

Oticon ♦ Dual



THE AUDIOLOGY IN DUAL
– A WHITEPAPER



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Oticon Dual – The Ideal Marriage between Design and Performance

Introduction

The role of physical factors and cosmetics on the selection of hearing instruments can never be overestimated. Even before hearing aids became electronic and miniaturised, their appearance determined if they would be used or not in public. Hearing instruments are often perceived not only as acoustic amplifiers but also, unfortunately, as disability amplifiers. To the wearers, hearing instruments are a visible indicator of the aging process and they therefore represent a decline of mental faculties. Signal processing technology has advanced by leaps and bounds, and the size of the hearing aids has become smaller. Although current attitudes and opinions are changing, the rejection of hearing devices due to stigma still remains a reality today. For this reason hearing aid manufacturers have striven to produce hearing aids that are designed to “hide the hearing loss”. In a 1978 study entitled “Factors influencing Use of Hearing Aids”, it was reported that 1 in 4 (26%) potential hearing aid users felt that others would see them as older if they wore hearing aids (Surr et al., 1978). Cox and Alexander (2000) found that new users are concerned about stigma and appearance. The majority of hearing aid users still prefer instruments that are inconspicuous. Judging from the various styles of hearing instruments available in the market today, the term “cosmetics” usually relates to the size of the hearing aids. Oticon Delta, however, redefined this term in the hearing aid industry. With its arrival, the shape of the hearing device, for the very first time became a crucial factor in the selection of hearing instruments. The triangular shape of the Delta was nothing short of a revolution in hearing aid design.

Non-occluding miniature BTE’s (also known as open fit) instruments such as Delta took the hearing aid

world by storm not just with their cosmetically appealing design but also with their receiver-in-the-ear (RITE) technology that produced a smoother gain across a broader frequency range. The triangular shape of the Delta also resulted in better mid frequency amplification by virtue of the horizontal placement of the microphones. Also, the 8 kHz bandwidth was an industry leader in Delta, contributing to markedly better speech reception, more natural sound quality and less listening effort. For the hearing health care professional, Delta changed the way hearing devices were dispensed forever. Same day fittings and repairs became a possibility with these open fit BTE instruments. The unique design and the high performance of Delta helped it lure reluctant users of hearing devices into dispensers’ offices. According to survey data obtained from approximately 3,000 Delta wearers (Lindley, 2008), over 73% were new users (versus the 39% overall new user rate reported in MarkeTrak VII). More important, 93% reported as being satisfied with the device. It was clear that Delta represented a viable option for attracting new users to the office.

Performance of hearing instruments is another crucial factor in the selection process. A positive correlation between performance and satisfaction of hearing devices has been demonstrated in several studies (reviewed by Wong et al., 2003). A high performance instrument typically has sophisticated signal processing algorithms that enable better speech perception in noisy as well as difficult listening environments.

Performance is also related to the functional capability of the hearing aid. Being able to use hearing device with telephones, the TV, the iPod and Mp3 players is another consideration for the young as well as the elderly. The hearing impaired elderly population spends a good part of their daily lives speaking on the phone and watching TV (Grajczyk and Zollner, 1998). For the younger users of hearing devices, however, there might be a greater need to use their hearing devices with the cell phone than with the TV.



With the arrival of Epoq, the hearing aid industry witnessed a new era in hearing aid technology. For the first time a hearing instrument in the right and left ears were able to communicate with each other and optimise each other's performance at very high speeds. The wireless RISE technology which drives these instruments also made it possible for them to connect wirelessly via a streamer to commonly used media and communication devices. This connectivity to the outside world dramatically changed the ways hearing instruments were perceived and used. Hearing instruments were no longer used as hearing aids but as total communication devices by the young and elderly alike. A vital part of the synchronisation capability of the Epoq is the feature known as Spatial Sound. This feature relates to the ability of the right and left instruments to function as one integrated system the same way our natural binaural hearing system does. Under normal listening circumstances, we rely on spatial cues such as inter-aural level differences between ears to help us localise to the signal of interest. In individuals with hearing loss, these cues are most likely lost or compromised. Fitting these individuals with hearing aids bilaterally does little to restore these cues. However, with Epoq it is possible for the user to access these cues by virtue of the level difference between the right and left instruments. Achieving this level difference is only possible because the two instruments are wirelessly exchanging information at high speeds to optimise their performance.

