Hearing Aid Technological Advancements Over Time Have Improved Subjective Outcomes

Hearing aid technologies have made great advancements in the past decade. You probably work with these technologies or features on a daily basis, for example, Receiver-In-Canal (RIC) devices, feedback suppression, trainable hearing aids, Bluetooth connectivity, and Made for iPhone hearing aids. These innovations have substantially shaped hearing aid provision and use. Given the fact that laboratory benefits of using individual technologies have been reported (Keidser, 2012), you may wonder whether there is significant improvement in real-world outcomes due to this technological march forward.

To answer this question, we reviewed subjective outcome data collected from three clinical validation trials conducted at Starkey Hearing Technologies using the Device Oriented Subjective Outcome (DOSO) scale between 2014 and 2015. These data were compared to a different set of DOSO data that was collected in private practices between 2004 and 2005 by other researchers. We expected that the differences between these two sets of DOSO data would demonstrate the outcome improvement attributable to technological advancements.

The DOSO is a device-oriented questionnaire designed to be minimally impacted by the device wearer’s personality (Cox, Alexander, & Xu, 2014). Each item of the DOSO is formatted with a starting phrase: “How good are the hearing aids at...” An example is “How good are the hearing aids at making loud speech clear?” The DOSO produces scores for six outcome subscales: Speech cues, Listening effort, Pleasantness, Quietness, Convenience, and Use. The items for all subscales except Use are rated on a 7-category scale from “Not at all” to “Tremendously.” The items in subscale Use are rated on a 5-category scale, and describe the amount of time or how frequently a listener wears their hearing aids. A higher rating always corresponds to a more positive outcome.

Subjective Outcomes Between 2015-era Technologies and 2005-era Technologies

Between 2014 and 2015, 132 experienced bilateral hearing aid wearers (60% male) who participated in clinical trials at Starkey completed the DOSO for their own devices as a part of the intake test battery. These devices were all digital and from a variety of manufacturers. These DOSO data were compared to the DOSO interim normative data that were collected from 179 hearing aid wearers (60% male) between 2004 and 2005 (Cox et al. 2014). Mean subscale scores for both sets of data are depicted in Figure 1. Statistical analyses showed that hearing aids with 2015-era

![Figure 1. DOSO subscale scores for the 2005-era technologies, the 2015-era technologies with the participants’ own devices, and 2015-era technologies with the Starkey devices. The error bars represent one standard deviation.](image-url)
technologies performed significantly better than their counterparts with 2005-era technologies in all DOSO subscales, except Listening effort. The average ratings for Listening effort for both 2005-era and 2015-era technologies were similar, which was between “Medium” and “Considerably.” The overall findings reveal that technological advancements over the past 10 years have significantly improved subjective outcomes in many domains.

**How Are the Most Recent Starkey Hearing Aids Doing?**

In an effort to understand the outcomes of hearing aids developed on the Synergy platform, we reviewed DOSO data from the same three clinical trials when the same 132 participants used pre-release prototype Starkey devices. These hearing aids feature bandwidth extended to 10kHz, with fast acting noise suppression algorithms, and other advanced signal processing.

The DOSO data collected with the prototype Starkey devices are provided in Figure 1 and contrasted to the DOSO data for the participants’ own devices. Statistical analyses revealed that the latest technologies used in Starkey hearing aids yielded significantly higher subjective outcome scores for all six DOSO subscales. In addition, it is worth noting that the Starkey hearing aids with the most recent technologies have substantially improved Listening Effort (see Figure 1). Profit from a series of well-established research conducted at Starkey, the benefit of using Starkey’s proprietary signal processing algorithms to reduce listening effort has been demonstrated and reported in peer-reviewed journals (Sarampalis, Kalluri, Edwards, and Hafter, 2009).

**Summary**

New hearing aid technologies and features that aim at improving outcomes are continuously evolving. It is encouraging that technological advancements over the past decade have improved subjective outcomes in many domains. As a company in the technology sector, Starkey has been dedicated to innovations for half of a century. Substantial research effort has been devoted to improve outcomes of aided listening. The DOSO data for our latest technologies have demonstrated additional subjective benefits of technological advancements compared to those afforded by the common 2015-era technologies.

The current wave of technological advances has lead us into a new era, where big data, machine learning, cloud computing, internet of things, and smartphone technologies provide us with immense opportunities to expand the spectrum of innovations. We envision the future with confidence that innovations will continue enabling Starkey to provide the best products and the best services to hearing health professionals and device wearers.

**References**

