Phonak
Insight.

Client satisfaction and fitting efficiency with verification

Elevate your practice with TargetMatch, an automatic and fully integrated real ear measurement system, based upon best clinical practices. Using TargetMatch allows for efficiency and effectiveness, supporting high quality hearing care for both existing and new clients.

August 2023: Jacqueline Drexler & Peter Kossek

Key highlights

- Real-ear measurements (REMs) are necessary for assessing audibility, appropriate output for different input levels, and verification of prescriptive fitting formulae (Jorgensen, 2016).
- TargetMatch guides through the steps of calibrating, placing the probe tube, and performing acoustic transformation measurements, real-ear aided responses, and automatic target matching.
- TargetMatch can be used by hearing care professionals with a wide variety of knowledge and experience with verification.
- Verification may improve speech perception with hearing aids (BSA, 2018; Narayanan et al., 2021).

Considerations for practice

- Automatic and fully integrated REMs based upon best clinical practices (Valente et al., 2006).
- Improve client satisfaction, loyalty and the perceived value of the fitting experience with verification (Amlani, 2017).
- Reduce refitting visits (Kochkin, 2011) and return for credit hearing aids (Kochkin et al., 2010), thereby reducing non-revenue generating visits.
- Reduce time performing REMs, and spend more time building client rapport.

Verification and validation

Verifying and validating hearing aids can enhance the service value of the hearing care professional (HCP) and the hearing aids they fit. Verification of a hearing aid fitting, such as real-ear measurements (REMs), is an objective measure that ensures the hearing aid is operating appropriately to the client's hearing loss prescription. Validation is a subjective measure that captures the client's perceived benefit and satisfaction from wearing hearing aids (Valente et al., 1998). Completing both verification and validation measures offer a complete and holistic view of the client's hearing care and strengthen the view that the HCP provides a quality service to their clients. While both are critical in providing the highest level of service to clients in their communication needs, this article will focus on verification measurements, specifically REMs.

REMs are critical for assessing audibility, appropriate output for different input levels, and verification of prescriptive fitting formulae. The client's hearing thresholds are converted from the audiogram measurement of dB HL to the measurement of hearing aid output in dB SPL. Analyzing the hearing aid through probe microphone measurements provides the hearing care professionals (HCPs) confidence that they are providing a quality fitting to their clients in an objective manner. For clients, the primary goal is access to acoustic information for appropriate speech communication and performing probe microphone measurements ensure audibility is provided (Jorgensen, 2016).

As shown in Figure 1, the fitting software's predictions of targets, also known as the "first fit approach", is that they are based on simulations of *in situ* output (Denys et al., 2019). These simulations might work for clients with ear canals that have close to average acoustic characteristics, but the reality is that many individual ear canal characteristics deviate from the average. REMs take these sources of variability into account (Denys et al., 2019). Without verifying, the client may leave the clinic unsatisfied with their hearing aids, wishing to return them. Leveraging verification as part of the clinical practice can reduce the likelihood of a return for credit and increase client satisfaction (Amlani, 2016; Jorgensen, 2016).

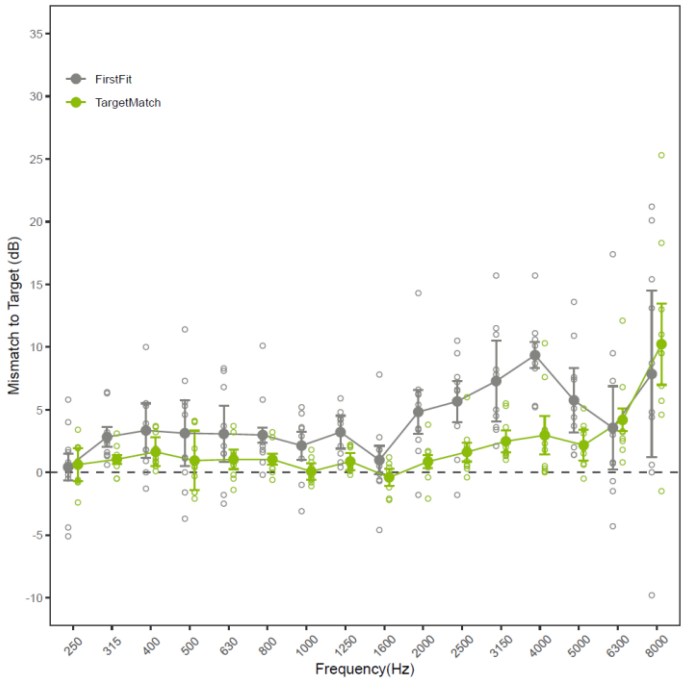

Figure 1. Mismatches to target using NAL-NL2 for the "first fit approach", marked in gray, compared to an automated REM solution (TargetMatch), marked in green. The horizontal line at zero indicates a perfect match to target. Positive values indicate under amplification and negative values indicate over amplification (Denys et al., 2019).

