Overview

AudSim, the Audiometer Simulator, let's you "test" different "patients". You can test the same patient different times. Unlike with a real human patient, the thresholds will change somewhat each time you test the patient, so that you can practice many times. There are three modes: hand-holding mode, a practice mode and a test mode. These modes guide you through pure tone testing with differing levels of assistance.

This program simulates a diagnostic audiometer. The audiometer has a left and right channel. You will need to "select" which channel (left / right) produces the pure tone signal that you are using to test the patient. You will use the same buttons to control frequency and present the tone, regardless of which ear you are testing. You can hear the frequency test tone you are presenting. You do not hear the change in intensity that you create.

Installing the Software and Starting the Program

1) CD Distribution:
Put the CD in the disk drive. Go to the "Start" button, click, select "Run". Assuming your CD is the D: drive, you would type in "D:setup" and return. (If you don't know what your CD drive is, you can go to My Computer or Windows Explorer and look at the options. The CD is entitled "audstudent", so that label should show up next to the drive letter.

1a) Web Distribution:
Download the file "instasim.exe" from the audstudent.com website. Remember where you save this file. (We suggest using the c:/windows/temp folder). Run this file to start the self-extracting zip file. Click the "Unzip" button.

2)
Please accept all of the default settings selected by the installation program. Once you have installed, you can choose to run the program immediately, or come back to it later.

To start the program, go to the Start button.
Select Programs
Select AuD Student

Select AudSim

When you click on AudSim, the program starts. It will check to see what sound card you have. Just click "OK" and the program will start.

3) Registration

Until you purchase a registration key, the program will be restricted to running the tutorial. A registration screen will appear on startup. To obtain a registration key:

a) Note the red 4 digit "local key" and click the "GetRegKey" button.
b) You will be logged on to our secure website, where you can purchase a registration key. Note that your registration key is computed based on the unique local key for the computer that generated it. Registration keys are not transferable.
c) At the registration screen; type in your name and your 6 digit registration key, then click "Register AuDSim".

Overview of Selecting a Testing Mode

The program starts up in hand-holding mode, which helps you do the first audiogram with step-by-step instructions. It is meant for the first time user. If you wish to change modes, click on Mode. You will see a drop-down box with the options

Test
Practice
Hand-holding

Practice mode lets you view the actual thresholds of the patient as you are doing the testing to see if you are correct or not.

Test mode is used when you are ready to do the testing independently. You can compare your test results to the "correct answers" at the end, and you can print out the results to submit to your professor to document that you have completed the assignment.

Loading a Patient File and Viewing History

Click on the top left drop down menu that says File. Then select Open Sim Patient. From the default directory, select the patient file as directed by your professor.

From the top drop down menu, select View, and Patient History. Read the information about the patient's history. Be sure to scroll down to make sure that you have read the complete case history.

Using the Audiometer Simulator

Selecting the ear to test. Clicking on the button marked "SEL" (located under the words left and right on the lower part of your screen) selects the ear to stimulate. The button turns red when it is selected. Clicking on a SEL button that is already red makes the opposite channel go on. You can also make the opposite channel "active" by clicking on the SEL button for the other ear.

Presenting the tone. To present the tone you can either click the mouse on the box marked "Present" (above the green frequency box) or you can press the space bar, or you can right click on the up or down arrows. You will probably find that using the space bar or the right click option speeds you up.

For some tests, you want the stimulus to stay on, even when you don't have the tone presentation button depressed. If you wanted to do that, you would click on the button marked "REV" which stands for reverse. (The tone button then has the reverse of its normal affect – it turns the signal off when you press it if that channel is active.) Click REV again to turn the stimulus off.

To adjust the intensity of the signals you are hearing ("monitoring"), click and drag the slider bars on the left side. The easiest way to adjust this is to reverse the signal so it stays on, and adjust the sliders. If the control over the pure tone monitor intensity doesn't work, it is because your computer does not support that function. You may or may not be able to adjust it with your computer's sound card controls.

To adjust your computer speaker volume using the Windows tool, double click on the yellow speaker (on the lower right of your screen). You will see options to adjust your sound card. If you don't hear a monitor tone, your sound is probably all the way down or muted. Look specifically for the volume control and the wave (or wave output, or similar) volume adjustments. (The masking noise comes out of the wave output, and the tones come out of your speakers internal tone generator.) If you don't get any monitor sound (particularly for the masking noise), you should check that your PC speakers are also on, and connected properly.

