

Fitting and counseling with Audible Contrast Threshold (ACT™)

ABSTRACT

The Audible Contrast Threshold (ACT™) is a diagnostic test of speech in noise ability. Just as we prescribe audibility with a fitting rationale, we can now prescribe help in noise using a single ACT value. This paper is divided into three sections that will provide an overall understanding of how ACT works, the rationale for its use as part of the fitting flow to your patient (and when to do so), as well as suggestions on how to use the ACT value as a counseling tool to strengthen a person-centered care approach during your appointments.

1) A short introduction to ACT and how it addresses the number one complaint of hearing aid users: hearing speech in noise. ACT provides tremendous value as a new tool in the clinical toolbox. It serves as the basis for an evidence-based help-in-noise prescription and is instrumental in providing data-informed counseling and supporting clinical recommendations.

2) Next, the recommended clinical flows are described: when to perform ACT as part of the clinical flow, and how to use it in the Oticon Genie 2 fitting software, including the use of MoreSound Intelligence™ 3.0.

3) Finally, counseling recommendations with ACT are defined in four areas related to diagnostics, needs and hearing solutions, the fitting of Oticon hearing aids, and considerations related to rehabilitation during the first few months of wearing hearing aids.

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Introduction

Would you be surprised to hear that the number one complaint of hearing aid users is hearing in noise (Jorgensen & Novak, 2020)? It's safe to say, you probably would not be.

One of the greatest challenges as a hearing care professional is meeting the needs of a patient who struggles to hear speech in noise. It is not rare to come across patients who complain about their hearing aids not performing as well as desired in background noise. In fact, not only is hearing in noise the number one complaint of hearing aid users (Jorgensen & Novak, 2020), it is also the second most common complaint preventing the continued use of hearing aids (Kochkin, 2000). We'll often hear that people continue to struggle in noisy environments such as cafes, large meetings, open-plan offices, and social events post-hearing aid fitting. So why, if hearing aids are helping in quieter environments, is hearing speech in noise such a prominent issue?

Hearing aids, unlike headphones, are equipped with microphones that pick up the full sound picture. This combination of incoming stimuli means that there is no clear differentiation between what is background noise (and therefore not a focus) and what is speech (what the patient would like to pay attention to). This age-old challenge is the motivation for continued exploration and development in advanced hearing aid technology. It is the reason that Oticon has an embedded deep neural network, spatial balancing, and several other technologies designed to make hearing in noise clearer and more comfortable for all hearing aid users.

A patient's hearing difficulties in the presence of noise may be hidden in standard tests (Kohrman et al., 2019). For this reason, speech-in-noise tests have helped us understand a patient's level of hearing difficulty in complex noise environments as an additional layer of information to the pure-tone audiogram. However, there are barriers to current methods. Current speech-in-noise tests are language dependent, often time consuming, and provide no consensus on how to translate findings into tangible outcomes during the fitting flow. This results in a missed opportunity to provide personalized prescriptions of help in noise...until now.

The new Audible Contrast Threshold (ACT) test is a simple, language independent, 2-minute diagnostic tool that provides a single value describing your patient's performance in noisy environments. Not only does it provide a result, but the ACT value is also integrated

into the Oticon Genie 2 software to ensure that the prescription provided to your patient is personalized for their specific needs. This can assist clinicians with providing a better standard of care - from quality rehabilitation to informative counseling - that will make all the difference for new and existing hearing aid users.

ACT approaches speech-in-noise testing like never before. Where previous speech in noise tests are used for validation measures, ACT addresses a different part of the clinical flow. It allows for a proactive approach to the hearing aid fitting, objectively addressing a prominent complaint among hearing aid users.

Perhaps a good way to envision what ACT can do is to consider a doctor prescribing medications to a patient. It is common for a doctor to prescribe several medications before finding one that works best for the patient. Similarly, an HCP will often need to try a variety of adjustments before finding the right settings for a patient. However, with ACT research studies, we have mapped out user preferences in terms of the advanced help features in Oticon hearing aids (Santurette & Laugesen, 2023). Additionally, ACT, as a test that can diagnose hearing ability in noise without language barriers, can be a greater indicator for the fitting process. This personal hearing in complex environment test will indicate users' hearing in noise ability, and its value is embedded into fitting software which can aid the HCP for best practice.

So, we have a more precise starting point going into the fitting.

