



## Guide To Using The Audibility Extender Successfully

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## Who should use the Audibility Extender?

A patient who has:

- A hearing loss that fits into the shaded area of Figure 1.
  - aidable hearing in the low frequencies (dashed line) also a possible candidate
- Insufficient high frequency gain from hearing aids to hear high frequency sounds (e.g., birds, consonants) because of:
  - limitation of chosen HA model
  - limitation in open fit
- A dead region in the high frequencies
- Tolerance problem with high frequency sounds

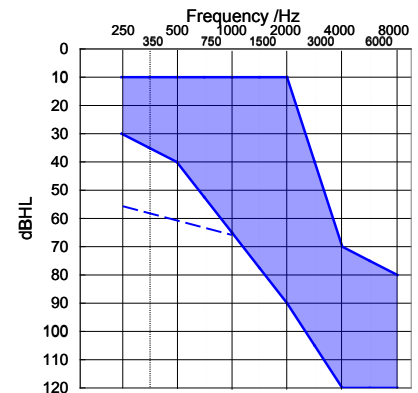


Figure 1: AE fitting range

## Steps in Fitting the Audibility Extender

I. Basic fitting (for more detailed instruction on how to perform a basic fitting; please consult your fitting guide)

- **Measure basic sensogram** (500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz).
  - Test desired inter-octave frequencies along slope of audiogram (expanded sensogram).
  - Enter audiometric threshold at 250 Hz as sensogram threshold (other than élan version).
- **Perform feedback test** for each ear.
- **Ensure optimal fit.** Verify using Frequency-Output curve, predicted aided threshold, SoundTracker or REM.
- **Select AE program** – After feedback test, click [Next] to continue to [Program Selection]. Choose [Audibility Extender] program and click arrow button. Click [Next].

## II. Determine if AE is necessary

- While patient is using the master program in the test booth, say /s/ at 30 dB HL.
- Use [SoundTracker] to visualize audibility of /s/ (Fig 2).
- If /s/ identified with [Master] program, then [AE] program may not be required. Delete [AE] program. **STOP.**
- Proceed to [AE] program if patient:
  - Is unable to hear /s/ or
  - Hears /s/ with distortion

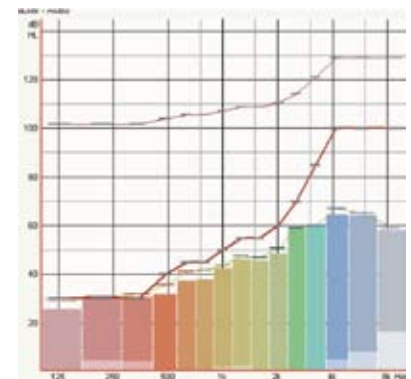


Figure 2: SoundTracker view when /s/ is presented to master program at 30 dB HL

### III. Verify default AE settings

- While patient is using the AE program in the test booth, say /s/ at 30 dB HL.
- Use [SoundTracker] to visualize audibility (see Figure 3).
  - If /s/ is identified **STOP**.
  - Adjust [AE gain] if necessary (see Figure 4).
  - Adjust start frequency if necessary and possible.
  - Use [Basic] transposition (3 bands of transposition) when start frequency is 2500 Hz or higher.
  - Use [Expanded] transposition (5 bands of transposition) when start frequency is at or below 2000 Hz (not possible in some models).

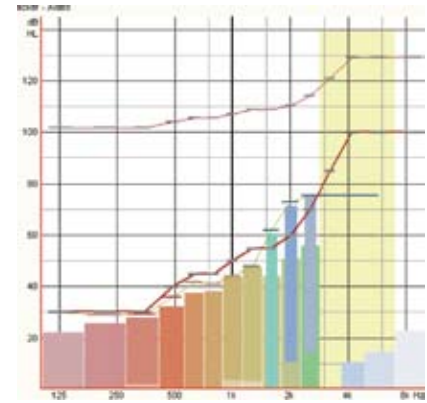


Figure 3: SoundTracker view when /s/ is presented to AE program at 30 dB HL



Figure 4: AE parameters

### IV. Facilitate Initial Adjustment

#### a. Use SoundTracker to counsel on frequency transposition.

- Demonstrate insufficient audibility in [Master] program. Use a high frequency sound such as a birdsong from LifeSounds or use conversational speech as stimuli (Figure 5).
- Next, switch to [AE] program and demonstrate sufficient audibility with the same sounds (Figure 6).

#### b. Facilitate real-life use.

- **Encourage use of [AE] program** – Go back to [Program Selection]. Keep [Master] and [AE] programs. Switch order of programs so that the [AE] program is in the first position (use arrows inside program box).
- **Keep track of the use of each program** – ensure long-term logging [Sound Diary] is activated before exiting Compass (activation is automatic in most models).
- **Increase awareness of “new” sounds** – Review List of Everyday Sounds checklist, Appendix B, with patient (or assign listening exercises). Ask patient to compare [Master] and [AE] programs in all sound environments.
- **Follow-up** – Schedule patient to return for a follow-up visit in two weeks.

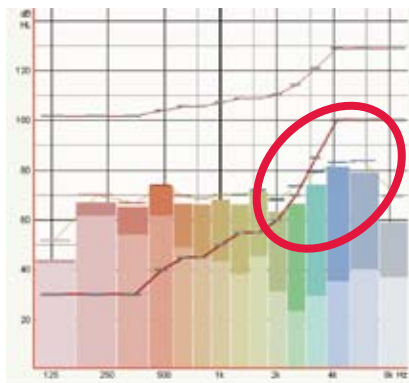


Figure 5: Conversational Speech in Master program.  
NOTE: With the Master program, speech above 2000 Hz is not audible to the patient.



Figure 6: Conversational Speech in AE program.  
NOTE: The Audibility Extender provides more information (audibility) along the slope of the audiogram. The frequencies that are inaudible with the Master program are now audible.

