Multimodal perception of Mandarin tones by children with cochlear implants

Ping Tang

Nanjing University of Science and Technology

Mandarin Chinese is a tonal language using four lexical tones to differentiate word meaning, primarily contrasting in pitch. However, tone perception is a great challenge for children with cochlear implants (CIs), because the devices cannot transmit pitch information effectively. Despite this, daily speech communication often takes place in contexts where the listener can both hear and see the speaker. It has been shown that seeing a speaker's face (e.g., lip, face, and head movements) improves normal-hearing (NH) adults' tonal perception accuracy when auditory information is unavailable or unreliable, such as perceiving CI-simulated speech or non-native tones in noise. However, it is unclear if children with CIs can also use visual (facial) cues to facilitate their perception of Mandarin tones, especially in noisy environments. This was tested in this study.

We have tested 85 children with CIs (3-7 years) and 85 NH peers in Northern China areas. Stimuli included Mandarin tones carried by high-frequency monosyllabic words, video-recorded by a female speaker. Tonal identification tasks were conducted in quiet and noisy (SNR: 0 dB) conditions separately. Children were presented with tonal productions (e.g., ma3 horse) in audio-only (AO) or audio-visual (AV) conditions (counterbalanced across participants). Children were asked to identify tones by selecting from two pictures describing two objects only differing in tone, e.g., ma1 mother and ma3 horse.

The results showed that, while the tonal perception accuracy was not significantly different between AO and AV conditions for NH group in any condition, or CI group in the quiet environment, it is significantly higher in the AV condition (74%) as compared to that in the AO condition (59%) for CI group in the noisy environment. This suggests that children with CIs have used visual cues to facilitate their tonal perception, though only in noisy environments.