The following sections will outline different suggestions on the wording you may use as a clinician when describing the use of ACT; both during the fitting to explain the reason for using ACT and how it is used, and when counseling on the patient's needs and available options.

“ The HCP can therefore use the ACT result as a starting point for a conversation with the patient about their daily life listening difficulties. ”

ACT Clinical Workflow Recommendations

This section describes recommendations related to when to perform ACT in the clinical workflow, how frequently the ACT value should be considered or revisited for a patient, and what the fitting implications are with and without an ACT value available.

The ACT diagnostic test is performed by a hearing care professional as part of the diagnostic test battery carried out with all patients. The test takes 2 to 3 minutes to complete and uses an audiometer, as well as headphones or insert earphones. Having pure-tone thresholds available is a pre-requisite for running the test, as the ACT presentation level depends on this information to be presented at an audible level for the patient. This is a critical and valuable aspect of the test, because it presents the ACT stimuli at audible levels similar to the levels of daily-life speech when using well-fitted hearing aids. The HCP can use the ACT value as a starting point for a conversation with the patient about their everyday listening difficulties, with the knowledge that hearing speech in noise remains the number one complaint of people with hearing loss. The fact that the HCP can address this complaint in an objective and measurable way means that they now have a powerful counseling tool available that helps to gain trust and show the value

of professional audiology services. Figure 1 shows where ACT fits into the clinical workflow. After the ACT value has been obtained, it can be automatically imported through NOAH, or manually entered in Genie 2. Here, it is used as the foundation for a help-in-noise prescription, defined within the advanced signal processing of the MoreSound Intelligence™ (MSI) feature.

We recommend that clinicians use ACT as part of the counseling process, ideally with a validated, subjective questionnaire to explore real-life challenges from the patient's perspective. This makes it easier for the HCP to provide informed counseling based on both objective data and subjective experience, to make decisions that will best serve the patient and result in solid, trustworthy recommendations. Using the ACT value, the HCP can provide evidence-based recommendations on hearing aid technology, hearing accessories, and communication strategies. These recommendations can significantly influence the patient's experience with the hearing aids within the first weeks post-fitting. This is applicable for both new hearing aid users and experienced users who may be switching technology level or hearing aid brand.

ACT is an important part of all aspects of the clinical flow

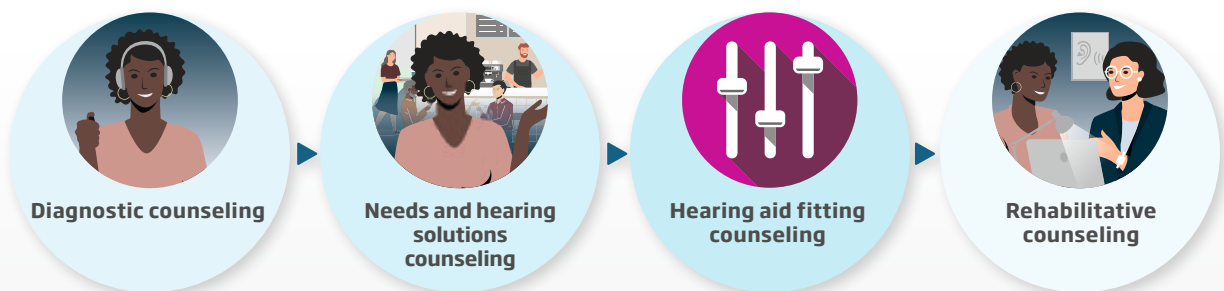


Figure 1: Overview of clinical flow with ACT.

