Changing the paradigm: Just-in-time programming of AAC apps for children with complex communication needs

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Magic & power of language development

- During the first 2 years of life, typically developing children make a remarkable transition
  - from birth
    - preintentional and presymbolic
  - to toddlers
    - express a wide range of intents
    - acquire hundreds of vocabulary concepts

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Challenges for children with complex communication needs

- In contrast, young children with complex communication needs typically
  - Have access to only a limited number of language concepts
  - Communicate for a limited range of intents
    - Typically to express needs and wants
  - Do not have access to new vocabulary immediately as the need or interest arises
  - Have limited control /involvement in vocabulary selection

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Limitations of current AAC technologies

- AAC technologies are often difficult for young children to learn & use
  - Children's rate of language learning is slowed by the operational demands
  - Children are not actively involved in vocabulary selection/ programming because of the complexity
- Maintaining & programming AAC systems adds demands to families & professionals who are already juggling many responsibilities
  - Children's language learning is limited if new vocabulary is not added regularly
  - Families & professionals cannot capitalize on teachable moments during daily interactions

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Language and communication outcomes for children with CCN

- Most young children with CCN
  - Start intervention late
  - Start out behind their peers
  - Rapidly fall further and further behind their peers
- But it doesn't have to be this way….

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Changing the paradigm

How can we better support young children with CCN in their language learning?

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Goals of the session

- To introduce a new approach to AAC intervention & technologies to maximize the language development of young children with CCN
- To present results of research to investigate the impact of this new paradigm
- To discuss implications to enhance language development with young children with CCN

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New approach to AAC Intervention

- Start **as early as possible**
- Provide **access to rich language** to support learning
- **Add new vocabulary "just in time"** during interaction in response to interests & needs
- **Involve children in vocabulary selection & programming** during daily interactions

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What is "just in time" programming?

- JIT programming of new vocabulary occurs on the fly within daily interactions in response to child's needs & interests
- Any AAC technology could be used "just-in-time"
  - Provided it is simple & easy to program
- JIT programming
  - Significantly reduces time demands for partners
  - Increases partner responsivity
  - Allows children to be involved in vocabulary selection

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Development of JIT technology with **visual scene displays** (VSDs)

- Visual scene displays (VSDs)
  - Photos of meaningful events within the child's life
  - Relevant vocabulary concepts are programmed as hotspots within the VSDs

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Potential advantages of VSDs

- VSDs represent familiar events and activities
  - replicate the contexts in which children learn language
- Language concepts are presented in context
  - provide support for understanding & learning
  - support access to language via episodic memory
- VSDs preserve conceptual & visual relationships between people & objects that occur in life
  - preserve the location, function, proportionality of concepts
- VSDs provide motivating & interesting contexts
  - stimulate interaction
- VSDs also offer visual processing advantages
  - regularly process scenes visually within daily life
  - rapidly process scenes

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Impact of visual scene displays

- Research demonstrates that young children with CCN
  - Are able to use VSDs to participate in social interactions immediately after modeling of use
  - Demonstrate significant increases in their participation /turn taking as a result of early intervention utilizing VSDs
  - Demonstrate significant increases in their expressive vocabularies (Light & Drager, 2012; Light, et al., 2016; Light et al., 2016)

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Development of JIT technology that **simplifies programming**

- Reduce number & complexity of programming steps
  - Allow quick & easy import of photos as VSDs
    - Using onboard camera or cell phone with Bluetooth connection
  - Allow quick & easy addition of hotspots and programming of vocabulary
    - Drawing of hotspots with finger or stylus
    - Recording of digitized speech
  - Provide programming controls easily understood & used by young children

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EasyVSD developed by InvoTek/ Jakobs

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Research to investigate the impact of this new paradigm

- Study 1
  - compare the time required to program VSDs and vocabulary across 3 VSD apps
- Study 2
  - investigate the effects of AAC apps on JIT programming by professionals during interactions with young children
- Study 3
  - investigate the effect of AAC JIT app on communication of young children with CCN

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Study #1: Caron, Light, Breakstone, & Drager (2016)

- Research objective
  - To investigate ways to simplify programming demands of AAC technologies for young children
  - To compare the time required to program VSDs and vocabulary across 3 apps
    - AutisMate (SpecialNeedWare)
    - Go Talk Now (Attainment)
    - EasyVSD (InvoTek)

