Effects of AAC systems with "just in time" programming for children with complex communication needs

JIT project team

Penn State Communication Sciences & Disorders

- Janice Light
- Kathryn Drager
- Jessica Currall
- Caitlin Brown
- Kelly Chew
- Megan Dooris
- Sarah Guthrie
- Evin Harbitter
- Lauren Herc
- Lisa Mellman
- Paige Moyer
- Nimisha Muttiah
- Gina Pecile
- Katherine Riley
- Vanessa Smith
- Carly Staffin
- Laura Wummer

Maximizing communication for children with complex communication needs

- AAC technologies utilizing visual scene displays (VSDs) can be used to significantly enhance the communication of young children with complex communication needs
- VSDs
  - Photos of meaningful events in the child's life
  - Vocabulary concepts embedded under hotspots with the scenes

Research on VSDs

- Infants at "first words" stage demonstrate strong preference for photo VSDs
  - Look first & longest at photo VSDs compared to grid displays (Wilkinson & Light, in progress)
- Toddlers perform better with VSDs
  - Are more accurate locating vocabulary with VSDs than grid displays (Drager, Light, et al., 2003)

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 seem to offer visual processing advantages
  - regularly process scenes visually within daily life
  - rapidly process scenes (<200 milliseconds)

Research on the effects of early intervention utilizing VSDs

- Young children with CCN
  - Were able use AAC technologies to participate in social interactions immediately after modeling of system use
  - Demonstrated significant increases in their participation /turn taking as a result of early intervention utilizing VSDs
  - Demonstrated significant increases in their expressive vocabularies (Light & Drager, 2012)

The Problem

- There are two major limitations to current AAC technologies /apps for young children
  - It is time consuming to program new VSDs & vocabulary
    - As a result, partners do not add vocabulary frequently.
  - It is not possible to dynamically capture new experiences / vocabulary and add them to AAC technologies on the fly during interactions.
    - As a result, it is difficult for partners to respond to children's interests.
    - It is difficult to capitalize on "teachable moments".

Potential Solution

- One potential solution to these problems is the implementation of AAC technologies that support "just in time" (JIT) programming.
- JIT programming
  - Allows the quick & easy import of photos as VSDs
  - Allows the quick & easy programming of vocabulary as hotspots within the VSDs
  - Allows partners to respond to their children's interests by adding new communicative contexts and vocabulary "on the fly" during daily interactions.

Goals of the session

- To present the results of 3 research studies designed to investigate the effects of AAC technologies that support JIT programming
  - Study 1 – Compared programming times for JIT technologies to traditional AAC technologies
  - Study 2 – Investigated the effects of JIT & traditional AAC technologies on the communication of young children with CCN
  - Study 3 – Provided extended investigation of JIT technologies at home & school

AAC technology with JIT programming

- Innovative JIT software called PlayTalk developed by InvoTek, Inc (Jakobs, et al.)
  - Allows quick & easy import of photos as VSDs
    - Using cell phone with Bluetooth connection
  - Allows quick & easy addition of hotspots and programming of vocabulary
    - Drawing of hotspots with finger or stylus
    - Recording of digitized speech
  - Provides drawing function to add text, numbers, or pictures to VSDs
  - Provides a simple menu easily understood by the children
    - Options always visible; represented as thumbnails of VSDs

Traditional AAC Technology

- Traditional AAC technologies
  - SGD with Speaking Dynamically Pro (SDPro) software or InterAACT software
  - Allowed preprogramming of VSDs and hotspots
  - Did not support JIT programming
  - Utilized traditional menu system
    - Options represented through thumbnails of VSDs, but not always visible
    - Required navigation through main menu or forward/ back arrows

Study 1

- Research objective
  - To compare the time required to program VSDs and vocabulary
    - AAC technologies with JIT programming
    - Traditional AAC technologies without JIT programming

Participants /Procedures

- 6 adults participated
  - No prior experience in AAC
- Procedures
  - Program 2 VSDs with 4 hotspots each (8 vocab concepts)
  - Programmed 3 different systems
    - PlayTalk technology with JIT programming
    - SD Pro software
    - InterAACT software on Vmax
  - Order of systems counterbalanced across participants
    - Control order effects

