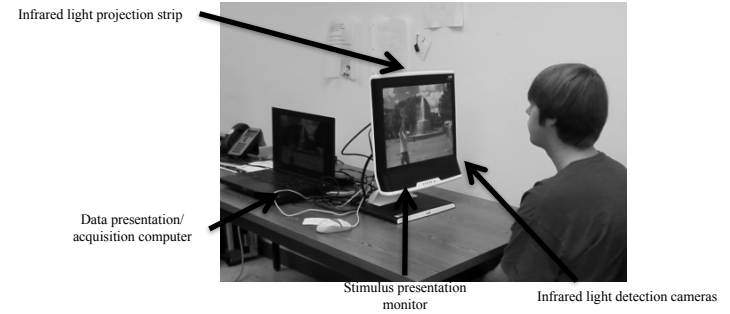
Grid project: How do physical features (such as the organization of symbols) influence attention patterns?

Step 1: Laboratory studies of visual attention, where there is no social demands on the participant. This step helps to define what are optimal versus non-optimal arrangements. Data are collected and under analysis.
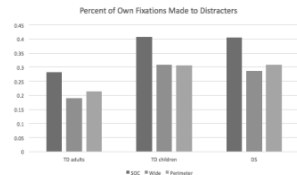
This suggests that the SOC draws attention to distracters –
Likely due to a phenomenon in vision science called "visual crowding."

NICHD 1R01HD083381 (Wilkinson,PI, McilVane, Gilmore, Co-Is)
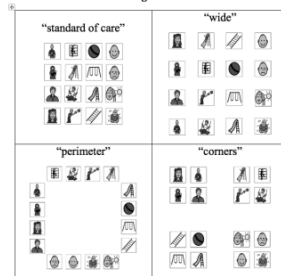
Step 2: How do optimal versus non-optimal arrangements influence both visual attention as well as actual communication behaviors when used during a storybook reading with a partner? Visual attention and communication will be measured while a child uses the AAC display during storybook reading with a partner.
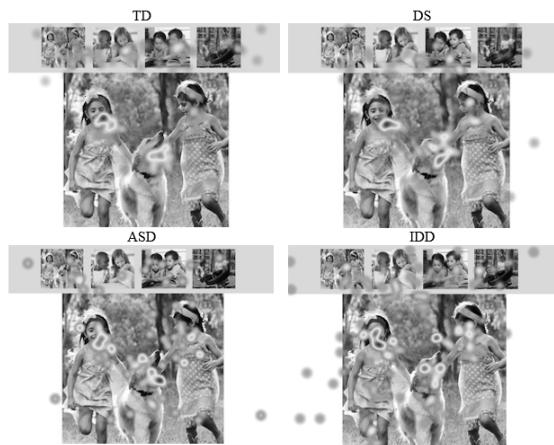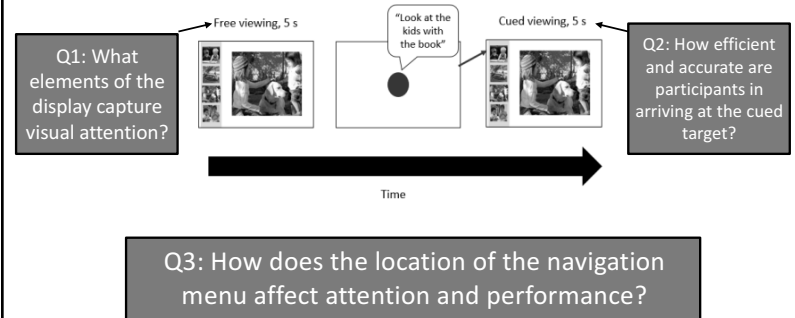

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RERC: Investigation of Eye Gaze on Visual Scene Displays with a Navigation Menu (Tara, Krista, Janice)

- Participants: Individuals with typical development, autism, Down syndrome, and intellectual and developmental disabilities

Procedures and Questions

Q1: What elements of the display capture visual attention?

