WHITEPAPER
2025

# ACT™ in action: Enhancing patient care with the Audible Contrast Threshold (ACT) test

## Clinical experiences and the value of integrating the ACT test into clinical practice


ABSTRACT

ACT is a game-changing tool that addresses the primary complaint of hearing aid users; the difficulty of understanding speech in noisy environments. Currently, there is no established best practice to match hearing aid fittings to the patient's help-in-noise needs. ACT is the first clinically applicable test that predicts aided speech-in-noise abilities in a fast and language-independent manner and automatically adjusts the hearing aid to optimize individual needs. We tested ACT in multiple real-life audiology clinics to gauge how hearing care professionals would integrate this new diagnostic test into their audiological clinical test battery. The feedback was very positive. On average, 82% of clinicians reported an overall positive experience and nearly 90% wanted to recommend ACT to other clinicians, suggesting that ACT can be adopted widely to enhance patient care.



02 ACT background refresher

02 ACT in Demant hearing aid clinics

08 Clinical feasibility of the ACT test

10 Conclusions and future directions

10 Acknowledgements

11 References



EDITORS OF ISSUE

**Marianna Vatti, MSc**
*Centre for Applied Audiology Research, Oticon A/S*

**Husmita Ratanjee-Vanmali, PhD**
*Demant Hearing Care, Audika Group*

**Søren Laugesen, PhD**
*Interacoustics Research Unit, Interacoustics A/S*

**Maral Ghamkhar, MAud**
*Centre for Applied Audiology Research, Oticon A/S*


oticon
life-changing **technology**

## ACT background refresher

Close to 50 years ago, Plomp (1978) described hearing loss as having two general categories: "sensitivity" and "distortion". Sensitivity refers to the audibility of soft sounds, i.e. whether soft sounds are loud enough to be heard or perceived. It is readily measured by means of the pure-tone audiogram and can generally be remedied by amplification and dynamic-range compression in hearing aids. Distortion refers to supra-threshold deficits and is also known as loss of discrimination in literature. The primary consequence of distortion is problems with speech understanding in noise, even if audibility has been properly addressed. Until recently, there was no simple and language-independent way of diagnostically quantifying this challenge for the individual patient, although many researchers had tried (e.g., Johannesen et al., 2014; Sanchez-Lopez et al., 2020; Strelcyk & Dau, 2009; Thorup et al., 2016). Promisingly, several studies on spectro-temporal modulation (STM) detection demonstrated strong correlations between STM detection thresholds and speech-in-noise performance (Bernstein et al., 2013; Mehraei et al., 2014). Early research versions of the STM test proved to be excessively challenging for a general clinical population (Bernstein et al., 2016). These experiences fueled a translational research effort spearheaded by the Interacoustics Research Unit, which advanced STM research (Zaar, Simonsen, Dau, et al., 2023; Zaar, Simonsen, & Laugesen, 2023) and ultimately led to the development of a clinically viable test now known as the Audible Contrast Threshold (ACT™) (Zaar/Simonsen et al., 2024).

ACT was designed to integrate seamlessly into the clinical test battery. The test automatically adjusts the presentation level based on the patient's audiogram to ensure audibility (Humes, 2007). It makes use of the same hardware (headphones/inserts and patient response button) as pure-tone audiometry. The test methodology is based on the commonly employed modified Hughson-Westlake test paradigm (Carhart & Jerger, 1959; Hughson & Westlake, 1944). These design considerations mean that ACT is easy to adopt by Hearing Care Professionals (HCPs) and can be readily measured right after pure-tone audiometry. Thus, ACT is a quick and easy measure to predict a patient's aided hearing-in-noise ability in realistic situations.

ACT is measured on a dedicated Contrast Level scale normalized such that 0 dB nCL corresponds to the median performance in young adults with hearing within normal limits (Zaar/Simonsen et al., 2024). Positive values indicate various degrees of "contrast loss", thus resembling the well-known dB HL scale used for pure-tone hearing thresholds. By relying on artificial, non-language stimuli, ACT can be used globally with patients irrespective of their native language and whether validated speech testing materials exist in the local language.

Clinical studies with external research partners (Zaar, Ihly, et al., 2023) have demonstrated the viability of ACT and extended the evidence base for the relationship between ACT and aided speech-in-noise tests to include German and Japanese-speaking populations. In addition, these studies have provided crucial data allowing hearing aid automatic prescription rules for help-in-noise settings, based on the individual patient's ACT value, pure-tone average, and age (Santurette & Laugesen, 2023). Finally, data from these studies were used to define contrast-loss categories: normal (-4 to 4 dB nCL), mild (4 to 7 dB nCL), moderate (7 to 10 dB nCL), and severe (10 to 16 dB nCL). Besides the technical value in prescribing help-in-noise settings, ACT has value as a counseling tool (Løve et al., 2023).

