Effect of Noise Reduction Gain Errors on Simulated Cochlear Implant Speech Intelligibility

It has been suggested that the most important factor for obtaining high speech intelligibility in noise with cochlear implant (CI) recipients is to preserve the low-frequency amplitude modulations of speech across time and frequency by, for example, minimizing the amount of noise in the gaps between speech segments. In contrast, it has also been argued that the transient parts of the speech signal, such as speech onsets, provide the most important information for speech intelligibility. The present study investigated the relative impact of these two factors on the potential benefit of noise reduction for CI recipients by systematically introducing noise estimation errors within speech segments, speech gaps, and the transitions between them. The introduction of these noise estimation errors directly induces errors in the noise reduction gains within each of these regions. Speech intelligibility in both stationary and modulated noise was then measured using a CI simulation tested on normal-hearing listeners. The results suggest that minimizing noise in the speech gaps can improve intelligibility, at least in modulated noise. However, significantly larger improvements were obtained when both the noise in the gaps was minimized and the speech transients were preserved. These results imply that the ability to identify the boundaries between speech segments and speech gaps may be one of the most important factors for a noise reduction algorithm because knowing the boundaries makes it possible to minimize the noise in the gaps as well as enhance the low-frequency amplitude modulations of the speech.