Q2: How efficient and accurate are participants in arriving at the cued target?

Q3: How does the location of the navigation menu affect attention and performance?

Follow up study underway!

- Investigation of eye gaze + motor responses (selection) on VSDs with a navigation menu
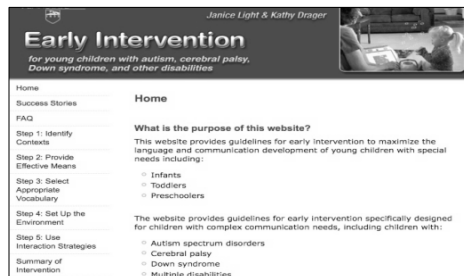
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Improving outcomes for young children and older beginning communicators with CCN

- Intervention to enhance language & communication of
  - young children with CCN
  - older beginning communicators
- Partner / parent training to enhance interactions

Enhancing language / communication for beginning communicators

- ▣ Intervention studies to investigate the effect of AAC interventions on language & communication skills of beginning communicators
  - ▣ Infants, toddlers and preschoolers
    - ▣ Longitudinal data
  - ▣ Older individuals with severe disabilities

Janice Light & Kathy Drager

Early Intervention
for young children with autism, cerebral palsy, Down syndrome, and other disabilities

Home
Success Stories
FAQ
Step 1: Identify Contexts
Step 2: Provide Effective Means
Step 3: Select Appropriate Vocabulary
Step 4: Set Up the Environment
Step 5: Use Interaction Strategies
Summary of Intervention

Home

What is the purpose of this website?
This website provides guidelines for early intervention to maximize the language and communication development of young children with special needs including:
- Infants
- Toddlers
- Preschoolers

The website provides guidelines for early intervention specifically designed for children with complex communication needs, including children with:
- Autism spectrum disorders
- Cerebral palsy
- Down syndrome
- Multiple disabilities

For further information on research with young children, visit our early intervention website at http://aackids.psu.edu

AAC technologies that support JIT programming
Janice, Kathy, Jess, Christine

- Focus on evaluating effects of AAC technologies that
  - Are easy to use
    - Use of visual scene displays (VSD)
  - Are fun
    - Personalized
  - **Are dynamic**
    - Can be programmed "**just in time**" during interaction
  - Offer shared interactive contexts
    - **Involve individuals with CCN in programming**

AAC Research at PSU

**RERC project D3: Video visual scene displays
Janice, David, Jess, Salena, Christine, Jessica, Ashley, Tara, Lauramarie, Mandy

- **Unmet need**
  - Many individuals with CCN benefit from VSDs to support communication
  - Current AAC apps with VSDs are limited to static photos; static VSDs fail to capture dynamic communication routines
  - Video offers potential to capture dynamic events
    - Potential to capture visual attention
  - Current AAC technologies only support passive video viewing

RERC on AAC

Video VSD

- Prototype AAC app that supports interactive video VSDs
  - Capture video of daily routines
    - Via built in camera or wireless import
  - Allow pause of video
    - Create VSDs at these junctures
    - Create hotspots with speech output

RERC on AAC

Video VSD

- Evaluation of effects of video VSDs with individuals with CCN
  - 6 studies in progress
  1. Effects on social interaction with youtube videos (Jess & Mandy)
  2. Effects on sharing of experiences (Jess)
  3. Effects on independent participation in community-based activities / employment (Tara)
  4. Effects on independent participation in vocational activities (Salena & Jessica)
  5. Effects on training partners to recognize signals of individuals with CCN (Christine)
  6. Effects on training partners in pediatric rehab (Jessica G.)

