

Bilingual language development as a lens into the relationship between child-directed speech and phonological processing

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Child-directed speech (CDS) is a speech register often characterized by hyperarticulation (expanded vowel space, enhanced phonological contrasts).¹ Children who hear more CDS early in life process speech and words faster^{2,3} which many have attributed to the hyperarticulation in CDS—CDS makes individual phonemes and words more discernable in the speech stream which facilitates phonological and lexical processing. However, CDS is not cross-linguistically universal,⁴ and children from cultures with low CDS rates nevertheless reach major phonological milestones.⁵ This presents a CDS PARADOX: how can CDS simultaneously facilitate phonological development in some contexts, but not others?

To resolve this paradox, we propose that children develop *language-specific phonological processing strategies* that accommodate the language system they are learning. Previous work on the relationship between CDS and phonological processing may have produced mixed results because metrics that are highly predictive of English acquisition, such as word token count in CDS, may not be as predictive for languages with morphological typologies differing from English. We evaluate this idea by measuring the relationship between CDS and phonological processing in bilingual children acquiring languages with highly distinct morphological structures (South Bolivian Quechua and Spanish): Quechua has an extensive, agglutinating, non-fusional morphology (high morpheme to word ratio) while Spanish is highly fusional (low morpheme to word ratio). Additionally, unlike previous work that compared individual monolingual children learning different languages, in this study design each bilingual child serves as their own control. This design allows us to attribute any differences observed to the languages studied, and not different children.

Data come from N=36 bilingual Quechua-Spanish children (age 3;0-7;2). We assessed each child's phonological processing skill using a classic experimental phonology paradigm: the nonword repetition task. In nonword repetition, children repeat phonotactically-plausible fake words, varying in syllable length, after a pre-recorded model speaker. The children completed two nonword repetition tasks: one with N=22 plausible Quechua nonwords⁶ and another with N=22 Spanish nonwords.⁷ Word stimuli length varied (2-5 syllables). Each repetition was scored on the basis of syllable omission, segment omission, and segment substitution. We quantified each child's CDS exposure using daylong audio recordings. The child wore a small, lightweight audio recorder in a specialized shirt for an entire day (~16 hrs.). We annotated 30-second segments from each recording for language spoken (Quechua, Spanish, Mixed) and addressee (e.g. CDS, adult-directed speech). We then employed a language-neutral, automated linguistic unit counter,⁸ trained on child-centered audio data, over CDS portions of the recording to quantify the number of syllables and words.

In a mixed effects model (random effects of Child and Word), we confirmed that children found shorter nonwords easier to repeat than longer (**# of Syllables**: $\beta=0.26$; $p<.001$) and older children had higher accuracy (**Child Age**: $\beta=-0.10$; $p<.001$) (Figs. 1 & 2). There was an effect of **CDS Quantity** (in seconds) ($\beta= -0.002$, $p=.03$): children who heard more CDS—in Quechua or Spanish—had stronger skills (Fig. 3). However, we then employed the automated linguistic unit counter and confirmed *higher word counts* in Spanish than Quechua CDS. This finding aligns with the languages' morphological structures) and suggests that the facilitative effect of CDS may not be language-neutral *when appropriate linguistic units are counted*. Overall, results from this population and language pairing suggest that the facilitative effect of CDS for phonological processing may depend on the linguistic structure the child is acquiring.

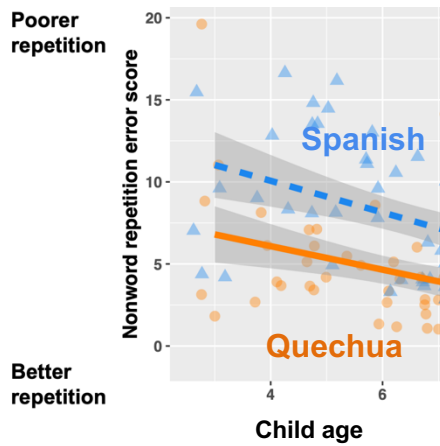


Fig. 1 The relationship between child age and nonword repetition score: older children repeat nonwords more faithfully.

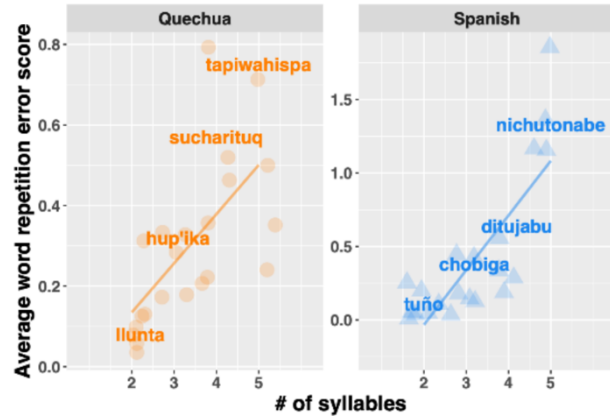


Fig. 2 The relationship between syllable count and nonword repetition score: children repeat shorter words more faithfully than longer in both languages.

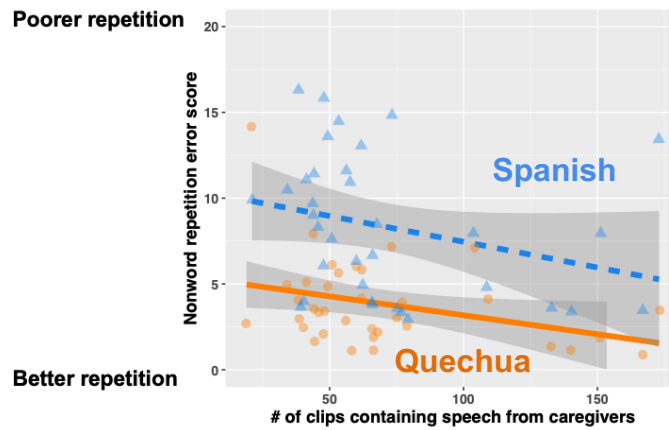


Fig 3. Children who hear more seconds of child-directed speech in the input repeat nonwords more faithfully.

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