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Participants /Procedures:

- 10 adults participated
  - No prior experience in programming the AAC apps
- Procedures
  - No training
    - Provided with step by step written instructions
  - Completed three different programming tasks with each app
- Within subjects design with repeated measures
  - IV = app condition (AutisMate, GoTalk Now, EasyVSD)
  - DV = programming time
  - Order of apps counterbalanced across participants
    - Control order effects

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3 Programming Tasks:

- 1. Time to program one visual scene with two hotspots on first exposure to the app
- 2. Time to program a different visual scene with two hotspots on second exposure to the app
- 3. Time to program a three-page linking story with one hotspot per page

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Results: Average programming times across tasks

	AutisMate	GoTalk Now	EasyVSD
Task 1:	**3:49**	**2:38**	**2:00**
Task 2:			
Difference between 1 & 2:			
Task 3:			

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Results: Average programming times across tasks

	AutisMate	GoTalk Now	EasyVSD
Task 1:	**3:49**	**2:38**	**2:00**
Task 2:	**2:37**	**1:31**	**1:04**
Difference between 1 & 2:			
Task 3:			

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Difference between 1 & 2:	1:23	1:07	0:56
Task 3:			

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Task 1:	**3:49**	**2:38**	**2:00**
Task 2:	**2:37**	**1:31**	**1:04**
Difference between 1 & 2:	1:23	1:07	0:56
Task 3:	**4:37**	**3:40**	**2:10**

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Study #1 - Implications of results

- Clinicians and parents with no prior experience would be able to add 5 new VSD with 10 concepts
  - In approximately 5 min using EasyVSD
  - In approximately 7 min using Go Talk Now
  - In approximately 12 min using AutisMate
- Reducing the complexity of programming should support
  - Increased programming of VSDs & vocabulary
  - Increased opportunities for language learning by young children with CCN
  - Potential for just in time programming during interactions with young children

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Will JIT programming work in real life interactions with young children?

Will partners be able to manage the demands of JIT programming during interactions?
Will young children remain engaged during JIT programming?

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Study #2 Research Objective (Caron, Light, & Drager, 2016)

- To investigate the effects of AAC apps on JIT programming by professionals during interactions with young children
- Specifically to compare the effects of 2 apps on:
  - Number of VSDs added JIT
  - Number of vocabulary hotspots added JIT during interactions with young children
  - Engagement of young children
  - Participation of young children in JIT programming

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Study #2 - Participants

- **Adults (N=8):**
  - Ages 24-56 (M= 45)
  - Experience working with individuals with complex communication needs
    - Range 3-33 years; M= 19.37
  - No prior programming knowledge in GoTalk Now or EasyVSD
    - 6 currently using tablets with kids with CCN
- **Children (N=2):**
  - Twin boys; 3.7 years old
  - No communication, vision, or hearing impairments

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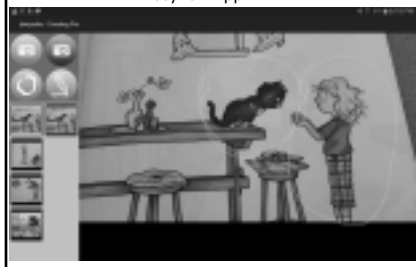
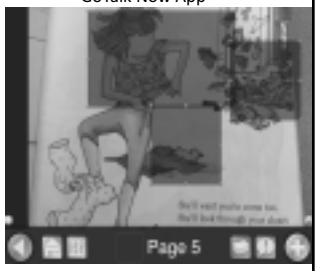
Study #2 - Materials

EasyVSD App



GoTalk Now App



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Study #2 - Procedures

- **Part 1:**
  - Self Training
  - 3 minute video
  - "Check out"
- **Part 2:**
  - 10 minute interaction using the application and storybook
  - Survey once both apps are used

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Study #2 - Results

- **Number of visual scene displays**
  - In the 10-min interaction, professionals programmed an:
    - Average of 2 visual scene displays in GoTalk Now
    - Average of 4.25 visual scene displays in EasyVSD
- **Child Engagement**
  - Momentary time sampling was used to record if child engagement was observed at a pre-set interval of ten seconds during the 10-minute interaction. Children were on task:
    - 84% of the time with GoTalk Now and participated in programming an average of 1 time per session.
    - 93% of the time with EasyVSD and participated in programming an average of 7 times per session.
- **Consumer Satisfaction Survey**
  - All participants (100%) found EasyVSD the easiest app to learn and use with a child in an interaction