The MSI 3.0 fitting pyramid

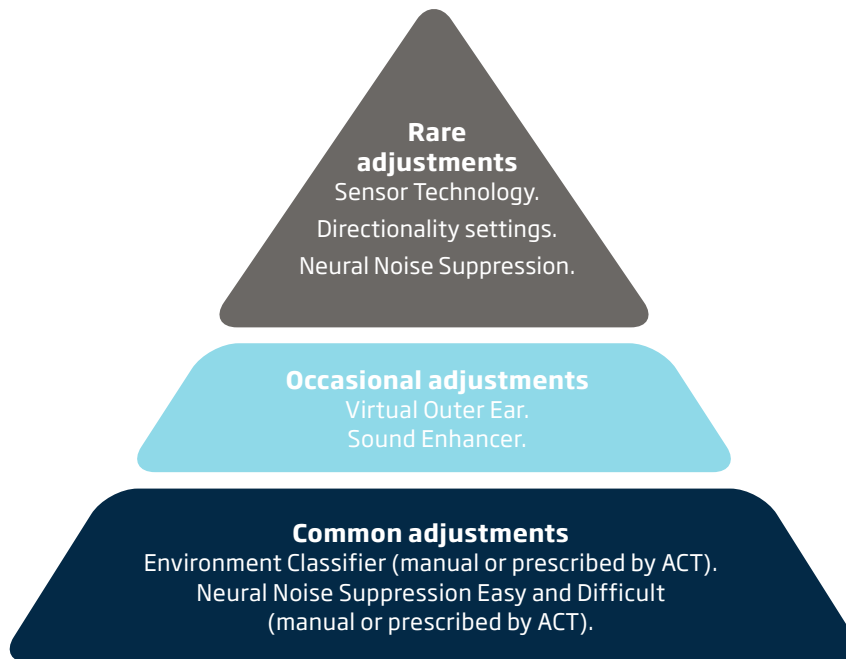


Figure 2: The fitting pyramid for advanced adjustments in MoreSound Intelligence 3.0.

ACT in Genie 2

Some features in the Oticon Genie 2 fitting software are used often, while others are rarely used. For good reason: the fitting software is developed to address both for common, as well as more complex, user needs and preferences. In Figure 2, Oticon features have been placed within a fitting hierarchy, ranging from commonly adjusted settings, to features or functionalities that should rarely be adjusted, but still serve an important purpose for some users.

Prescription of help in noise with an ACT value belongs in the 'common settings' category. The ACT test was introduced into the greater field of Audiology in October 2023. Therefore, it can be expected that it will take some time before this new diagnostic test is cemented as a standard clinical tool. Compatible equipment, clinical confidence, and a change in both mindset and behavior are required for the ACT test to become mainstream.

Nevertheless, it is now our clinical recommendation to use your patient's ACT value when fitting Oticon hearing aids, given the extensive research effort that has shown the justification for its use, as well as its clinical and practical applicability.

“
ACT has a high test-retest reliability and can be revisited as frequently as needed for quick, necessary adjustments.
 ”

Other fitting implications

Implementing an ACT value into a fitting means that the fitting now has a prescription of gain (based on the chosen fitting rationale) and a prescription of help from the hearing aid's advanced signal processing, based on the patient's speech-in-noise ability (ACT-based help-in-noise rationale). A clear benefit that comes with this is a reduced need for adjustments related to the advanced processing in MoreSound Intelligence, in comparison to a prescription with no involvement of the ACT value. This recommendation is based on the extensive studies conducted to support the use of ACT in hearing aid fittings (Santurette & Laugesen, 2023).

In Figure 3, two recommended fitting flows are shown for Oticon hearing aid fittings: one with an ACT value as a starting point, and one without. The main difference between the two is the recommendation for the follow-up visit. If you are starting by measuring a new ACT value and integrating it into the hearing aid fitting, the recommendation is to only visit the MoreSound Intelligence tab in Genie 2 as part of a follow-up visit, if the patient has specific adjustment needs. If the starting point is a pre-existing ACT value, it is recommended to use the ACT prescription as the starting point for the first days and weeks post-hearing aid fitting, so that the patient can experience this prescription before making potential adjustments.