Time required to program 2 VSDs with 4 hotspots each

Participant	Programming time in minutes		
	PlayTalk	SDPro	V Max
Participant 1	5	22	37
Participant 2	4	19	31
Participant 3	5	23	46
Participant 4	6	20	38
Participant 5	4	21	40
Participant 6	5	20	34
Mean	4.8	20.8	37.7

Time required to program

- Programming with JIT system was incredibly efficient compared to traditional AAC systems
  - SDPro required 5 times as much programming time
  - Dynavox InterAACT software required 7 times as much programming time
  - Clinicians and parents with no prior experience would be able to add 5-10 new concepts using JIT in less than 5 minutes

Study 1 - Implications of results

- Results of Study 1 suggest that JIT technologies should support
  - Increased programming of VSDs and vocabulary for young children with CCN
  - Increased opportunities for language learning by young children
- But will it work in real life interactions with young children with CCN?

Study 2 - Research Objectives

- To investigate the effects of AAC technology that supports JIT programming on the communication of young children with CCN
- Specifically to compare the effects of JIT technology to a traditional AAC system (without JIT capabilities) on:
  - the number of communicative turns taken and
  - the amount of vocabulary available to preschoolers with CCN.

Participants

- 3 children participated
  - Aged 3-5 years
  - Developmental delay
    - E.g., Down syndrome, severe developmental apraxia
  - Had complex communication needs
    - Speech inadequate to meet their communication needs
  - Used AAC to enhance their communication
    - Signs, low tech systems, schedules
    - Were not using SGDs at the time of the study

Procedures

- Alternating treatment design with two conditions
  - 2 intervention sessions per week (counterbalanced)
    - One with JIT PlayTalk software
    - One with SD Pro software
- AAC technologies were preprogrammed with VSDs /hotspots
  - Identical VSDs & hotspots programmed in each condition

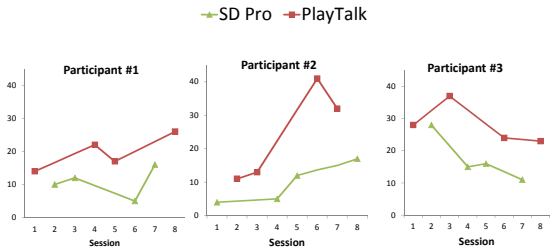
Procedures

- AAC technologies were introduced during play interactions with children with CCN
  - New VSDs and hotspots added during the play interactions as required in JIT condition
  - Not possible to add new VSDs or hotspots during interaction in SDPro condition

Results

- Children with CCN
  - Took significantly more turns during 15-min play interactions using JIT PlayTalk compared to SDPro
    - Mean of 13 turns with SDPro (range 10-18)
    - Mean of 25 turns with JIT (range 19-29)

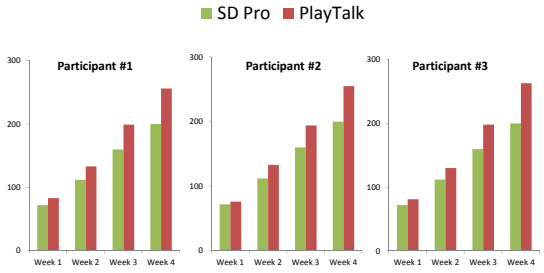
Comparison of JIT & SDPro Number of communicative turns



Results

- Children with CCN
  - Had access to significantly more vocabulary concepts using JIT PlayTalk compared to SDPro
    - Mean of 14.5 more concepts added each week with JIT than SDPro
    - Mean of 58 more concepts per child added across the 4 weeks with JIT than SDPro

Number of concepts available



Discussion

- Children with CCN
  - Took more turns using JIT PlayTalk compared to SDPro
  - Had access to more vocabulary concepts using JIT PlayTalk compared to SDPro
    - Relevant VSDs and vocabulary were easily added
    - Partner could easily capture new events & vocabulary in response to children's interests
    - Children were motivated to communicate since they had easy access to vocabulary of immediate interest to them

