SmartFocus™

Article 2 - Clinical approach

The role of user control in optimizing hearing instrument performance

Hearing instruments must meet the needs of wearers across a wide variety of listening situations. This represents a significant challenge for clinicians. In the relatively static environment of their office, clinicians make adjustments meant to meet the wearer's need for performance in the real world. A key concern for clinicians is resolving the disconnect between the moment when the wearer experiences unmet listening goals and when the instrument is adjusted.

The solution is to provide an intuitive user control – smartFocus™ – that allows the wearer to adjust the performance of their hearing instrument in real time, while maintaining natural environmental awareness. Ensuring that the hearing instrument also has the capacity to learn the wearer's preferences reduces the frequency of follow-up adjustments and increases customer satisfaction.

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The goal of amplification

People typically purchase hearing instruments to improve their perception of speech. The amplification provided by a properly fitted hearing instrument will achieve that goal in quiet environments. However, amplification invariably impacts the entire listening experience. It often increases awareness of background noises and environmental sounds, some of which the wearer may not be interested in hearing.

An example of this experience can be seen in Figure 1.

Figure 1

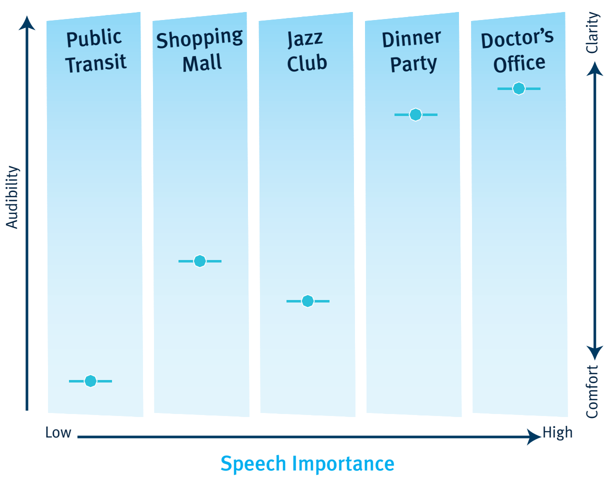


Figure 1 demonstrates how a typical hearing instrument wearer may desire their devices to work in five common listening situations. For this individual, these situations vary, from left to right, on the necessity for speech understanding. For each situation, the round symbol indicates the individual's relative desire for sound awareness and comfort (near the bottom) versus clarity for speech. This is a slight oversimplification as comfort and clarity are not necessarily mutually exclusive. But the analogy holds up in a general sense and is certainly true at extreme settings of comfort or clarity. For example, the wearer needs to be aware of his surroundings while riding on the bus and the amplification should remain comfortable. If he is riding the bus alone there is little need for speech clarity. In contrast, if this wearer is in the doctor's office it is essential to clearly understand the diagnosis and recommendations. Thus the bars for public transit and the doctor's office are at opposite ends of the continuum for these specific situations.

Differing goals represent a fitting challenge

Achieving the wearer's desired goals in the widest range of listening situations is a daunting task for clinicians. Each wearer's goals will shift back and forth across the continuum, from comfort/awareness to clarity/speech perception, as they move from one listening situation to the next. Furthermore, different people can have very different goals in the same listening situation. While one person goes to a jazz club exclusively to enjoy the music, another prefers the music only as a backdrop to conversing with friends. Despite these different objectives, when asked at the initial fitting in which situations they would like to hear better, both might respond, "At the jazz club." This will doubtlessly lead the clinician to set both of their hearing instruments in the same way.

Figure 2

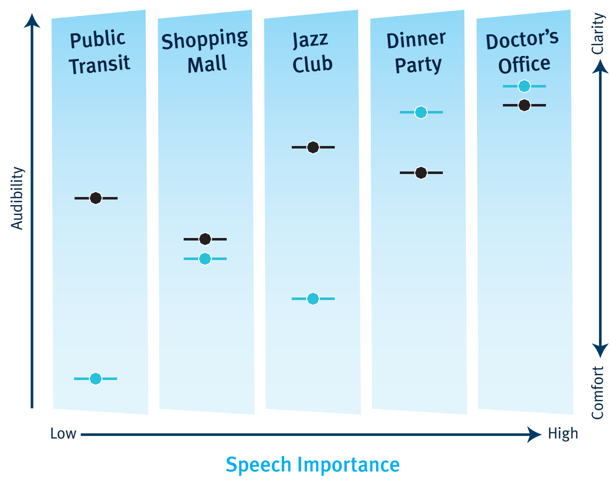


Figure 2 shows how preferences for comfort and clarity can vary across individuals in any given situation. The second individual (black dot) has a much higher need for clarity in the jazz club than the first individual (blue dot) because he is more interested in social interaction than in primarily listening to the music. Even though the two individuals represented in this diagram frequent the same listening situations, and may have similar hearing losses, their goals in many cases are quite different.

The clinician's dilemma

Before any wearer has direct experience with their new hearing instrument, the device must be preset to achieve their goals across the widest possible range of listening situations. If the wearer is dissatisfied with the instrument's performance out in the real world, they must return to the clinician. The clinician will then adjust an abstract set of parameters, such as speech enhancement, noise reduction or microphone strategies.

These adjustments are meant to optimize the output of the instrument for a situation the clinician has never personally experienced and cannot replicate in the office. Essentially this means that the clinician is adjusting parameters on the basis of intuition, loosely correlated with performance, to achieve the wearer's desired outcome. However, the clinician does not have the luxury of empirically assessing the efficacy of the adjustments. In other words, the customer complains to the clinician, who tweaks the fitting, and tells them to come back in a week if that doesn't fix the problem.