Changing the stimulus type. The simulator presently has three types of stimuli – a steady pure tone, a pulsed pure tone, and a masking noise. When presenting these signals as stimuli, they are all assumed to be calibrated in dB HL, and you will get equivalent thresholds, regardless of signal type. Of course, pulsed or steady pure tones are the standard stimuli. When the noise is used in the non-selected ear as a masking stimulus, it is assumed to be calibrated in dB Effective Masking.

The type of stimulus is changed independently for each ear, by clicking on the box below the intensity of the stimulus for that channel. Highlight the desired stimulus and left click the mouse.

Changing the transducer. Version 1.6 of the simulator only supports simulations two types of transducers, the "old style" earphones called TDH supraaural earphones (this is what you want to use when testing air conduction) and "bone", when testing bone conduction. The type of mark made on the audiogram will change depending upon the transducer (and ear) selected. At the upper right of the screen, you have confirmation of the ear and transducer.

Changing frequency.
Below the green frequency box are left and right arrow keys. Use them to change frequency. Note that as you change frequency, the location of the color dot on the audiogram also changes. The color dot will be blue when the left channel is selected, and red when the right channel is selected.

Changing intensity. There are separate intensity controls for the left and right channels. You increase the intensity by clicking on the intensity control or by using the left and right arrows (or the up and down arrows). The color dot will move on the audiogram to show the intensity presently selected.

To use the volume control, note that when you place the cursor on the volume control a hand appears. That lets you know that you can change the volume if you click on that spot. Click just a little higher or lower creates a small change, clicking a farther distance from the current setting creates a large change. However, this is not the easiest manner for changing volume.

The recommended way to change volume is with the left and right arrow keys on your computer keyboard. You can present the tone with the space bar, so that you do not have to use the mouse to do threshold searching.

Knowing if the patient "heard it". When you present a signal, if it was heard by the "patient", then the green light (located below the present button) will light up briefly.

Marking thresholds. After you have used the proper Hughson-Westlake technique to establish the threshold, click on the box marked "Mark Threshold". The mark will be placed at the frequency and intensity at which the controls are presently set. If you make a mistake, and want to change threshold, simply go to the proper intensity and hit "Mark Threshold" again. If you want to erase the mark altogether you will have to set the transducer and ear to the frequency desired and mark it again. Then immediately go to "Test" "Reset Current Marker". (This only erases the mark you just made.) Note, you can reset all markers by selecting "Test" "Reset All Markers".

If the simulated patient does not hear the tone, even at the maximum output level of the audiometer, you will want to mark this lack of hearing by clicking the "No Response" button at the highest intensity that you tested.

Hand-Holding versus Practice versus Test Mode and Retesting a Patient. You can practice with the same "patient" as many times as you like. Each time you do, the thresholds will change a little bit, so that you have a different experience each time.

Hand-holding mode steps you through the basic pure tone testing procedures and use of the simulator. When finished, you can document your completion of the exercise by printing a verification notice.

When in practice mode, you can "cheat" and look at the patient's thresholds any time you want. To do this, click on View , then Test Results. Note that you can't print out the results and submit them to document completion of an assignment when you are in practice mode. You can only print the results when in Test mode.

When you wish to test another "variation" of the same patient (do another practice, or do a "test" version, click on "Test", and "Regenerate Simulation". This starts a new session with the same patient. Remember: Test, Reset blanks out your previously marked thresholds and lets you keep the exact same patient. Another way to obtain a new simulation is to go to "Mode" and reselect the same test mode.

To switch between Practice and Test modes, click on Mode, and select the type of session you desire. Switching modes automatically "regenerates" the patient (provides you with somewhat different thresholds.)

When you are in Test mode, you can see the results only one time. (A "caution" screen will remind you of this warning.) After viewing the results, you must print them if you wish to submit them, as you cannot view them again. After you print them (click on box at bottom of the screen), when you close the screen, you will be starting a new session with the same patient with slightly different thresholds.

Help Messages

The box on the upper right provides you with some "coaching" when you are in practice mode. For instance, it alerts you if the sound is crossing over to the non-test ear. This is especially helpful when you are doing masking.

In hand-holding mode, this box is used to provide step-by-step instructions.

Masking

When masking is needed, select "NBN" as the stimulus for the non-test ear. Toggle the "REV" button. Remember the slider helps control the intensity of the noise that you hear, as does your sound card.

