Phonological development in a three-vowel language

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Very young children demonstrate regular phonological patterning, such as velar fronting, that nevertheless diverges from their input (Pater & Barlow 2004; Inkelas & Rose 2007). Yet even once these early patterns subside, children still have years of phonological development ahead of them. For example, from one production to the next, a child's speech is more variable than an adult's. Children don't reach adult-like levels of variability until around age 12. This is a robust finding in developmental phonology, replicated innumerable times (Hillenbrand et al. 1995; Lee et al. 1999; Ménard et al. 2007; Pettinato 2016; c.f. McGowan et al. 2014). And generally, this instability in child speech is attributed to physiology: the child's transient anatomy (Vorperian & Kent 2007) or underdeveloped motor routines (Goffman et al. 2008) explain their speech variability.

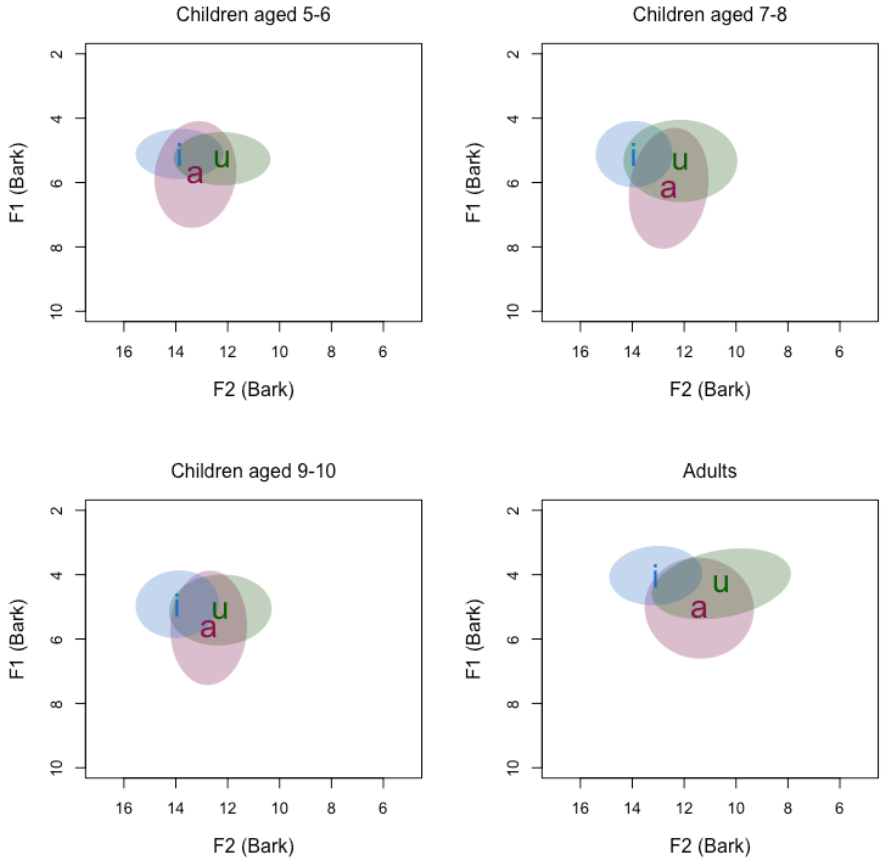
However, this conclusion on child speech may be premature because the data were drawn from a limited set of languages: English and French. For children's acquisition of vowel categories in particular, these languages present a confounding factor. Both English and French have a relatively large number of vowel contrasts – and vowel inventory size and intra-category dispersion may be negatively correlated in adult speakers (Manuel & Krakow 1984; Recasens & Espinosa 2006; 2009; c.f. Bradlow 1995). So we ask, could children learning a language with less vowel contrasts have even *more* variable speech production? Additionally, since children tend to first master consonants that are most frequent in their ambient language (Edwards & Beckman 2008), phonological development in systems with different vowel frequencies warrants investigation. Linguistic structure, instead of anatomy alone, may affect children's vowel development. If so, we expect children acquiring a language with few vowel contrasts to be equally, if not more, variable than adults.

To test these hypotheses, we measured vowel category dispersion in Chuquisaca Bolivian Quechua, a highly agglutinating three-vowel (/a, i, u/) language with non-contrastive mid vowels. Recordings for this study come from oral child and adult corpora (Kalt 2009; *to appear*). *N*=26 (F=14) children aged 5;0-10;0 completed a picture selection and description task. *N*=2 adults (F=1) narrated the Duck Story (Kalt et al. 2009). This resulted in naturalistic yet contextually-consistent narratives of 10-20 minutes. Participants responded to questions about the stimuli posed by an adult native or fluent heritage speaker.

A native speaker transcribed and morphologically segmented the narratives, which were aligned in Praat (Boersma & Weenink 2017). Formant measurements were automatically extracted from *N*=8868 child tokens and *N*=1752 adult with IFC Formant (Watanabe 2001). Given the high frequencies of child speech, automated extraction can be problematic. Measurements were hand-verified in spectral slices to ensure reliability with peak harmonics. Intra-category vowel variability was calculated in two ways 1) the Mahalanobis distance, a metric of normalization that can reflect oblong dispersions that are common in 2D acoustical space and 2) the coefficient of variation described in Lee et al. (1999) to compare our findings with previous works.

Mixed-effects models fit to predict the dispersion of each vowel category demonstrated that age did not improve model fit. This means that by age 5;0, child Quechua speakers' vowel dispersion does not reliably differ from adults' (figure 1). However, vowel dispersion did differ by morphological form (suffix versus root morpheme) as well as syllable position in the word. In word roots, vowel categories were more dispersed in children 5;0-6;0 than any other age group. These findings suggest that child speech variability does not stem entirely from children's articulatory limitations. Linguistic structure – vowel inventory size and morphological composition – may play a role in how children master their vowel categories. With these results, we stress the need to supplement existing studies of child phonology with data from languages underrepresented in the literature.

FIGURE 1. Vowel dispersion by age



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Syllables and geminates in Tashlhiyt Berber language acquisition

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We present preliminary results of a longitudinal study that focuses on the developmental trajectory of speech production capacities in two Berber children acquiring Tashlhiyt from the babbling period to the emergence of early grammar. Very few studies, if any, are devoted to the Berber language acquisition, and Tashlhiyt, the variety spoken in South-west Morocco, presents very interesting phonetic and phonological characteristics to study in a developmental perspective. One of the most salient characteristic is the use of complex consonants clusters, resulting in a highly marked syllable structure where any segment, even a voiceless obstruent, may occur in the nucleus position (cf. Dell & Elmedlaoui 1985, 2002). Another feature, which deserves to be studied relates to consonant length. Tashlhiyt Berber contrasts singleton and geminated consonants in various contexts, including word-initial, medial and final positions. Geminates raise many issues with regard to their syllabic representation, especially when they occur in contexts where ambisyllabicity is required.