## V. Potential Fine-Tuning of the Audibility Extender

### a. Use Sound Diary to validate complaints.

- Use Sound Diary to monitor frequency of program use (Figure 7) and listening environments encountered.
  - If **[AE]** program is used frequently, it is probably satisfactory.
  - If **[Master]** program is used exclusively, fine tuning of AE settings may be needed.

### b. AE Fine-tuning steps (also see Table 1):

1. Connect hearing aids to NoahLink and **[Detect]** hearing aids.
2. Select **[Fine Tuning]**. Go to **[AE]** program.
3. Change **[View]** to **[SoundTracker]**.
4. Present /s/ at 30 dB HL. Use **[Sound Tracker]** to visualize audibility.
5. Begin with AE start frequency **three steps above default start frequency** or at 6000 Hz, e.g., Figure 8 shows the default and initial start frequencies (not possible in some models).
6. Present /s/ sound at 30 dB HL.
  - If the patient hears and identifies /s/, **stop**.
  - If the patient is unable to hear /s/ or hears /s/ with distortion, increase AE gain until:
    - /s/ is identified or
    - maximum AE gain (+ 14) is reached.
7. If /s/ is still not identified, decrease AE start frequency to the **next lower start frequency** (not possible in some models). Repeat step 6.
8. When patient identifies /s/, record AE start frequency and AE gain.
9. Ensure **[AE]** program is in first program position for real-world use.
10. It may take an average of one month to acclimatize to AE.
11. Consider the use of Audibility Training CD for motivated patients.

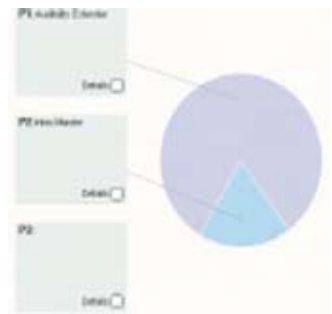


Figure 7: Sound Diary

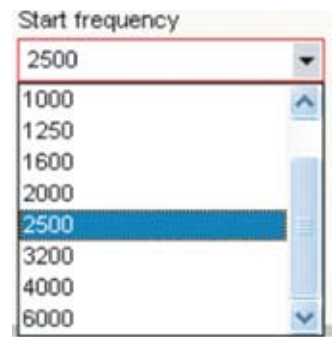


Figure 8: AE start frequencies

AE Parameters	Complaints		
	<i>Echo/hollow</i>	<i>Speech not clear</i>	<i>Transposed Sound not audible</i>
Start frequency	Increase	Increase	—
AE Gain	Decrease	Decrease	Increase
Basic or Expanded	—	Change expanded to basic	Change basic to expanded

Table 1: Fine-tuning tips

## VI. Audibility Training CD:

For most patients the use of the (master) and (AE) programs alone would have solved most, if not all of their communication needs. However, we have also learned that some wearers could benefit even more when we direct their attention to the most difficult speech sounds – the voiceless consonant sounds. Thus, we have made the training materials that we used in our research available to you so you may further enhance your patient’s ability to understand speech in quiet. The Audibility Training CD consists of two discs: Training on Vowels and Voiceless Consonants. If the patient fits the recommended hearing loss criteria as outlined in section 1, the patient should not have difficulty understanding vowels and should focus on the Voiceless Consonant CD. However, if the patient’s hearing loss is more severe and/or s/he likes to have more listening practice, the Training on Vowels CD can be utilized as well to provide up to ten more additional days of training. The training CD is most effective when the patient uses the AE program exclusively in his/her daily activities.

Our exercise is by no means a replacement of the aural rehabilitation training materials that are commercially available today. Indeed, the commercial materials are probably more inclusive in scope and are more preferred. The materials we offer should be viewed as a supplement. This material is not intended to provide direct training on auditory processing skills, although such skills are involved in the exercises. The use of this with children, people with central auditory processing disorders, or people with a more severe loss has not been validated. Obviously, because this is a computer driven interactive exercise, it should only be used with people who have a computer (with loudspeakers) and are motivated to improve their speech understanding.

Make sure you are familiar with the training program and the exercises before you show it to your patients.

**Instructions:** *“I would like you to focus on speech sounds that you have been missing. This CD includes exercises that we hope can do that. I would like you to go through the exercises during the next two weeks. It requires only ten days of training at only 20 minutes per day (only appropriate for consonant training only)!” “I would like you to look at the training program with me right now so that you are familiar with the activities that are included. We will do a couple of examples in each activity. If you have any questions, do not hesitate to ask.”*

## **Demonstration Program**

A tutorial of the training program (Appendix A) is available on the CD. The tutorial program will enable your patient to view a couple of items on each activity to gain familiarity with the procedure.

**Instructions:** *“Mr. Smith, the take-home exercises are designed to help you focus on speech sounds that may have been difficult for you to hear in the past. We have grouped these sounds into ten days of activities. You may choose to do the exercises for five days, take two days off, and then complete the rest of the training”*

*“There are four different activities that comprise the consonant training exercises. I would like to show you some examples of each exercise so you will be comfortable in completing the training at home.*

- 1. The first exercise is a “Sound Matching” exercise. You will listen to a sound in Column A and try to match it to a sound in Column B. If you make a match, the button in Column A will disappear and the button in Column B will change color. If the sounds do not match, the buttons will remain the same. When you have completed the exercise, a picture will appear. Let’s try one out now.*
- 2. The next exercise, “Picture Puzzle”, is to help you detect the difference between two similar sounding words. You will listen to a sentence and determine which target word was said. The exercise will continue until you have selected all the words correctly, and a picture will be revealed to you. Let’s practice to see if you can choose the correct word.*

