Spoken vocabulary outcomes of toddlers with developmental delay: A phonetic description and analysis

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Speech Sound Development

Typical Speech	Atypical Speech
• Shriberg's (1993) classification of consonant development: Early-8 /m,b,j,n,w,d,p,h/ Middle-8 /t,ŋ,k,g,f,v,tʃ,ʤ/, and Late-8 /ʃ,ð,s,z,θ,l,r/. • Some speech sound errors persist even after first words stage (e.g., cluster reduction, final consonant deletion, /r/ distortions, some substitutions).	• Children with intellectual disabilities exhibit increased frequency and persistence of speech sound errors and deletion of consonants (Bauman- Waengler, 2012). Speech Generating Device (SGD)

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Augmentative and Alternative Communication and Speech Outcomes

Myth 1 (Romski & Sevcik, 2005)

"AAC hinders or stops further speech development."

→ AAC intervention may result in increasing vocal and speech development (Bauman-Leech & Cress, 2011; Millar, Light, & Schlosser, 2006; Romski et al., 2010)

→ As of yet, relatively few studies have investigated specific effects of AAC on speech sound development

Myth 2 (Romski & Sevcik, 2005)

"Children must have a certain set of skills to be able to benefit from AAC."

→ Language growth as an outcome of AAC intervention (Barton, Sevcik, & Romski, 2006; Branson & Demchak, 2009; Romski et al., 2010).

Challenge Remains

Hesitation persists for parents and professionals in using this method with the fear that spoken-verbal communication will be hindered (Romski & Sevcik, 2005).

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Research Aims

1. To characterize the phonetic make-up of the children's spoken target vocabulary words .

2. To identify if augmented interventions using SGDs have an effect on the phonemic accuracy of spoken target vocabulary compared to a non-augmented intervention.

3. To examine factors that influence spoken target vocabulary outcomes.

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Methods

- Participants
- Intervention
- Data Analysis

Participants

- The current study used data from two larger studies (Romski et al., 2010 & Romski et al., in preparation).
- Inclusionary criteria for both studies:
    - 24 to 36 months of age at the beginning of recruitment
    - an expressive vocabulary of less than 10 intelligible words
    - significant expressive language delay (i.e., less than 12 months) on the Mullen Scales of Early Learning (MSEL; Mullen, 1995)
    - indication of intentional communication (e.g., intentional gestures, joint attention, vocalizations)
    - upper extremity motor control to access symbols on the speech generating device (SGD)
    - primary diagnosis other than delayed speech and language skills, hearing/vision impairment, or autism.

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Participants Cont'd

- 48 children (12 females and 34 males) produced at least one spoken target vocabulary word at session 18 and/or session 24
    - 42% of the larger sample ($n = 113$)
- Mean chronological age was 31.09 months
- African American ($n = 18$), Asian ($n = 4$), multi-racial ($n = 1$), and Caucasian ($n = 23$) backgrounds
- The children were diagnosed with variety of disorders including: apraxia of speech, cerebral palsy, Down syndrome, developmental disability, mitochondrial disorder, pervasive developmental disorder, speech delay, seizure disorder, and unknown etiology

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Intervention

- Participants were randomly assigned to one of four intervention groups:
    - Spoken communication input (SCI),
    - Augmented communication output (ACO),
    - Augmented communication input (ACI),
    - Augmented communication input and output (AC-IO).
- Intervention usually occurred twice per week for 24 sessions

