WIDEX HIGH DEFINITION HEARING

WIDEX**PRESS**

**NO.36**

JUNE 2016

By: Andrée Boissonneault, M.H.Sc.
Audiological Affairs Specialist

# UNIQUE **SOLUTIONS** FOR **FIRST TIME** HEARING AID WEARERS

## Introduction

The MarkeTrak VIII (2009) report on 25-year trends in the hearing aid industry revealed that only 1 in 4 people with a hearing loss wear hearing aids. Among those with a hearing impairment, only 1 in 10 with a mild hearing loss wears hearing aids, whereas 4 in 10 with a moderate-to-severe hearing loss wear hearing aids. These numbers show that those in the mild hearing loss category do not wear hearing aids as readily as those with more significant hearing loss. Looking at this from a different perspective, it suggests that there is still a market of potential hearing aid wearers that the hearing care professionals can tap into: those with a mild hearing loss.

Converting people with a mild hearing loss into first time hearing aid wearers requires additional considerations on the part of hearing care professionals. New hearing aid wearers face many challenges when adjusting to hearing aids, such as getting used to 'new' sounds and having something in the ear, retraining their brain to hear and so on, and these challenges can be overwhelming. With the UNIQUE family of hearing aids, our design objective is 'effortless hearing' so that all wearers, first time or experienced, young or old, cognitively impaired or otherwise, use as little effort as possible hearing and understanding across as many listening situations as possible (Kuk et al., 2016).

The focus of this article is to explore the areas which may impact a first time hearing aid wearer's satisfaction with their hearing aids, and illustrate how the new features in UNIQUE may be particularly helpful.

**Who are the first time wearers?**

It is reasonable to assume that people with a more moderate degree of hearing loss would have already purchased hearing aids and that people with a mild hearing loss are less likely to have purchased hearing aids. Thus, in this article, we will limit our discussion to first time wearers with a mild degree of hearing loss, and/or those with a high frequency hearing loss with relatively normal or near normal audiogram in the lower frequencies. These individuals will likely require special considerations in the style of hearing aids (and earmoulds) that they can wear, special functions on their hearing aids so they can experience a change in sound perception with the use of the hearing aids (over the unaided condition), and minimal artifacts from the use of the hearing aids. In essence, these people have

9 502 3814 001 #01

minimal listening difficulty, high expectations for their hearing aids, and less acceptance of any hearing aid artifacts. We believe that the technology offered in UNIQUE hearing aids can significantly help to tackle the challenges experienced by first time wearers. We will explore how UNIQUE is particularly outstanding in regards to sound quality, physical fit, and speech in noise performance.

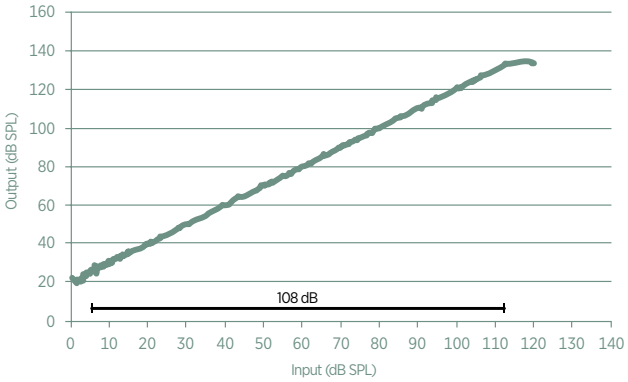


Figure 1. The UNIQUE analog-to-digital converter captures sounds from 5 dB SPL to 113 dB SPL linearly, significantly reducing input saturation distortion. The resulting input dynamic range of 108 dB provides a cleaner signal and improves the hearing aid sound quality.