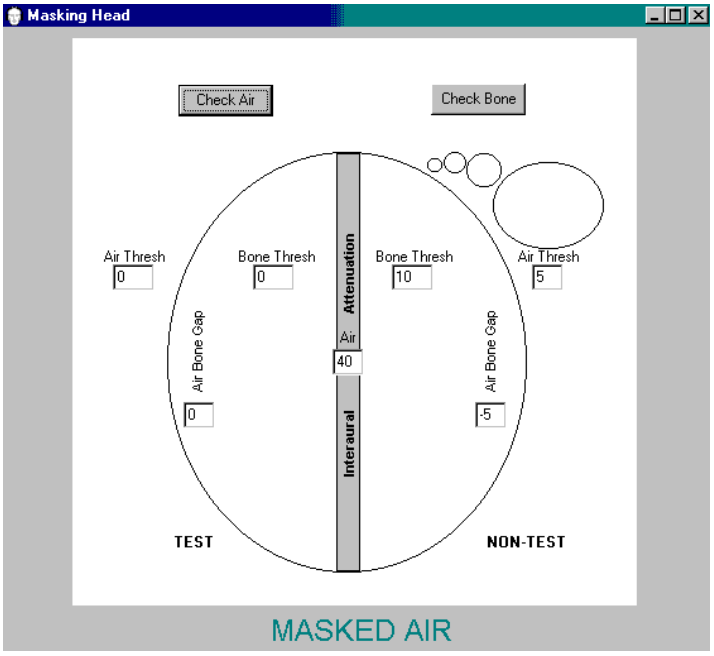
Printing Audiograms

You can print the audiogram at any time for your records. .

To print, select

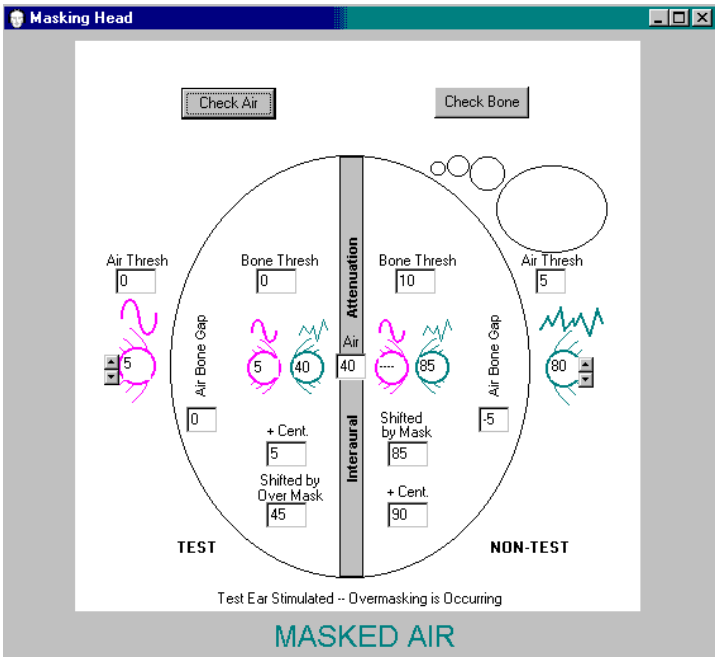
File

Print Audiogram



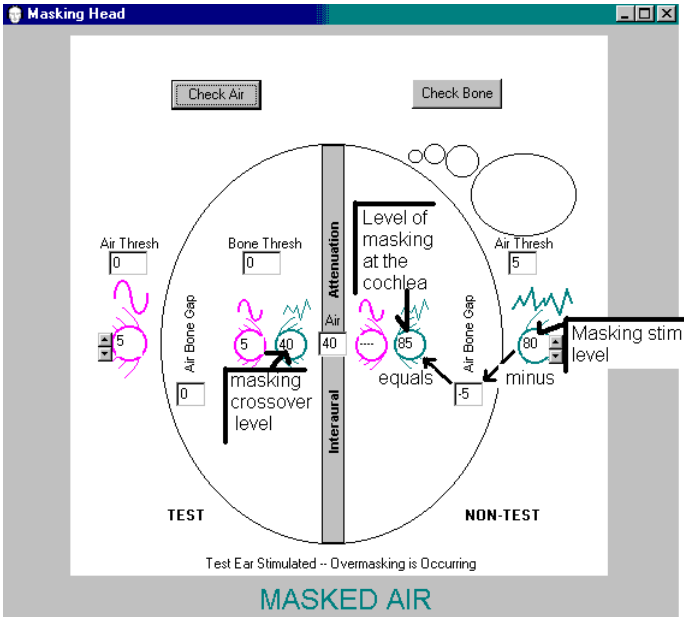
Masking Diagram

To better allow you to see what is happening as you mask, the AuD Student Audiometer Simulator provides a masking diagram that can be viewed when you are in practice mode. To see the diagram, you must have masking already set up (NBN chosen as the stimulus and reversed in the ear that is not "selected" as the test ear). Then when you select "View" "Masking Diagram", you will see a graphic such as this, which we call "Masking Head". Below is a step by step explanation of this diagram.