There is no doubt that the development of binaural synchronisation and Spatial Sound in Epoq added a whole new dimension to our perception and expectation of instruments in terms of performance. For a long while hearing aid manufacturers have focussed on improving speech reception in quiet and in noise. While these are very important considerations for most hearing aid wearers (Meister et al., 2002), we are now able to evaluate the performance of hearing devices in complex listening environments. Complex listening environments refer to those typical everyday listening situations in which listeners have to follow conversation between mul-

iple speakers in noise, locate the distance and direction of various sounds and segregate them, and understand speech in a reverberant room. Spatial Hearing, traditionally considered a domain of neuropsychologists and neuroscientists, has now emerged as a key area for a hearing aid manufacturer like Oticon. With the extended bandwidth and binaural coordination that was first introduced in the Epoq, we are better able to facilitate the link between the peripheral hearing system and the higher order listening processes. While we have a good understanding of how the peripheral system works, and a fairly good grasp of the role of the brain in spatial hearing in normal hearing individuals, the use of technology to facilitate spatial hearing in individuals with hearing impairments has hitherto never been explored. With the introduction of binaural wireless technology with the Epoq, this is no longer a dream but a reality. Internal and external laboratory based and real world investigations have shown the binaural wireless technology, by virtue of its co-ordinated compression, extended bandwidth, and the RITE technology, to produce better speech perception in complex listening environments (Schum and Bruun-Hansen, 2008).

What is Oticon Dual?

Dual encapsulates the best of performance and design. Dual's performance is driven by technology that is without peers in the industry today. The RISE platform that enables the use of an industry leading bandwidth of 10 kHz, and wireless exchange of data at broadband speeds between the right instruments and left instruments represent a huge leap in technology from its predecessors or peers. Moreover, it provides wireless connectivity to the external world via a streamer that can be linked to a Bluetooth-enabled device such as TV, cell phone, home phone, and MP3 players. It's this ideal marriage of design and performance that sets Dual apart from other instruments in the market.

Design of Dual

Though Dual may seem to share much of the external physical characteristics as Delta, it has been



designed and built from scratch. It still maintains the highly successful triangular shape of Delta but unlike Delta, Dual is housed in a robust single shell construction with no hinges. The Dual shell also comes nano-coated to keep it moisture and corrosion free. For the dispenser, there is also an added convenience of programming the device through a plug-in port as opposed to using programming strips.

Performance of Dual

It is in the performance department where Dual is peerless. At the heart of Dual is the wireless RISE platform that allows for sophisticated and high speed signal processing and communication between instruments Dual also addresses a major limitation that exists in most hearing instruments today— limited battery life. Dual uses less power than most receiver-in-the-ear (RITE) instruments giving wearers up to 140 hours of battery life from a standard 312 battery. Another noteworthy development in Dual is the autophone function that provides extraordinary performance.

However, Dual’s unparalleled strength lies in its performance in complex listening environments. This is made possible by the extended bandwidth and binaurally co-ordinated compression between instruments that facilitate Spatial Hearing.



Figure 1: Dual represents the best of both the Design and Performance worlds.

The superior performance of the binaural wireless platform on which Dual is based was clearly demonstrated in a controlled laboratory setting and in the real world by researchers at Oticon (Denmark) and Towson University (The United States). At Oticon,

researchers studied how well the binaural wireless technology compared with an advanced non-wireless platform in terms of spatial hearing abilities. One way to analyse spatial hearing abilities is to take the difference between the speech recognition threshold (SRT) measured with the target speech and the competing speech coming from the same location (co-located) and the SRT measured with the target speech and the competing speech being spatially separated. This is known as spatial release from speech-on-speech masking (SRM). For normal hearing individuals, SRM can be substantial, implying that they perform much better when the target speech and competing speech are spatially separated as compared to when they are co-located. For hearing impaired individuals, SRM is typically much smaller, implying that they do not perform much better when the target speech and competing speech are spatially separated as compared to when they are co-located. This apparent difference between individuals with normal hearing and those with hearing impairment could be due to normal hearing individuals having better access to spatial acoustic cues compared to hearing impaired individuals, for whom these cues may be distorted or perhaps removed altogether as a result of their hearing loss. It could also be due to differences in the ability to “enhance” a target signal by means of central (cognitive) processing skills. These processing skills are known to degrade with aging, and, are therefore, common in elderly hearing impaired individuals.

Speech recognition in noise is commonly measured with the Quick Speech in Noise Test (QuickSIN) (Killion et al., 2004), or the Hearing in Noise Test (HINT) (Nilsson et al., 1994). Both these tests use sentences under free field or headphones conditions with varying signal to noise ratio. The QuickSIN measures the signal to noise ratio at which 50% of the sentences are correctly identified (which is known as SNR loss), and the HINT measures the reception threshold for sentences (RTS). In the study conducted at Towson University, speech recognition in noise was measured in a free field setting with both the QuickSIN and HINT. One commonly used tool for measuring the real life performance of hearing in-



struments is the Speech, Spatial and Quality (SSQ) Scale (Gatehouse and Noble, 2004). In the Towson study, an abbreviated version of the scale was administered using 18 items of the scale that relate to the domains of spatial hearing, listening effort and sound quality (Gatehouse and Akeryod, 2006).