In Phonak Target fitting software is TargetMatch, an automated verification system with integrated REMs. TargetMatch was designed to reduce complexity around verification, compared to manually matching to targets using a standard non-integrated REM system (Denys et al., 2019; Latzel et al., 2017.

What goes into a prescriptive target

Ever wonder how a prescriptive target, such as NAL, DSL or Phonak's proprietary algorithm, Adaptive Phonak Digital (APD), are defined? A prescriptive target is the desired output or amplification of the hearing aid, given a specific hearing loss and using a particular hearing solution. In order to define a prescriptive target, several parameters must be taken into consideration which influence the final target curve. Below, the focus will be on target calculation parameters used for adult real ear fittings. The main parameters can be divided into the following categories: client information, audiometry information, converting hearing thresholds from dB HL to dB SPL and verification setup.

Client information

Client information includes age, gender, and experience. The client's experience is taken into account for the overall gain level of amplification for some fitting rationale. For example, the fitting rationale, NAL-NL2, may adjust the targets based

on whether the client is a new or experienced hearing aid wearer, as chosen in the REM system.

Audiometry information

Audiometry information refers to audiometry results and test conditions of audiometry. Audiometry results include air conduction (AC) and bone conduction (BC) thresholds, as well as uncomfortable loudness levels (UCLs). AC thresholds are always used for the prescriptive target calculation, whereas BC thresholds and UCLs are used with some fitting formulae. The test conditions of audiometry means which transducer is used, for example, supra-aural earphones or insert earphones.

Hearing aid information

Target calculation requires hearing aid information, such as how the hearing aid is programmed. For example,

- acoustic coupling, such as venting and real ear occluded gain (REOG). REOG indicates the openness of the acoustic coupling and influences how much direct sound, occlusion and vent compensation are applied.
- fitting rationale and if the fitting is monaural or binaural.
- the hearing aid processing information, such as compression speed, compression bands and compression kneepoints. These parameters are important in understanding how dynamic the response of the hearing aid is.

Verification setup

The verification setup refers to the measurement conditions for performing REM, such as the stimulus type and stimulus level, including soft, medium, and loud input levels.

Entering of these parameters result in the final target curve for the chosen fitting rationale, whether it is NAL, DSL or APD. The HCP strives to match the gain of the client's hearing aid to these targets to ensure audibility is being achieved. However, note that not all prescriptive targets make use of all of the parameters listed above.

What are acoustic transformation measurements

TargetMatch guides the HCP through the steps to calibrate, place the probe tube, and perform the acoustic transformation measurements, real-ear aided responses (REAR), and automatic target matching.

The acoustic transformation measurements include real ear unaided gain (REUG), acoustic coupling and REOG response. Measuring the acoustic transformations on a specific client provides customized information about the acoustical properties of the individual ear of the client, such as the ear canal volume and resonance. These individual acoustic transformations will then be used to adapt the gain of the hearing aid to the individual ear of the client. For example, if a client has a smaller than average ear canal, less gain will be needed to achieve the same SPL at the eardrum than for a client with an average ear canal size. Measuring these variations first and adapting the gain accordingly can lead to a more accurate match to targets.

The acoustic transformation measurements are not routinely performed when manually performing REMs, most likely due to the additional time required to perform more measurements and the further complexity it adds to the verification workflow. Thus, average values are used. However, using average values can result in mismatches to targets as many clients' ear canals deviate from the average. This may be more noticeable for hearing aid fittings with power or vented domes. Fittings with domes significantly vary across ear canals as these couplings are generic and not customized to the client's ear canal. As shown in Figure 2, a client's measured REOG with a power dome could indicate an occluded fitting, which is expected, whereas for another client, the measured REOG may look similar to an REUG, indicating the fitting is more open than expected, increasing risk of feedback and reduced sound quality.