The left side of the diagram is always the test ear, regardless of whether you are testing the right or left ear, and of course that means the right side is always the non-test side.

The air and bone conduction thresholds for each ear are shown. The interaural attenuation is also displayed. If you are set up for bone conduction testing, both air and bone conduction interaural attenuation values are shown.
All of these displays are values that the program selected for this patient.

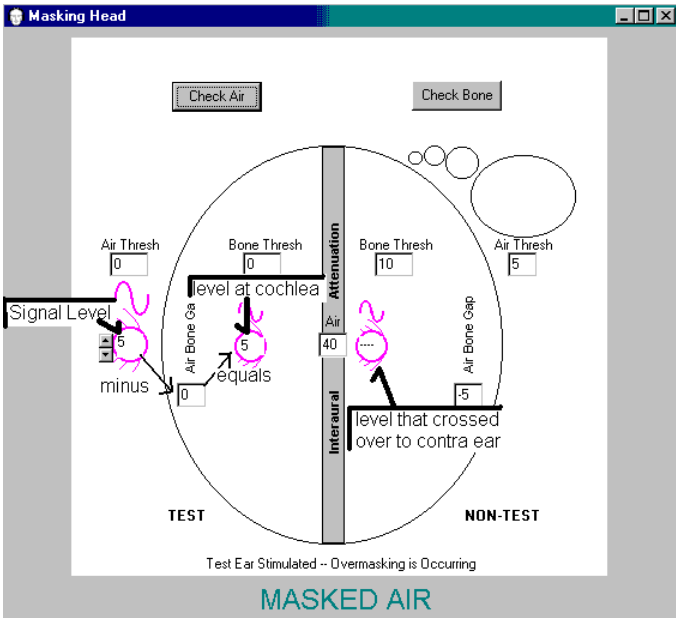


Now focus on the pink circles if you are viewing this in color. Underneath the sine wave to the left is the intensity at which you are currently presenting the test signal. Under the masking head is a note reminding you if you are testing air or bone conduction. The level at the test ear cochlea is shown under the sine wave that is second from the right. It is calculated as the signal presentation level, minus the air bone gap, if the signal is air conducted.

The signal level minus the interaural attenuation provides the level that has crossed over to the non-test ear cochlea. If there are dashes, as shown to the right, that means that the level that crossed over is not enough to be heard.

If you want to see how these values change, you can do so by altering the signal level right in the masking head diagram. The up and down arrows by the first pink sine wave adjust the level. The values are not recalculated until you press the button "check air" or "check bone" as appropriate.

You can tell if the patient heard the tone by looking in the thought bubble. The message will be "tone heard" if the patient responded.



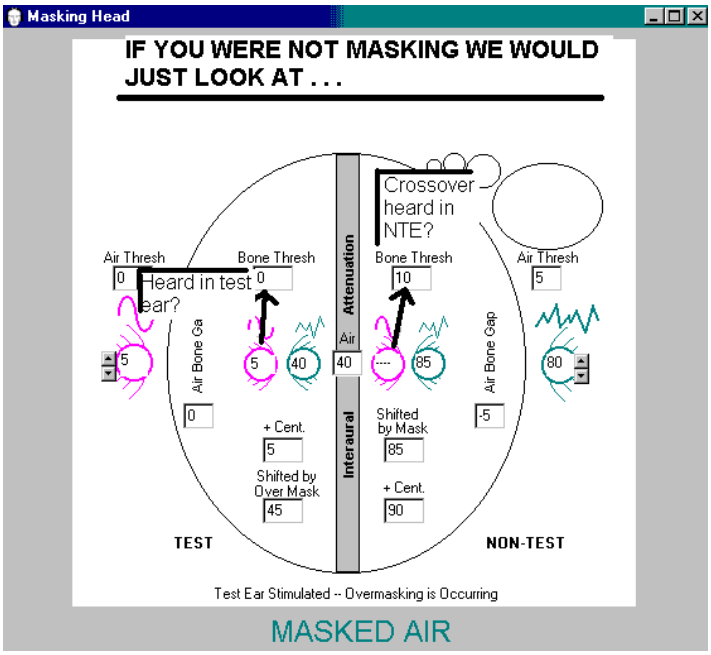
Next, look at the masking stimuli, which will be in green on the screen.