Oticon's Spatial Hearing Study: Do binaural wireless aids facilitate spatial hearing compared to advanced non-wireless aids?

In a spatial unmasking study, 6 current users of the binaural wireless technology were each fitted with a pair of advanced non-wireless hearing aids. Current users of the binaural wireless technology showed better spatial release from masking (as evidenced by spatial unmasking [SU] scores) with the binaural wireless devices than they did with the advanced non-wireless device. This result could be explained by the fact these users were able to exploit the interaural level cues provided by the extended bandwidth and co-ordinated compression that the binaural wireless instruments provided.

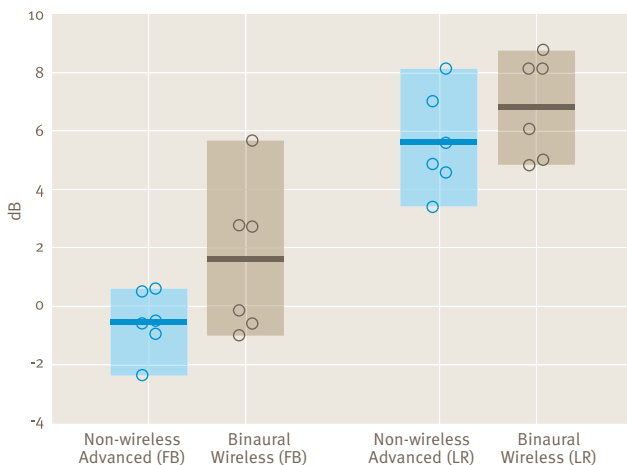


Figure 2: Spatial unmasking (SU) scores for the 6 users of the binaural wireless technology for the Front-Back (FB) and Left-Right (LR) conditions.

Towson University Study: Are speech recognition in noise and spatial hearing with binaural wireless technology used in Dual?

In the Towson study, results of laboratory based measurement of speech recognition in noise as measured by the QuickSIN (Figure 3) and HINT (Figure 4)

demonstrated that the binaural wireless instruments performed better than the the advanced non-wireless instruments. Real world evaluation of listening in complex environments, listening effort and sound quality using subscales of the SSQ (Gatehouse and Akeroyd, 2006) also indicated that wireless instruments with extended bandwidth and co-ordinated compression showed superior performance on all of the subscales: speech in quiet, speech in noise, multiple speech processing and switching, localisation, distance and direction identification, externalisation, source segregation, listening effort and sound quality (see Figure 5) .

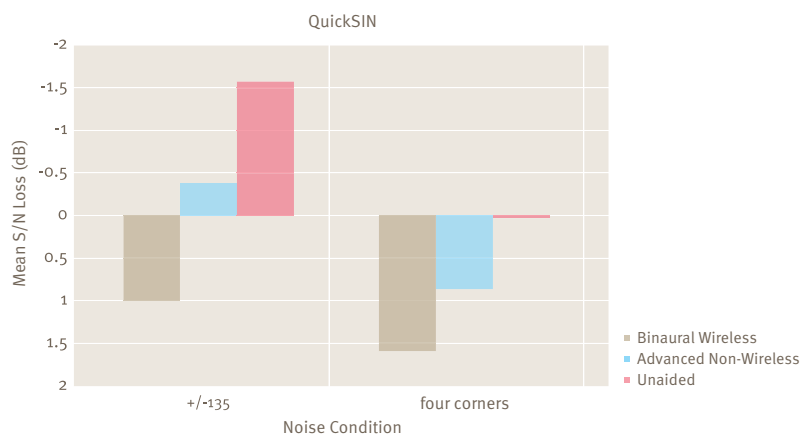


Figure 3: QuickSIN results for the Binaural Wireless and the Non-Wireless Advanced instruments. Note that the lower the S/N loss the better the performance.