The goal of this work was to understand how ACT operates in a real-life clinical setting and how HCPs accept and integrate this new test into their practice. We present findings from two studies. The first study examined the perspectives of HCPs in Demant hearing aid clinics regarding the patient journey, from identifying speech-in-noise difficulties to counseling patients and fitting their hearing aids. The second study, conducted at Henry Ford Health, evaluated the feasibility of performing ACT in clinics and highlighted its added diagnostic value by assessing, among others, a normal-hearing population.

## ACT in Demant hearing aid clinics

Conducting this study in a real-world clinical setting was essential for evaluating HCP acceptance, readiness for implementation, and integration of a new test, while gaining insights into the patient journey. 30 HCPs with varying years of experience with hearing evaluations and hearing aid fittings were included in this study

from multiple Demant hearing aid clinics in the United Kingdom, Ireland, and Portugal. All HCPs involved in this study received training on the theory of ACT and participated in face-to-face, hands-on training sessions to build confidence in conducting the test before the study began.

The HCPs added ACT to their clinical hearing test battery for a period of four months. ACT was performed at the diagnostic appointment after pure-tone audiometry, utilizing Interacoustics Affinity Compact or MedRx Avant ARC. The HCPs were instructed to use the ACT-based prescription of help-in-noise features across Demant hearing aids of all technology levels, with no other changes in their standard clinical practice.

At the end of the study period, each of the HCPs completed an anonymized online survey where they rated five categories: (i) Usability, (ii) Clinical value, (iii) Hearing aid fitting value, (iv) Counseling value, and (v) Overall recommendation. The survey comprised 24 items and used an 11-point Likert scale (0 = totally disagree, 10 = totally agree). HCPs were also encouraged to provide feedback describing their experiences with ACT in their own words.

In total, close to 3,000 patients were tested with the ACT test during the study period. The average number of ACT-tested patients per HCP was 98. Figures 1-6 display the results of the survey in the five categories. The results are divided into three agreement levels: 0-3 = disagree, 4-6 = neutral, 7-10 = agree. An excerpt of the survey results is presented in Figures 1-5 showing at least 70% of clinicians reporting a positive experience for all items. The median response for all items was 8 or higher – more details are provided below.

**Usability**

As shown in Figure 1, most of the HCPs found the ACT test simple to administer (77%), easy to integrate into their clinical routines (93%) and to explain to patients (77%). Remarkably, every HCP found that the data transferred from their digital diagnostic audiometer to the Oticon Genie's help-in-noise features in a seamless and straightforward manner. Among these HCPs, 80% reported feeling confident using the ACT test, suggesting that ACT can be comfortably learned and incorporated into the clinical workflow.