MSI 3.0 fitting flow recommendations

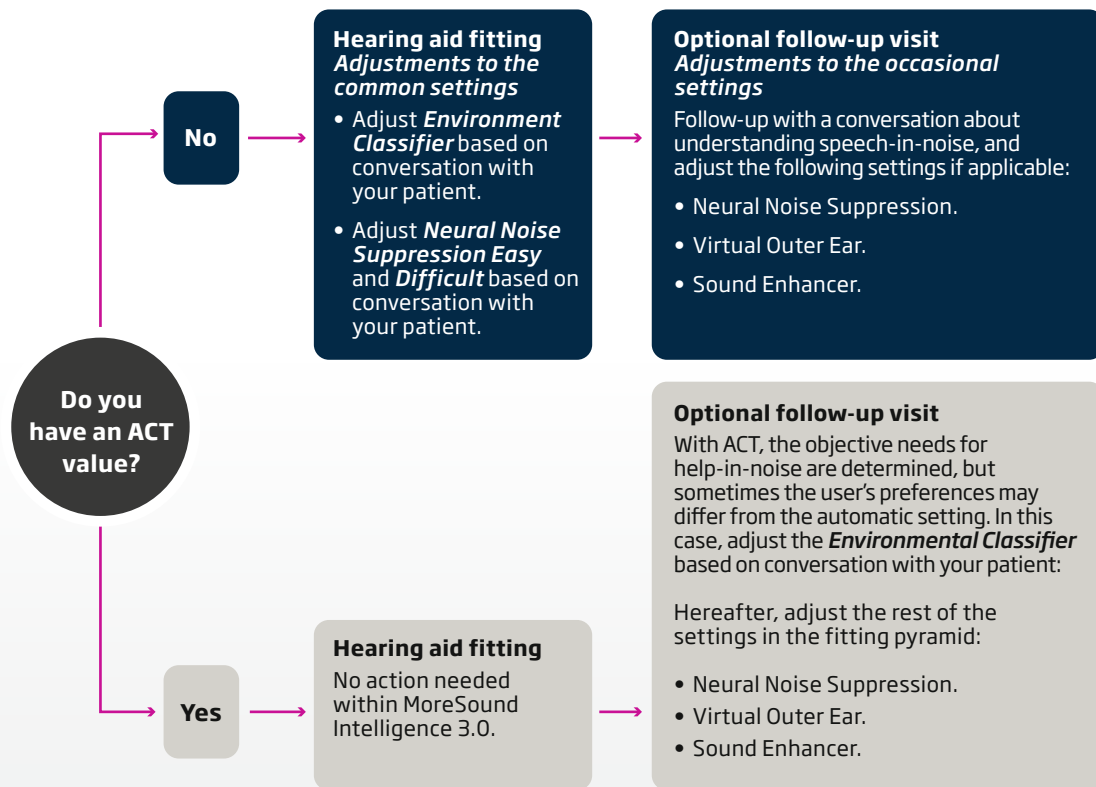


Figure 3: Using the integrated ACT value changes the order of the fitting flow.

Counseling with ACT

There are four areas of the clinical rehabilitation flow where the hearing care professional may need new or additional vocabulary to ensure the most effective use of ACT in daily clinical work:

- A) Diagnostic counseling
- B) Needs and hearing solutions counseling
- C) Hearing aid fitting counseling
- D) Rehabilitative counseling

A) Diagnostic counseling

You have chosen to add a new diagnostic test, ACT, to your test battery. This is not an impulsive choice for most clinicians. We should not underestimate that it takes time for a clinician to gain confidence and solid clinical instincts with a new tool.

Every minute in the clinic counts and therefore, every minute spent on a task or test should reveal something that is valuable for the rehabilitation of your patient.

There are a few helpful points that you can communicate to your patient before and immediately after performing the ACT test.

Key messages to share with your patient before ACT

- 1) **Quantity versus quality:** *"We learn which sounds to make available to you, and how much to turn them up, by measuring your hearing thresholds and recording them in an audiogram. We learn about your ability to hear speech in noise and how much we need to clarify and emphasize speech for you, by measuring your ACT value."*
- 2) **Level is important:** *"ACT must be performed at a level where you can hear it well, because it is a test related to how you hear speech when there is a challenging level of background noise present."*
- 3) **ACT is about speech:** *"Even though the siren/signal you will hear in the test is not speech, it is a valid and tested measure of how you hear speech in noise."*

2 main factors of a good hearing aid fitting

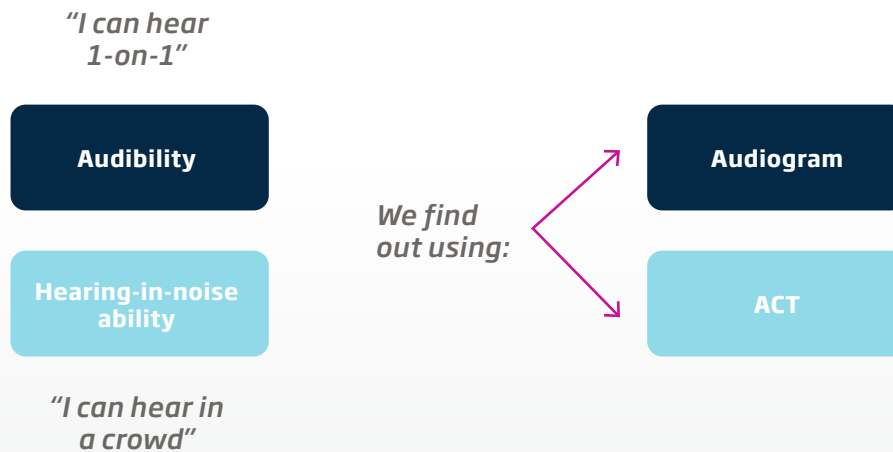


Figure 4: A visualization of the purpose of ACT and the purpose of the audiogram.