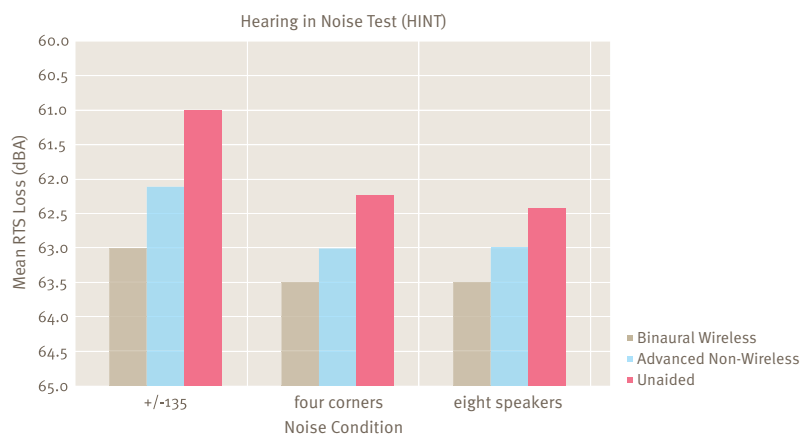


Figure 4: HINT results for the Binaural Wireless and the Non-Wireless Advanced instruments. Note that the lower the RTS the better the performance.

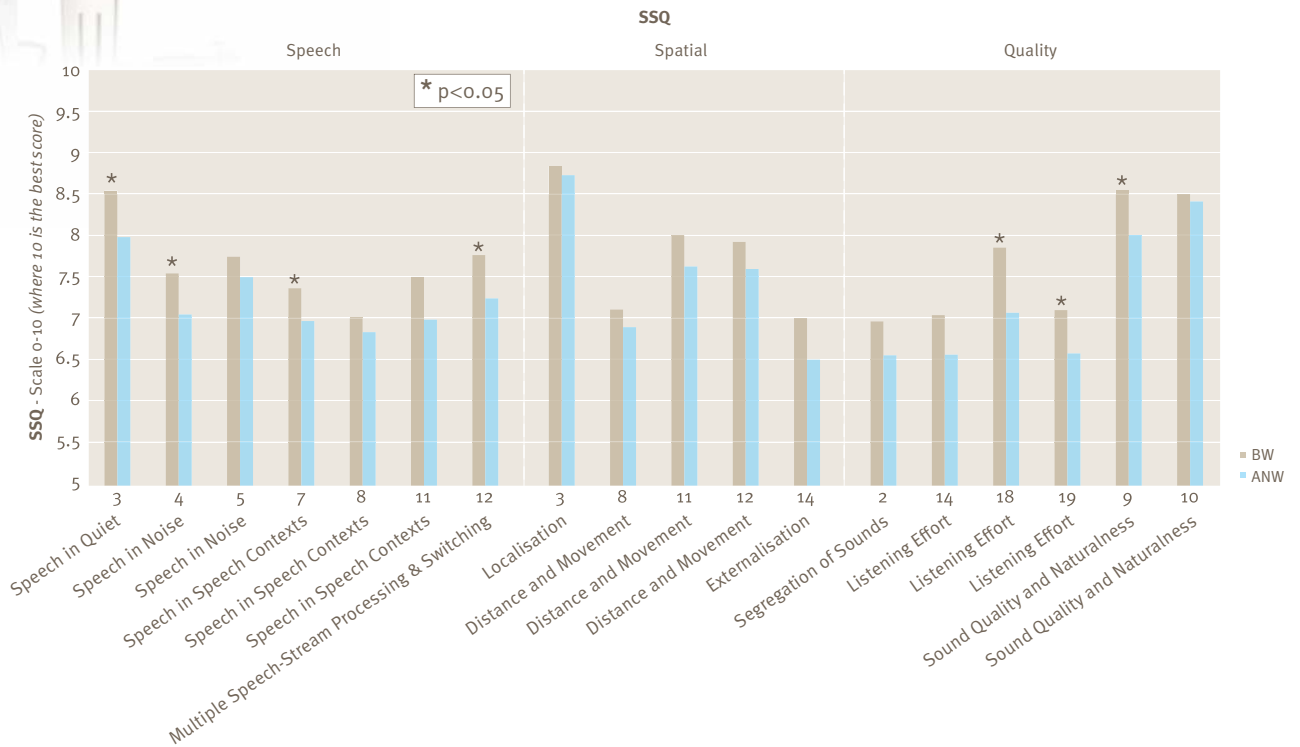


Figure 5: The performance of the Binaural Wireless (BW) instrument versus the Advanced Non-Wireless (ANW) instrument in terms of Speech Spatial and Quality (SSQ) item numbers and subscales. A statistically significant difference between instruments ($p < 0.05$) is indicated by *.

Conclusion

Dual is a hearing instrument for the client who wants the best in design and the best in performance. It is an answer to those reluctant to wear hearing instruments because of the way they look, feel and sound. It is for the elderly as well as the young, for those who spend most of their waking hours at home watching TV or talking to their spouse, and for the most demanding listener who needs to communicate in complex listening environments.



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People First

We believe that it takes more than technology and audiology to create the best hearing instruments. That's why we put the individual needs and wishes of people with hearing loss first in our development of new hearing care solutions.