

Early signed language exposure does not harm phonemic discrimination for individuals with cochlear implants (CIs): evidence from fNIRS neuroimaging

Authors: Shakhlo Nematova¹, Benjamin Zinszer¹, Thierry Morlet², Giovanna Morini¹, Laura-Ann Petitto^{3*}, Kaja Jasinska^{1,4}

*Senior Author

¹Department of Linguistics and Cognitive Science, University of Delaware

²Nemours/Alfred I. duPont Hospital for Children

³PhD in Educational Neuroscience program, Gallaudet University

⁴Haskins Laboratories

Abstract

We tested two competing hypotheses about age of signed language exposure (age-ASL) with CIs. Geers et al. (2017) claimed that signed language exposure harms spoken language development, while others argue the contrary suggesting that early signed language exposure supports language development by offsetting the negative effects of language deprivation prior to implantation (Davidson et al., 2014; Jasinska & Petitto, 2013; Petitto et al., 2016). Hypotheses tested: (1) only early-life spoken language exposure through CI— or, (2) early-life simultaneous signed and spoken language exposure— support neural systems underlying phonemic discrimination. Eighteen adults with CIs exposed to signed language between age 1-22 years completed an auditory phoneme discrimination task while undergoing fNIRS neuroimaging. Phonemic discrimination showed no significant effect of age-ASL, and was only marginally better for individuals implanted earlier ($b = -.019$, $t(16) = -1.777$, $p = .094$). There was significant age-ASL and age-CI interaction in LIFG and LSTG. As age-CI increased, adults with earlier age-ASL showed increased activation in LIFG ($b = 2.345$, $t(23) = 3.034$, $p < .0001$) and STG ($b = 2.027$, $t(23) = 3.938$, $p = .0006$), and adults with later age-ASL showed reduced activation in LIFG ($b = -.827$, $t(23) = -3.207$, $p = .003$) and angular and supramarginal gyri ($b = -1.450$, $t(23) = -4.085$, $p = .0004$). We found no negative impact of sign language exposure on phonemic discrimination. Earlier versus later sign-exposed individuals with early implantation showed greater activation in language areas (LSTG, LIFG), supporting Hypothesis 2. Early-life language exposure, irrespective of modality, supports neurodevelopment underlying phonemic discrimination.