Impact of Noise and Noise Reduction on Processing Effort: A Pupillometry Study - DTU Orbit (04/12/2018)

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Speech perception in adverse listening situations can be exhausting. Hearing loss particularly affects processing demands, as it requires increased effort for successful speech perception in background noise. Signal processing in hearing aids and noise reduction (NR) schemes aim to counteract the effect of noise and reduce the effort required for speech recognition in adverse listening situations. The present study examined the benefit of NR schemes, applying a combination of a digital NR and directional microphones, for reducing the processing effort during speech recognition. The effect of noise (intelligibility level) and different NR schemes on effort were evaluated by measuring the pupil dilation of listeners. In 2 different experiments, performance accuracy and peak pupil dilation (PPD) were measured in 24 listeners with hearing impairment while they performed a speech recognition task. The listeners were tested at 2 different signal to noise ratios corresponding to either the individual 50% correct (L50) or the 95% correct (L95) performance level in a 4-talker babble condition with and without the use of a NR scheme. In experiment 1, the PPD differed in response to both changes in the speech intelligibility level (L50 versus L95) and NR scheme. The PPD increased with decreasing intelligibility, indicating higher processing effort under the L50 condition compared with the L95 condition. Moreover, the PPD decreased when the NR scheme was applied, suggesting that the processing effort was reduced. In experiment 2, 2 hearing aids using different NR schemes (fast-acting and slow-acting) were compared. Processing effort changed as indicated by the PPD depending on the hearing aids and therefore on the NR scheme. Larger PPDs were measured for the slow-acting NR scheme. The benefit of applying an NR scheme was demonstrated for both L50 and L95, that is, a situation at which the performance level was at a ceiling. This opens the opportunity for new means of evaluating hearing aids in situations in which traditional speech reception measures are shown not to be sensitive. This is an open access article distributed under the Creative Commons Attribution License 4.0 (CCBY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

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