RERC on AAC

vVSD YouTube with Older Children

- **Question:**
  - Effect of a visual scene display app with embedded videos on contingent turns, during a 10-min. interaction around a preferred Youtube video, for individuals with ASD and CCN

- **Methods:**
  - Single-subject, across participants
  - 5 participants with ASD (9-18)

RERC on AAC

AAC Research at PSU

vVSD YouTube Older

- **Intervention:**
  - Prompt: "Lets watch some videos and talk about them together"
  - Watch videos and engage in communication about the video by responding to attempts or model a comment/question every 30s
- **Results:**
  - All participants made progress from baseline
    - # of turns
      - Baseline Mean = 4 (0-28)
   - Intervention Mean = 45 (14-111)

RERC on AAC

Video VSD Sharing experiences (Jess)

- **Question:**
  - Do communication turns change from baseline levels, with the instruction of an AAC app with speech output, embedded videos, and VSDs, during a 5-minute sharing opportunity, by an individual with ASD and CCN?
- **Methods:**
  - AB
  - 1 participant with ASD (9)
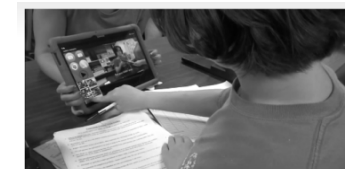
RERC on AAC

vVSD Sharing

- **Intervention:**
  - 5 minute sharing
    - prompt "What have you been doing?"
- **Results:**
  - In progress
    - + gains from baseline for # of turns
    - + gains from baseline for engagement per 10 sec interval samples
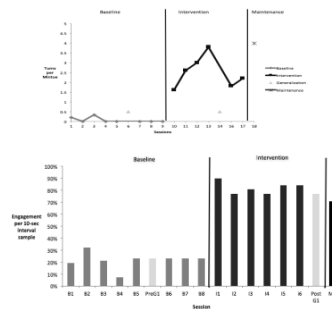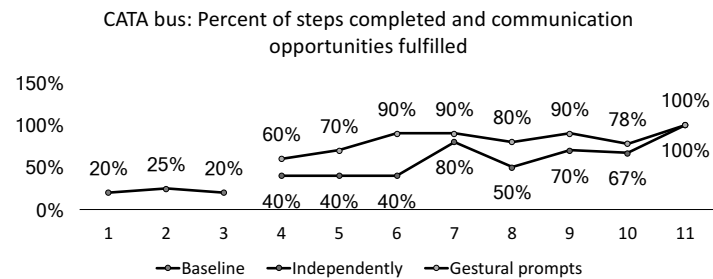
RERC on AAC

Video VSDs to Enhance Participation in Community and Vocational Activities (Tara)

- 16 year old with autism
- Uses some speech to communicate, but fulfills few communication opportunities
  - Highly prompt dependent during community and vocational activities
- Goal: To increase independent participation in community and vocational tasks
  - Using public transportation
  - Working at the print shop
  - Shredding job at school
- Procedures and implementation
  - Perform a task analysis of activity that identifies steps and communicative opportunities
  - Participant uses the video VSD app as a dynamic visual schedule with embedded to VSDs to support communication within routine

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Preview of Results: Riding the Bus

CATA bus: Percent of steps completed and communication opportunities fulfilled

Legend: —○— Baseline —●— Independently —○— Gestural prompts

Video VSDs to Enhance Participation in Vocational Activities (Salena & Jessica)

- What is the effect of video VSDs on the percent of steps completed successfully during vocational activities for an adolescent with ASD and CCN?
- Participant & Setting
  - 18 year old male with autism
  - High school student
  - No functional speech
    - A few signs – mostly yes/no, thank you
  - Prompt dependent
- Vocational activities
  - Local elementary school library
    - 3 tasks – Checking in books, putting away/sorting books, and making dye cuts

Developing technologies with video visual scene displays

- **Benefits**
  - Individuals with severe cognitive /language limitations will have access to AAC technologies that provide **dynamic contextual support** to
    - Enhance their communication
    - Increase participation in society

RERC on AAC

Parent and professional training

- Studies focused on intervention with families & professionals to improve supports for beginning communicators
  - Mothers of children with ASD (Beth)
  - Families/ family-centered services (Kelsey)

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Research to support family-centered services (Kelsey)