Time to add VSDs and vocabulary

- Programming using the JIT software during interaction with the child was very efficient
  - Took less than 1 min from the time it was decided to add a VSD & hotspots until the child was able to use the new concepts to communicate
    - Took an average of 33 sec to take a photo & import it to the system as a VSD
    - Took an average of 16 seconds to draw the hotspots and record the vocabulary

Challenges of JIT programming

- JIT programming allowed partners to rapidly add VSDs & vocab during interactions
  - Vocabulary concepts were immediately available to the children for use in the interaction
- But did the children lose interest during JIT programming?

Children's engagement during JIT programming

- The children demonstrated high levels of interest during JIT programming
  - 97% engagement during VSD import /creation
  - 95% engagement during hotspot creation
  - Engagement levels were higher than expected
    - Children were very engaged in the process of building AAC displays
    - They assisted with the process

Limitations of the study

- Limited number of participants/preschoolers
  - Future research is required to investigate effects with larger number of children with CCN
    - Range of ages and disabilities
- Short term evaluation with clinician/ researcher
  - Future research is required to investigate effects over a longer time period across various partners and environments

Study 3 – Long term evaluation

- Research objectives
  - To investigate the effects of AAC technologies compared to baseline prior to intervention
  - To compare the effects of JIT technology to a traditional AAC system (without JIT capabilities) on:
    - the number of communicative turns taken and
    - the amount of vocabulary available
  - To investigate the long term effects in the home/ school environment

Participants

- 5 children participated
  - 4 were between 18-30 months; 1 was 5 years old
  - Developmental delay
    - Down syndrome, Down syndrome & autism, cerebral palsy, Prader Willi, rare chromosomal disorder
  - Had complex communication needs
    - Speech inadequate to meet their communication needs
  - Used AAC to enhance their communication
    - Signs, low tech systems, schedules
    - Were not using SGDs at the time of the study

Study 3 - Design

- Parents /school team involved in all phases
- Three phases
  - Baseline prior to intervention
  - Alternating treatment with two counterbalanced conditions
    - JIT software
    - SD Pro software
  - Long term follow up at home, preschool, day care
    - Using JIT technology only

Procedures

- Procedures in alternating treatment were similar to those in Study 2
- Follow up phase
  - Lasted at least 2 months post alternating treatment phase
  - Parents /early intervention teams were primary facilitators
    - Provided with training in JIT system operation / use
      - 30-60 minutes
    - Responsible for programming / care / implementation of JIT system

Effects of AAC technologies

- The children with CCN took significantly more turns using the AAC technologies compared to baseline condition without AAC technology
  - Mean gain of +12 turns with traditional AAC technology compared to baseline
    - range +7 to +21 turns across the children
  - Mean gain of +28 turns with JIT technology compared to baseline
    - range +10 to +40 turns across the children

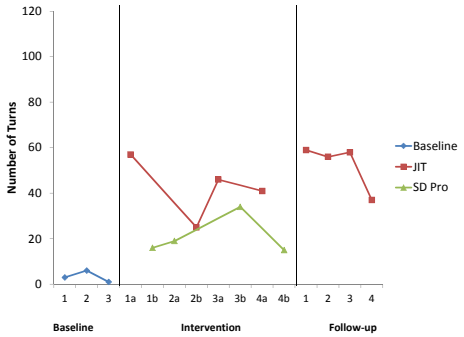
Effect of JIT technology compared to traditional AAC technology

- The children took significantly more turns using JIT PlayTalk compared to SDPro
  - Mean of 22 turns in 15 min with SDPro
    - Range of 8-41 turns across the children with SDPro
  - Mean of 38 turns in 15 min with JIT system
    - Range of 11-60 turns across the children with JIT system