Key messages to share with your patient immediately after ACT

- 1) **This result is used for your hearing aid fitting:** *“The ACT value is used specifically to prescribe the right amount of help from the hearing aids for when you are in noisy and challenging listening situations.”*
- 2) **Your ACT value is unique to you:** *“The ACT value is used to address your specific, unique hearing-in-noise needs. These may change over time, so we may run the ACT test again if you feel your hearing has changed.”*
- 3) **#1 complaint:** *“Did you know that hearing in noise is the number one challenge for people with hearing loss? ACT addresses this pain point; that is why it was important that we took the time to measure it.”*

How to talk about ACT value severity with your patient

Example of what you can say to frame the interpretation of the ACT result: *“The result of this test is a single number, or value. The number falls within one of four categories: Normal, Mild, Moderate, or Severe.”*

It is highly recommended that you explain your patient’s audiometric results (air, bone and speech) in combination with their ACT value, as it opens the possibility to talk about the patient’s hearing ability holistically. As an example, *“When we tested the softest tones and speech that you could hear, the results showed that your hearing falls within the mild-to-moderate category of hearing loss. However, I can see from your ACT value that your ability to hear speech in noise is compromised. When patients present this combination of results, they sometimes state that they can hear people talking, but cannot make out what is being said, especially when it’s noisy. Does this type of difficulty resonate with you?”*

Normal value (-4 to < 4 nCL)

“Your result falls within the normal range for your ability to separate speech sounds from background noise. This is great news because it means that your brain can sort sounds in an effective way, and that the hearing aid will amplify your hearing needs but may not need to actively help you to the same degree as some other hearing aid users. A high degree of help in a hearing aid generally means reducing unwanted noise in most situations and providing the greatest possible contrast between the speech you wish to hear and the background sounds around you. When your ACT value falls within the normal category, it means

your chances of receiving optimal benefit from your hearing aids is very high.”

Mild value (4 to < 7 nCL)

“Your result falls within the mild range for your ability to separate speech sounds from background noise. This means that your ability to hear what is going on around you is quite good in quiet environments, with the right amount of amplification. However, when it comes to busier situations with multiple people speaking; a busy back-and-forth conversation; or background noise, such as music at a café, you may struggle with the details of what is being said. Although you may be coping in most situations, the result can be that you are more tired at the end of the day or feel the urge to take a break to recharge, to be able to communicate at your best again.”

Moderate value (7 to < 10 nCL)

“Your result falls within the moderate range for your ability to separate speech sounds from background noise. Your ability to hear effectively in busy or noisy listening environments is compromised to an extent. This means that you are working hard to hear and understand speech in these situations. Sometimes you may be able to cope, but it may come at the cost of listening fatigue and needing to recharge when you leave the situation, feeling more tired earlier in the day or evening. Unfortunately, it may also mean that you miss parts of conversation, or that you concentrate so hard to hear what is being said that you struggle to recall information from the conversation at a later time. An example of this is remembering the name of a person you were just introduced to, or details of a conversation. Our brains have limited capacity and when most of our brain resources are used to try to hear and understand, this leaves fewer brain resources to store the information that we heard in our memory for later use.”

Severe value (10 to 16 nCL)

“Your result falls within the severe range for your ability to separate speech sounds from background noise. Your ability to hear effectively in busy or noisy listening situations is therefore compromised. This means that you are working very hard just to understand what is being said in these situations. Sometimes you are successful in hearing well, but it may come at the cost of getting more tired and frustrated, or losing motivation to hear, far more quickly than someone with a normal ability to hear in noise. It can also impact your energy levels and ability to concentrate after the situation; sometimes for the remainder of the day or evening. When you are not successful in hearing, you miss parts of conversation. You may concentrate so hard to hear

what is being said that your brain will struggle to remember information from the conversation later, such as the name of a person you were introduced to, or important details in a conversation."

Specific recommendations related to hearing aids, hearing accessories, communication strategies, and setting expectations, are provided in the section, 'Needs and hearing solution counseling'.