- Theoretical paper
  - Considered family systems theory as a framework to guide family-centered AAC services
  - Reviewed family-focused research in AAC, considered how AAC may impact the family system, and provided examples of the clinical implications of using the proposed framework (Mandak, O'Neill, Light & Fosco, 2017)

- Focus Group
  - Online focus group with 15 school-based SLPs to examine the experiences and beliefs of the SLPs that serve families of children with complex communication needs (CCN)
  - Across the SLPs, there seemed to be variation in terms of their understanding and implementation of family-centered services. The way the SLPs conceptualized and implemented family-centered services appeared to differ from how the service delivery model is highlighted in the research literature (Mandak & Light, under review)

- Survey
  - 99 parents of children with ASD and limited speech and 211 SLPs who served children with ASD and limited speech completed questionnaires measuring their experiences with the provision of family-centered services.
  - Findings revealed that parents and SLPs differed in their views on the degree to which family-centered services were being implemented. (Mandak & Light, early online)

- Intervention
  - Online training for pre-service SLPs
  - Will investigate the use of a strategy to improve SLP-parent interactions

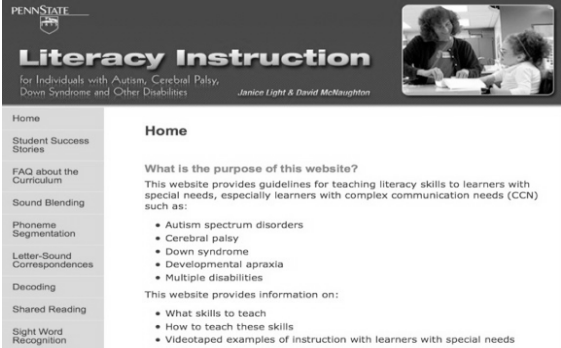## Improving outcomes for **school age children with CCN**

- Intervention to build literacy skills
- Parent /professional training
- System design to enhance literacy skills

## Improving **literacy** outcomes for individuals with CCN (Jess, David, Janice)

- Effects of intervention to build emergent literacy skills
- Intervention studies to develop, implement, and evaluate literacy instruction to meet the needs of individuals who use AAC
- Development & evaluation of resource materials for parents & educational personnel
  - Distance education

For further information on literacy intervention, visit http://aacliteracy.psu.edu

AAC Research at PSU

Improving literacy outcomes for individuals with CCN
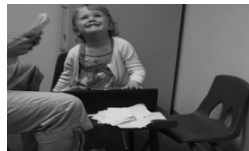
- Intervention studies to develop, implement & evaluate intervention to build
  - Early reading skills
  - More advanced reading comprehension skills
  - Early writing skills
  - With young children
  - With older individuals

Literacy Instruction: Perspectives of SLPs (Jess & David)

- **Question:**
- Explore the experiences of the provision of literacy instruction, by speech-language pathologists, who work with individuals with complex communication needs, including
  - (a) current challenges
  - (b) success stories
  - (c) approaches that are used to adapt and modify the instruction, and
  - (d) training received or want to receive in order to provide quality evidence-based instruction.
- **Methods:**
  - Semi-structured interviews, with 6 main questions, were conducted over email
  - 22 SLPs were interviewed
    - 12 school SLPs
    - 10 SLPs that work in settings other than school (e.g., outpatient, private practice)

Perspectives of SLPs

- **Results:**
  - 5 main themes

- **Conclusion:**
  - SLPs have specialized knowledge that can be used to provide the instruction and adaptations for students with CCN who require AAC in order to build vital communication and literacy skills (ASHA, 2016).
    - Yet SLPs report the need for training at the pre-service and in-service levels in order to effectively translate the positive research outcomes and implement adapted literacy instruction
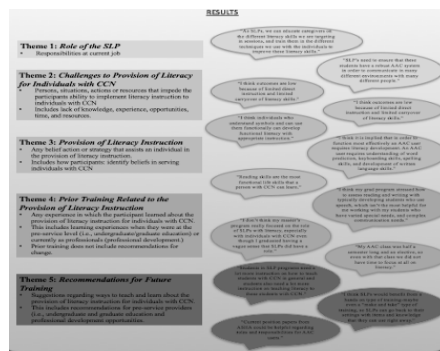
Online Training of Preservice Students

- **Question:**
  - Effect of online training on LSC intervention knowledge and implementation
- **Methods:**
  - SPLED 419 Students
  - Pre/post quiz & LCS Lesson role play
- **Results:**
  - Working on them!

