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Improving communication with face masks

White paper

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The main goal of amplification is to provide audibility for sounds that cannot be heard due to hearing loss. The complexity of listening environments makes that seemingly simple task much more difficult. Whether it is various talkers speaking at softer levels, or competing environmental sounds masking speech sounds, the hearing aids' acoustic settings must adjust to accommodate these dynamic listening situations.

Fortunately, over the years, hearing aid technology has progressed to effectively adapt to various listening environments. Whenever wearers move to a different listening environment, their modern hearing aids recognize the change in the acoustics of the new situation and automatically adjust to optimize performance.

The Hearing Care Professional (HCP) usually programs the hearing aids to optimize speech intelligibility in quiet listening situations. The initial setting for a quiet listening situation serves as a baseline for further adjustments for different listening environments, with the hearing aid favoring speech in those environments. Of course, each wearer has unique listening needs and their preferred settings for any listening situations may deviate from the baseline settings of the hearing aids. In those cases, hearing aid adjustments are programmed by the HCP into a dedicated memory in the hearing aid accessible via a push button on the device, remote control, or smart phone app. Some popular dedicated programs are for noisy environments, music, and places of worship, but the HCP and the patient may decide on other dedicated hearing aid programs.

With the Covid-19 pandemic, people must change how they interact with others. In addition to mandates to practice social distancing, in which people must keep a physical distance of six feet from one another, the use of face masks is required in many places. These Covid-19 restrictions place significant burden on hearing aid wearers and other individuals with hearing loss. Thus, it is important to consider how these restrictions impact speech communication.

Effects of Masks

Wearing masks can become a communication challenge in two ways. First, masks cover the mouth, restricting any visual speech cues the wearer might receive. Secondly, masks can impact the acoustic properties of the speech signal itself.

The value of visual cues for everyone, especially persons with hearing loss, is an important consideration. Visual cues are particularly important for listeners in background noise, as visual cues provide additional information that augments the degraded acoustic signal. Lip movements provide temporal cues for awareness of words and sounds to the listener. Additionally, they provide the listener with cues to spoken sounds, particularly consonant sounds[1].

These visual cues can help a listener with normal hearing or hearing loss more accurately identify spoken words than just the acoustic or the visual information alone[2]. Dell'Aringa et al[3] reported the addition of visual cues improved word recognition in quiet for patients with hearing loss both with and without hearing aids. Atcherson et al[4] evaluated speech perception using the Connected Speech Test at 65 dB SPL with a +10 dB Signal to Noise Ratio (SNR). Participants with hearing loss showed significant improvement in accuracy when visual cues were present over a mask condition without visual cues.

Furthermore, the addition of visual cues has been shown to help improve listening performance in noise. Middelweerd and Plomp[5] noted a 4 dB improvement in Speech Reception Threshold (SRT 50%) when visual cues were available to study participants listening to speech in the presence of background noise. Further, when comparing SRTs for a modified SPIN test with and without lipreading, Grange and Culling[6] reported a 3 dB improvement for normal hearing listeners and 5 dB improvement for cochlear implant users.

The acoustic impact of masks can be quite detrimental as well. Goldin and Weinstein[7] evaluated three types of medical masks: a simple medical mask and two types of N95 masks. Their findings indicated a high frequency reduction in the 2000-7000 Hz range of 3-4 dB for the simple mask and approximately 12 dB for the N95 masks (Figure 1). Llamas et al[8] noted a 12 dB decrease in the high frequencies for a surgical mask. Palmiero et al[9] evaluated several personal protective masks as part of an occupational health study. Two types of masks used in the evaluation were N95 and general protective facemasks. Results showed a decrease in sound levels from 2000 Hz and above of about 1 dB for the protective facemask to about 6 dB for the N95 on a dB-A octave band scale.

Face Mask Attenuation

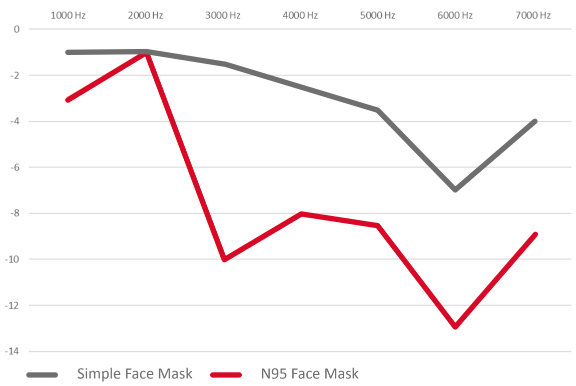

Figure 1. Face mask attenuation shown in dB by frequency for a simple face mask and a N95 face mask (adapted from Goldin, Weinstein, and Shiman, 2020).