3. *The third exercise, “Count the Number”, will focus your attention to a particular sound. Each day you will listen for a sound such as the /t/ sound in the word “teapot”. You will listen to several sentences and will be asked to count the number of times you hear a particular sound in each sentence. In our example, there are 2 /t/ sounds in the word “teapot.” You need to remember to focus on the sounds in the words and not the spelling. For example, in the word “sugar” the /s/ in sugar has a /sh/ sound and not a /s/ sound. Next to each play button you will see a list of numbers to select from. You click on the number corresponding to the number of sounds you think you heard. If your answer is correct, the sentence will appear with the sounds highlighted. If your answer is incorrect, the button you pressed will flash red. Let’s try one and see how you do.*
4. *The fourth exercise is a crossword puzzle. There are clues listed for Across and Down in the two columns. You will need to press the number of the clue you would like to listen to. You will see the sentence clue with a target word left blank at the top of the screen. You will hear the sentence and try to listen for the missing word. If you need to hear the sentence again, just press the same item number. If you know the answer, type it in the answer box. If it is correct, it will appear in the crossword. If it is not correct, it will not appear.”*

After you have demonstrated the Voiceless Consonant-Training Program, schedule the patient to return in two weeks (after the program is complete). Call the next day to determine if the patient has any problems with the training exercises, such as loading the program, etc.

However, if during the demonstration of the Voiceless Consonant Training CD you determine that your patient may have too much difficulty, you may want to also introduce the Training on Vowels CD.

*“I am thinking that you may want to start with some easier exercises than the Consonant training. Let’s take a look at the Training on Vowels CD. This may help you ease into the training with the consonants and help you with adapting to your new program.”*

*“The Training on Vowels CD has most of the activities that I just demonstrated to you from the consonant training CD. It includes the sound matching, picture puzzle, and the crossword puzzle. However, it has one more activity that I would like to show you called the Sound Matrix.”*

*“For this exercise, you will see a grid with words that differ by the vowel sound that you will hear. The purpose of this exercise is to give you practice in hearing the difference between the various vowel sounds. This is just a listening task. Let’s listen to this pair of words. Can you hear a difference? If you can, click the “yes” button and the square will turn green. If you cannot hear a difference, click the “no” button and the square will turn red. At the end, press the “finished” button and it will show you a percentage of the words that you were able to hear the difference. The Training on Vowels CD also has ten days of training. You can complete this training before you continue to the Voiceless Consonant Training.”*

## VII. Follow-up Visit

At your patient’s follow-up visit, review the results of the training with your patient. Some questions you may want to ask:

1. Do you still find the AE program distracting or has that diminished?
2. Did the training help you focus on sounds in every day life?
3. Did the training help you to understand speech better in quiet?
4. Did the training help you to understand speech better in noise?
5. Were you better able to focus on the speech sounds you have been missing?
6. Were you better able to recognize those speech sounds?

By this time, after the training sessions, most wearers who had prior objection to the additional sound in the AE program would have acclimatized to the sound. If they have found that the AE program has improved their ability to communicate as well as hear sounds in their environment, you may want to

discuss the option of leaving the AE program as the default program (program #1) and discuss other listening needs. For example, do they need a T-coil or was the acoustic program successful with phone use? Do they frequently listen to music and would they like a music program?

Some hearing aid wearers may take longer to acclimatize to the AE program. If your patient decides that they cannot adjust to the additional auditory information, you can switch the order of the programs back so the master program is the first program and the AE program the second. This would allow the patient additional time to adapt to the AE program. If they are unwilling to make an additional effort with the AE program, it may be taken out.

## **Appendix A: Audibility Training CD:**

### **Training on Vowels and Voiceless Consonants [Research]**

The purpose of the CD is to provide your patient with “bottom-up” training through activities that incorporate sound awareness, sound identification and word identification. The goal is to increase awareness of the voiceless speech sounds and the recognition of such sounds in the transposed form. Since a severe hearing loss may have deprived inputs to the auditory cortex, your patients may not be able to recognize these speech sounds even when they become audible again. By focusing their attention to these particular speech sounds and by providing repeated exposure to these sounds, it is hoped that your patients will learn to associate the new sound percepts with their identities and improve their speech identification ability over time. The training is by no means exhaustive and other computer programs may be used instead to direct the patients’ attention to speech sounds and achieve the same goal.

There are two training discs: Voiceless Consonants and Training on Vowels. The training activities on the CD for Voiceless Consonants have been divided into ten days of training. Your patient should be instructed to use the training program for five consecutive days; take two days off; and then complete the remaining five days of training. The first five days will focus on the voiceless fricative sounds such as /s, ʃ, θ, and f/. The last five days will focus on plosives /p, t, and k/ and a review of all sounds. The training sessions will take approximately 20 minutes per day. When the folder for a particular day is opened, a list of that day’s activities will be seen. The activities include: Memory Game, Picture Puzzle, Count the number of phonemes in the sentence, Crossword Puzzles, and Fill in the blank sentences (using minimal pair words). To increase the challenge of the exercises, your patient also has the opportunity to add background noise.

If your patient finds that the Voiceless Consonants CD is too difficult, you can start them with the Training on Vowels CD. The Training on Vowels CD is also divided into ten days of training which will take approximately 20 minutes per day to complete. The activities are similar to the Voiceless Consonants CD. There is the Memory Game, Picture Puzzle and Crossword Puzzle. It does not have the Count the Number activity but it does have an activity called the Sound Matrix. After they have completed the Training on Vowels CD, they can then attempt the Voiceless Consonants CD. You should demonstrate the program to your patients before they leave with the CD.