B) Needs and hearing solution counseling

This section covers how the ACT value can be used to guide hearing solution recommendations. The first part is for you, the hearing care professional (HCP), to understand the rationale behind clinical recommendations. The second part is counseling suggestions that can be used with your patients, based on judgment.

Guidance for the hearing care professional: hearing solution selection based on ACT

ACT prescription for help-in-noise is available in hearing aids built on the Polaris R™ platform (Oticon Real™ and onwards). This includes all technology levels, and as a result, different degrees of help-in-noise will be available, depending on the technology level chosen.

In other words, the help-in-noise prescription default will be based on what is possible in the chosen hearing aid and you will not have the same tools available to help your patient in one solution, compared to another. This is simply demonstrated in Figure 5, where the highest level of technology has the highest adaptability to different environments and the highest strength of support available, in all environments. This gives the HCP the flexibility to support patients with poor hearing-in-noise abilities and improves the signal-to-noise ratio in not only complex environments, but also simpler, quieter environments.

An example of Oticon technology level effects

In Oticon Intent 4, the maximum noise suppression prescribed for a poor ACT value is 6 dB in situations classified in Genie 2 as Difficult, and 0 dB in situations classified in Genie 2 as Easy. In Oticon Intent 1, the same poor ACT value will result in a prescription of 12 dB neural noise suppression in situations classified as Difficult, and 6 dB in situations classified as Easy. In addition to this, the spatial balancing effect is 100% in Oticon Intent 1, versus only 40% in Oticon Intent 4, meaning that the suppression of individual noise sources is more effective in a higher technology level. Lastly, the 4D Sensor technology paradigm is available in Oticon Intent 1 and

Support strength provided by technology levels

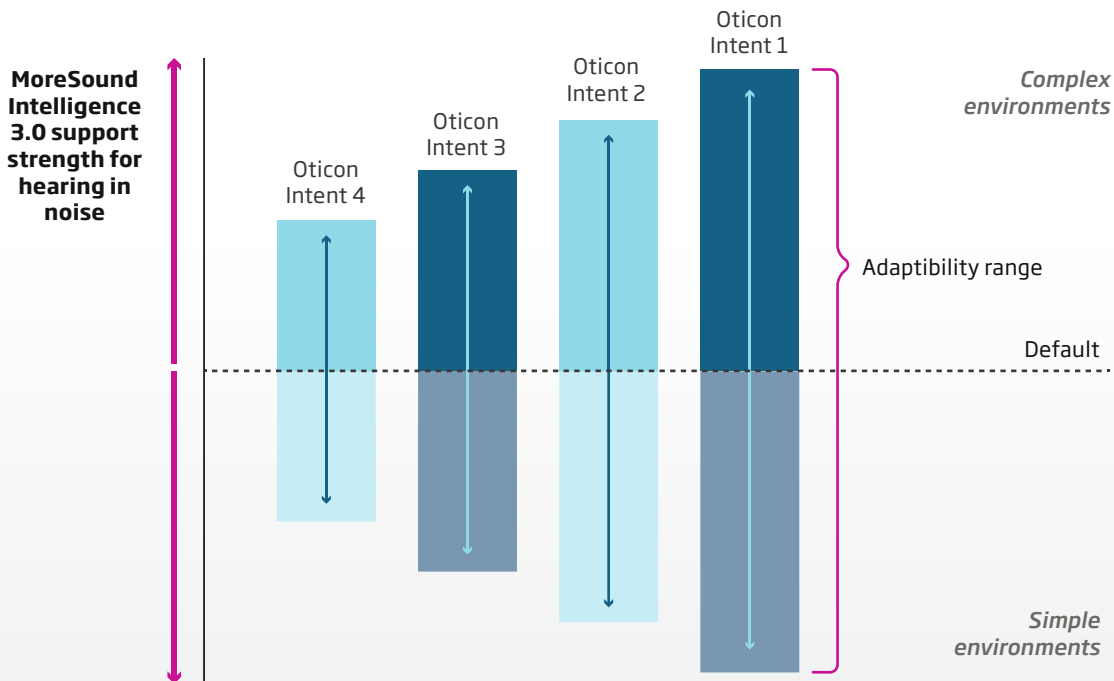


Figure 5: How technology level affects the MoreSound Intelligence 3.0 support strength for hearing in noise, in complex and simple environments.

2, which means that these two technology levels can support user engagement and listening ease with additional input from user head movements and body movements, and support more intelligent decision-making in difficult listening environments.