When considering the impact of visual cues and the high frequency attenuation of the speech signal, masks present substantial communication challenges for many individuals, including hearing aid wearers and persons with hearing loss. To illustrate the negative effect masks have on communication, it is helpful to use Killion and Mueller's Count the Dots Audiogram[10]. Recall that each of the 100 dots represent audible speech cues. Mask usage, because it reduces the intensity of the talker's speech, reveals on Count-the-Dots Audiogram that someone with normal hearing could easily experience about a 30% decrease in audibility when using a properly fitted N95 mask. This could translate in some cases to a 10% decrease in intelligibility[11] in a quiet condition. With the addition of background noise and a poorer SNR, the lack of visual cues becomes more apparent, especially for individuals with hearing loss.

On top of these challenges with face masks, it is also important to note that social distancing recommendations advise keeping at least 6 feet (2 meters) from others. In general, many conversations happen at a 3-foot distance. Doubling that distance also decreases the intensity of the already reduced speech signal received by the listener. Ultimately, an already challenging communication situation becomes even more difficult.

How Can the HCP Help?

At first it may seem daunting to consider new challenges that can be perceived like an additional hearing loss. However, knowing the effects of masks and distance introduces solutions.

The first step in addressing these issues is to consider the clinical environment and good communication guidelines when interacting with the patient.

- Face the end user when talking
- Consider an approved clear face shield to maximize lip/face cues
- Walk / sit close together but keeping the recommended 6 feet / 2 meter distance
- Speak slow and clear
- Rephrase rather than just repeat what was not heard
- Minimize environmental noise
- Have information ready in written form to minimize communication errors

Another critical tool in the HCP skillset is to counsel on the effects of face masks. It may also be helpful to share the mentioned strategies with the hearing aid wearer as many may be applicable in their day to day activities. By eliminating some of the mystery behind the mask, the wearer can be more cognizant of communication strategies.

Understanding that the hearing aid wearer is receiving a reduction in high frequency information from a given speaker, it is possible to adapt the amplification to this particular situation.

Programming the hearing instruments for a “Mask” situation is a viable solution to addressing the modified speech signal to make it audible. This solution can also be achieved via Signia Telecare remote programming without the patient needing to visit the office. Additionally, utilizing the video option alleviates the need of donning a face mask for the clinical Telecare visit, thus eliminating one of the potential challenges of an in-office visit.

How to use CONNEXX to assist listening and speech understanding when face masks are used.

A “Mask” program will be based off the Universal program. Compensation for the face mask and other communication considerations can be addressed with the following combination of programming adjustments:

Dedicated Mask Program:
Under Program Handling, select the next available program and choose Universal to copy Program 1 settings to the new Program. Rename the program (i.e. “Mask”).

