**Title**: Vowel accuracy predicts word learning in minimally verbal children with autism spectrum disorder

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**Introduction**: An estimated 30% of autistic children are minimally verbal, which has a significant impact on behavioral, educational, social, and vocational outcomes over the lifespan (Tager-Flusberg & Kasari, 2013). Understanding what skills predict progress in language intervention is critical for developing personalized treatments and improving outcomes, and recent work has identified speech production ability as a key predictor of language development in autism (Chenausky et al., 2019). While vowel accuracy is not often the primary focus of clinical speech production measures, recent research has focused on vowels because of the effect they have on prosody and the potential implications for intelligibility (e.g., Maffei et al., 2024). In addition, vowel production in other populations is associated with dysarthric speech and may be an indicator of the motor difficulties with articulation. Allison et al. (2017) found that reduced precision in the production of vowel targets and significantly smaller vowel space areas were present in children with cerebral palsy and dysarthria when compared to typically developing same-aged peers. The objective of the current study is to explore how features of minimally verbal autistic children’s vowel productions (i.e., accuracy, duration, and distinctiveness) relate to progress in a word learning intervention.

**Method**: 22 school-age children with autism (mean age = 6.45 years, range = 4.58-10.75 years; 5 girls) participated in a word learning intervention targeting speech and vocabulary skills (Brady et al., 2021). All participants were minimally verbal (i.e., used fewer than 50 spoken words and no phrase level speech) at study onset. An expressive vocabulary probe of CVC words was administered 1x/week over the course of the intervention study, and probe responses were transcribed and scored for accuracy. Vowel accuracy was determined by measuring whether the probe response matched the target along four parameters: height, advancement, tenseness, and roundedness, resulting in a score between 0 and 4.  All vowel productions were also analyzed for vowel duration, fundamental frequency, F1, and F2 using Praat software (Boersma, 2001). 20% of vowel productions across all participants were randomly selected and analyzed again for reliability. At baseline, all participants also completed a Verbal Imitation Battery (VIB; Rogers et al., 2003) which included both gross motor and oral motor imitation tasks. Response to intervention was measured by averaging the number of words learned in all subsequent weeks of intervention. We examined whether baseline performance on oral motor imitation, vowel accuracy, and vowel acoustic features were associated with response to intervention.

**Results**: Participants’ mean vowel accuracy across all attempted probe words ranged from 0 to 3.58 (mean = 2.03). Vowel accuracy at baseline was significantly associated with response to intervention, such that higher vowel accuracy at baseline was associated with more words learned per week (*F*(1, 20) = 6.13, *p* = .022). Higher oral motor imitation scores at baseline also significantly predicted greater response to intervention (*F*(1, 16) = 6.98, *p* = .018), and oral motor skills were moderately significantly associated with vowel accuracy (*r* = 0.53, *p* = .024). Vowel duration at baseline did not significantly predict response to intervention (*F*(1, 17) = 4.18, *p* = 0.057). Planned analyses will assess vowel distinctiveness by standardizing vowel formant values to account for differences in age and gender (Fourakis, 1993) and measuring the distance between vowel productions. We hypothesize that higher vowel distinctiveness will be associated with greater response to intervention.

**Discussion:** The current findings underscore the importance of speech production as a key predictor of treatment outcomes for autistic children who are minimally verbal, and replicate previous work showing the relationship between speech production and language skills in autism (Brady et al., 2021; Chenausky et al., 2019; Saul & Norbury, 2020). The current study builds on prior research by focusing specifically on vowel productions and their relationship to intervention outcomes. We found that vowel accuracy was a unique predictor of speech and language intervention progress, and that differences in vowel accuracy may be related to oral motor imitation skills, highlighting the importance of vowel productions in characterizing general speech production abilities and predicting treatment outcomes. Further research is needed to identify specific patterns and characteristics of children’s vowel productions that may predict language development and language intervention progress, which may inform future interventions.

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