RERC Lang Tech R2: Investigating AAC technologies to support literacy (T2L)

Janice, David, Jess, Shelley, Jessica G., Christine, Lauramarie

- **Unmet need**
  - More than 90% of individuals with CCN enter adulthood without literacy skills
  - As a result, they are severely restricted in education, employment, healthcare & community living
  - Current AAC technologies do not support the transition from graphic picture symbols to literacy

Investigating AAC technologies to support literacy (T2L)

- Improving AAC apps
  - Prototype AAC apps /user interface guidelines to support transition from pictures to orthography
    - Grid-based app
    - VSD-based app
- Studies to investigate effects of technology on literacy learning
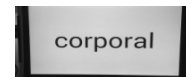 - With individuals of various ages with various disabilities
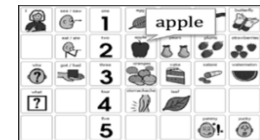
T2L with children with ASD "Angry Birds" (Jess)

- **Question:**
  - Effect of exposure to dynamic text within graphics-based grid displays, on the acquisition of single-word reading of 12 words
- **Methods:**
  - Single-subject, across participants
  - 5 participants (6-14)

RERC on AAC

T2L ASD "Angry Birds"

- **Intervention:**
  - Angry Bird words (e.g., Corporal Chuck, slingshot, shoot)
  - "Matching task"
  - Targeted all 12 sight words at once, 4 exposures to each word per session
- **Results:**
  - All of the participants demonstrated + gains, 100% non-overlapping data
    - Mean # of exposures – 25
    - Mean # of intervention sessions – 6
  - All participants generalized to text only display

RERC on AAC

AAC Research at PSU

T2L with children with ASD "limited literacy" (Jess)

- **Question:**
  - Effect of exposure to dynamic text within graphics-based grid displays, on the acquisition of single-word reading of 12 words
- **Methods:**
  - Single-subject, across word sets
  - 4 participants (7-19)

RERC on AAC

T2L ASD "limited literacy"

- **Intervention:**
  - Motivating/personally relevant words
  - "Matching task"
  - 12 total words, 4 sight words at once
  - 12 exposures to each word per session

- **Results:**
  - All of the participants demonstrated + gains, 100% non-overlapping data
    - Mean # of exposures – 96
    - Mean # of intervention sessions – 13

RERC on AAC

T2L with children with IDD/DS Storybook Reading (Jess)

- **Question:**
  - Effect of exposure to dynamic text within graphics-based grid displays, on the acquisition of single-word reading of 10 words during a storybook reading activity
- **Methods:**
  - Single-subject, across participants
  - 5 participants (6-20)

RERC on AAC

T2L IDD/DS Storybook Reading

- **Intervention:**
  - Personally relevant/ motivating words
  - Storybook reading
  - Targeted all 10 sight words at once, 4 exposures to each word per session
- **Results:**
  - All of the participants demonstrated + gains, 4/5 met criterion for acquisition
    - Mean # of exposures – 51
    - Mean # of intervention sessions – 13
  - 4/5 participants generalized to text only display

Clifford decides to go eat

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T2L Landform/Para (Jess)

- **Question:**
  - Effect of exposure to dynamic text within graphics-based grid displays, on the acquisition of single-word reading of 15 words when implemented by paraprofessionals
- **Methods:**
  - Single-subject, across word sets
  - 1 participant with ASD