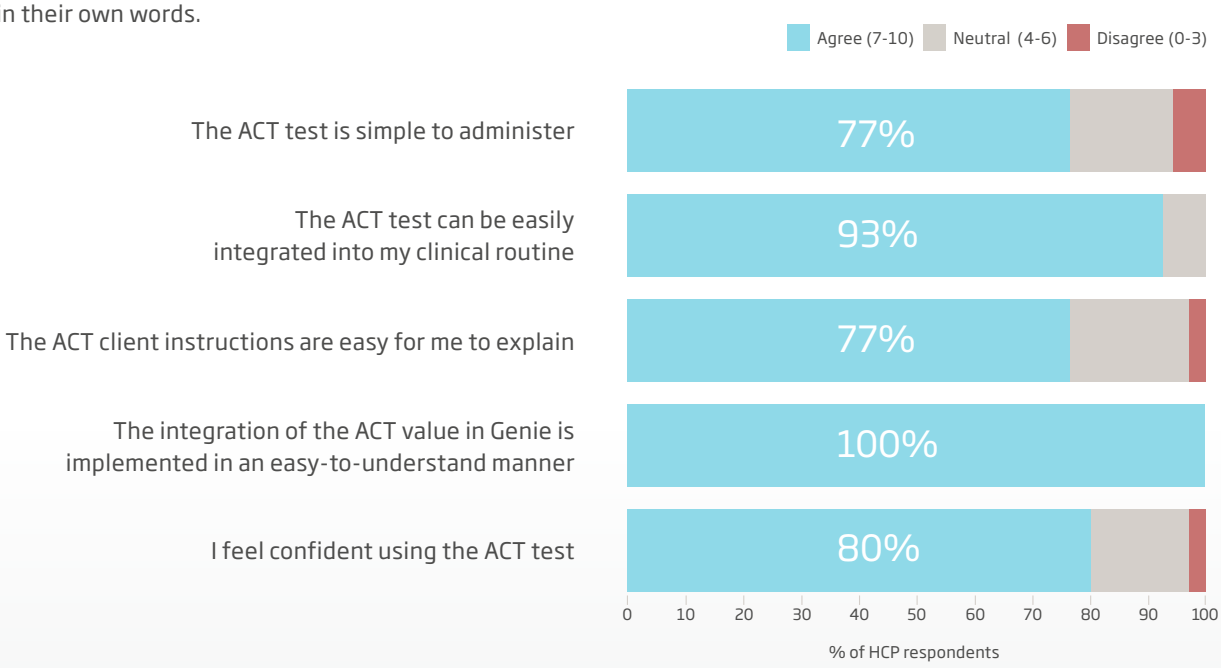


*Figure 1. Survey results on the usability of ACT.*

**Selected HCP feedback***

"When performed, it has a logical explanation and good technical support".

"It's automatic passage does not "steal" time from the diagnostic test appointment".

*The quotes represent individual, self-reported feedback provided through the open comment section of the survey and should not be interpreted as representative of all participants.

**Clinical value**

The majority (74%) of HCPs found that ACT provides an additional layer of information to the patient's hearing profile and 70% reported that the ACT test increases their confidence in identifying those patients who are most challenged with hearing speech in noise.

Furthermore, most HCPs (84%) highlighted the value of the ACT test as a clinically valid tool. In summary, it is evident that ACT constitutes a significant enhancement to the audiological test battery and should be regarded as a standard practice in the future.

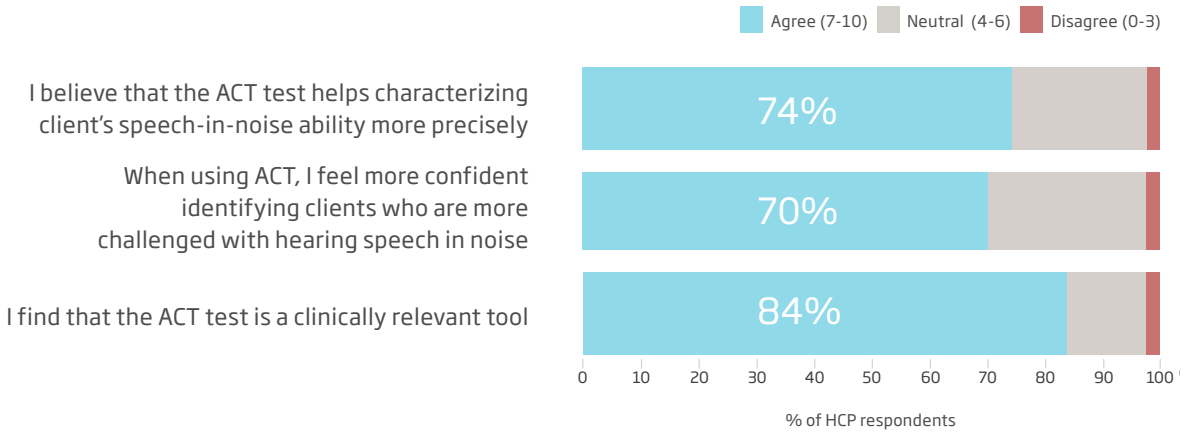


*Figure 2. Survey results on the clinical value of ACT.*

**Selected HCP feedback***

"I have valued adding ACT to my consultation. It makes our assessment even more thorough. I have found it quick and simple to run and I feel clients take on board the results".

"Delighted to have this facility (ACT), as it helps the client understand their issue better, particularly as audiometry is performed in quiet and people have commented on this".

"I am enjoying being part of the ACT study and I think it is very important to include the ACT test in clinical practice, as it will be an added value for the client".

*The quotes represent individual, self-reported feedback provided through the open comment section of the survey and should not be interpreted as representative of all participants.

**Counseling value**

Nearly 90% of HCPs in this study agreed that using ACT as a counseling aid supports family and person-centered care principles in explaining speech-in-noise difficulties to both patients and their loved ones. The HCPs also ranked highly (70%) the likelihood of the patient returning for their hearing aid fitting appointment if the ACT value was used to explain the patient's speech-in-noise difficulty. Most (85%) HCPs reported that ACT helps them in making relevant technology recommendations for their patients.