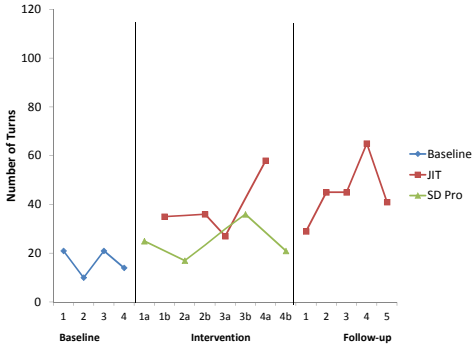
Long term follow up at home, school, daycare

- The children continued to increase their rates of turn taking with JIT technology during long term follow up in home, school, or daycare settings
  - Mean of 51 turns in 15 min during follow up
    - Range of 17-78 turns across children
  - Mean gain of +13 turns from intervention with JIT to follow up
    - Range of +6 to +23 across children
  - Mean gain of +40 turns from baseline to follow up with JIT
    - Range of +16 to +58 across children

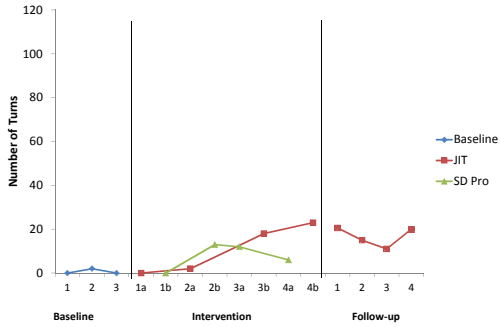
Number of Turns: EK



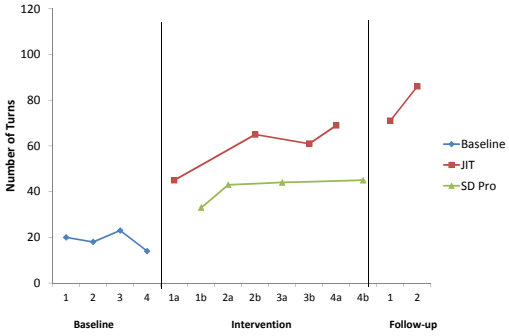
Number of Turns: ER



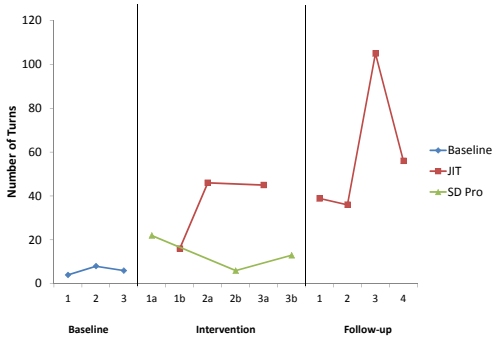
Number of Turns: ZZ



Number of Turns: JH



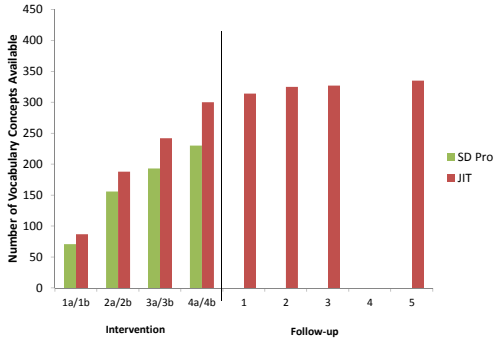
Number of Turns: EM



Results

- The children had access to significantly more vocabulary concepts using JIT technology compared to SDPro
- Parents and professionals continued to add vocabulary regularly with the JIT technology at home, school, or daycare
  - Mean rate of +23 vocabulary concepts added per week for the children
    - Range of +6 to +52 concepts added across children per week