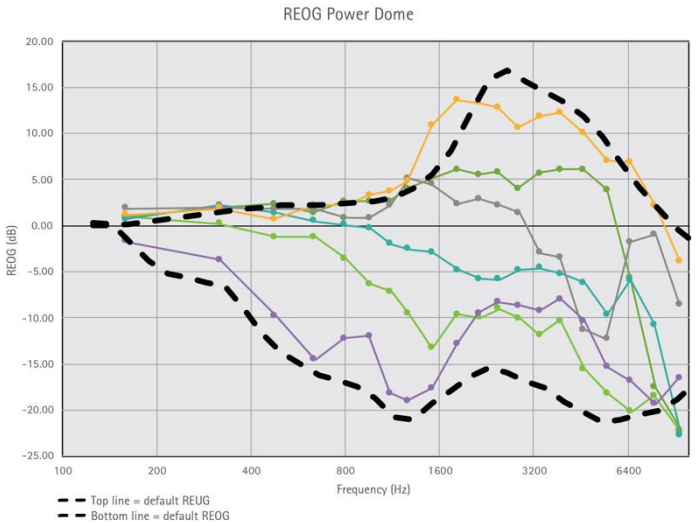

Figure 2. The top dashed line is the default REUG and the bottom dashed line is the default REOG for an occluded fitting. The measurements in between the boundaries are different individual REOGs obtained with a power dome. Fittings with power domes sit either as intended (close to the occluded REOG) or they do not seal at all and are almost as open as an open dome (close to the REUG).

With TargetMatch, the acoustic transformation measurements are automatically measured and applied as part of the workflow. No additional step is needed from the HCP and the amount of actions at the client's ear is kept to a minimum. The benefit is an individualized fitting pre-calculation. The application of acoustic transformation measurements to a hearing aid fitting allows the clients'

hearing aids to be set up with a strong foundation from the initial fitting.

What leads to differences in the targets shown

There may be differences between targets generated by TargetMatch and the targets generated in the standalone REM software. When comparing targets, it is important to recognize the reasons for these variances.

Target calculation parameters
When setting the target calculation parameters in the REM software, the HCP has to enter in the parameters discussed above in the section on what makes a prescriptive target. These parameters are based on the client's fitting. If the parameters entered differ between Phonak Target and the REM software, this can lead to differences in how the target curve is calculated.

One example is measuring real-ear aided gain (REAG) versus real-ear insertion gain (REIG). In Phonak Target, NAL-NL2 and APD are based on REIG and use REUG. When performing TargetMatch and measuring REUG, REUG is factored into the overall gain calculation. When skipping the REUG measurement, average REUG is used. The use of average versus measured REUG influences the overall REAG target curve. On the other hand, DSL is based on REAG and does not take the REUG into account in the calculation of the output SPL target curve.

Furthermore, there are different implementation methods for calculating the target curve across various REM software and not all REM software show the same target parameters available for manual entry. Therefore, deviations in settings may occur.

Optimized compensation for venting
TargetMatch may apply compensation to the calculated targets as it can read more information about the hearing aid, fitting conditions and acoustic coupling, than what is foreseen when looking at a generic fitting formula, such as NAL or DSL, in the REM software. For example, the NAL targets generated by TargetMatch is vent dependent and may apply vent loss compensation for open fittings. Only when the fitting is occluded, the NAL-target curve generated by TargetMatch is similar to the one seen in the standalone REM software.

For more open vents, TargetMatch reduces the NAL-targets in the low frequencies in order to maintain sound quality – particularly sound quality of the client's own voice – as natural amplification for low frequency hearing will come in through the vent for open fittings. This compensation manifests itself as a target curve with lower values below 1000 Hz compared to a standard target curve calculated by the REM software. This venting compensation from TargetMatch is not transferred to the standalone REM software. Thus, the targets generated by the REM software do not have access to the same level of detail as TargetMatch has.

With these differences in mind, if comparison of targets is important, it is imperative to recognize the details of the fitting and to ensure the target parameters in the REM software correctly reflect the settings seen in Phonak Target.

What is unique about TargetMatch

TargetMatch measurements take into account the unique anatomy of the client's ear, for a more personalized and precise fitting in order to maximize the potential benefit of amplification.

TargetMatch minimizes the need to switch between fitting and REM software as the REM workflow can be carried out within Phonak Target itself. TargetMatch can be used with all fitting formulae available in the fitting software, including APD.

The ability to measure REUG with guided probe tube placement, provides visual feedback on insertion depth. When the probe tube is at the ideal location, approximately 2-4 mm from the eardrum, a clear indication via a green check is provided and a REUG curve is displayed. The HCP can use the curve to verify the unaided gain response of their client's ear canal. Furthermore, TargetMatch can inform when a placement is not successful and provide a reason why. For example, there was excessive movement from the client, or the probe tube was clogged or squeezed, indicating that a reinsertion is required.