The masking stimulus level presented is shown, and just like with the signal level, you can turn the level up and down to see what will happen. Just remember to press "check air" or "check bone" to get the program to update.

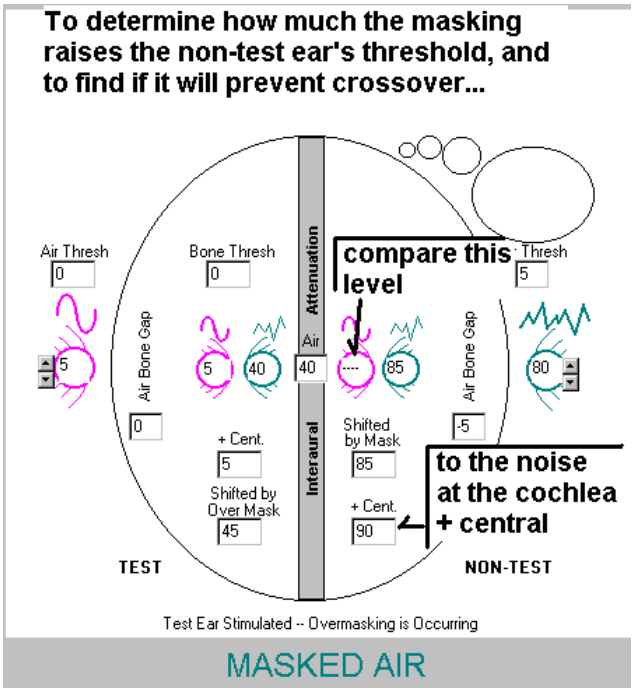
The signal level minus the air bone gap yields the level of the masking at the cochlea. In the example here, there is a bone-air gap (a negative air bone gap), so the level of the masking at the cochlea is actually increased (minus a negative = addition). We believe this is the proper way to model masking for the uncommon occurrence of a bone-air gap.

Next, note that the level of the signal that crossed back over to the test ear (masking noise level minus interaural attenuation) is shown. (This is the noise on the test side of the head.)

Now, how do we decide whether the patient should hear the tone? If you were not masking, it would be a case of comparing the level at the test ear cochlea to the test ear's bone conduction threshold. If the signal is louder than the threshold by bone, the patient would hear it in the test ear. If the level of the crossed-over tone is greater than the non-test ear bone conduction threshold, then the crossover is heard.

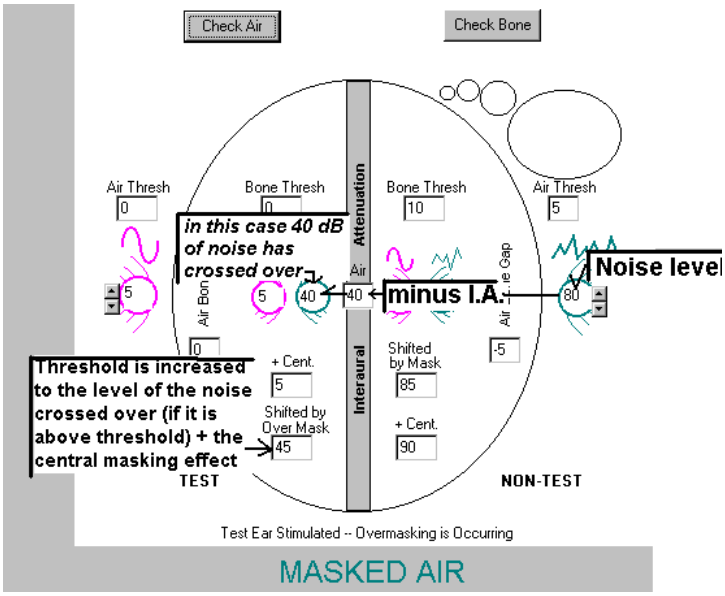


But of course you are doing masking, which potentially alters the bone conduction thresholds in several ways. First, if the noise is enough to overcome any air-bone gap, then the bone conduction threshold in the non-test ear is raised to the level of the masking. Additionally, central masking elevates the non-test ear threshold. The amount of central masking changes depending upon how loud the noise is. So, once the noise is present in the non-test ear, compare the crossed-over signal level to the box



marked + Cent (the threshold of the bone, shifted by masking, plus shifted by central masking).

