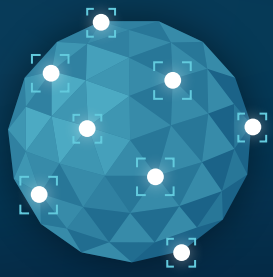
MoreSound Intelligence™



MoreSound Intelligence (MSI) is a groundbreaking BrainHearing™ technology in Oticon More™ that provides access to the full sound scene with clear contrast and balance. This information helps the brain orient and focus better and makes it easier for patients to enjoy, follow and engage in conversations.

Providing access to a full and balanced sound scene

Sound scenes are dynamic, complex and unpredictable, and it is the brain's role to handle this complexity–to hear, and to create meaning from it all.

The signal processing in the hearing aid needs to provide a good neural code to the brain. However, this does not happen by applying traditional noise reduction and directionality because that limits the sound scene. Giving the brain the information it needs to work optimally requires innovative and advanced signal processing. MSI uses a Deep Neural Network (DNN) to not only provide access to the full sound scene, but to also process the information with greater precision. This allows Oticon More to work more like the brain, because the DNN learned through experience and thus provides better speech understanding with less effort for patients.

Precise analysis and balancing of the full sound scene

MSI processes the sound environment with surgical precision to provide clear contrast and balance for all sounds. It includes three parts that work together to provide the brain a more precise and natural representation of all sounds in the environment. The three parts include:

1. **Scan and Analyze:** Scans the full sound scene 500 times per second, which results in a precise analysis of all sounds and the complexity of the surroundings
2. **Spatial Clarity Processing:** Recreates natural spatial cues provided by the pinna by using a Virtual Outer Ear (three true-to-life pinna models that can be chosen based on the patient's spatial sound needs) in easy environments and a Spatial Balancer in noisier environments to quickly balance distinct sound sources
3. **Neural Clarity Processing:** Where the unique and dedicated development for Oticon More resides. It uses a highly intelligent, onboard DNN to process sound and reduce noise

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life-changing **technology**

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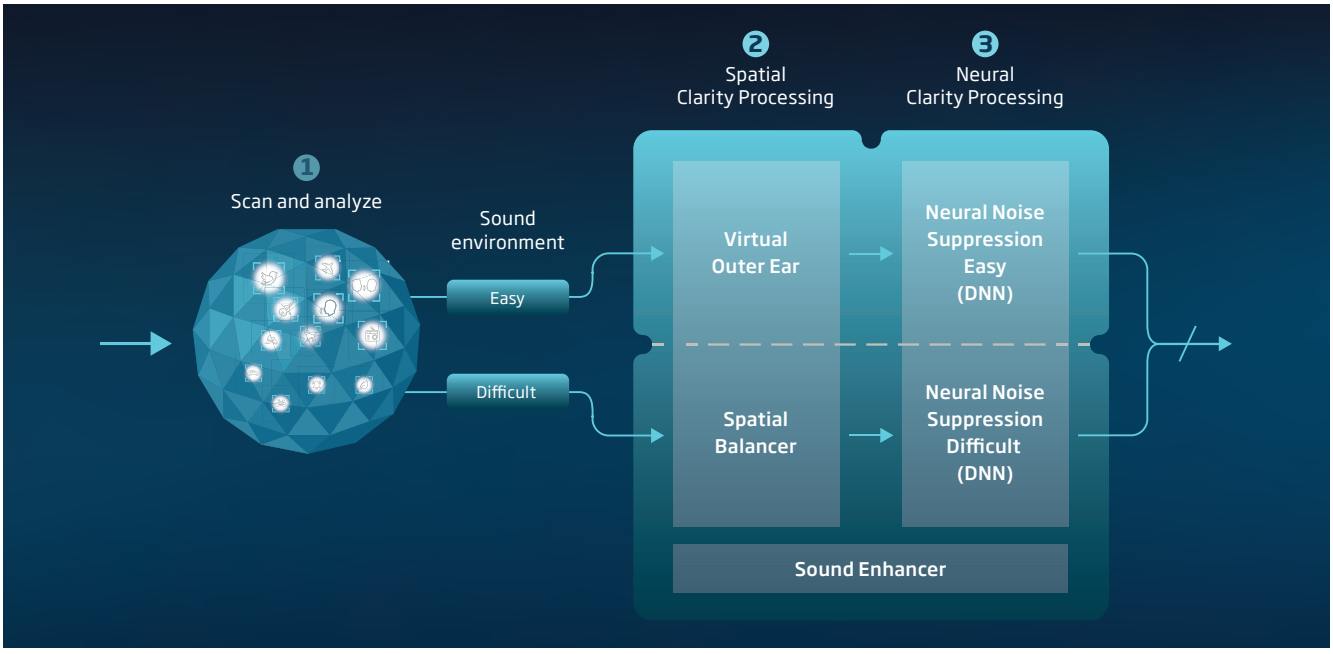
Throughout MSI, input sound processing is done in 24 channels, more than in previous Oticon hearing aids. This provides double the precision in a frequency range that includes the 1.5-5 kHz frequency channels,[1] which are the most important for speech sounds. The extra channels are also linked, which improves the sound quality by minimizing the risk of artifacts created by a type of sound being categorized incorrectly in just one channel.



