Speech Sound Development

**Typical Speech**
- Shriberg’s (1993) classification of consonant development:
  - Early-th [θ, ð, ʒ, ʃ, ð, ʒ], [θ, ð, ʒ, ʃ, ð, ʒ], [θ, ð, ʒ, ʃ, ð, ʒ]
  - Mid-th [s, z, ʒ, ʃ, s, z, ʒ, ʃ], [s, z, ʒ, ʃ, s, z, ʒ, ʃ]
  - Late-th [t, d, n, m, d, n, t, d], [t, d, n, m, d, n, t, d]
- Some speech sound errors persist even after first words stage (e.g., cluster reduction, final consonant deletion, /r/ distortions, some substitutions).

**Atypical Speech**
- Children with intellectual disabilities exhibit increased frequency and persistence of speech sound errors and deletion of consonants (Bauerman-Waengler, 2012).

Speech Generating Device (SGD)

Augmentative and Alternative Communication and Speech Outcomes

**Myth 1** (Romski & Sevcik, 2005)
- "AAC hinders or stops further speech development."
  - A AAC intervention may result in increasing vocal and speech development (Bauerman-Leech & Cross, 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).

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.
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.

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

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.
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).

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.
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

<table>
<thead>
<tr>
<th>Group Descriptions</th>
<th>Mean (SD)</th>
<th>Median (Mdn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Baseline</td>
<td>31.25(6.23)</td>
<td>30.44(3.89)</td>
</tr>
<tr>
<td>Number of different spoken target words</td>
<td>5.46(5.31)</td>
<td>1.44(1.51)</td>
</tr>
</tbody>
</table>

Phoneme Descriptions (M(SD))

- PCC (Early-8): .87(.21) vs .95(.11)
- PCC (Middle-8): .80(.21) vs .60(.42)
- PCC (Late-8): .70(.30) vs .60(.42)
- PCC (Total-8): .81(.14) vs .82(.21)

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.

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; Bytersveldt, 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).
Results: Aim 3

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Variable</th>
<th>B</th>
<th>SE(B)</th>
<th>β</th>
<th>t</th>
<th>p</th>
<th>r²</th>
<th>Sig</th>
<th>Δr²</th>
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<tbody>
<tr>
<td>1</td>
<td>Intervention Group*</td>
<td>4.61</td>
<td>1.94</td>
<td>.33</td>
<td>2.37</td>
<td>.02</td>
<td>.11</td>
<td>.02</td>
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<td>.03</td>
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<td>.01</td>
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<tr>
<td>3</td>
<td>Receptive Lang at Baseline*</td>
<td>.32</td>
<td>.12</td>
<td>.23</td>
<td>2.66</td>
<td>.01</td>
<td>.07</td>
<td>.14</td>
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<tr>
<td></td>
<td>Intervention Group*</td>
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<td>1.87</td>
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<td>.21</td>
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<td>.11</td>
<td>.07</td>
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<tr>
<td></td>
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<td>1.71</td>
<td>.10</td>
<td>.06</td>
<td>.10</td>
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</tbody>
</table>

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

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.

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.

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.
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

Examples of words in spoken vocabulary

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

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