Abstract

Over 3 million U.S. adults with single-sided deafness (SSD, one normal hearing ear, one deaf ear) struggle with everyday communication. Sound input to only one ear and the resultant loss of binaural processing cues has disabling effects on speech understanding, especially in noise. Communication ability among those with SSD varies; reasons for this are unknown. Some variability may be due to the timing of SSD (age at onset, length of SSD) and its impact on neural reorganization. Some variability may also be due to differences in SSD listeners’ use of non-auditory cognitive resources when listening to speech in noise. Cochlear implantation (CI) as a treatment for SSD has greatly increased, yet some CI outcomes are poor. Our studies employ high-density diffuse optical tomography (HD-DOT) to study reorganization in higher-level regions associated with cognitive processing and speech recognition. Importantly, HD-DOT is compatible with CIs, a novel breakthrough in the study of neural activity in implanted patients. In Aim 1, we study SSD listeners with no CI, to evaluate the effects of two key variables, age at onset and length of SSD, on behavioral outcomes and on the brain networks engaged during speech recognition. In Aim 2, we study SSD listeners with a CI, who have access to bilateral input. Using HD-DOT, we test whether engaged networks change when SSD-CI recipients listen bilaterally (normal hearing ear and CI) versus unilaterally (CI off) and whether the CI may actually impede bilateral speech processing cues for some listeners (e.g., those with lengthy SSD experience).