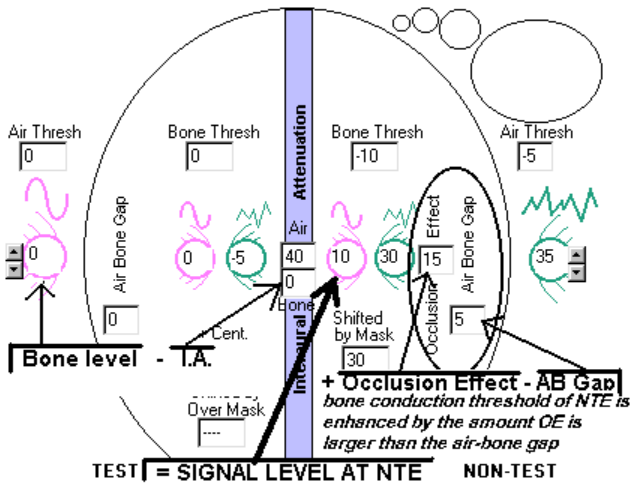
Masking noise in the non-test ear elevates the test ear threshold also. This occurs in two ways, through central masking and via overmasking. This simulator accurately shows the fact that central masking is not really a constant 5 dB threshold shift, but varies depending on the perceived loudness of the sound. The box marked + Cent on the LEFT side of the head shows the bone conduction threshold, as elevated by central masking.



If the level of the air conduction noise has crossed over to the test ear, causing over masking, the level to which the test ear's bone conduction threshold is elevated is shown in the box "Shifted by Over Mask". This was derived by finding the noise level in the test ear, and subtracting the interaural attenuation.

When testing for bone conduction, the crossover to the non-test ear occurs more readily, since the interaural attenuation is less. This simulator properly simulates slight interaural attenuation values when the frequency is high. (You might have thought that interaural attenuation for bone conduction is zero, but that is the minimum level. It is usually not zero for the high frequencies. Even in the low frequencies there is usually a little interaural attenuation, but most of the test cases will use a zero value.) In the example below, however, the interaural attenuation value for bone conduction is zero, so there is no loss of energy as the bone conduction crosses the head.

When conducting bone conduction testing, the occlusion effect may enhance the bone conduction threshold of the non-test ear. This will only happen if the occlusion effect is larger than the air-bone gap, because as you know, an ear with a conductive pathology does not have an occlusion effect. The software calculates the size of the enhancement due to the occlusion effect as "occlusion effect" minus "size of the air-bone gap", so in the case below, the enhancement is reduced by the 5 dB air-bone gap.



Masking Has Shifted NTE Threshold -- Patient No Longer Hears Tone in NTE

MASKED BONE

In summary, for bone conduction, the crossover signal is the test level, minus the interaural attenuation. We then add the amount that the occlusion effect is above the air-bone gap. This tells you the signal level at the non-test ear cochlea.

The Simulator Can Be a Realistic Patient

Patients don't always respond to stimuli at and above threshold. Attention of real patients wanders somewhat, so a real patient won't always hear the sound at threshold. The AuD Student Audiometer Simulator can simulate this. Depending upon how a given patient is programmed, the simulated patient might be completely reliable (always respond at and above threshold) or much harder to test. Real threshold is defined as the lowest intensity level that can be heard 50% of the time. Just as a real patient may occasionally hear a sound below real threshold level, the audiometer simulator can do this too! As the simulated patients become more realistic or simulate a difficult to test patient, it becomes increasingly important to follow the exact Hughson-Westlake technique when finding threshold. If the patient is particularly challenging, you might find that even if you follow exactly the proper technique, you might be off in finding your thresholds.

Also, the patient can be programmed to have a "real" threshold that is not on a 5 dB step, which will create a difference between your measured threshold and the real threshold.

Patients don't always hit the response button at the same time post-stimulus. Real patients take a little longer to respond to a near threshold signal, and less time as the signal gets to be above threshold. This is simulated in the AuD Student Audiometer Simulator. Also, some patients are faster responders than others. For example, younger people are usually fairly quick to respond, while seniors may take a little longer to press the response button. You will find this is simulated.