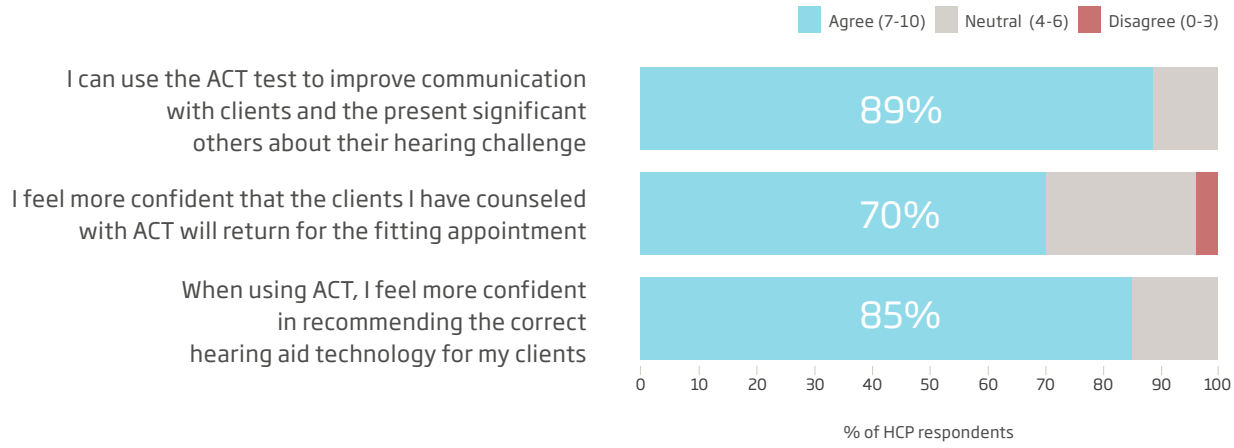


*Figure 3. Survey results on the counseling value of ACT.*

**Selected HCP feedback***

"An excellent tool that helps in providing more assertive counseling for the client's needs and facilitates the most appropriate programming for each client's auditory needs".

"I think the ACT test is easy to do – it only takes 2 minutes, and it adds another level to the hearing test that other HCPs are not currently doing. A lot of clients have come out of the sound booth and immediately said, I have never had such a comprehensive test. The results are precise and it is another tool to help warrant looking at better tech for background noise. Clients who are struggling in background noise and have scored poorly in the ACT test can appreciate the results, as it gives them a deeper insight into their hearing loss. They already knew they were struggling and to have the results in front of them along with the audiogram gives a better understanding of their hearing loss".

*The quotes represent individual, self-reported feedback provided through the open comment section of the survey and should not be interpreted as representative of all participants.

**Hearing aid fitting value**

The majority (96%) of HCP respondents confidently used the ACT value to adjust hearing aid settings, with 89% feeling confident in the resulting first fit of help-in-noise settings. Interestingly, many HCPs (74%) subjectively perceived that this first fit led to fewer adjustments in the follow-up appointments, and (78%) perceived a decrease in patient complaints related to speech-in-noise difficulties.

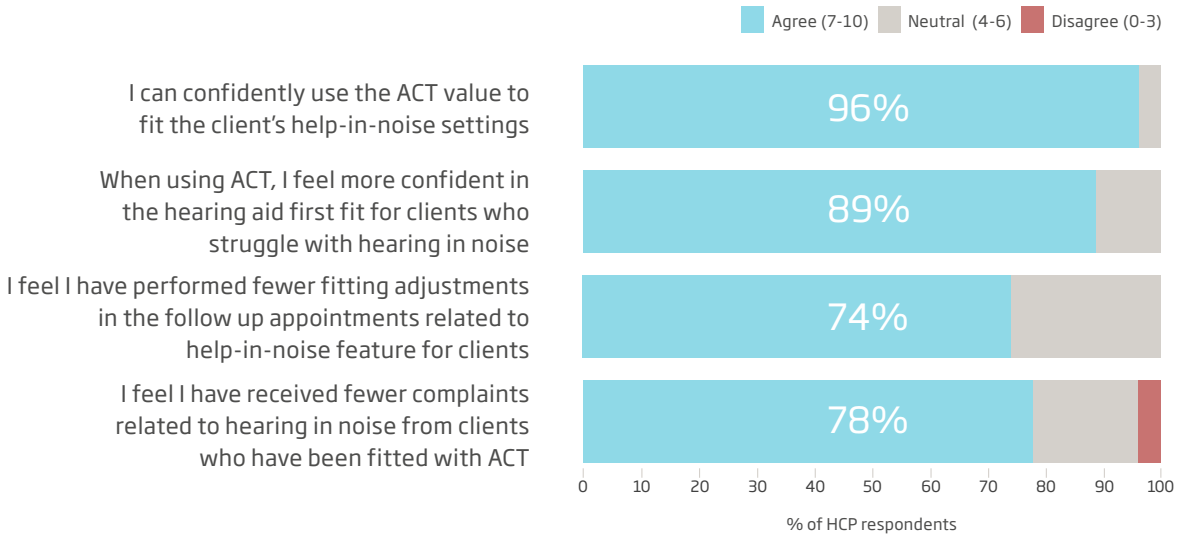


*Figure 4. Survey results on the hearing aid fitting value of ACT.*

**Selected HCP feedback***

"I firmly believe the test is beneficial to both the HCP in terms of less manual adjustment and more accurate initial first fit and to the client as less time is spent on fine-tuning".