### **Computer Requirements:**

- Windows XP SP2, Windows Vista
- PC with 1 GHz Pentium Processor or higher
- 256 MB of RAM or higher
- 500 MB of free hard drive space
- 800 x 600 or higher resolution video adapter and monitor
- CD-ROM or DVD drive
- Keyboard and mouse
- DirectX 9.0 or higher capable sound card and speakers

There is a Set-Up program that will need to be run before any of the activities can be opened. The Set-Up program is easy to install. The purpose is to update Windows in order for the programs to run correctly. Without the update, it is possible that the programs will not run and the patients will receive an error message.

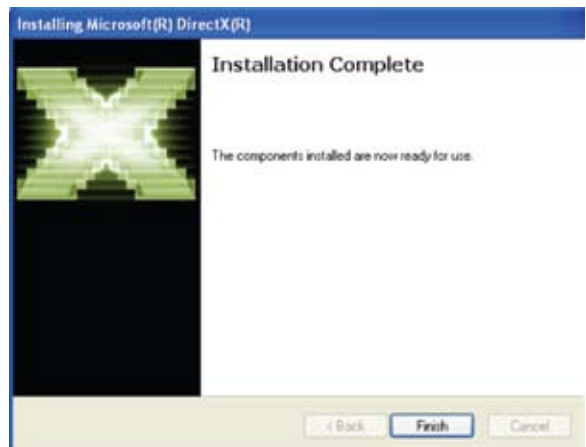
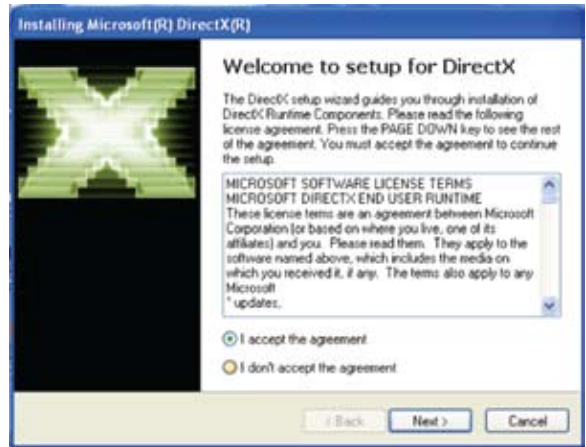
From the Vowels CD, run either “Windows VISTA Setup” or “Windows XP Setup” depending on which operating system you are using. Once you double click on the appropriate installation program, the installation will begin.

The first window that will pop up is for the DirectX setup license agreement. Instruct your patient to click [“I accept the agreement”] and then click [Next >].

The next screen to appear will be a prompt to begin the installation. Instruct the patient to click [Next >].

DirectX will then begin installing all necessary components. This may take several minutes.

After all necessary DirectX components have been installed; the following screen will be displayed. Instruct the patient to click [Finished].



If this is a Windows XP computer installation, the Microsoft .NET Framework 3.0 installation will begin. Note: Windows Vista computers already have the .NET Framework 3.0 installed, so the Windows Vista Setup Program will be complete at this point.

For Windows XP computers, the next screen to be displayed will be the License Agreement for the .NET Framework 3.0. Instruct the patient to select “I have read and ACCEPT the terms of the License Agreement” and then click [Install >].





If the computer already has the Microsoft .NET Framework 3.0 installed, the following screen will be displayed.

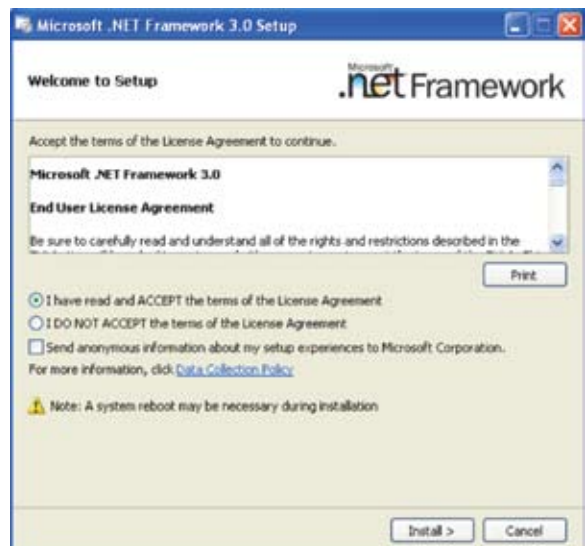
If this screen appears, instruct the patient to click [Cancel]. The installation will be complete for this user and they may begin using the training programs.

If the .NET Framework 3.0 is not already installed on the computer, the installation will continue.

After the setup has completed, instruct the patient to click [Exit].

Now the programs will be ready for use. This installation will only need to be completed once on the computer that will be used for training.

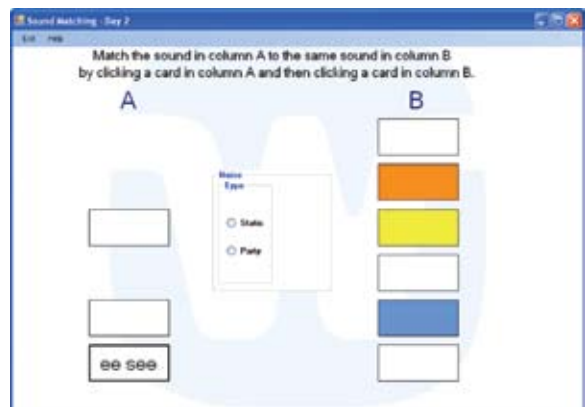
If your patient switches computers for training, they will need to install the set-up program on each computer that they will be using.



### Sound Matching Exercise: *(Training on Vowels and Voiceless Consonants)*

The purpose of this exercise is to familiarize the patient with high frequency consonant sounds or vowel sounds. By asking them to match a sound with another sound, it is also hoped that they improve their auditory memory. Have your patient try to focus on the subtle differences between the sounds as they listen.

