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An Oddball Investigation of Monolingual and Bilingual Infants' Phonetic Discrimination Using Functional Near-Infrared Spectroscopy (fNIRS)

Matthew Dubins¹ Melody S. Berens¹ , Ioulia Kovelman² , Mark Shalinsky¹ , Laura-Ann Petitto¹;
¹University of Toronto, ²Massachusetts Institute of Technology

Abstract

For decades, behavioral data have not adjudicated the question of whether infants use general-auditory or language-specific mechanisms to learn the set of phonetic units that comprise their native language. Here we ask this question by using functional Near-Infrared Spectroscopy (fNIRS, Hitachi ETG-4000) to investigate the neural correlates of language processing in monolingual and bilingual infants. Using an Oddball/Event paradigm, monolingual and bilingual Young infants (age 2-6 months, n = 19), Older infants (age 10-14 months, n=14), and Adults (n=38) were presented with nonlinguistic Tones, and linguistic syllables that differed by one phonetic feature in English, and in Hindi, while undergoing fNIRS. fNIRS measures hemodynamic change (deoxygenated, oxygenated, total hemoglobin), is child-friendly, quiet, portable, and tolerates movement. Its temporal resolution (10-Hz) and spatial resolution (~3-4 cm depth) are excellent for cortical studies of language. Results: Specific neural tissue classically associated with language processing was recruited differently across ages, reflecting maturational changes corresponding to universal linguistic timing milestones. Young monolingual and bilingual infants recruited Left Broca, and bilateral STG, while listening to native and non-native contrasts. Remarkably, all Older infants showed decreased neural recruitment of Left Broca for native English relative to non-native Hindi contrasts. Conclusions: The findings provide first-time imaging evidence that infants use languagespecific tissue when learning the set of phonetic units in their native language. Significance: fNIRS allowed examination of the neural underpinnings of phonetic learning in infants, providing important information about the interplay between biology and experience in the developing brain. Funding-Petitto (P.I.): NIHR21HD05055802. NIHR01HD04582203.