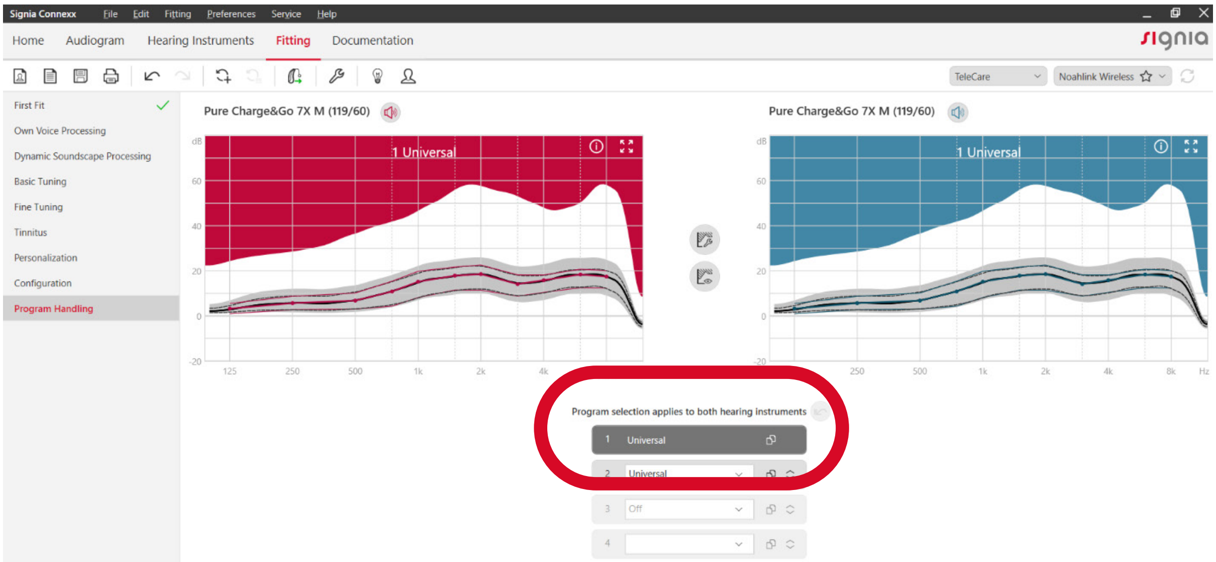

Figure 2. Adding additional program based off Universal.

Compensate for mask attentuation:
Under Fine Tuning, increase gain by 3dB between 2000 Hz and 4000 Hz and by 5dB above 4000 Hz.

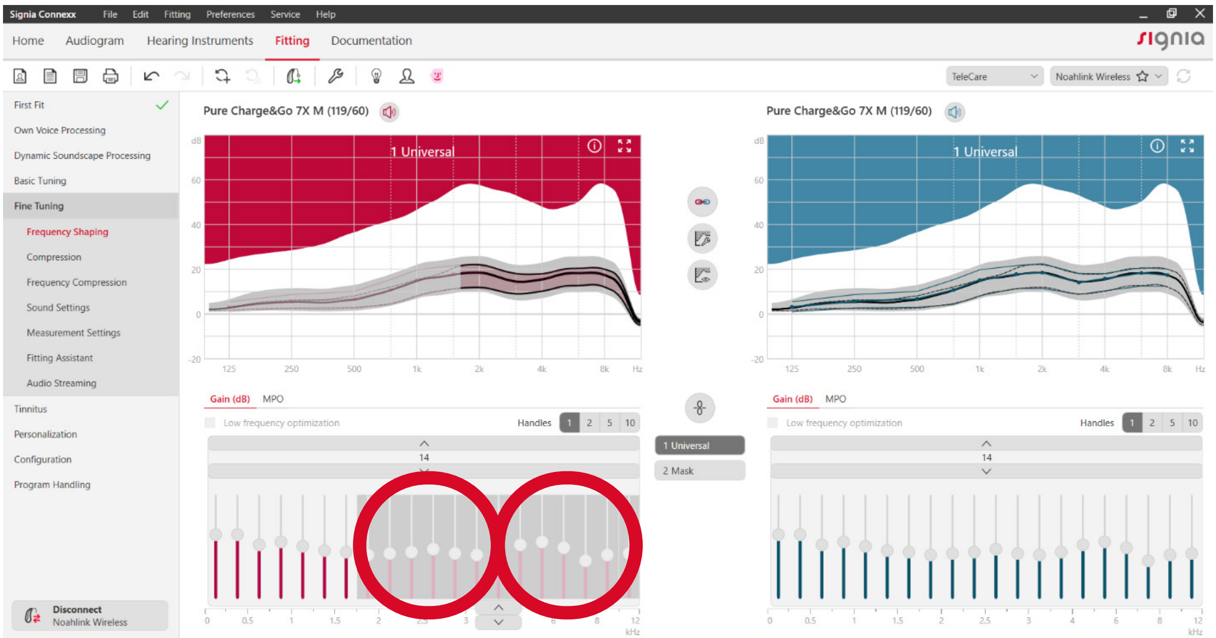

Figure 3. Increase gain between 2000 Hz - 4000 Hz and 4000 Hz and above.

Compensate for increased distance to speaker:
Under Compression, increase LI50 gain by 2 dB in all channels.