Scan and analyze

First, MSI comprehensively scans and precisely analyzes the sound scene. To ensure that all the details are captured, the sound scene is scanned 500 times per second to correctly map the different sound sources. Based on this scanning and mapping, MSI calculates the optimal signal-to-noise ratio (SNR), as well as overall noise levels, to determine the complexity of the environment. It then benchmarks the level of complexity against each patient's personal listening preferences established in Genie 2. Once the environment is scanned and analyzed, the information is passed over to Spatial Clarity Processing.

Spatial Clarity Processing

Being able to place sound sources in the spatial environment is an important ability, and it becomes more difficult when hearing loss is present.[2] When we place hearing aid microphones behind the ear, the ability to use the natural spatial cues provided by the pinna is eliminated. To help ensure meaningful sounds remain accessible and stay balanced precisely against dominating noises around the patient, Spatial Clarity Processing uses two technologies: Virtual Outer Ear and Spatial Balancer. The complexity of the environment and the patient's personal listening preferences determine which technology is active. In easy environments, Virtual Outer Ear is active, and in more complex environments, Spatial Balancer takes over.

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Virtual Outer Ear

Virtual Outer Ear (VOE) was developed to compensate for the loss of the pinna-effect from having hearing aids that sit behind the ears. VOE consists of three different true-to-life pinna models that can be set in the fitting software based upon the patient's spatial sound needs. With VOE, you can set the directionality to the kind of sound picture the patient prefers in easy listening situations. The three settings are:

- **Balanced (default):** Enables a balanced sound picture between the front and back
- **Aware:** Provides an open sound picture toward the sides and back
- **Focused:** Gives a more focused sound picture toward the front–this setting may be considered if the user needs more speech focus in quiet settings

Spatial Balancer

Spatial Balancer is a more powerful feature in difficult environments. It quickly cleans up the sound environment by controlling and balancing sources of noise, even when they are moving. Spatial Balancer consists of very fast adapting polar plots. The null direction of these plots balances the sound environment by attenuating sounds not in focus to keep them from interfering with the sound in focus.

Omnidirectional and back-cardioid signals from the two microphones are sent to Spatial Balancer. The omnidirectional signal provides all the sounds in the sound scene, including the sounds from in front, which are often the most important signals to the patient. The back-cardioid signal provides every sound from the sound scene except the sounds from in front. The two signals are constantly being compared to define the placement of the noise sources. Based on this information, the system creates the best possible polar plots for the situation. With both an omnidirectional and back-facing cardioid to work from, the system is able to attenuate more toward the back. Spatial Balancer runs in 24 independent channels for each ear. At all times, the channels have information about what the neighboring channels are doing. This helps in targeting noise sources, making it possible to suppress more of the unwanted sound sources.

Neural Clarity Processing

Neural Clarity Processing is our innovative new approach to noise reduction. It organizes the sounds around the patient and uses our highly trained, onboard DNN to process sound instead of algorithms written and developed by engineers. The DNN is embedded on the Polaris™ chip so that all of the incoming sounds in the sound scene around the user can be processed incredibly fast.

The DNN has been trained with 12 million real-life sound scenes so it could learn the way the brain does naturally. It enables the sounds of the world to be handled precisely and automatically, making sounds more distinct and working seamlessly across varying listening environments. By training it to exactly the right level, the DNN has learned to recognize all types of sounds, their details and how they should ideally sound–all in order to optimally support the brain. It has learned to recognize what should be put in the foreground

(sounds of interest with a lot of information) and what should be put in the background (sounds of less interest with less information). As a result, it knows how to represent sounds naturally, with better clarity and contrast between sound scenes.

Sound Enhancer

Normally, the maximum effect of environmentally adaptive systems has to be a compromise that works for all users, even though some would have preferred more sound to be removed and some find that too much sound has been removed. Working with both Spatial Clarity and Neural Clarity Processing, Sound Enhancer provides more details or more comfort in difficult situations by dynamically adding sound detail, based on patient preference.

The added detail is mostly provided in the mid-frequencies (1–4 kHz), which means it will primarily enhance speech sounds. The compromise is that it also enhances other types of sound, but because noise is often low frequency and speech cues are mid-frequency, a slightly better contrast will be created between speech and noise when sound is added to the signal.

Key takeaways

- MoreSound Intelligence includes a group of signal processing technologies designed to allow access to the full sound scene with clear contrast and balance
- Uses a highly intelligent, onboard Deep Neural Network to seamlessly handle virtually all sound scenes with unparalleled precision and clarity
- Helps the brain orient and focus better by providing clear information, which increases speech understanding while reducing listening effort
- Provides more precise and natural representation of all sounds, making it easier for patients to enjoy, follow and engage in conversations

References

1. Braendgaard M. 2020. The Polaris Platform. Oticon tech paper.
2. Akeroyd MA. 2014. An overview of the major phenomena of the localization of sound sources by normal-hearing-impaired, and aided listeners. *Trends in Hearing*. 2014;18:1-7.

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