ReSound custom hearing aids are the natural choice for better spatial hearing

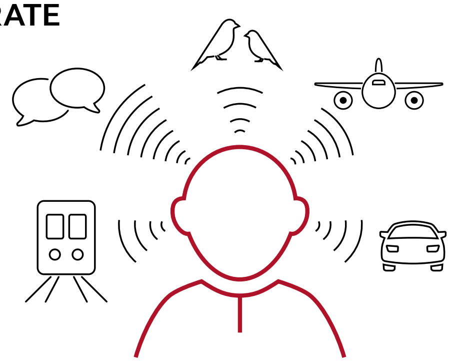
Spatial perception is important for listening in dynamic environments

We rely on our hearing to stay aware of all the sounds around us, determine where they come from, and tune out noise. The auditory system uses interaural cues – subtle differences in time of arrival, intensity and frequency as sound enters the ears – and the filtering effects of the ear, head and body to map out the location and distance of sounds[1,2]. This allows us to listen while staying connected with our surroundings, even as conversation shifts across different people and background noise ebbs and flows.

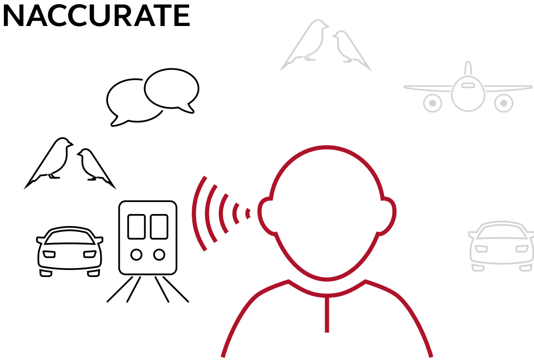
People with hearing loss often struggle with spatial perception[1]. Not only are many sounds harder to hear, but interaural cues can become distorted. Listeners may no longer be able to detect the direction sounds originate from and the listening environment can "flatten," as distance becomes more difficult to perceive via audition with the reduction in sound intensity caused by hearing loss.

Ideally, hearing aids should enhance spatial perception, in addition to increasing audibility of sounds. Historically, they have not[1,2]. Design and performance characteristics of hearing aids can work against spatial cues, in the interest of better audibility or reducing noise. This is especially true for hearing aids that process sound or implement features independently between the right and left ears[2].

ACCURATE



INACCURATE



Spatial cues are vital for people to accurately determine the location and distance of various sounds in the environment (left side labelled Accurate). Without spatial cues in hearing aids, the sounds can flatten or shift to a single location around the listener, as seen in the right side labelled Inaccurate.

In-ear hearing aids and localization

Custom hearing aids, like the designs by ReSound, have a built-in advantage for spatial hearing because the microphones are located near the opening of the ear canal. This means the microphones collect sound at a similar location as sound naturally entering the ear. This is opposed to hearing aids worn behind the ear. While pinna cues can be approximated in behind-the-ear devices, in-ear hearing aids filter sound by default based on the person's own unique ear, head and body anatomy (i.e., the head-related transfer function, or HRTF).

In-ear microphone placement is a factor associated with better sound localization for hearing aid wearers[2,3]. In one experiment, participants attempted to localize sound using simulated behind-the-ear and in-ear hearing[3]. The participants confused the location of sounds between front and back 50% of the time – equal to chance – in the behind-ear condition, but correctly identified front versus back sounds 75-80% of the time using the in-ear condition[3]. Similar effects for front-back localization have been observed in studies using commercially available hearing aids[2,4].

In-ear microphone placement has also allowed participants to correctly detect at least some element of elevation in sounds directly in front of them in the vertical plane[3]. Integrating each participant's own HRTF into the sound signal also had a positive impact on localization, compared to using an average HRTF based on a KEMAR manikin[3], which further supports the use of the individualized in-ear cues found in ReSound custom hearing aids.

ReSound custom hearing aids are designed to support spatial hearing

This is an important aspect of our Organic Hearing philosophy, where the human auditory system acts as inspiration for designing hearing solutions. The default All Access Directionality program utilizes a binaural directional strategy that allows for directional benefit in noise while simultaneously preserving audibility for sounds around the user[5]. Speech intelligibility in noise is improved while listeners stay aware of their surroundings and switch their focus to other sounds, if desired.

The custom hearing aids also actively maintain interaural cues in a binaural fitting. The microphones maintain an omnidirectional response in the low frequencies, no matter the directionality setting, to keep interaural timing cues intact for better localization, separation of multiple sound sources and a rich, full sound quality[5]. In a situation where sound is louder in one ear – perhaps the main source of sound is on one side of the listener – the difference in intensity between the ears is preserved, even as gain is added to the signal.

References

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