## SOUND QUALITY

### Access to a fuller sound picture with minimum input distortion

At Widex, we have always believed in giving hearing aid wearers access to the full sound picture. When we first introduced the Widex Fitting Rationale over twenty years ago, we opted for low compression knee-points and slow compression. Slow compression preserves the spectral and temporal contrasts and provides the best speech clarity. A low compression knee-point provides extra gain for soft sounds. This is important for consistent audibility. To this day, slow compression with low knee-points is still an integral part of the foundation of the Widex sound.

It is just as important to keep the sounds captured by the hearing aid as distortion free as possible in order to minimize the risk of input saturation distortion. With the launch of the DREAM hearing aid in 2013, we expanded the upper input limit of the analog to digital (A/D) converter to 113 dB SPL. This ensured that the hearing aid was capable of capturing sounds from 17 dB SPL up to 113 dB SPL, linearly (Bækgaard et al., 2013). With the launch of UNIQUE, we extended it even further, lowering the floor of the A/D converter input range from 17 dB SPL to 5 dB SPL, and allowing for an impressive linear input dynamic range of 108 dB (see Figure 1). Increasing the input limit of the A/D converter ensures that the adaptive features in the hearing aid can work more efficiently with a cleaner signal, even in loud environments (Kuk et al. 2015). Reducing the input saturation distortion also ensures that the amplified signal is a truer representation of the original signal, drastically improving the sound quality of the hearing aid. A hearing aid that offers true-to-life sound across more listening situations – from very quiet to very loud - will help increase the acceptance of the hearing aids.

### Without adding undesirable sounds

Giving hearing aid wearers access to all sounds improves audibility. For many of those sounds, such as whispers or soft footsteps, improved audibility equals improved detection and understanding. For other sounds, such as fan noise or refrigerator noise, improving audibility may be bothersome for new hearing aid wearers, who often have normal or near normal hearing in the low to mid frequencies. This may not be a problem if the hearing aid provides minimal gain for soft sounds. However, limiting gain for soft sounds will not only cut out undesirable sounds, it will also sacrifice the audibility of desirable soft sounds, such as soft speech sounds. In order to minimize the audibility of soft, undesirable noises without affecting the audibility of soft speech, UNIQUE includes an algorithm which attenuates these potentially distracting soft level noises: the Soft Level Noise Reduction (SLNR) system.

The UNIQUE SLNR system only affects soft, unmodulated noises. When the hearing aid detects a quiet environment, it analyzes the environment and determines if there are any unmodulated signals below 62 dB SPL. If there are, the algorithm will engage and suppress these soft noises. This suppression will also be applied if internal hearing aid noise is detected.

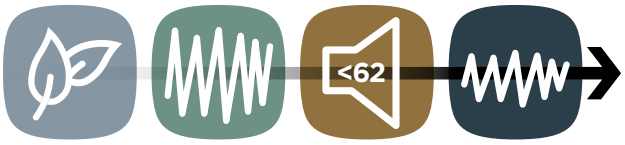


Figure 2. The Soft Level Noise Reduction system will suppress noises below 62 dB SPL, without affecting other soft sounds like soft speech.

The advantage of the SLNR is that it will instantly eliminate soft background noises once they are detected. This provides a "noise free" experience for the new hearing aid user at the first fit. Because it will only affect unmodulated sounds, other soft sounds in the environment (soft voices, footsteps, etc.) will be unaffected and still be audible. The benefit, especially for first time wearers with sloping losses, is that they will experience clean, comfortable sound quality, with audibility for desirable soft sounds and speech, without being bothered by soft, ambient noises. This feature is also very easy to demonstrate in the clinic by simply turning the feature ON and OFF.

### Extending the use to outdoor situations

Another source of annoyance and poor sound quality for hearing aid wearers is wind noise. As reported by Kochkin (2010), wind noise is the second most bothersome situation for all hearing aid wearers.

