Authors' response to Comment on Ohlenforst et al (2016): Exploring the Relationship Between Working Memory, Compressor Speed, and Background Noise Characteristics. Ear Hear 37(2), 137–143

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We appreciate the opportunity to respond to the comment on our study (Ohlenforst et al., 2016). The issue of concern to the letter writer, “*The speech and the noise signals were separately compressed before the SNRs [signal-to-noise ratios] were computed based on the signal’s root mean square values.*” referred to a calibration process in which the compressor gain function, derived from the mixed signal, was applied separately to the speech signal and to the separate noise signals to quantify the output SNR. This was done to investigate compressor functionality. However, to create the test stimuli presented to the participants, the compressor was applied to the mixed speech-plus-noise signal at a specified input SNR (−4, −2, and 0 dB), not on the speech signal or the noise signals alone. That is, the actual stimulus processing was all done on the mixed speech-plus-noise signal, which we believe to be the method that best represents realistic hearing aid situations. We regret the confusion that this inadvertent omission has caused, and would like to thank Dr. Leijon for bringing the issue to our attention.

The Letter raises the question as to whether direct interpretation of our study leads to the conclusion that different compression speed should be fit according to individual users’ working memory test results. We agree with Dr. Leijon that such a conclusion is premature, although not for the reasons put forward in his Letter. While our data and others (e.g., Lunner & Sundewall-Thoren, 2007) have demonstrated a relationship between working memory capacity and compression speed, wholesale reliance on that relationship fails to consider other factors which contribute to variability in response. For example, there is very likely to be a tradeoff between audibility and distortion, such that fast compression may improve phoneme audibility while altering sound patterns in such a way as to disadvantage low working memory listeners. In any individual case, there might be positive benefit of fast compression if it creates an audibility advantage over slower compression *for that listener*

and communication environment. That advantage is likely to be underestimated in laboratory studies, where sound levels are usually well controlled and hearing aids (or simulations thereof) are carefully matched to the target. In everyday listening, the input sound is likely to vary with talker vocal level and distance, such as a talker in another room, and the potential advantage of audibility may be greater. Moreover, in a clinical fitting, the audiologist may not match the target closely due to any number of other factors (e.g., earmold venting, listener dislike of sound loudness or quality, desire to minimize feedback). The Ohlenforst et al. (2016) paper provides a proof of concept and supports models of working memory (Rönnberg et al., 2013) but does not provide a literal representation of how clinical hearing aids should be fit. That point may be lost if readers do not consider lab-to-clinic differences, and is an important one to emphasize here.

There are a number of different approaches to studying the effects of hearing aid signal processing. Laboratory studies offer the advantage of more precise control but, as Dr. Leijon notes, they cannot capture the full range of effects that could occur in wearable aids. Wearable aid studies offer the advantage of realism but make it difficult to fully understand the factors at play due to the complex and interacting nature of signal processing and, often, the inability to know the details of the processing itself due to its proprietary nature. Neither approach is perfect and both approaches are needed to shed light on our clinical choices.

Dr. Leijon ends his letter by stating that we still do not know if measurements of working memory are useful for individual fitting of the compression speed in real hearing aids. This is an emerging area of research and we agree that our collective knowledge has not reached the stage of clinical best practice. In summary, while we regret the confusion we caused by the unclear presentation of our method, we are pleased to have an opportunity to comment on the larger issues and in doing so, to affirm our commitment to designing laboratory studies in such a way as to mimic realistic listening while maintaining experimental control.

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References

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