1. When the activity is opened, there will be two columns: column A is the target stimulus that should be matched to the response stimulus in column B.
2. The patient may click on any one of the items in column A. Once they listen to the target sound in A, they should click on an item in column B and listen.
3. If it is a match, the item in column A will disappear and the item in column B will change colors. If it is not a match, both items will remain the same. The patient should then start over with either the same item in column A or a new item in column A.
4. The exercise continues until all of the items are matched.
5. When the exercise is completed, a picture will appear. The client should click on “End Exercise” to proceed to the next exercise.

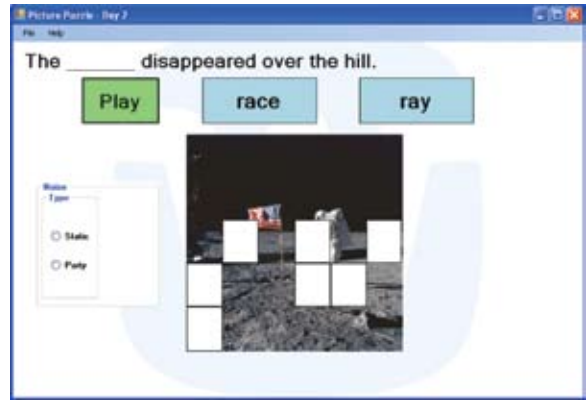


### Picture Puzzle: *(Training on Vowels and Voiceless Consonants)*

This activity is a minimal pair word activity. The target word in the sentence will differ by the vowel sound on the Training on Vowels CD or it will differ by the consonant sound on the Voiceless Consonants CD. The purpose of this activity is to sharpen your patient’s auditory attention and discrimination ability

1. When the activity is started, the first sentence will appear at the top of the screen with the “target” word left blank.
2. The patient will need to press the green “play” button to hear the sentence. Two word options will appear.

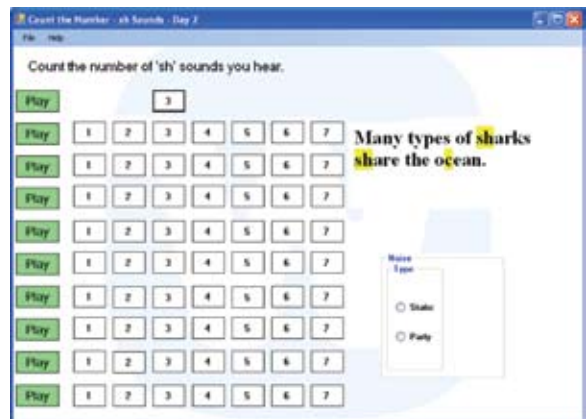
- The patient has the option to click on the “play” button to listen to the sentence for as many times as they wish before they choose an answer.
- The patient will decide which word of the pair was said. S/he clicks on the target response.
- If the chosen response is correct, a piece of a picture will appear on the lower half of the screen.
- If the chosen response is incorrect, no picture piece will appear.
- After a word has been selected, the word pair and sentence disappears. The patient will need to click the play button for the next item.
- The exercise continues until all correct words are chosen and the picture is revealed.
- The patient may click on the “End Exercise” button located on the bottom of the screen to exit this exercise.



**Count the number:** (*Voiceless Consonant CD only*)

This activity is to increase auditory attention by focusing the patient’s attention on a selected phoneme in running speech. The patient is asked to count the number of target sounds within the sentence s/he heard.

- When the activity is opened, the patient will see a list of play buttons.
- The patient may choose any sentence to listen to as s/he wishes.
- The patient needs to listen carefully and count the number of times s/he hears the target sound.
- The patient will click on the number which corresponds to the number of sounds s/he counted.
- If the number is incorrect, the number button will turn red.
- If the number is correct, the sentence will appear to the right with the sounds highlighted.
- For review, the patient may listen to the sentence again while focusing on the highlighted sounds in the sentence.
- The patient should attempt all ten sentences.

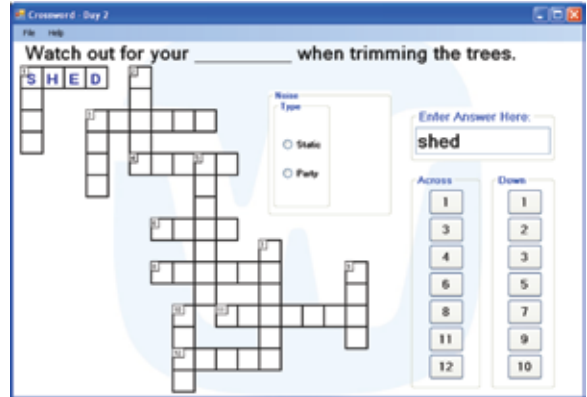


**Crossword Puzzle:** (*Training on Vowels and Voiceless Consonants*)

The goal of this exercise is to reinforce attention to a particular “target” sound in a discourse context. It is an additional auditory attention and discrimination task. The missing words in each puzzle will focus on a particular sound for that day.

- When the activity is opened, the crossword puzzle will be displayed with a list of numbered clue “buttons” for Across and Down.
- The patient should click on the number button to listen to the clue. The clues can be listened to in any order.

3. The sentence will appear with the target word left blank.
4. The patient should type in the missing word in the text box “Enter Answer Here”.
5. If the word entered is correct, it will appear in the puzzle.
6. If the word is incorrect, it will not appear and the patient should try again.
7. The clues may be listened to as many times as the patient wishes.



### Sound Matrix: *(Training on Vowels CD only)*

The purpose of this exercise is to improve your patient’s auditory discrimination by focusing on the differences between vowel sounds. This will be particularly helpful for patients with a more severe hearing loss or with a lower start frequency with the Audibility Extender.

1. Press any button in the display matrix. The patient will hear the two “target” words. They do not need to identify these words but listen to see if they can hear a difference.
2. If they feel they can hear a difference between these words, press the “YES” button.
3. If they do not hear a difference, they should press the “NO” button and choose a new set of “target” words. They may play the words as often as they like.
4. When the patient has completed listening to all word pairs in the matrix, they can press the “Finished” button and they will see a percentage displayed.