When wind noise hits the hearing aid microphones, it creates turbulence and drowns all other sounds. Due to the annoyance caused by such turbulent noise, many wearers simply remove the hearing aids when in windy situations. This may prevent first time wearers from using or and keeping their hearing aids, or they may limit their use of the hearing aids to indoor situations only. Behind-the-ear hearing aid microphones are especially vulnerable to wind noise compared to CICs, where the microphones are naturally protected by the pinna. The patented Wind Noise Manager in UNIQUE440 is able to separate uncorrelated wind noise from correlated speech sounds and filter out the uncorrelated wind noise from the input to the hearing aid (see figure 3). The advantage of this system is that it works independently in each ear, without relying on inter-ear communication, and independently from wind azimuths (Korhonen et al., 2016; Lee L, 2016).

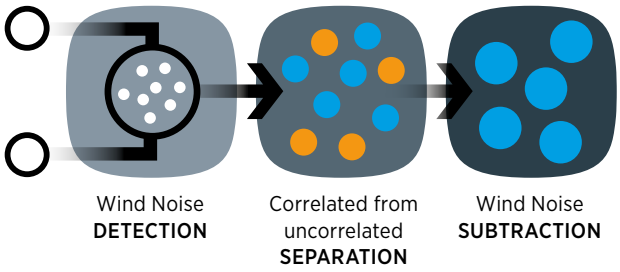


Figure 3. Illustration of the Wind Noise Manager in UNIQUE440. When wind noise is detected by the hearing aid, the algorithm engages and the hearing aid goes into a "wind noise attenuation mode". The system will identify the uncorrelated signal (wind noise) and subtract it from the input, leaving a much cleaner output.

## IMPROVING PHYSICAL FIT

New hearing aid wearers with mild hearing loss most likely prefer the smallest hearing aid possible, in particular a Completely-in-the-canal type. However, for first time wearers with normal low frequency hearing, blocking the ear canal with a CIC will likely create occlusion problems. Most hearing care professionals will therefore recommend an open fitting solution, coupling a small Behind-the-ear (BTE) hearing aid with an open ear-tip or open earmould, as they are cosmetically attractive and also reduce the occlusion effect. Of the BTE style hearing aids, the Receiver-in-canal (RIC) or the Receiver-in-the-ear (RITE) styles are the most cosmetically appealing. Indeed, recent statistics by the Hearing Industries Association (2015) reported that 63.7% of the hearing aids sold in the USA were RIC/RITE types.

RIC/RITE Behind-the-ear hearing aids are small and the use of thin-wires, to couple the hearing aid to the receiver, adds to their physical attractiveness. At Widex, the RIC/RITE Behind-the-ear option is available with the FUSION and PASSION hearing aids. For traditional BTEs with a thin tube solution, Widex offers FASHION and UNIQUE FASHION MINI. These form factors are an optimal solution for improving the physical fit and preventing occlusion problems, and are also very cosmetically attractive.

Figure 4. The FASHION MINI BTE (left) with EASYWEAR Thin Tube and the FUSION (right) with EASYWEAR external receiver.

### Ergonomically designed thin tubes and wires

Physical fit is also one of the major challenges for new hearing aid wearers. A common issue when using a RIC/RITE or a BTE with thin tube is lateral migration (Sweetow et al., 2014). This is often due to poor retention of the earwire/thin tube in the ear canal because of the design of the wire or thin tube. During any mandibular movement such as speaking, eating, yawning, and so on, the wire/thin tube can move out of the ear canal. This gives the feeling that the hearing aid is about to fall out of the ear and prompts the hearing aid wearer to push the thin tube/wire back in the ear canal. This can draw unnecessary attention to the ear/hearing aid and may lead to less use, as it can be an unpleasant experience.

Another potential problem with lateral migration is reduced hearing aid output. That is, the in-situ output will be reduced since there is a larger residual ear canal volume as the receiver is farther away from the tympanic membrane. This reduced output could lead to poor sound quality, inconsistent speech understanding and an overall dissatisfaction with hearing aid use.