"Very well put together and easy to put into practice, a valuable test unleashing the full benefit of new hearing aid technology".

*The quotes represent individual, self-reported feedback provided through the open comment section of the survey and should not be interpreted as representative of all participants.

**Overall recommendation**
Almost 90% of the HCPs in everyday clinical practice rated ACT as a valuable addition, elevating their clinical test battery. These HCPs would highly recommend ACT to other HCPs for inclusion in their clinical test protocols.

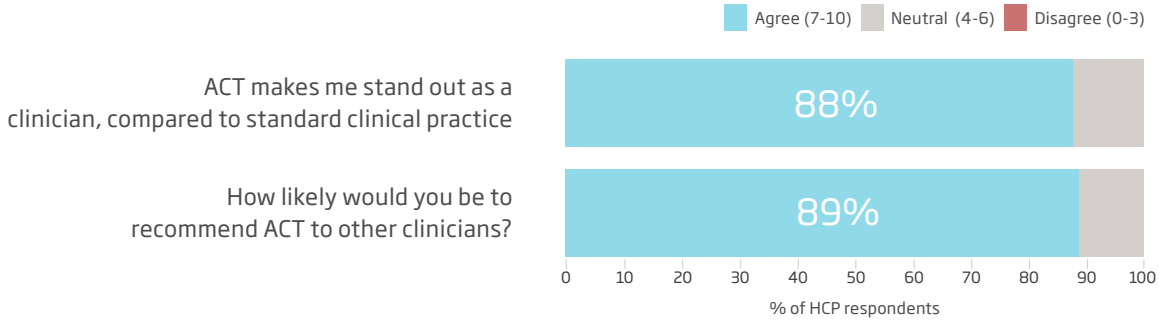


*Figure 5: Survey results on the overall recommendation for ACT.*

**Selected HCP feedback***
"I think ACT is an asset".
"Very useful tool and will definitely continue to use it".
"Overall ACT is a brilliant tool and I would highly recommend it to all".
"ACT provides added value".

**Results overview**
Figure 6 shows the overall percentage score for each category and agreement level, where on average 82% of clinicians reported a positive experience across all evaluated categories. The median of the HCPs' average responses across all items within each category was significantly higher than 7, as indicated by a one-sided Wilcoxon signed-rank test ($p < 0.002$).

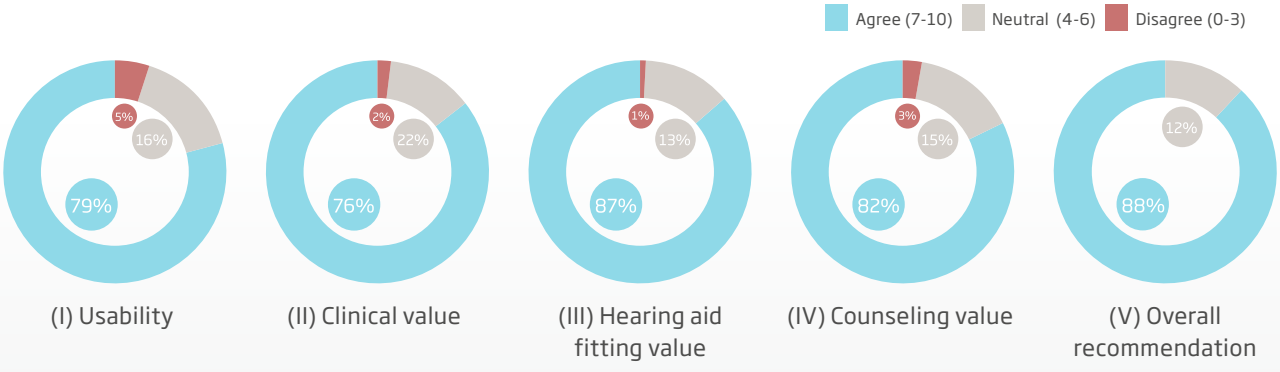


*Figure 6: Percentage of HCP respondents for each category and agreement level.*

*The quotes represent individual, self-reported feedback provided through the open comment section of the survey and should not be interpreted as representative of all participants.