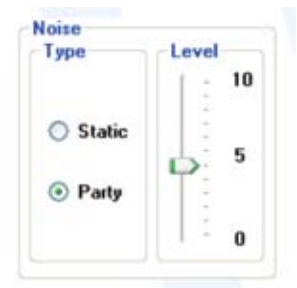


This is the percentage of word pairs that the patient was able to hear a difference. They may repeat the task as often as they like to see if their percentage improves.

### Background Noise

To increase the challenge of any activity, there is an option box in each activity screen for the patient to choose a background noise. There is a static noise, which is a speech-shaped noise, and party noise which is an eight person multi-talker babble noise. The patient should select whichever background noise they would like to try and adjust the level of the noise so that they can hear it.

Each day, the patient can increase the level of the noise to increase the challenge. If they are unable to perform the activity, they may decrease the level of the background noise until they are able to do so.



## Appendix B

### List of Everyday Sounds

Check the box next to each sound you hear under the appropriate listening situation when that sound was heard. Place two check marks in the box if one program is more preferable than the other. If you do not hear it, leave it blank. If it is a sound you do not encounter, write NA.

<u>Sounds at home</u>	<u>Program 1</u>	<u>Program 2</u>	<u>Sounds at home</u>	<u>Program 1</u>	<u>Program 2</u>
<b><i>Kitchen:</i></b>			<b><i>Office:</i></b>		
1. Dripping faucet	<input type="checkbox"/>	<input type="checkbox"/>	25. Keyboard buttons	<input type="checkbox"/>	<input type="checkbox"/>
2. Gas stove ignition	<input type="checkbox"/>	<input type="checkbox"/>	26. Rustling paper	<input type="checkbox"/>	<input type="checkbox"/>
3. Microwave buttons	<input type="checkbox"/>	<input type="checkbox"/>	27. Paperclips on hard surface	<input type="checkbox"/>	<input type="checkbox"/>
4. Microwave alarm	<input type="checkbox"/>	<input type="checkbox"/>	28. Clicking a pen	<input type="checkbox"/>	<input type="checkbox"/>
5. Cracking ice	<input type="checkbox"/>	<input type="checkbox"/>	29. Scissors	<input type="checkbox"/>	<input type="checkbox"/>
6. Aluminum foil	<input type="checkbox"/>	<input type="checkbox"/>	30. Stapler	<input type="checkbox"/>	<input type="checkbox"/>
7. Candy wrappers	<input type="checkbox"/>	<input type="checkbox"/>	31. Computer sounds	<input type="checkbox"/>	<input type="checkbox"/>
8. Whistling tea kettle	<input type="checkbox"/>	<input type="checkbox"/>	32. Computer mouse click	<input type="checkbox"/>	<input type="checkbox"/>
9. Plastic bag/wrap	<input type="checkbox"/>	<input type="checkbox"/>	33. Phone ring (in same room)	<input type="checkbox"/>	<input type="checkbox"/>
			34. Phone ring (in other room)	<input type="checkbox"/>	<input type="checkbox"/>
			35. Phone button tones	<input type="checkbox"/>	<input type="checkbox"/>
<b><i>Dining:</i></b>			<b><i>Family Room:</i></b>		
	<u>Program 1</u>	<u>Program 2</u>		<u>Program 1</u>	<u>Program 2</u>
10. Silverware	<input type="checkbox"/>	<input type="checkbox"/>	36. Squeaky furniture	<input type="checkbox"/>	<input type="checkbox"/>
11. Spoon stirring a drink	<input type="checkbox"/>	<input type="checkbox"/>	37. Door hinge	<input type="checkbox"/>	<input type="checkbox"/>
12. Ice clinking inside glass	<input type="checkbox"/>	<input type="checkbox"/>	38. Ticking clock	<input type="checkbox"/>	<input type="checkbox"/>
13. Glasses clinking for a toast	<input type="checkbox"/>	<input type="checkbox"/>	39. Coo-coo clock	<input type="checkbox"/>	<input type="checkbox"/>
14. Tapping glass with a spoon	<input type="checkbox"/>	<input type="checkbox"/>	40. Adjusting window blinds	<input type="checkbox"/>	<input type="checkbox"/>
15. Hitting chop-sticks together	<input type="checkbox"/>	<input type="checkbox"/>	41. Fire crackling in fireplace	<input type="checkbox"/>	<input type="checkbox"/>
16. Soda fizzing	<input type="checkbox"/>	<input type="checkbox"/>	42. Hearing aid held in hand	<input type="checkbox"/>	<input type="checkbox"/>
17. Other people eating	<input type="checkbox"/>	<input type="checkbox"/>	43. Door bell	<input type="checkbox"/>	<input type="checkbox"/>
18. Chair scraping the floor	<input type="checkbox"/>	<input type="checkbox"/>	44. Door locking	<input type="checkbox"/>	<input type="checkbox"/>
			45. Rain on the roof	<input type="checkbox"/>	<input type="checkbox"/>
			46. Various light switches		
<b><i>Personal:</i></b>			a. Pull chain	<input type="checkbox"/>	<input type="checkbox"/>
	<u>Program 1</u>	<u>Program 2</u>	b. Standard flip switch	<input type="checkbox"/>	<input type="checkbox"/>
19. Clothes rustling	<input type="checkbox"/>	<input type="checkbox"/>	c. Switch on a lamp	<input type="checkbox"/>	<input type="checkbox"/>
20. Brushing hair	<input type="checkbox"/>	<input type="checkbox"/>			
21. Jewelry (ring on hard surface, noisy bracelet, etc.)	<input type="checkbox"/>	<input type="checkbox"/>			
22. Watch alarm	<input type="checkbox"/>	<input type="checkbox"/>			
23. Tapping fingernails	<input type="checkbox"/>	<input type="checkbox"/>			
24. Snap closures	<input type="checkbox"/>	<input type="checkbox"/>			