To ensure consistent use and fit of RIC/RITE or thin tube BTE hearing aids, Widex patented the EASYWEAR external receiver and thin tube solution. EASYWEAR receivers and thin tubes have a unique shape which prevents sideways movement (lateral migration) of the receiver or thin wire/tube from the ear canal. Widex EASYWEAR also improves the cosmetic gap between the thin wire/thin tube and the wearer's head and makes the thin wire/thin tube less visible (see Figure 5). And because of its innovative design, it will stay in the ear without the need of an anchor, even with small ear canals. The open ear solution, along with the use of the EASYWEAR, ensures consistent use of the UNIQUE hearing aids.

Figure 5. The image on the top shows an example a receiver laterally migrating out of the ear canal, creating a large cosmetic gap between the wire and the head. The image on right shows the EASYWEAR solution, with no lateral migration and no cosmetic gap.

# IMPROVING SPEECH INTELLIGIBILITY IN NOISE

**Increased speech intelligibility with open fittings: the UNIQUE Real-Time Speech Enhancer**

Tackling sound quality and physical fit challenges is only part of the solution. Having difficulty hearing speech in noise remains one of the biggest challenges of all hearing aid wearers (Kochkin, 2010). We need to ensure that speech intelligibility in noise remains optimal, even with open fittings, and in all situations.

In 2006, Widex introduced a patented Speech Enhancement algorithm, which was based on maximizing the hearing aid wearer's Speech Intelligibility Index (SII). (Kuk et al., 2006). Detectors in the hearing aid ensured a differentiation between speech and noise, and the Speech Enhancer worked together with the Noise Reduction algorithm by providing gain increase for speech and gain decrease for noise. If noise was dominant, noise reduction was applied and if speech was the dominant signal, speech enhancement was applied. Because the Speech Enhancer takes into account the hearing loss of the hearing aid user, the more severe the hearing loss, the less gain reduction applied. This ensures adequate audibility for more severe losses.

With the UNIQUE family, we introduced the Real-Time Speech Enhancer. Compared to the previous generation of the algorithm, it is more responsive to changes in the environment and is better at detecting speech. Like the previous version of the Speech Enhancer, the Real Time Speech Enhancer also takes into account the hearing aid wearer's hearing loss. The InterEar feature ensures that both hearing aids are constantly aware of each other, and enhances the speech from the side with the dominant speaker while reducing noise on the other.

**The new Real Time Speech Enhancer and the Vent effect**

One of the new features in the UNIQUE Real-Time Speech Enhancer is that it now takes into account the vent effect by using the results from the AISA (Assessment of In-situ Acoustics) test measured during the feedback test. The AISA value is used internally to modify the gain reduction to ensure sufficient audibility in the open fit condition. The result is that in an open fit (or other vented) situation, the UNIQUE Real-Time Speech Enhancer ensures the best signal-to-noise ratio possible.

In an internal study conducted at ORCA US, the research team evaluated the effectiveness of the new UNIQUE Real-Time Speech Enhance, comparing it to the DREAM hearing aid in an open fit condition. The results showed that there was up to 2 dB SNR improvement in the HINT scores for UNIQUE hearing aids compared to DREAM. From a clinical perspective, this means that the wearers of UNIQUE with open ear-tips will understand speech better in noise compared to DREAM. Hearing care professionals can now be ensured that their clients, even new wearers with mild sloping losses, will be able to benefit from the effects of the Real-Time Speech Enhancer.

**Increased speech intelligibility in wind**

We discussed previously the benefit of the Wind Noise Attenuator with regards to reduced wind noise leading to increased sound quality. However, another benefit of the Wind Noise Attenuator is increased speech intelligibility in wind.