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Study #2 - Implications

- **Practice:**
  - Communication partners face many challenges in their interactions with children with complex communication needs because they must balance the demands of the AAC devices while interacting and responding to the child
    - Just-in-time programming ensures that children have access to the personally relevant, meaningful vocabulary that they need and want immediately during their interactions
    - JIT programming also provides a way to involve children in vocabulary selection

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Study #2 - Implications

- **Technology development:**
  - Most AAC systems required offline programming of new vocabulary because programming involves multiple steps.
  - Develop AAC apps with only necessary customization features in order to optimize efficiency, reduce learning demands, and increase appeal

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How will AAC JIT app affect communication & language of young children with CCN?

Will parents and teachers be able to incorporate the app into daily interactions with children with CCN?

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Study #3 – Evaluation with children with CCN

- Research objectives
  - To investigate the effect of AAC app with JIT programming on:
    - Number of communicative turns taken by young children with CCN
    - Number of unique vocabulary concepts expressed
    - Amount of vocabulary available for communication
  - To investigate generalization & maintenance of effects in home/ day care environments
- Single case multiple probe across participants

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Participants

- 5 children participated
  - 15-33 months old at start of study
  - Developmental delay
    - Down syndrome, PDD-NOS, rare chromosomal disorder resulting in motor & intellectual impairments
    - 1 child experienced medical issues during study
  - Had complex communication needs
    - Speech inadequate to meet their communication needs
  - Were beginning communicators
    - Signs, low tech systems, visual schedules
    - Were not using SGDs at the time of the study

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Study 3 - Procedures

- Data collected during 15-min play interactions in homes /day care
  - Primary caregivers involved in all phases
- 3 phases
  - Baseline prior to intervention
    - Use of typical modes of communication
  - Intervention
    - Introduction of the AAC app with JIT programming
  - Generalization /maintenance at home or day care
    - Parents /early intervention teams were
      - Provided with 10-30 min training in AAC JIT app
      - Responsible for programming & implementation with child

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Results - Effects of AAC JIT app on children's turn taking

- Children had low rates of communication at baseline
  - Mean of 0 – 17 turns across children in 15 min interactions at baseline
- Children took significantly more turns during intervention with the AAC JIT app
  - Mean of 23-47 turns across children in 15 min interactions during intervention
    - Mean gain of +22 to +42 turns with AAC JIT app
  - % nonoverlapping data
    - 100% for 4 of children; highly effective intervention
    - 89% for 1 child; effective intervention despite medical issues

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Generalization & maintenance of turn taking at home & daycare

- Only 4 children completed maintenance /generalization
  - 1 child was hospitalized and unable to continue
- The other children maintained /increased frequencies of turn taking with AAC JIT app during maintenance /generalization
  - Mean of 50 turns in 15 min during maintenance/ generalization
    - Range of 39-55 turns across children
  - Mean gain of +48 turns from baseline to maintenance /generalization with JIT AAC app at home /daycare
    - Range in gains of +37 to +53 turns across children

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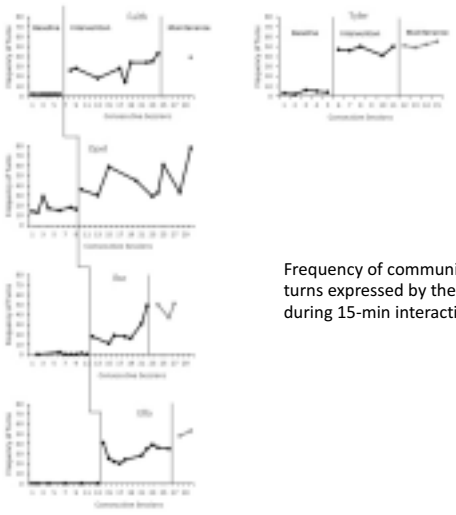

Frequency of communication turns expressed by the children during 15-min interactions

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Results - Effects of AAC JIT app on unique concepts communicated

- Children expressed limited range of concepts at baseline
  - Mean of 0 – 6 unique concepts expressed in 15 min interactions at baseline
- Children expressed significantly more unique concepts during intervention with AAC JIT app
  - Mean of 13-21 unique concepts expressed across children in 15 min interactions during intervention
    - Mean gain of +9 to +19 unique concepts expressed
  - % nonoverlapping data
    - 100% for all 5 children; highly effective intervention

