Speech perception is a complex process involving the ability to detect the speech signal, separate it from interfering sounds and decode the transmitted speech information. In contrast to normal hearing (NH) listeners, hearing-impaired (HI) listeners often show a large reduction in the masking release (MR), which is the improvement in speech intelligibility when the interferer is different from steady-state noise (e.g., a competing talker). MR is usually measured as the difference in speech reception thresholds (SRTs), the signal-to-noise ratio (SNR) where 50% of the speech is understood, and has mainly been linked to the ability to separate the target from the interferer. However, it is still not clear why HI listeners show a reduced MR and how the ability to decode the speech information is affected by impaired hearing. Thus, the purpose of this thesis was to investigate MR in both NH and HI listeners, to study the effects of hearing loss on the ability to decode speech, and to establish a framework for modeling speech intelligibility based on an auditory processing model. The first part of the thesis established the modeling framework and showed that, by using a model that captures the processing of the different stages of the auditory system, it is possible to predict speech intelligibility using a very simple back end. Furthermore, the results indicated that the high-energy segments are the most important for speech intelligibility.

The second part focused on recent indications that the large reduction in MR often observed in HI listeners is a result of measuring the MR of HI listeners at a higher signal-to-noise ratio (SNR) in stationary noise relative to NH listeners. The present work presented noise-band vocoded as well as low-pass and high-pass filtered stimuli to NH listeners, thereby decreasing their speech intelligibility and making it possible to compare the MR of NH and HI listeners not only at the same SNR, but also at the same same percent correct, which was not done in previous studies. The MR was found to be only partially related to the SRT obtained in stationary noise. Furthermore, for a competing talker, noise-vocoding strongly reduced the MR of the NH listeners to that obtained with HI listeners. This indicated that deficits in coding of temporal fine structure and fundamental frequency (F0) information may play a critical role for the reduced MR of the HI listeners. The third part investigated the contribution of high-rate envelope fluctuations, at the output of the auditory filters, to MR. High-rate envelope fluctuations are produced by the interaction between unresolved harmonics and are related to the F0 of voiced speech. A new vocoder technique was developed to effectively attenuate the high-rate envelope fluctuations. Furthermore, high-pass filtering was used to reduce the amount of F0 information from resolved harmonics. The results showed high-rate envelope fluctuations, related to the F0, were sufficient to obtain a large MR. Furthermore, F0-related information from resolved harmonics were also sufficient for MR. However, when both high-rate envelope fluctuations and F0-related information from resolved harmonics were reduced, the MR was strongly reduced. Thus, the results indicated that F0 information is crucial for MR, but that it does not matter if it is obtained from low-order resolved harmonics or from high-rate envelope fluctuations produced by interaction between unresolved harmonics.

The final avenue of investigation focused on the effects of hearing loss on the ability to decode speech by measuring consonant confusions for both individual HI listeners and also individual utterances of the same consonants. In general, the results showed that individual HI listeners consistently confused the presented utterances with only one other consonant, and that most of the HI listeners actually made the same confusions. The results also indicated that the reason for the large variability in the confusion patterns of HI listeners observed in previous studies is that different utterances of the same consonant promote different confusions and that the HI listeners experience problems with different utterances. Overall, this thesis provides insights about the large MR observed for NH listeners, why this MR is often reduced for HI listeners and in which way impaired hearing affects the ability to decode speech information.