Toward a more comprehensive understanding of the impact of masker type and signal-to-noise ratio on the pupillary response while performing a speech-in-noise test

Difficulties arising in everyday speech communication often result from the acoustical environment, which may contain interfering background noise or competing speakers. Thus, listening and understanding speech in noise can be exhausting. Two experiments are presented in the current study that further explored the impact of masker type and Signal-to-Noise Ratio (SNR) on listening effort by means of pupillometry. In both studies, pupillary responses of participants were measured while performing the Danish Hearing in Noise Test (HINT; Nielsen and Dau, 2011). The first experiment aimed to replicate and extend earlier observed effects of noise type and semantic interference on listening effort (Koelewijn et al., 2012a). The impact of three different masker types, i.e. a fluctuating noise, a 1-talker masker and a 4-talker masker on listening effort was examined at a fixed speech intelligibility. In a second experiment, effects of SNR on listening effort were examined while presenting the HINT sentences across a broad range of fixed SNRs corresponding to intelligibility scores ranging from 100 % to 0 % correct performance. A peak pupil dilation (PPD) was calculated and a Growth Curve Analysis (GCA) was performed to examine listening effort involved in speech recognition as a function of SNR. The results of the two experiments showed that the pupil dilation response is highly affected by both masker type and SNR when performing the HINT. The PPD was highest, suggesting the highest level of effort, for speech recognition in the presence of the 1-talker masker in comparison to the 4-talker babble and the fluctuating noise masker. However, the disrupting effect of one competing talker disappeared for intelligibility levels around 50 %. Furthermore, it was demonstrated that the pupillary response strongly varied as a function of SNRs. Listening effort was highest for intermediate SNRs with performance accuracies ranging between 30 % -70 % correct. GCA revealed time-dependent effects of the SNR on the pupillary response that were not reflected in the PPD.