Benefit of Higher Maximum Force Output on Listening Effort in Bone-Anchored Hearing System Users: A Pupillometry Study

OBJECTIVES: The aim of this study was to compare listening effort, as estimated via pupillary response, during a speech-in-noise test in bone-anchored hearing system (BAHS) users wearing three different sound processors. The three processors, Ponto Pro (PP), Ponto 3 (P3), and Ponto 3 SuperPower (P3SP), differ in terms of maximum force output (MFO) and MFO algorithm. The hypothesis was that listeners would allocate lower listening effort with the P3SP than with the PP, as a consequence of a higher MFO and, hence, fewer saturation artifacts in the signal. DESIGN: Pupil dilations were recorded in 21 BAHS users with a conductive or mixed hearing loss, during a speech-in-noise test performed at positive signal-to-noise ratios (SNRs), where the speech and noise levels were individually adjusted to lead to 95% correct intelligibility with the PP. The listeners had to listen to a sentence in noise, retain it for 3 seconds and then repeat it, while an eye-tracking camera recorded their pupil dilation. The three sound processors were tested in random order with a single-blinded experimental design. Two conditions were performed at the same SNR: Condition 1, where the speech level was designed to saturate the PP but not the P3SP, and condition 2, where the overall sound level was decreased relative to condition 1 to reduce saturation artifacts. RESULTS: The P3SP led to higher speech intelligibility than the PP in both conditions, while the performance with the P3 did not differ from the performance with the PP and the P3SP. Pupil dilations were analyzed in terms of both peak pupil dilation (PPD) and overall pupil dilation via growth curve analysis (GCA). In condition 1, a significantly lower PPD, indicating a decrease in listening effort, was obtained with the P3SP relative to the PP. The PPD obtained with the P3 did not differ from the PPD obtained with the other two sound processors. In condition 2, no difference in PPD was observed across the three processors. The GCA revealed that the overall pupil dilation was significantly lower, in both conditions, with both the P3SP and the P3 relative to the PP, and, in condition 1, also with the P3SP relative to the P3. CONCLUSIONS: The overall effort to process a moderate to loud speech signal was significantly reduced by using a sound processor with a higher MFO (P3SP and P3), as a consequence of fewer saturation artifacts. These findings suggest that sound processors with a higher MFO may help BAHS users in their everyday listening scenarios, in particular in noisy environments, by improving sound quality and, thus, decreasing the amount of cognitive resources utilized to process incoming speech sounds.

General information
Publication status: Published
Organisations: Department of Health Technology, Oticon Danmark AS, Oticon Medical, Oticon Medical AB
Contributors: Bianchi, F., Wendt, D., Wassard, C., Maas, P., Lunner, T., Rosenbom, T., Holmberg, M.
Pages: 1220-1232
Publication date: 1 Sep 2019
Peer-reviewed: Yes

Publication information
Journal: Ear and hearing
Volume: 40
Issue number: 5
ISSN (Print): 0196-0202
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
Original language: English
Keywords: BAHS, Bone-anchored devices, Growth curve analysis, Listening effort, Maximum force output, Pupillometry, Pupil dilation, Speech-in-noise test
Electronic versions:
Fulltext
DOIs:
10.1097/AUD.0000000000000699
Source: Scopus
Source ID: 85071514578
Research output: Contribution to journal › Journal article – Annual report year: 2019 › Research › peer-review