The HCPs who participated in this study provided overwhelmingly positive feedback on ACT across all five categories: (i) Usability, (ii) Clinical value, (iii) Hearing aid fitting value, (iv) Counseling value, and (v) Overall recommendation. ACT was noted for its clinical efficiency throughout the entire workflow, with HCPs reporting no disruption to the clinical process. They highlighted the design benefits of ACT, including how it draws information from the audiogram, runs quickly, and ensures automatic transfer of the results to the hearing aid fitting. This streamlined process limits the need for manual adjustment by automatically creating a personalized first-fit setting, and HCPs feel confident it addresses the individual speech-in-noise needs of the patient. This indicates that ACT contributes overall to more efficient patient care. HCPs also reported a subjective sense of receiving fewer speech-in-noise complaints and fewer readjustment requests of the help-in-noise settings, suggesting that the ACT-prescribed help-in-noise settings are likely to be accepted by the patient. Furthermore, the role of ACT in enhancing patient counseling was notably highlighted, particularly in explaining hearing test results, setting expectations, and recommending the most appropriate technology. With nearly 90% of HCPs expressing a willingness to recommend ACT to their peers, this highlights ACT's strong potential to be widely adopted into clinical practice with the goal of improving patient care.

While the overall response has been positive, some professionals mentioned technical challenges at first. However, over a short period of time with hands-on experience, they became more comfortable and confident with the test. Hearing care clinics that plan to incorporate ACT testing into their clinical protocols should ensure sufficient time is allocated for team member training. Providing hands-on training will help build HCP confidence in using the system effectively and support a smoother integration into daily practice.

## Clinical feasibility of the ACT test

This study focused on the clinical feasibility of the ACT test within busy audiology clinics. At Henry Ford Health (Detroit, Michigan, USA) ACT was integrated into clinical practice across the three busiest sites (Bennett et al., 2024). Over a one-month period, a total of 108 patients were tested, ranging in age from 22 to 96, with a median age of 61 years. Routine audiometric tests, including immittance measurements, pure-tone audiometry, and speech audiometry were conducted. ACT was performed last by utilizing the GSI AudioStar audiometers.

ACT proved to be feasible and easy to integrate into clinical practice, adding an estimated one to three minutes to the test battery duration. Only 7% of patients (n=8) were unable to complete the test due to cognitive impairment or debilitating tinnitus. Additionally, two patients were unable to understand the task and one was unable to understand instructions due to language barriers. The above indicates that ACT can overcome some of the barriers of traditional speech-in-noise tests, which often restrict routine clinical implementation and are typically limited to a single language that may not match the patient's first language.

Out of the 100 patients who completed the ACT test successfully, a quarter of these patients (n = 25) exhibited normal hearing sensitivity, defined as pure-tone thresholds of 20 dB HL or better across all frequencies (0.25 to 8 kHz), measured bilaterally. These patients with normal hearing sensitivity were divided into two groups based on whether they reported hearing difficulties as a primary complaint (shown in figure 7). Among the 14 patients who reported a complaint, almost

one third (4 patients) exhibited elevated ACT values, with ACT successfully detecting a contrast loss despite audiometric thresholds in the normal range. In contrast, all 11 patients without hearing difficulty complaints had normal ACT values, suggesting excellent specificity of ACT in accurately identifying individuals without self-perceived hearing difficulties. This highlights that ACT can serve as an additional tool for counseling patients who struggle, despite the audiogram suggesting normal hearing sensitivity.

ACT values were also evaluated for patients (n = 37) with excellent word recognition in quiet (WRQ). Figure 8 illustrates the percentage of patients falling within each ACT contrast loss group among patients who obtained 100% correct speech recognition on recorded NU-6 word lists. In this case, only 65% exhibited normal ACT values, whereas a notable 35% showed mild to moderate contrast loss, i.e. elevated ACT values. This suggests that WRQ alone is often not predictive of patients who may struggle hearing or communicating in background noise, highlighting that ACT provides additional insights into real-world hearing-in-noise abilities beyond what WRQ can reveal in clinic today.

Overall, the study concluded that the ACT test is easy to implement, practical, and can identify patients with difficulties in hearing speech in noise; even those with audiometrically normal hearing, and those exhibiting excellent speech-in-quiet performance.