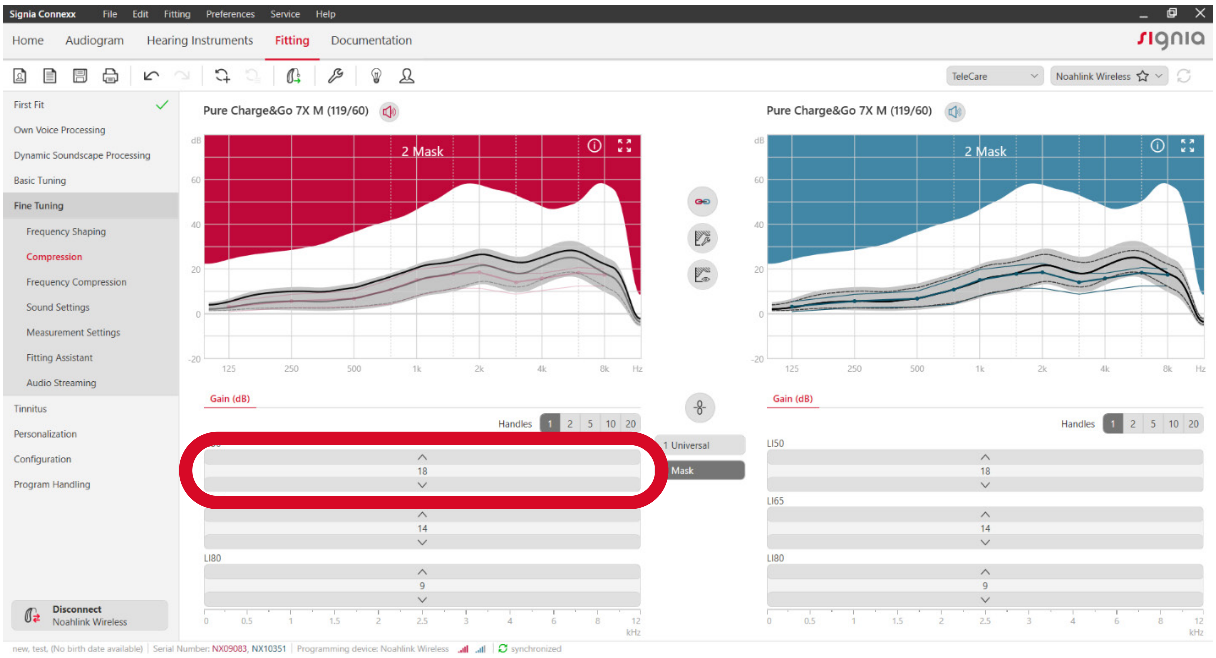

Figure 4. LI50 gain increase.

Compensate for lack of visual cues:
Under Basic Tuning, increase the Speech button by 1 click.

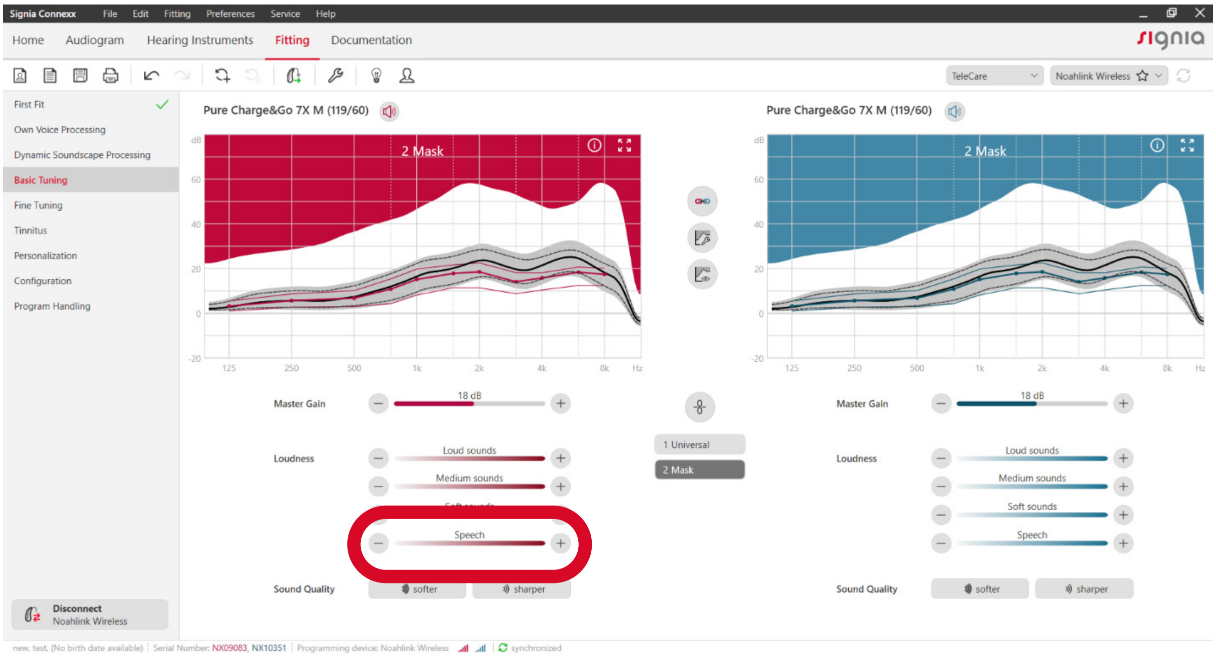

Figure 5. Speech gain increase.
The hearing aid wearer can also make adjustments to their hearing aids in the Signia app.