_____ are mountains with lava

RERC on AAC

VSD T2L app (Janice, David, Jess, Christine, Kelsey, Lauramarie, Suz, Shelley)

- Studies to investigate the effects of VSD T2L app with
  - Young children with ASD
  - Young children at risk in small groups
  - Young children with IDD in small groups
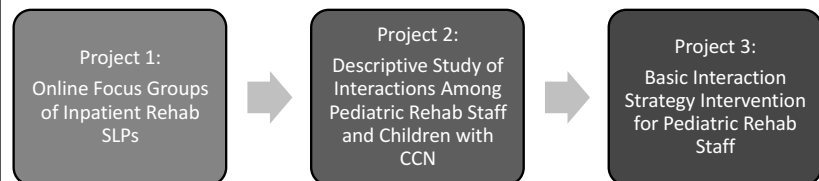 - Older adults with severe disabilities

cat

AAC technologies to support literacy

- **Anticipated benefits**
  - Individuals with CCN will improve their literacy skills through the apps
  - With improved literacy skills, they will have increased access to
    - Education/ employment
    - Healthcare
    - Community living
    - Mainstream technology

Understanding and Improving AAC Services in inpatient rehab (Jessica)

Project 1:
Online Focus Groups of Inpatient Rehab SLPs

→

Project 2:
Descriptive Study of Interactions Among Pediatric Rehab Staff and Children with CCN

→

Project 3:
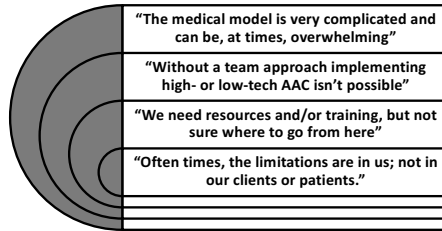Basic Interaction Strategy Intervention for Pediatric Rehab Staff

Online Focus Groups of Inpatient Rehab SLPs

Research Questions:

1.) What are the experiences of SLPs who work within the inpatient rehabilitation setting when providing services to individuals with CCN?

2.) What are the challenges and facilitating factors of AAC service delivery within this context?

Design: Asynchronous online focus group methodology (Stewart & Williams, 2005)

Results:

"The medical model is very complicated and can be, at times, overwhelming"

"Without a team approach implementing high- or low-tech AAC isn't possible"

"We need resources and/or training, but not sure where to go from here"

"Often times, the limitations are in us; not in our clients or patients."

Interactions Among Pediatric Rehab Staff and Children with CCN

- **Setting**: Inpatient pediatric rehabilitation unit
- **Participants**: (a) pediatric rehabilitation providers, (b) children with CCN receiving inpatient services
- **Design**: descriptive/exploratory
- **DV**: (a) number of communicative turns taken by child and partner, (b) number of communicative turns directed at child, (c) communicative success
- **IV**: staff role (e.g., nurse, therapist), child's age, child's diagnosis etiology

**RERC Access D1: Developing multimodal technologies to improve access
Janice, Jessica, Mari, Lauramarie, Mandy

- **Unmet need**
  – Current AAC access technologies all rely on a single access modality
  – Single modality approaches pose significant challenges (fatigue, over-use injuries, inefficiency) & limit participation for those with severe motor impairments

Access D1: Developing multimodal technologies to improve access

- **Expected outputs**
  – Prototype multimodal access system that provides universal access to all operating systems via Bluetooth keyboard & mouse interface
  – Supports integration of multiple modalities

RERC on AAC

AAC Research at PSU

Multimodal **Project**

- **Multimodal system development**
- **Multimodal access system:** incorporates switch access + eye gaze
- **Initial testing process completed with individuals without disabilities**
- **Learning Curves Project (adult):**
  - **Participants:** adults with CCN and severe physical disabilities
  - **Equipment:** RealTalk keyboard + system
  - **Goal:** obtain learning curve data for system use