In a study conducted at ORCA US (Korhonen et al., 2016), it was found that there was an improvement of almost 50% in phoneme scores on speech intelligibility tests, equivalent to an improvement in SNR of 8.4 dB, when the Wind Noise Manager was ON vs OFF (see Figure 7). In the study, participants were able to identify phonemes correctly 50% of the time when speech was presented at 65 dB SPL in the presence of 5 m/s wind when the wind noise attenuator was ON. If the wind noise attenuator was OFF, the speech level had to be increased to 73.4 dB SPL to achieve a 50% correct result. That is a significant improvement and allows hearing aid users to keep wearing their hearing aids while outside without worrying about not hearing speech. Since the WNA works independently in each ear, without relying on inter-ear communication, it does not matter what direction the wind is coming from. Widex UNIQUE offers a solution for better speech intelligibility in the presence of wind noise.

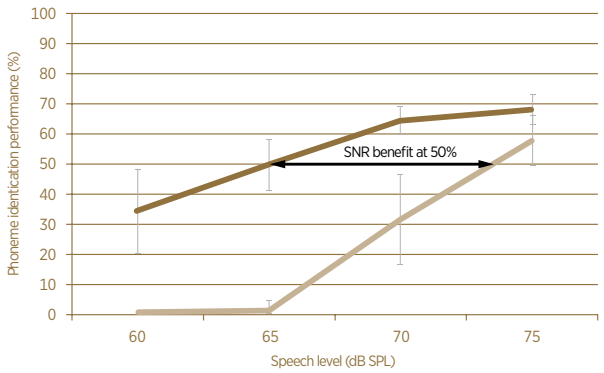


Figure 7. Results of phoneme identification test with WNA ON vs OFF, showing a 8,4 dB improvement at the 50% correct criterion

**Conclusion**

With the recent launch of the UNIQUE family of hearing aids, Widex introduced features that target the challenges often experienced by all hearing aid wearers: sound quality, physical fit, and speech intelligibility in noise. These UNIQUE features, designed to provide as effortless listening as possible, are particularly useful for those making the transition from a non-adopter to a new hearing aid wearer.

First, with regards to sound quality issues, the A/D converter, the Soft Level Noise Reduction and the Wind Noise Attenuator all help contribute to improved sound quality and reduced noise. Secondly, the Widex EASYWEAR solution significantly reduces lateral migration - and ensures a good physical fit for a new hearing aid wearer and encourages consistent hearing aid use. Finally, the UNIQUE Real Time Speech Enhancer improves speech intelligibility in noise over the DREAM in an open fitting configuration.

Taken collectively, these features help to tackle the challenges experienced by new hearing aid wearers and help ensure consistent and satisfactory hearing aid use.

## REFERENCES


Abrams HB, K. J. (2015). *An Introduction to MarkeTrak IX: A New Baseline for the Hearing Aid Market.* Retrieved from Hearing Review: http://www.hearingreview.com/2015/05/introduction-marketrak-ix-new-baseline-hearing-aid-market/

Baekgaard L, Knudsen NO, Arshad T, Andersen HP. (2013). Designing Hearing Aid Technology for Demanding Situations, Part 1. *Hearing Review, 20(3), 42-50*. Retrieved from http://www.hearingreview.com

Baekgaard L, Rose S, Andersen HP. (2013). Designing a Hearing Aid Technology to Support Benefit in Demanding Situations, Part 2. *Hearing Review, 20(6), 30-33*.

Gellman MD, T. J. (Ed.). (2013). *Encyclopedia of Behavioral Medicine.* Springer New York. Retrieved from http://link.springer.com/reference-work/10.1007/978-1-4419-1005-9

Hearing Industries Association . (2016). *Hearing Aid Sales Increase by 7.2% in 2015 after Strong Q4 by Private Sector.* Retrieved from http://www.hearingreview.com/2016/01/hearing-aid-sales-increase-7-2-2015-strong-q4-private-sector/

Hougaard S, R. S. (2016). *Hearing Aids Improve Hearing - and A LOT More.* Retrieved from Hearing Review: http://www.hearingreview.com/2016/06/hearing-aids-improve-hearing-lot/