Number of Vocabulary Concepts Available: EK



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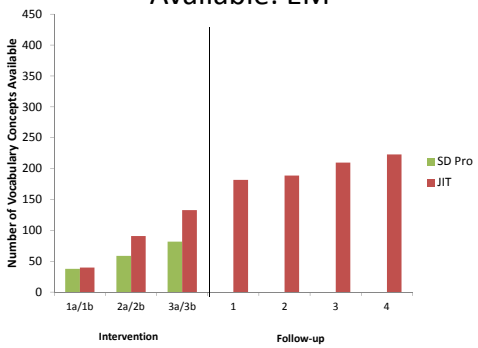
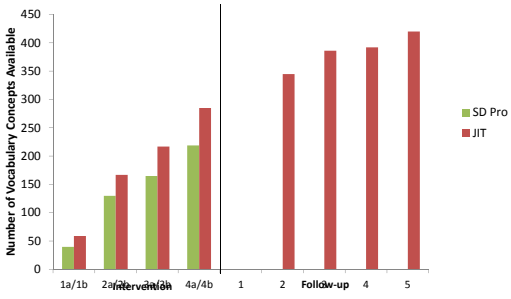


Number of Vocabulary Concepts Available: ER



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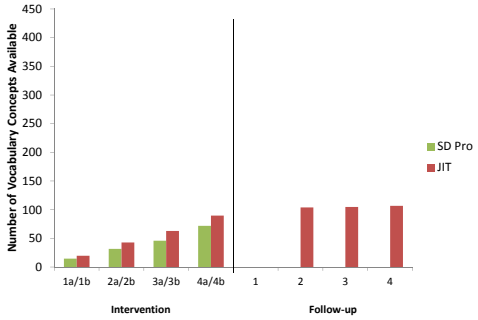
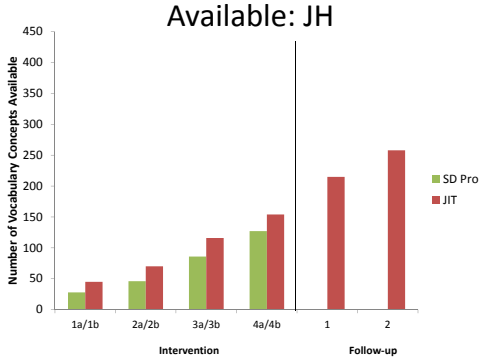


Number of Vocabulary Concepts Available: JH



Summary

- This study
  - Replicates effects of Study 2 with more children
    - Younger (ages 2-5 years)
    - Range of disabilities
  - Confirms positive effects of AAC technologies/ SGDs
  - Specifically demonstrates the advantages of SGDs with JIT programming compared to traditional SGDs
    - Increased turn taking
    - Access to increased vocabulary

Children's engagement in vocabulary development

- The children demonstrated significant involvement in developing their AAC systems
  - Adding new contexts as VSDs
  - Adding new vocabulary concepts within these contexts
- They expressed frustration with the traditional AAC technology when vocabulary could not be added

Extension to natural environments

- The positive effects of JIT programming extended to
  - Use by parents / professionals
  - In natural environments at home, school or daycare
  - With only minimal training required
    - 30-60 min of informal training

Limitations

- Results would be strengthened with
  - Additional data collected at baseline and during alternating treatment
  - Additional replications across more individuals
    - Different ages and disabilities
    - Older individuals who are beginning communicators
  - Longer term evaluation in home, school, daycare environments

Conclusions

- This project represents an exciting transition for the field to AAC systems that are truly dynamic
  - Capture interaction on the fly as it occurs
  - Support dynamic learning /language growth
    - Allow partners to respond to children's interests
  - Reduce programming demands on clinicians & families
    - Incredibly easy and time saving
  - Allow children to be actively engaged in the development of their AAC systems

Impact on children with CCN

- With access to JIT technologies, parents & clinicians will be better able to support
  - Increased participation by children with CCN
  - Increased opportunities for language learning
  - Greater vocabulary development
  - Increased learning & educational achievement
- Children with CCN will have
  - Increased control over vocabulary acquisition
  - Increased ownership of their AAC systems

Acknowledgements
Conflict of interest

- We are very grateful to the children, families, & professionals who participated in these studies.
- These projects were funded by NIH grant #1R43HD059231-01A1 and by NIDRR grant #H133E080011 (AAC-RERC)
- Funding for some of the students involved in this project was provided by U.S. Department of Education grant #H325K080333
- The authors of this paper have no financial or nonfinancial conflict of interest