Multimodal Project

- **Learning Curves Project (child):**
  - **Participants:** children with CCN and severe physical disabilities
  - **Equipment:** EasyVSD app + system
  - **Goal:** obtain learning curve data for system use

Access D1: Developing multimodal technologies to improve access

- **Anticipated benefits**
  - Individuals with severe speech & motor impairments will have improved access to AAC /mainstream technologies
  - As a result, they will have the opportunity for improved communication & increased participation in society

RERC *on* **AAC**

Interventions with adults

- *Experiences of individuals with ALS transitioning from speech to AAC (Vanessa, Sean, Janice)
- * Experiences of individuals with ALS in healthcare system (David, Godfrey, Felicia)
- Social media experiences of adults with CP who use AAC (Jess)
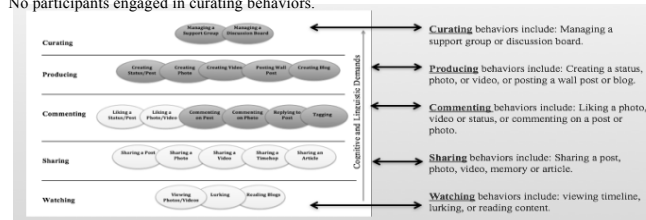
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Communication supports and barriers for persons with ALS (David & Godfrey)

- Investigation of the interactions between persons with ALS and their medical personnel, from the perspective of the person with ALS
- Collection of critical incident reports
  - Thematic analysis

Social Media Observations (Jess)

- **Question/Aim:**
  - This study aimed to use observations to systematically analyze common behaviors individuals who use AAC and social media engage in on Facebook (e.g., liking, commenting, sharing).
- **Results:**
  - Commenting was the dominant behavior across all participants
  - No participants engaged in curating behaviors.

- **Methods:**
  - 8 participants (high-tech AAC & Facebook use), all with CP diagnosis
  - 3 months of online observations were used to gather data across time, perspectives, and participants in the natural setting (i.e. the virtual setting of Facebook) – gathered through Activity Logs
  - Data Analysis: An *a priori* coding system was established to apply the components of social media engagement framework to Facebook Activity Logs (see *below* for image of Engagement Framework)

Curating behaviors include: Managing a support group or discussion board.

Producing behaviors include: Creating a status, photo, or video, or posting a wall post or blog.

Commenting behaviors include: Liking a photo, video or status, or commenting on a post or photo.

Sharing behaviors include: Sharing a post, photo, video, memory or article.

Watching behaviors include: viewing timeline, lurking, or reading content.

Translation of research to practice: Effective dissemination

- Overview of AAC research
  - AAC at Penn State website http://aac.psu.edu
  - RERC on AAC website http://rerc-aac.psu.edu
- Webcast series /MOOC
  - http://rerc-aac.psu.edu
- Websites
  - Maximizing language /communication development with young children
    - http://aackids.psu.edu
  - Maximizing literacy skills
    - http://aacliteracy.psu.edu

Massive Online Open Course (MOOC) (David)

- Free access to instructional content on AAC
- Instructional modules combining text, video, webcasts, print materials, etc
  - Supporting instructional activities (quizzes, certificates)

- **Topics**
  - Literacy : Jessica Caron
  - Working with Families: Kelsey Mandak
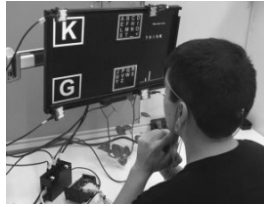 - Alternative Access: Jessica Gormley
  - Funding

AAC Research at PSU

Learning Factory (David)

- Partnerships w/ PSU undergraduate students in engineering
- Research and development to address challenges in AAC
  - Alternative access

- Capstone experience
  - 12 -14 weeks

- Submit to RESNA Student Design Competition
- RERC on AAC award

Final thoughts

- There are so many unanswered questions
- Research is urgently required to
  - advance our understanding and
  - improve outcomes for individuals with CCN and their families
- There are so many opportunities to contribute & make a difference