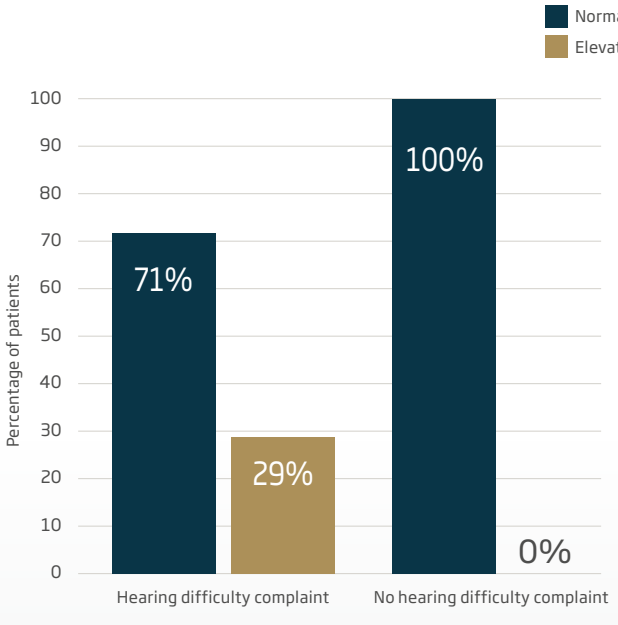


*Figure 7: Percentage of patients with normal hearing sensitivity (n = 25) who had normal (dark blue bars) and elevated ACT values (brass bars). Patients were divided into two groups, those with hearing difficulties as a primary complaint and those without.*

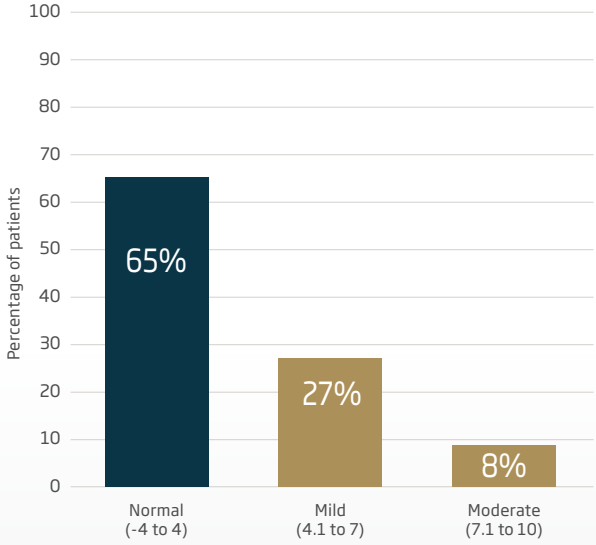


*Figure 8: Percentage of patients with 100% WRQ (n = 37) across different contrast loss categories.*

## Conclusions and future directions

ACT is the first test to address the lack of an established best practice for matching hearing aid fittings to a patient's help-in-noise needs. The studies reported here provide evidence that ACT is well-received by clinicians, with positive experiences reported across the entire patient journey. This indicates that ACT can be adopted more widely with the development of international clinical protocols that incorporate it as a standard best practice, ensuring a high quality of audiological care.

## Acknowledgements

We extend our gratitude to the HCPs from Demant Hearing Care clinics in the United Kingdom, Ireland, and Portugal for their dedication throughout the 2024 study. Special thanks to the lead audiologists and team members at Demant Hearing Care offices for their support, Amber Wang for project management, and Asta Kristensen Vølund for data analysis. We also extend our thanks to the audiologists and management at Henry Ford Health, as well as Erica Bennett and Brad A. Stach, for their collaboration and support in assessing the clinical feasibility of the ACT test.

**Key takeaways**

- ACT is practical for clinical use and enhances overall patient care efficiency. It is easy to learn and adds approximately one to three minutes to the test battery duration. ACT is designed to integrate smoothly into the clinical workflow for selected Demant audiometers, such as the Interacoustics Affinity Compact, MedRx Avant ARC, GSI and Inventis (not part of this work), facilitating an optimal initial fit of the help-in-noise settings for the patient while limiting the need for further manual adjustments.

- ACT provides a deeper understanding of the patient's real-world hearing abilities and helps identify the most challenged patients, including those with audiometrically normal hearing, making it a clinically relevant tool.

- ACT enhances counseling by better explaining problems to patients and their loved ones, acknowledging complaints that may not be supported by the audiogram, and reassuring patients that their concerns are valid. It also helps set realistic expectations for the hearing aid solution and supports the HCP in recommending the most appropriate technology.

- ACT provides an initial first fit of the help-in-noise hearing aid settings that is meaningful to the HCP and likely to be accepted by the patient.

- ACT represents a significant advancement in the audiological test battery and is shown to enhance patient care. Its language-independent design allows for the test's implementation into international audiological protocols, enhancing patient care globally.