Adjustments by the Hearing Aid Wearer

Xperience devices:
The Signia App provides users with a simple, effective solution for addressing communication with masks. The Face Mask Mode makes specific changes to the hearing aid settings with a single touch of a button. The changes are applied in the Universal Program (Program 1) to provide improved audibility for speech impacted by a communication partner wearing a mask. The changes remain active until the wearer turns the Face Mask Mode off, changes programs, or restarts the hearing instruments. The changes applied to the Face Mask Mode differ somewhat from the recommended changes for the Mask program where the HCP can discuss specific needs and wishes of the wearer. Without the benefit of the HCP, the app-based Face Mask Mode applies some additional adjustments for environmental noise management as well.

Three primary adjustments are made to the Universal Program settings when Face Mask Mode is selected:

- **Increase High Frequency Gain:** a slight gain increase is provided around 2000 Hz loping to increased gain around 4000 Hz, based on the Universal program
- **Increase Noise Reduction:** The Speech and Noise management is increased to maximum to aggressively address competing environmental noise
- **Increase Dynamic SoundScape Processing:** The Dynamic Soundscape Processing is increased by one step towards "Highlighting" to help provide more focus on the speaker

The Face Mask Mode is located in the Signia App next to the volume control adjustment for easy access by the wearer. It is grey when not activated and displays red when activated (Figure 6).

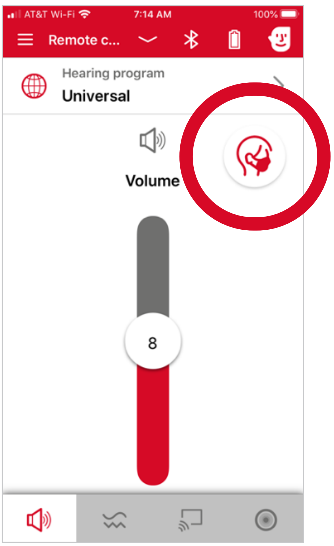

Figure 6. The Face Mask Mode activated in the Signia app.

All Products using the Signia App:

The Volume control will increase gain for the selected program.

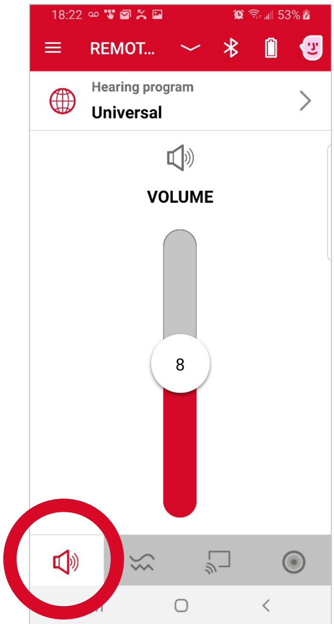

Figure 7. Volume Control.

The Sound Balance control specifically increases high frequency gain. The wearer may increase this to help improve speech clarity.

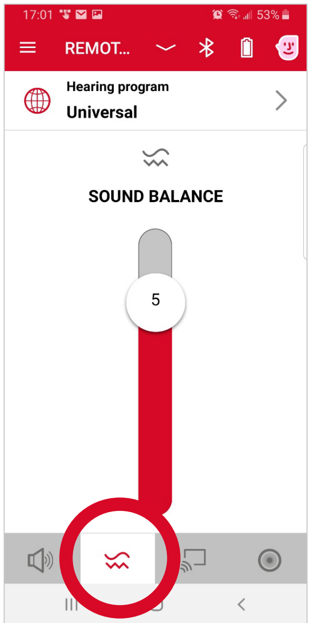

Figure 8. Sound Balance control.

Summary

Hearing loss can be challenging in a variety of situations. Hearing aid technology is constantly being enhanced to help wearers manage the most difficult listening situations. The use of masks as well as increased distancing while talking is a unique challenge that can be very frustrating for people with normal hearing and especially for those with hearing loss. Signia hearing aids offer flexibility for both the HCP and the user to apply dedicated strategies to help optimize speech intelligibility in these situations.

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