Kochkin, S. (2000). MarkeTrak V:"Why my hearing aids are in the drawer": The consumers' perspective. *Heairng Journal, 53(2), 34-41.*

Kochkin, S. (2007). *MarkeTrak VIII: Obstacles to adult non-user adoption of hearing aids.* Retrieved from The Hearing Journal: http://journals.lww.com/thehearingjournal/Citation/2007/04000/MarkeTrak_VII__Obstacles_to_adult_non_user.7.aspx

Kochkin, S. (2009). MarkeTrak VIII: 25-Year Trends in the Hearing Health Market. *Hearing Review, 16(11), 12-31.* Retrieved from http://www.betterhearing.org/hearingpedia/marketrak-publications/marketrak-viii-25-year-trends-hearing-health-market

Kochkin, S. (2010). MarkeTrak VIII: Customer satisfaction with hearing aids is slowly increasing. *The Hearing Journal, 63(1), 11-19.* Retrieved from http://journals.lww.com/thehearingjournal/Fulltext/2010/01000/MarkeTrak_VIII__Consumer_satisfaction_with_hearing.4.aspx

Kochkin, S. (2011). *MarkeTrak VIII: Min-BTEs tap new market, users more satisfied.* Retrieved from The Hearing Journal : http://journals.lww.com/thehearingjournal/Citation/2011/03000/MarkeTrak_VIII_Mini_BTEs_tap_new_market,_users.4.aspx

Kochkin, S. (2012). MarkeTrak VIII: The Key Influencing Factors in Hearing Aid Purchase Intent. *Hearing Review, 19(3), 12-25.*

Korhonen P, K. F. (2016). Evaluation of a wind noise attenuation algorithm on subjective annoyance and speech-in-wind performance. *Journal of the American Academy of Audiology, In press.*

Kuk F, Lau C, Seper E, Sonne M. (2016). Real-life Satisfaction with a Hearing Aid Designed to Enhance Effortless Listening. *Hearing Review, 23(4), 40-48.*

Kuk F, P.-M. C. (2006). Noise Management Algorithm May Improve Speech Intelligibility in Noise. *Hearing Journal, 59(4), 62-65.*

Kuk F, Schmidt E, Jessen AH, Sonne, M. (2015). *New Technology for Effortless Hearing: A "Unique" Perspective.* Retrieved from Hearing Review : http://www.hearingreview.com/2015/10/new-technology-effortless-hearing-unique-perspective/

Kuk, F. L.-C. (2015). Speech Intelligibility Benefits of Hearing Aids at Various Input Levels. *Journal of the American Academy of Audiology, 26(3), 1-14.*

Lee, L. (2016). *Efficiency of a Wind Noise Attenuation Algorithm.* Retrieved from Hearing Review : http://www.hearingreview.com/2016/05/efficiency-wind-noise-attenuation-algorithm/

McCormack, A., & Fortnum, H. (2013). Why do people fi tted with hearing aids not wear them? *International Journal of Audiology, 52(5), 360-368.*

Oliver SD, P. M. (2012). *Attracting First-time Users: An Insight-based Marketing Approach.* Retrieved from Audiology Online: http://www.audiologyonline.com/articles/attracting-first-time-users-insight-789

Strom, K. (2014). *HR 2013 Hearing Aid Dispenser Survey: Dispensing in the Age of Internet and Big Box Retailers.* Retrieved from Hearing Review: http://www.hearingreview.com/2014/04/hr-2013-hearing-aid-dispenser-survey-dispensing-age-internet-big-box-retailers-comparison-present-past-key-business-indicators-dispensing-offices/

Sweetow, RW, Caporali, S, Ramos, PM, Ahrens-Berke, C, Finkelstein, E. (2014). *A Solution for Lateral Migration and Cosmetic Gaps in RIC Hearing Aids.* Retrieved from Hearing Review : http://www.hearingreview.com/2014/05/solution-lateral-migration-cosmetic-gaps-ric-hearing-aids/