Obtaining and applying these transformation measurements to the client's fitting results in a truly customized and personalized fitting for the client.

Even further, TargetMatch measures and matches at the three speech levels – including soft speech at 50 dB SPL, average speech at 65 dB SPL and loud speech at 80 dB SPL – using the International Speech Test Signal (ISTS). The importance of not only measuring at each speech level, but also automatically matching to the prescriptive targets at each level ensures optimal dynamic range can be achieved for soft, medium, and loud signals. These measurements, in addition to the guided check for REUG, allow results to be

obtained with increased reliability. This means, HCPs can spend more time building client rapport and less time on manual fine tuning.

Who could benefit from using TargetMatch

The use of verification demonstrates high level of knowledge from the HCP and perceived value of the fitting experience (Amlani, 2016; Jorgensen, 2016). TargetMatch can be used by HCPs with a wide range of knowledge and experience with verification. It also provides standardization and consistency to the REM process. This can be beneficial in clinics with more than one HCP and where they may share the same client caseload. A consistent workflow can ensure that the client receives the same level of care regardless of the HCP they are seeing which is important for driving a clinic at a well-defined service level.

TargetMatch can support HCPs that may perform verification regularly, but looking to be more efficient and effective in their appointments, while still offering high level of care. TargetMatch is also for HCPs that do not regularly perform verification, but looking to increase usage of it in their clinical practice. It is well known that the benefits of REMs have been clearly proven (Amlani, 2016), but the number of HCPs performing REMs is relatively low (Amlani et al., 2017). This could be due to a variety of factors, such as lack of equipment access, training, time, and difficulties of operating several software applications or systems simultaneously. However, TargetMatch can help overcome some of these factors.

It is also suitable for HCPs learning how to perform verification. TargetMatch offers a step-by-step guided workflow on performing REMs and provides real time feedback. If an unexpected result is obtained or an error, TargetMatch will inform the HCP and provide suggestions to help the HCP effectively troubleshoot.

TargetMatch offers a streamlined workflow and automated fine-tuning adjustments to both proprietary and standard fitting formulae. It supports HCPs that wish to incorporate clinical best practices with additional guidance and without compromising time.

How does TargetMatch benefit the practice

There are several factors which can improve clients' success with hearing aid technology. The top five factors include physical fit, number of required visits, HCP attributes, use of REMs, and subjective benefit (Kochkin et al., 2010). A lack of both, verification and validation measures, can increase the number of client visits for various reasons, such as a less-than-optimal fit, reduced hearing aid use, and lack of perceived benefit. Each of these reasons can result in rejection and/or the return of the hearing aids for credit (Kochkin et al., 2010). A combined use of verification and validation measures can lead to clients being successful hearing aids wearers (Kochkin, 2011). In fact, use of REMs, in combination with validation measures, has been suggested to reduce client visits by an average of 1.2 less visits per client. This means fewer visits for refitting and that time is used effectivity, rather than being lost due to unnecessary client visits (Kochkin, 2011).

There are several benefits to incorporating verification, such as TargetMatch, into clinical practice.

- Verification may improve client satisfaction, loyalty and perceived value of the fitting experience (Amlani, 2016). An increase in perceived value may lead to an increase in purchase and repurchase, as well as increased referrals from client recommendation (Jiang et al., 2015; Trasorras et al., 2009).
- Using verification may reduce refitting visits (Kochkin, 2011), thereby reducing nonrevenue generating visits.
- Save time by leveraging the automated procedure of target matching and reduce the amount of manual fine tuning effort.

An automated workflow can provide the HCP with more time spent assisting the client to get the most out of their hearing solution. This can be achieved through counselling, goal setting, communication strategies, benefits of myPhonak app, accessories and/or Roger™. It can also be a convenience savings for clients by reducing time spent traveling to additional follow-up appointments, especially if they have busy schedules, minimum access to transportation, or other health-related issues affecting mobility (Kochkin, 2011). Therefore, integration of verification into clinical practice can enhance the perceived value the HCP brings to their client's hearing health.

Conclusion

TargetMatch, an automated match-to-target approach, provides HCPs with the opportunity to use their time for other aspects of clinical practice while supporting the use of best practice verification procedures during the hearing aid fitting process. By spending less time on manual fine tuning, HCPs can focus on further counseling, marketing, community outreach, or fitting new clients with hearing aids.

By fitting clients with hearing aids that are specifically fit to their listening needs using verification and validation measurements, the HCP is confirming the value of the hearing aid and themselves as the expert. With precise real ear target matching, TargetMatch provides peace of mind and supports gold-standard verification.

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