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Unique concepts expressed during generalization & maintenance at home & daycare

- Children demonstrated significant increases in number of unique concepts expressed during maintenance /generalization at home or daycare
  - Mean of 17-40 unique concepts expressed across children in 15 min during maintenance/ generalization
  - Gain of +17 to +38 unique concepts expressed from baseline to maintenance /generalization at home /daycare

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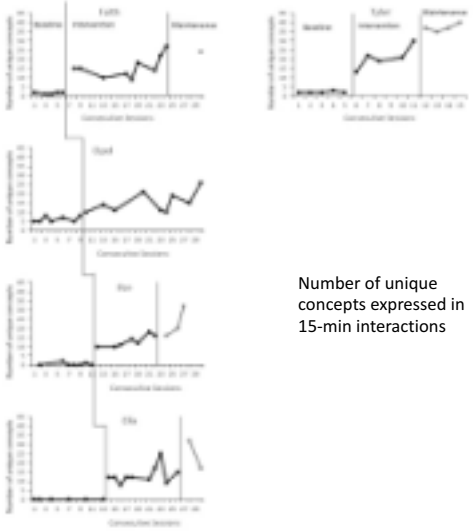

Number of unique concepts expressed in 15-min interactions

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Results – Amount of vocabulary available to children

- Children had access to significantly more vocabulary concepts during intervention with the AAC JIT app
  - After 5-10 intervention sessions, children had access to
    - Range of 156 - 289 concepts across 75 - 94 VSDs
- Parents & professionals continued to add vocabulary regularly during generalization /maintenance at home or daycare
  - Mean of +18 vocabulary concepts added by parents /professionals per week for the children
    - Range of +7 to +32 concepts added across children per week

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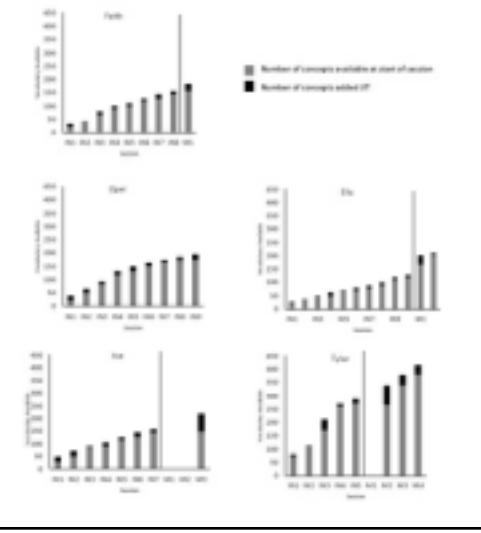

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Implications

- Demonstrates the advantages of AAC apps that support JIT programming
  - Fewer programming steps required
  - Vocabulary added regularly by typical partners
  - Increased responsivity of partners during interactions
- Demonstrates positive effects of AAC JIT app on communication of young children with CCN
  - Increased turn taking of children
  - Increased number of unique concepts expressed
- Demonstrates children's involvement in selecting & programming vocabulary
  - Empowered in language development

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Extension to natural environments

- These positive effects extend to
  - Use by parents / professionals
  - In natural environments at home or daycare
  - With only minimal training required
    - 10-30 min of informal training

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Limitations

- Results would be strengthened with
  - Additional replications across more participants
    - Different ages and disabilities
  - Longer term evaluation in home, school, daycare environments
  - Evaluation of long term effects on language learning

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Conclusions

- Exciting paradigm shift for the field
  - Supports early intervention with infants & toddlers
  - Allows capture of meaningful events in their lives as they occur
    - Allows partners to respond immediately to children's interests
  - Provides access to vocabulary immediately as needed
    - Allows partners to capitalize on teachable moments
  - Reduces programming demands on clinicians & families
    - Supports regular programming of new vocabulary concepts
  - Supports children in selecting & programming vocabulary in AAC apps
    - Empowers children in language learning

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Impact on children with CCN

- With paradigm shift, parents & clinicians will be better able to support
  - Increased participation by children with CCN
  - Increased opportunities for language learning
  - Greater vocabulary growth
  - Increased learning & educational achievement
  - Greater empowerment of children with CCN

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Conflict of interest

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