<b><i>Children:</i></b>	<b><u>Program 1</u></b>	<b><u>Program 2</u></b>	<b><u>Sounds outdoors</u></b>	<b><u>Program 1</u></b>	<b><u>Program 2</u></b>
47. Child's squeaky toy	<input type="checkbox"/>	<input type="checkbox"/>	62. Cracking ice	<input type="checkbox"/>	<input type="checkbox"/>
48. Child's toy that plays music or beeps	<input type="checkbox"/>	<input type="checkbox"/>	63. Rustling leaves	<input type="checkbox"/>	<input type="checkbox"/>
			64. Bird	<input type="checkbox"/>	<input type="checkbox"/>
			65. Crickets	<input type="checkbox"/>	<input type="checkbox"/>
			66. Whistling	<input type="checkbox"/>	<input type="checkbox"/>
			67. Wind chimes	<input type="checkbox"/>	<input type="checkbox"/>
			68. Bicycle bell	<input type="checkbox"/>	<input type="checkbox"/>
<b><i>Pets:</i></b>	<b><u>Program 1</u></b>	<b><u>Program 2</u></b>			
49. Pet toe nails on tile	<input type="checkbox"/>	<input type="checkbox"/>			
50. Pet collar tags	<input type="checkbox"/>	<input type="checkbox"/>			
51. Whining dog	<input type="checkbox"/>	<input type="checkbox"/>			
52. Meowing cat	<input type="checkbox"/>	<input type="checkbox"/>			
53. Pet toys with bell or squeak	<input type="checkbox"/>	<input type="checkbox"/>			
			<b><u>Car sounds</u></b>	<b><u>Program 1</u></b>	<b><u>Program 2</u></b>
			69. Car turn signal	<input type="checkbox"/>	<input type="checkbox"/>
			70. Shaking keys	<input type="checkbox"/>	<input type="checkbox"/>
			71. Left key in ignition with door open (warning ding)	<input type="checkbox"/>	<input type="checkbox"/>
			72. Door locking	<input type="checkbox"/>	<input type="checkbox"/>
			73. Screeching tires	<input type="checkbox"/>	<input type="checkbox"/>
			74. Checking air in tires (hiss)	<input type="checkbox"/>	<input type="checkbox"/>
			75. Washing window or mirror	<input type="checkbox"/>	<input type="checkbox"/>
<b><u>Sounds in public</u></b>	<b><u>Program 1</u></b>	<b><u>Program 2</u></b>			
54. Elevator bell	<input type="checkbox"/>	<input type="checkbox"/>			
55. Coins jingling	<input type="checkbox"/>	<input type="checkbox"/>			
56. Wet shoes on tile	<input type="checkbox"/>	<input type="checkbox"/>			
57. Shopping carts	<input type="checkbox"/>	<input type="checkbox"/>			
58. Instruments (ex: piccolo)	<input type="checkbox"/>	<input type="checkbox"/>			
59. Cash register printing receipt	<input type="checkbox"/>	<input type="checkbox"/>			
60. Music in stores over intercom (doctor's office/ waiting area)	<input type="checkbox"/>	<input type="checkbox"/>			
61. High heel shoes on hard floor	<input type="checkbox"/>	<input type="checkbox"/>			

## Appendix C: AE Verification with the Audioscan Verifit [version 3.4.8]

The Verifit contains frequency lowering test signals which can be used with AE start frequencies above 1250 Hz. The signals were based on the original male speech signal (Speech-std) and have been modified so that there is 30 dB less energy between 1000 Hz and the target frequency. The target frequency is a 1/3 octave band centered at the frequency of interest (Figure 1). The test signals available to use in the evaluation are fixed at 3150, 4000, 5000 or 6300 Hz (labeled as Speech3150, Speech4000, Speech5000 and Speech6300).

It is important to choose the appropriate test signal based on the needs of the patients to hear at that frequency. For example, if it is intended that the patient hears 4000 Hz, the Speech4000 signal should be used. However, the start frequency used by the AE program could also interact with the test signal and affect the measurement results. This is because the amount of transposition is limited to one octave (or 3 channels) above the start frequency in the Basic mode and 2 octaves (or 5 channels) in the expanded mode. As an example, a start frequency of 1600 Hz in the basic mode will transpose frequencies up to the 2500 Hz channel. A test signal such as Speech3150 will be beyond the range of transposition and thus it would appear that no transposition has occurred. To transpose this signal (i.e., 3150 Hz) at a start frequency of 1600 Hz, one needs to use an expanded transposition mode (Figure 2). Thus, the absence of a response is not necessarily an indicator that the AE is not working; rather, it may suggest some adjustment of the AE parameters is necessary.

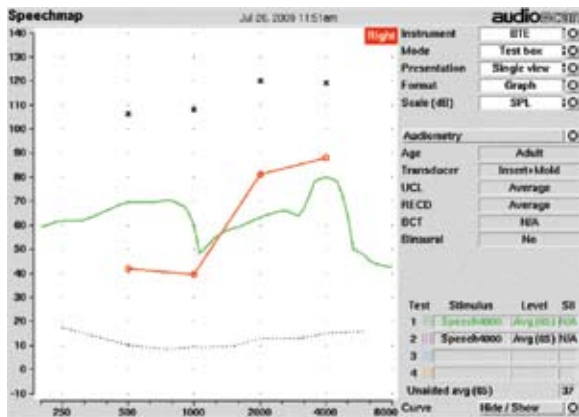


Figure 1: Output of the M4-9 master program with a 30, 30, 65, 80 dB HL hearing loss in response to 65 dB SPL Speech4000 from the Audioscan Verifit v. 3.4.8.

