

Datalogging:

A tool to better understanding of the benefits of automatic systems for children

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The rapid development of digital hearing aids featuring advanced automatic systems (e.g. automatic directionality and/or noise reduction) there is some concern about the benefits for children. For example, can the audiologist be certain about the accuracy of the system to cancel the unwanted noise signal while leaving the speech signal intact?

Datalogging provides a solution to this issue, as the performance of the hearing aid is recorded over time and displayed later to the audiologist¹. Information is provided regarding the use of the hearing aid in terms of total hours and access to telecoil or FM systems. Data regarding the use of automatic systems is available and the audiologist can be certain that automatic systems were applied sparingly and appropriately.

To better understand the operation of automatic systems for children, we evaluated the use of Oticon Syncro with 25 children in middle school (ages: 9 – 15 years). For each child, an Envirogram was collected and group data was averaged. An Envirogram is a level histogram collected over time that allows graphical representation of the action of the noise reduction and directionality systems².

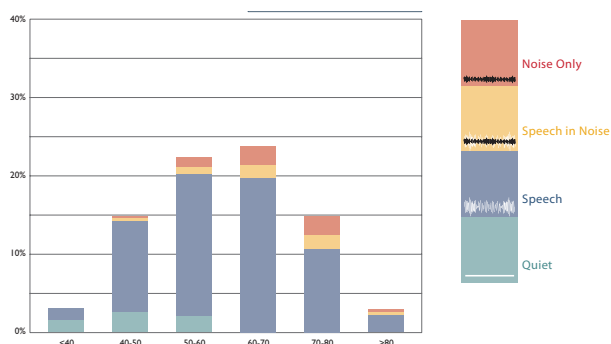


Figure 1. Envirogram data for 25 children showing the action of the TriState Noise Reduction system across sound levels.

Overall Envirogram

The overall Envirogram (Figure 1) illustrates the wide range of sound levels that children are exposed to during their day. This variability demonstrates the necessity of multiple channel non-linear compression systems for children. Compression ensures the softest sounds are amplified sufficiently to be within the child's dynamic range while controlling the amplification of loud sounds to avoid discomfort. Matching a compression approach with amplification strategies such as DSL v5.0³ results in the best possible access to the speech signal.

The Envirogram provides information about the action of the TriState Noise Reduction and Directionality systems. The TriState system is unique in that it combines both speech (VoiceFinder⁴) and noise detection systems. The benefit of this approach is that the dedicated speech detector ensures that when speech is present the noise reduction is shaped by the Articulation Index so that little reduction is applied in the important speech frequencies, thus ensuring that speech understanding is never degraded. It should be noted that noise reduction does not make noise inaudible, but rather reduces the impact of noise so that the child's daily listening effort is reduced.

The Envirogram demonstrates how salient speech information is to the child, with 76% of the child's listening day spent listening to speech. Importantly, for most of the day, the speech signal was provided in clear listening situations, with speech in noise representing 10.5% of listening time and noise only occurring 20% of time. All of these occurrences were when the listening situation was complex and allowed the signal to be remapped at more appropriate levels for the child ensuring greater listening ease in difficult listening situations.

Similarly, the action of the multiband adaptive directionality system is instructive as to the use and benefits that directionality provides (Figure 2). In Oticon hearing instruments, the directional decision making is controlled by Artificial Intelligence technology⁵. Artificial Intelligence (AI) makes real-time calculations of the Speech to Noise ratio (SpNR). Only when

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the SpNR can be improved will directionality be implemented.

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For the children (Figure 2), directionality was implemented on average 22% of the time which is consistent with other independent evaluations of directional benefit in the real-world⁶. Importantly, for any given sound level, the hearing instrument is capable of being in either directional or surround mode. Directional benefit is therefore based on more than input level or the sound scene (e.g. speech in noise) but within each and every complex listening situation various microphone modes may provide benefit at any given time. Through the analysis provided by AI, the hearing instrument makes a decision based on actual benefit rather than environmental sound scene. The audiologist can then be certain that directionality is implemented sparingly and only when it provides quantifiable benefit.

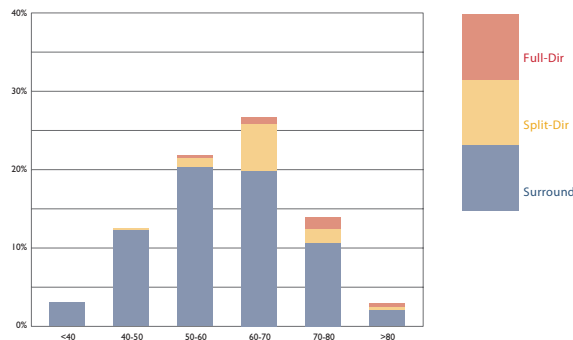


Figure 2. Envirogram data for 25 children showing the action of the directionality system across sound levels.

Unique to the Oticon Syncro and Safran hearing instruments is the implementation of three microphone modes. Those being Surround, Split-directional and Full directional. Surround provides the full omnidirectional response where signals from all sides are equally audible. Surround is excellent for quiet listening situations or when signals from behind the child are important (e.g. another child in class asking a question). Split-directionality provides directionality above 1000 Hz, leaving the signal below

1000 Hz in surround. Therefore, the child receives the benefit of directionality for the higher frequency speech sounds while the omni-directional signal ensures environmental awareness. Full-directional, which is only available at louder levels, provides directionality across the full bandwidth of the hearing instrument. Datalogging demonstrates that for most situations, in which directionality is preferred, Split-directional is more likely to be implemented. Thereby, reducing any concerns regarding removing access to important environmental sounds (e.g. warning sirens or traffic).

Summary

Datalogging in hearing instruments provides many benefits to the audiologist such as information about amount of hearing aid and FM use per day. In addition to this usage data the audiologist can make use of the Envirogram to examine the performance and benefit of the various automatic systems in the child’s hearing instrument.

While there has been some concern about the implementation of advanced automatic systems for children, the use of datalogging and the Envirogram increases the certainty of paediatric fittings. Using these tools, the audiologist can quickly evaluate whether automatic systems are enacted appropriately, the degree of operation and the types of environments in which they operate. The audiologist can verify advanced systems are operating only when they provide a benefit and only in the most difficult listening situations.

References

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