## References


1. Bennett, E., Marino, J., Stach, B., Ramachandran, V., & Faulkner, K. (2024). Clinical feasibility of the Audible Contrast Threshold (ACT) test. The Hearing Review. https://hearingreview.com/hearing-products/testing-equipment/testing-software/clinical-feasibility-of-the-audible-contrast-threshold-act-test
2. Bernstein, J. G. W., Danielsson, H., Hällgren, M., Stenfelt, S., Rönnberg, J., & Lunner, T. (2016). Spectrotemporal modulation sensitivity as a predictor of speech-reception performance in noise with hearing aids. Trends in Hearing, 20(0). https://doi.org/10.1177/2331216516670387
3. Bernstein, J. G. W., Mehraei, G., Shamma, S., Gallun, F. J., Theodoroff, S. M., & Leek, M. R. (2013). Spectrotemporal modulation sensitivity as a predictor of speech intelligibility for hearing-impaired listeners. Journal of the American Academy of Audiology, 24(4), 293–306. https://doi.org/10.3766/jaaa.24.4.5
4. Carhart, R., & Jerger, J. F. (1959). Preferred method for clinical determination of pure-tone thresholds. Journal of Speech and Hearing Disorders, 24(4), 330–345. https://doi.org/10.1044/jshd.2404.330
5. Hughson, W., & Westlake, H. (1944). Manual for program outline for rehabilitation of aural casualties both military and civilian. Trans Am Acad Ophthalmol Otolaryngol, 48(Suppl), 1–15.
6. Humes, L. E. (2007). The contributions of audibility and cognitive factors to the benefit provided by amplified speech to older adults. Journal of the American Academy of Audiology, 18(7), 590–603.
7. Johannesen, P. T., Pérez-González, P., & Lopez-Poveda, E. A. (2014). Across-frequency behavioral estimates of the contribution of inner and outer hair cell dysfunction to individualized audiometric loss. Frontiers in Neuroscience, 8. https://doi.org/10.3389/fnins.2014.00214
8. Løve, S., Ghamkhar, M., Wang, M.A. (2023). Fitting and counseling with Audible Contrast Threshold (ACT™). Oticon Whitepaper.
9. Mehraei, G., Gallun, F. J., Leek, M. R., & Bernstein, J. G. (2014). Spectrotemporal modulation sensitivity for hearing-impaired listeners: Dependence on carrier center frequency and the relationship to speech intelligibility. The Journal of the Acoustical Society of America, 136(1), 301–316. https://doi.org/10.1121/1.4881918
10. Plomp, R. (1978). Auditory handicap of hearing impairment and the limited benefit of hearing aids. The Journal of the Acoustical Society of America, 63(2), 533–549. https://doi.org/10.1121/1.381753
11. Sanchez-Lopez, R., Fereczkowski, M., Neher, T., Santurette, S., & Dau, T. (2020). Robust data-driven auditory profiling towards precision audiology. Trends in Hearing, 24, 2331216520973539.
12. Santurette, S. & Laugesen, S. (2023). Audible Contrast Threshold (ACT™). Oticon Whitepaper.
13. Strelcyk, O., & Dau, T. (2009). Relations between frequency selectivity, temporal fine-structure processing, and speech reception in impaired hearing. The Journal of the Acoustical Society of America, 125(5), 3328–3345. https://doi.org/10.1121/1.3097469
14. Thorup, N., Santurette, S., Jørgensen, S., Kjærbøl, E., Dau, T., & Friis, M. (2016). Auditory profiling and hearing-aid satisfaction in hearing-aid candidates. Danish Medical Journal, 63(10).
15. Zaar, J., Ihly, P., Nishiyama, T., Laugesen, S., Santurette, S., Tanaka, C., Jones, G., Vatti, M., Suzuki, D., Kitama, T., Ogawa, K., Tchorz, J., Shinden, S., & Jürgens, T. (2023). Predicting speech-in-noise reception in hearing-impaired listeners with hearing aids using the Audible Contrast Threshold (ACT™) test [Preprint]. PsyArXiv. https://doi.org/10.31234/osf.io/m9khu
16. Zaar, J., Simonsen, L. B., Dau, T., & Laugesen, S. (2023). Toward a clinically viable spectro-temporal modulation test for predicting supra-threshold speech reception in hearing-impaired listeners. Hearing Research, 427, 108650. https://doi.org/10.1016/j.heares.2022.108650
17. Zaar, J., Simonsen, L. B., & Laugesen, S. (2023). A spectro-temporal modulation test for predicting speech reception in hearing-impaired listeners with hearing aids. PsyArXiv. https://doi.org/10.31234/osf.io/5fk6s
18. Zaar, J., Simonsen, L. B., Sanchez-Lopez, R., & Laugesen, S. (2024). The Audible Contrast Threshold (ACT) test: A clinical spectro-temporal modulation detection test. Hearing Research, 453, 109103. https://doi.org/10.1016/j.heares.2024.109103

25-750248 15555-10602/07.25

oticon.com

Oticon is part of the Demant Group.

oticon
life-changing **technology**