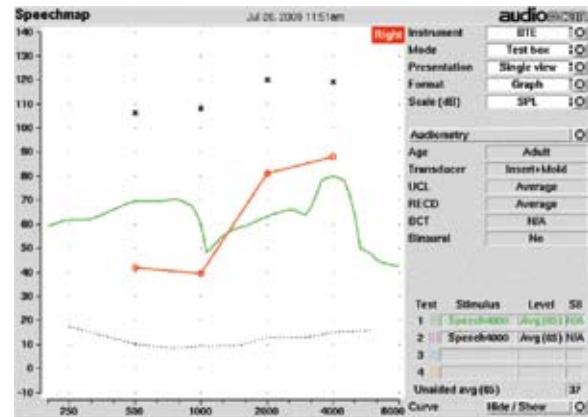


Figure 2: Output of the M4-9 with a 30, 65, 80, 80 dB HL hearing loss in response to 65 dB SPL Speech3150 from the Audioscan Verifit v. 3.4.8. The green line is the master program, and the pink line is the AE program with start frequency 1600 Hz in the basic mode. The blue line is the AE program in the expanded mode. Evidence of transposition is seen in the expanded mode.

## Recommended Steps for AE Verification

1. Go to the Audioscan Verifit Speechmap screen and select Test Box mode.
2. Select [Audiometry], [Continue] and enter the Audiogram of the wearer.
3. Select [Continue] and the entered audiogram will be displayed on the test screen.
4. Determine the appropriate test signal based on the AE start frequency (Table 1).
  - a. For example, pink noise should be appropriate for a start frequency lower than 1250 Hz in the basic mode.
  - b. Any Verifit signals can be used when the start frequency is 2500 Hz used in the expanded mode.

AE Start Frequency (Hz)												
	1250		1600		2000		2500		3200	4000	6000	
Verifit Signal	Basic	Expanded	Basic	Expanded	Basic	Expanded	Basic	Expanded	Basic	Basic	Basic	
Pink Noise	X		X									
Speech3150		X		X	X	X	X	X				
Speech4000				X	X	X	X	X	X			
Speech5000				X		X	X	X	X	X		
Speech6300								X		X	X	

Table 1: Test signals from the Audioscan Verifit which can be used with each AE start frequency for test box verification. All start frequencies lower than 1250 Hz should be evaluated with pink noise.

5. Prepare the Verifit to present the appropriate test signal at 65 dB SPL.
  - a. Click on the button with the circle on it located next to the test number to be used.
  - b. Select the signal from the list and select the level 65 dB SPL.
6. Program the master program so that it is has omni directional microphones, NR off, and FBC off [no test mode will be needed]. Also ensure that an AE program is available with the desired start frequency and gain level.
7. With the hearing aid in the master program, attach the hearing aid to the 2 cc coupler and place it in the middle of the test chamber.
8. Present the test signal to the hearing aid for about 10 s (until the response is stable). The curve on the screen indicates the response of the master program. For example, the result of a 65 dB SPL Speech4000 presented to the hearing aid in the master program is shown in Figure 1.
9. With the hearing aid in the AE program, obtain a second curve by presenting the test signal to the hearing aid for about 10 s (until the response is stable). The curve should be above the hearing loss line up through the start frequency of the AE.
  - a. With a default start frequency of 2500 Hz and 0 dB AE gain, greater output can be seen just below 3000 Hz. Frequencies above 2500 Hz are being transposed one octave lower. This is illustrated in Figure 3.
  - b. With an increase in AE gain, the test signal becomes more audible as seen in Figure 4.

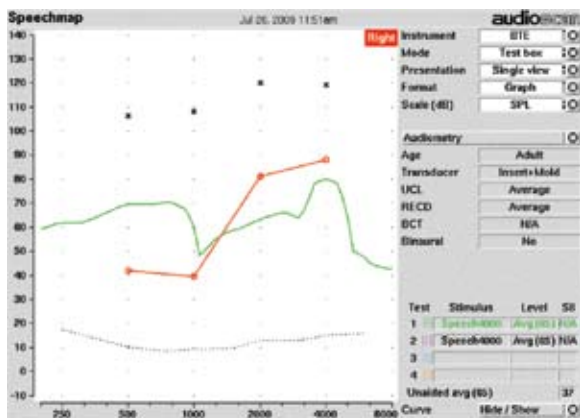


Figure 3: Output of the M4-9 with a 30, 30, 65, 80 dB HL in response to 65 dB SPL Speech4000 from the Audioscan Verifit v. 3.4.8. The green line is the master program, and the pink line is the AE program with start frequency (2500 Hz) and 0 dB gain.

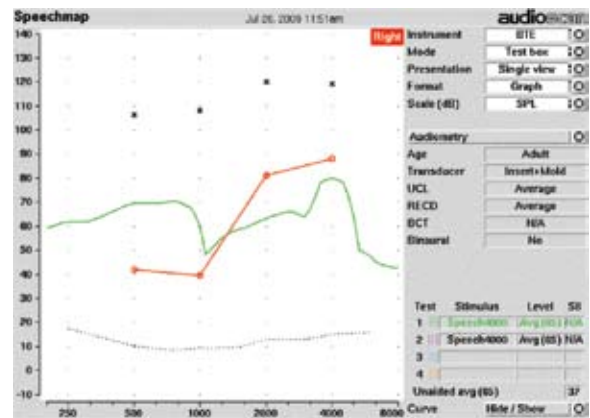


Figure 4: M4-9 with a 30, 30, 65, 80 dB HL hearing loss in response to 65 dB SPL Speech3150 from the Audioscan Verifit v. 3.4.8. The pink line is the AE program with 2500 Hz start frequency and 0 dB AE gain and the blue line is the AE program with 2500 Hz start frequency and 14 dB AE gain.