This is the basis of the clinician's dilemma. There must a better way.

User control is the better way

The crux of the clinician's dilemma is the disconnect between the place and time where the wearer experiences unmet goals and the place and time where the adjustments are made to try and solve the problem. The obvious solution is to adjust the instruments where and when the problem occurs. For example, if the problem is experienced in the jazz club, why not adjust the hearing instrument on the spot until the wearer is satisfied?

Giving the wearer more control to do self-adjustment in real time is the best way to overcome the place/time disconnect. But for user control to be a viable solution several conditions must be met; otherwise the wearer can easily become overwhelmed by complexity, leading to frustration and failure.

Requirements to make a user control a success include:

1. The adjustment must be powerful and responsive. If the effect is too subtle it is unlikely to provide enough benefit to achieve the wearer's goals.
2. The control for the adjustment must be simple to use. Hearing instrument wearers cannot be expected to understand the complexities of digital devices, nor should they have to. A single control should adjust multiple features simultaneously to achieve the wearer's goals with one easy motion.
3. The effect of the adjustment must be concretely linked to the goals of the wearer. The best control is one that allows the wearer to adjust the performance of the hearing instrument along the entire continuum, from maximum clarity for speech to maximum comfort, while maintaining natural environmental awareness. This type of control empowers the wearer to easily achieve their goal wherever it exists on the continuum.
4. The wearer should be able to optimize the control to achieve different goals in each of several listening environments. The instrument should recognize several listening environments and learn the wearer's preference for the control in each of them. This helps the wearer quickly converge to optimal settings across the widest range of listening environments and minimizes the need for repeated adjustments over time.

Providing a hearing instrument that meets the above conditions significantly alters the adjustment paradigm to the advantage of both the clinician and the client. The clinician still fits the instruments on a wearer, who has no experience with the new devices, but now the wearer is empowered to optimize the settings of multiple parameters quickly and easily within the context of their listening situations. The hearing instrument learns the correct settings required to achieve that wearer's goal for each specific situation. Whenever the wearer returns to that listening environment, the hearing instrument automatically transitions to the learned, optimized settings.

This model of user control benefits the wearer by ensuring a more efficacious fitting that has been quickly customized in real time, providing a greater sense of ownership and connectedness to the devices. The clinician also benefits from fewer follow-up visits and greater customer satisfaction.

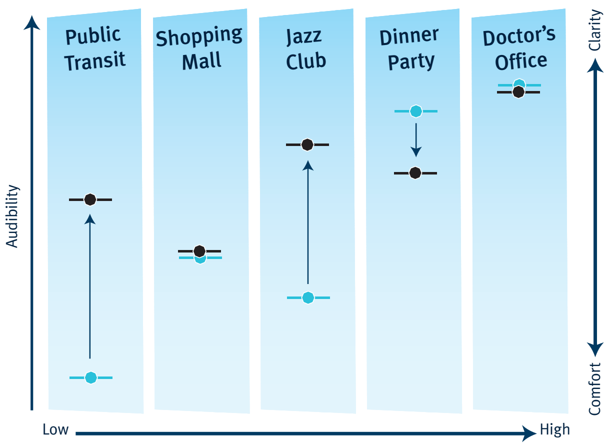
Getting it right

Manufacturers typically try to control artifacts caused by conflicting parameter settings by limiting the strength and adjustability of all parameters. The difficulty with this approach is that clinicians can't directly observe the effects of small changes to multiple parameters in the actual listening environment where the problem occurs.

If the traditional method of controlling artifacts isn't ideal, then how does one best achieve coordinated control of multiple parameters? The advantage of providing a single user control that simultaneously adjusts multiple features is that the range and direction of adjustment are carefully coordinated across all those parameters. This eliminates unforeseen interactions between parameters that occur when all of them are independently adjustable.

Figure 3 is an example of how coordinated control of multiple parameters benefits the hearing instrument wearer. It increases the range of adjustment, as well as the granularity of adjustment, beyond that which would otherwise be clinically feasible.

Figure 3



At the top of Figure 3 are five listening situations: Public Transit, Shopping Mall, Jazz Club, Dinner Party and Doctor's Office. The blue symbols in each panel indicate the parameter settings for each listening environment as programmed by the clinician at the initial fitting. The black symbols indicate the wearer's preferred settings for those features when wearing the aids in real world environments. The fitted values and the preferred values are essentially identical for the shopping mall and the doctor's office. However, there is considerable divergence between the fitted and preferred values for Public Transit, Jazz Club and Dinner Party. Taking advantage of the user control's fine granularity and wide range it is possible for the wearer to adjust the underlying parameters of the instruments to perfectly match their desired amplification settings, thereby achieving their personal amplification goals in each listening environment. By offering this control of individual parameters using coordinated adjustment the wearer has far more degrees of freedom to optimize the fitting and achieve their goals.

Summary

Hearing instruments are meant to provide the correct balance of comfort and clarity across the widest range of listening situations. This can be best achieved by optimizing the device to different values along the comfort-clarity continuum, in order to meet the individual goals of the wearer for multiple listening situations. This is often a daunting task for a clinician who must infer appropriate values for multiple parameters based on the preferences of the wearer without the ability to validate the settings in the wearer's environment.

The good news is that this dilemma can be resolved by providing the wearer with a user control that has a greater range and granularity of adjustment than would typically be possible. The user control allows the wearer to easily optimize the fitting to achieve their goals in the listening situations of their choice. The instrument then learns their preferences, improving their success without requiring an onerous number of ongoing adjustments.

Author

Don Hayes, Ph.D., Director of Audiology, Unitron

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