Abstract

Younger adults with normal hearing (YNH) have a remarkable ability to comprehend a single talker in the presence of multiple talkers. This ability to understand the speech is hindered due to the acoustic as well as auditory changes with increase in age and hearing loss. Even people with today's best hearing aids often complain that they have major difficulties in the above-mentioned circumstances. Although a difference in voice pitch (fundamental frequency, F0) has been shown to be an important cue for talker segregation, the neural mechanisms for the difficulties faced by listeners with the acoustic and auditory changes in complex environments remains unknown. Thus, the present research focuses on the neural mechanisms of speech perception to better understand the auditory (cochlear) signal-processing mechanisms that contribute to a listener's ability to segregate talkers in real-world listening environments.

Concurrent vowel identification was used as an experimental task for understanding how F0 difference cue can be used to segregate multiple talkers prior to perception. In this experimental setup, two steady-state synthetic vowels with equal duration and sound level are presented simultaneously to one ear of a listener. The task of the listener is to identify them on the basis of F0 difference between the two vowels. For YNH listeners, the percent identification of both vowels improves with increasing F0 difference between the two vowels and then typically asymptotes at ~3 Hz F0 difference or higher. These overall identification of concurrent vowel scores were reduced with the acoustic (low and high sound levels, shorter duration) and auditory changes due to increase in age and hearing

loss. To investigate the neural mechanisms underlying the acoustic changes on concurrent vowel scores, a physiologically realistic auditory-nerve (AN) model was cascaded with an F0-guided segregation algorithm in this dissertation. Similarly, to include the auditory changes on concurrent vowel scores with an increase in age and hearing loss, physiological and anatomical functional changes were incorporated in the AN model with a uniform F0-guided segregation algorithm. The obtained model scores matched qualitatively with the behavioral scores due to acoustic and auditory changes.

For the variations of sound levels, the possible reason for the minimum scores at lower level is due to the limited F0-guided segregation of the concurrent vowels, whereas at higher levels the scores were reduced due to the poor phase-locking to formants due to broadened auditory filters. The reduced concurrent vowel scores at shorter duration was due to the limited ability to avail the F0-guided segregation cue between the vowels. Predictions with the inclusion of EP reduction and cochlear synaptopathy showed a degradation in the concurrent vowel scores, that matched well with the aged listeners. Whereas, the model predictions with the inclusion of hearing loss and cochlear synaptopathy showed a lower concurrent vowel scores, that matched well with the hearing loss listeners. Overall, the findings from the current dissertation provide a valuable perceptual and physiological insight to improve signal-processing strategies in hearing aids for better speech perception in complex listening environments.