- Each child was given a selection of target vocabulary words, chosen by the parent and the speech-language pathologist, to use throughout the intervention.
- Target vocabulary words chosen based on the following factors: 1) lack of comprehension at baseline, 2) were motivating to the child, and 3) were easily generalizable to the child's home setting.
- Developmental appropriateness of phonemes in target words was not considered in target word selection.
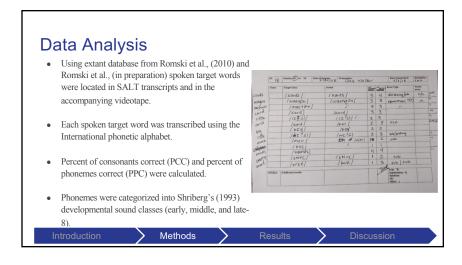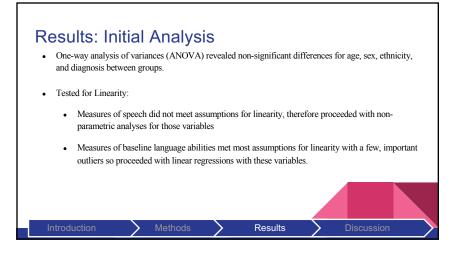
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Component	SCI (Study 1) n=6	ACI (Study 1) n=6	ACO (Study 1 & 2) n=16	ACIO (Study 2) n=10
Mode	I/P and child use speech to communicate	I/P uses SGD to provide communication input to child	Child uses SGD to communicate	I/P uses SGD to provide communication input to child
Target vocabulary	Individualized vocabulary of spoken words	Individualized vocabulary of visual-graphic symbols + words	Individualized vocabulary of visual-graphic symbols + words	Individualized vocabulary of visual-graphic symbols + words
Strategies	I/P encourages and prompts the child to produce spoken words	I/P provides vocabulary models to child using the device; symbols are positioned in the environment to mark referents	I/P encourages and prompts the child to produce communication using the device	I/P provides vocabulary models to child by using the device; symbols are positioned in the environment to mark referents; I/P encourages and prompts the child to produce communication using the device
Parent coaching	I provides resource and coaching for P	I provides resource and coaching for P	I provides resource and coaching for P	I provides resource and coaching for P

Note: I=interventionist P=parent

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Data Analysis

- Using extant database from Romski et al., (2010) and Romski et al., (in preparation) spoken target words were located in SALT transcripts and in the accompanying videotape.

- Each spoken target word was transcribed using the International phonetic alphabet.

- Percent of consonants correct (PCC) and percent of phonemes correct (PPC) were calculated.

- Phonemes were categorized into Shriberg's (1993) developmental sound classes (early, middle, and late-8).

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Results

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Results: Initial Analysis

- One-way analysis of variances (ANOVA) revealed non-significant differences for age, sex, ethnicity, and diagnosis between groups.

- Tested for Linearity:

  - Measures of speech did not meet assumptions for linearity, therefore proceeded with non-parametric analyses for those variables

  - Measures of baseline language abilities met most assumptions for linearity with a few, important outliers so proceeded with linear regressions with these variables.

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Results: Aim 1

To characterize the phonetic make-up of the children's spoken target vocabulary words to determine if they follow typical developmental patterns.

- On average, 81.5% of spoken target vocabulary phonemes were accurately produced.

- Across intervention groups, the majority of errors (75.5%) were age appropriate.

Table 1
Session 24 Description of errors in production by phonemes

	AAC(*n*=33)	SCI(*n*=6)
Group Descriptors *M(SD)*		
Age at Baseline	31.25(6.23)	30.44(3.89)
Number of different spoken target words	5.46(5.31) range 0-21	1.44(1.51) range 0-2
Phoneme Descriptions *M(SD)*		
PCC (Early-8)	.87(.21)	1(0)
PCC (Middle-8)	.80(.21)	.95(.11)
PCC (Late-8)	.70(.30)	.60(.42)
PCC (Total-8)	.81(.14)	.82(.21)
Percent of Errors *M(SD)*		
Final Consonant Deletion	.02(.03)	0
Substitution	.03(.03)	0
Deletion	.01(.02)	.08(.02)
Cluster reduction	.04(.06)	0
Vocalic /r/ errors	.03(.07)	0
Vowel errors	.006(.02)	0
Other	.01(.02)	0

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Discussion

- Producing more errors when beginning to speak is a common trait of emerging talkers.

- These results confirm prior research that young children with developmental disorders beginning to speak, produce developmentally appropriate speech-sound errors (Bauman-Waengler, 2012; Bysterveldt, 2009; Kumin et al., 1994; Shriberg, 1993).

- Negates the potential negative effects of AAC intervention on articulation development in young children with developmental disorders (Miller et al., 2006; Romski et al., 2010; Romski & Sevcik, 1996).

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Results: Aim 2

To identify if augmented interventions using SGDs have an effect on the phonemic accuracy of spoken target vocabulary compared to a non-augmented intervention.
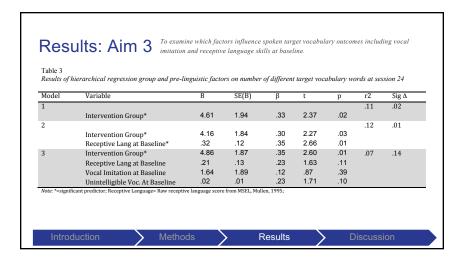
- Non-parametric, Mann-Whitney U to determine if differences between groups on speech sound error patterns at session 24.
  - AAC group produced significantly more cluster reductions than children in the spoken condition, *U*(38) = 118.50, *p* =.03
  - We examined clusters available in target vocabulary--no significant differences between groups.