The example illustrates the need for the HCP to consider the technology level, not just in terms of the entire feature set, but also in terms of the patient’s ACT value.

Why not just prescribe the maximum help in noise for all patients?

Santurette and Laugesen (2023) show that, in terms of pure speech-in-noise performance, patients with normal, mild, moderate, and severe ACT values can all achieve results close to, or on par with, young people with normal hearing, when more help is provided by the hearing aid. So why not just prescribe maximum support from the hearing aid for all patients? To quote Santurette and Laugesen, “ACT allows us to determine the appropriate dosage of the additional help in noise provided by the hearing aid. Ideally, this dosage should be high enough to allow the user’s brain to process speech in noise as effortlessly as possible. It should also not be higher than needed to limit the risk of side effects, as some users may be more sensitive than others to strong processing of the incoming sound.” In other words, the individual brain tolerance for signal processing may be a factor to consider in addition to only speech-in-noise performance.

The right amount of help for a person with hearing loss is a hearing aid that intervenes as little as possible and only when necessary, in terms of shaping the sound.

A person with normal hearing generally does not need help from an external device to hear. But even with normal hearing, we can benefit from wearing noise-reducing headphones on an airplane, or we might prefer a presenter to wear a microphone, even though we can technically hear them without. For people with damage to their hearing system, hearing aids provide support by applying gain for valuable sounds and applying signal processing for various unwanted or disturbing sounds. The ACT value provides information about how much help the patient in front of you may need. This, however, does not mean that the patient needs the same high dose of hearing aid support at home, as they need in a busy restaurant or, that all patients need the same very high dose of help.

How to talk to your patient about hearing solution considerations, using ACT

You can start by tying all results from the diagnostic evaluation together and relating them to the rehabilitation you are planning to provide:

“We have now completed testing related to your hearing thresholds, which are X (audiogram), and we have measured your hearing-in-noise ability, which is in category Y (ACT). Combined, this tells me that you are a candidate for hearing aids, and I now know how much help you need for different listening situations. Let’s discuss the technology that is available to help you with your specific needs.” (Figure 6)

Now, relate the patient’s individual ACT value to hearing aid considerations.

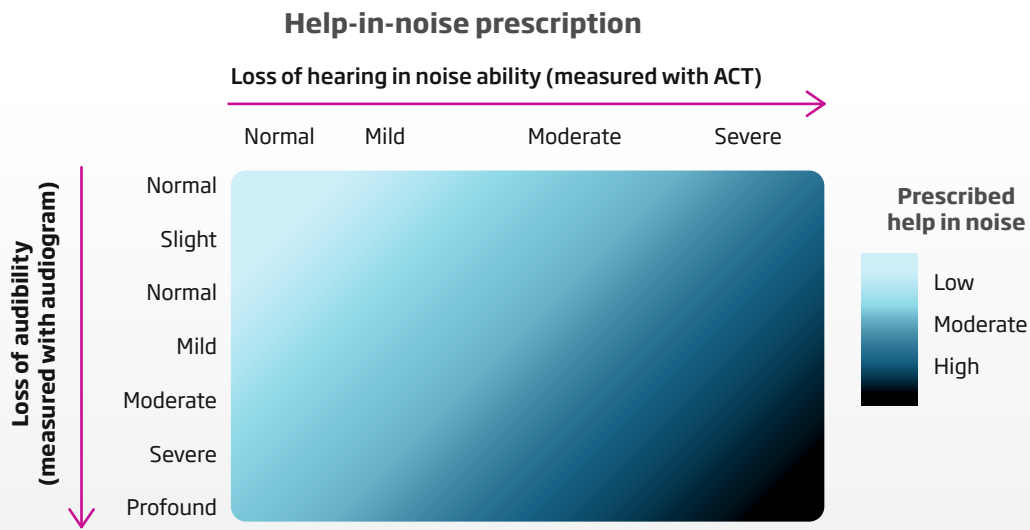


Figure 6: When using an ACT-based prescription, the level of help in noise provided to an individual user will depend on both their audibility loss and contrast loss severity.

Normal ACT value hearing aid considerations:

"When your ACT value falls within the Normal category, it means that your chances of receiving optimal benefit from your hearing aids are very high. You will benefit from a hearing aid with high customization and adaptation ability so that we can start with a small degree of help-in-noise support, with the option to increase this in the future, if needed. As your speech-in-noise ability and your sound preferences can change over time, I can accommodate your changing hearing needs effectively when you choose technology that has high adaptability. You may already find that there are situations where additional support from the hearing aid is appreciated, even if you don't need it all the time. Just like a normal-hearing person loves noise-reducing headphones on a noisy airplane, you may appreciate strong help-in-noise features at certain times in your daily life."