- Non-parametric, Mann-Whitney U to determine if SGD had an effect on the accuracy of phonemes in different developmental classes.

- No significant differences at session 24.

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Discussion

- Intervention specifically targeting spoken language did not yield better accuracy of spoken target vocabulary words compared to AAC interventions.

- This adds to the literature that supports AAC using SGDs as a means of early intervention, and dispute the idea that AAC may cause some detrimental effects to speech-sounds development

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Results: Aim 3
To examine which factors influence spoken target vocabulary outcomes including vocal imitation and receptive language skills at baseline.

Table 3
Results of hierarchical regression group and pre-linguistic factors on number of different target vocabulary words at session 24

Model	Variable	B	SE(B)	β	t	p	r2	Sig Δ
1							.11	.02
	Intervention Group*	4.61	1.94	.33	2.37	.02		
2							.12	.01
	Intervention Group*	4.16	1.84	.30	2.27	.03		
	Receptive Lang at Baseline*	.32	.12	.35	2.66	.01		
3	Intervention Group*	4.86	1.87	.35	2.60	.01	.07	.14
	Receptive Lang at Baseline	.21	.13	.23	1.63	.11		
	Vocal Imitation at Baseline	1.64	1.89	.12	.87	.39		
	Unintelligible Voc. At Baseline	.02	.01	.23	1.71	.10		

*Note: *=significant predictor; Receptive Language= Raw receptive language score from MSEL, Mullen, 1995;*

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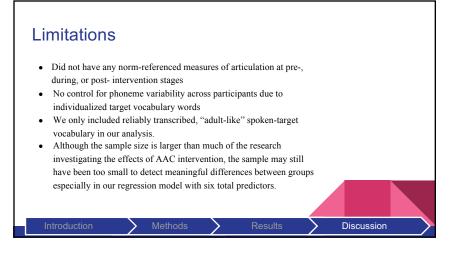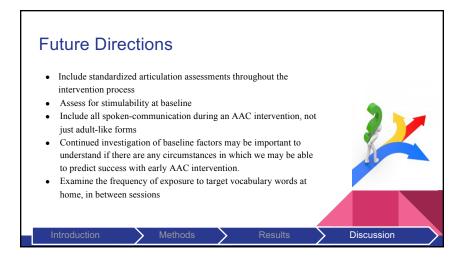

Discussion

○ These findings support Romski et al. (2010) outcomes, which showed that participation in augmented intervention produced an increased probability of spoken target vocabulary.

○ Similar to language development in typical children, baseline receptive language skills are important predictors of expressive language outcomes. However, these results do not support that a prerequisite level of skill is *necessary* for speech outcomes.

○ Having AAC intervention, versus a spoken language intervention, was the most reliable predictor of number of different spoken words at the end of intervention.

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Clinical Implications

● Clinicians should use AAC with young children with severe communication disorder to support expressive language development without fear that it will impair articulation skills.

● Findings reject the myth that a certain level of prerequisite skill is required prior to intervening with AAC (Romski & Sevcik, 2005).
  ○ Method of intervention is more important than the baseline skillset.

● AAC options in speech-language therapy allows children with severe developmental delay to continue to develop expressive language abilities in parallel to articulation skills.
  ○ Without pressure of having to communicate orally.

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Limitations

● Did not have any norm-referenced measures of articulation at pre-, during, or post- intervention stages
● No control for phoneme variability across participants due to individualized target vocabulary words
● We only included reliably transcribed, "adult-like" spoken-target vocabulary in our analysis.
● Although the sample size is larger than much of the research investigating the effects of AAC intervention, the sample may still have been too small to detect meaningful differences between groups especially in our regression model with six total predictors.

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Future Directions

- Include standardized articulation assessments throughout the intervention process
- Assess for stimulability at baseline
- Include all spoken-communication during an AAC intervention, not just adult-like forms
- Continued investigation of baseline factors may be important to understand if there are any circumstances in which we may be able to predict success with early AAC intervention.
- Examine the frequency of exposure to target vocabulary words at home, in between sessions

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Examples of words in spoken vocabulary

- *Giraffe*
- *Ball*
- *MyTurn*
- *Bubbles*
- *Jumping*
- *Apple*
- *More*
- *AllDone*

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