Mild ACT value hearing aid considerations:

"With your hearing ability, you will benefit from some level of help when the hearing aids detect that you are in a difficult listening environment. Here, the hearing aid will automatically increase the contrast between speech and noise for you, so you can engage better in conversation and be less tired at the end of the day. This can optimize your overall hearing experiences."

Moderate ACT value hearing aid considerations:

"With your hearing ability, you will benefit from support from the hearing aid both when the listening environment around you is difficult, and less difficult. With active, higher strength help features available in your hearing aid, it can detect when you need more support. This allows you to engage in conversation and focus on what is being said, due to a greater contrast given between what you want to hear, and the disturbing sounds around you. Your ACT value tells me that I need to program your hearing aids to give you a lot of support to help you hear better. This doesn't just mean turning up the volume, but rather providing clarity when the listening environment can be challenging."

Severe ACT value hearing aid considerations:

"With your hearing ability, you can benefit from the most support available in hearing technology today. You will need help, not only to turn up the volume of important sounds, but also to provide clarity in many different situations throughout your day; and this is not only for when there is background noise. With your ACT value, I will consider if hearing aids alone will be enough for you. You may benefit from extra help from a hearing aid accessory, for example to hear better on the phone

or when watching TV; but we will know more about your needs when you wear the hearing aids and try them out at home."

It may be helpful to use a visual, as shown in Figure 6. This figure powerfully illustrates that there are two aspects to better hearing: audibility and clarity. Addressing both aspects builds your value as a hearing care professional because you can address the common pain of hearing speech in noise.

C) Hearing aid fitting counseling

So, you have your patient's ACT value and have counseled on ACT during the diagnostic evaluation stage, as well as the needs and hearing solution selection process. You are now ready to fit the Oticon hearing aids with an ACT-based prescription. The Oticon Genie 2 fitting software implementation is very simple, but an Oticon Fitting Guide for ACT is available if you need specific support during the fitting.

Key messages to share with your patient during fitting:

- 1) **Audibility and clarity:** *"With your audiogram and your ACT value, I have all the information I need to customize a set of hearing aids really well to your needs"*
- 2) **The right dose:** *"The fitting software will prescribe the right dose of sound and right dose of help for you. This is based on large-scale research studies of user preference for different hearing losses and different speech-in-noise abilities"*
- 3) **Starting point:** *"When you leave here today, we have the best possible, evidence-based starting point for your first few months wearing hearing aids."*

D) Rehabilitative counseling

Before your patient leaves the clinic, there are some points that may be appropriate for you to make, and where having the ACT value available can help support your message to your patient. Because ACT is an evidence-based method for measuring speech-in-noise ability, you can use it to support your fitting and rehabilitation recommendations and thereby help build trust and credibility with your patient. Mainly, an ACT value will support considerations you have related to:

- A) The need for spending more time on setting expectations
- B) The need for spending more time going through useful communication strategies

C) The need to consider assistive listening technology
Key messages to share with your patient related to rehabilitation:

All ACT values:

"Your hearing aid has now been set up as correctly and precisely as possible, according to your unique needs for audibility and clarity. You do not have to do anything now, other than go back to your daily life and start noticing sounds around you. If you'd like, you can seek out situations that have previously been challenging for you, to see how they sound now."

Normal and mild ACT values:

"I have adjusted the sounds around you to be available to you and clear to you. When I see you back for your follow up appointment, we may or may not need to make minor adjustments, based on your feedback about your experiences. But with the tests I have done, I have been able to set up your hearing aids to be at the best starting point possible and I anticipate that you will do really well with hearing aids."

Moderate and severe ACT values:

"We now know that your ability to hear clearly and hear well in noise is compromised. When you return, let's discuss your experience and if there are situations you still find challenging. With your severe ACT value, this means you may need help in addition to your hearing aid, for instance the use of a streaming device that can transmit speech from someone talking to you directly to your hearing aids. I will now also go through some simple strategies you can use in your daily life to hear better and get the most out of your hearing aids"

"Use it to support your fitting and rehabilitation recommendations... help build trust and credibility with your patient."

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