Theta User Manual
Version 3.1: 08/01/2023

General information:

Theta was created by Audiology Technology Solutions, LLC in response to the increased need for clinical simulation in audiology due to the COVID-19 pandemic in 2020. This program is the sole property of Audiology Technology Solutions, LLC. Any distribution, modification, or other use without written consent is prohibited.

Preface: This guide contains information on how to use the program. Specific app components (buttons, tabs, check boxes) have been bolded for ease of reference. If you are unsure what a component does, look for it here in **bold text** and a description should be provided. Information in *italics* are tips to help you in your use of the program.

Contact: https://audiologysimulator.com/contact

Setup: You can access Theta 3 at https://audiologysimulator.com

First-time users should create a user account (https://audiologysimulator.com/signup) to access their Dashboard. If you are a student/learner – please contact your instructor for instructions on how to sign up under the correct affiliation. Access to Theta and other tools requires a subscription to the service (contact us for current pricing information).

Preferred settings/computer requirements:

Theta 3 is currently only fully compatible <u>with the Google Chrome web browser</u>.
Other browsers (Firefox, Safari, Edge, Opera) may also supported, but may contain visual, audio, or other bugs.

Minimum system requirements: 4GB RAM, Intel i5 (8th generation or later) or equivalent processor, display, stable high-speed internet access, web browser installed and up-to-date (as mentioned above).

Dashboard

When you log into your Theta account, you are taken to the Dashboard. The Dashboard provides you with some basic user account information and a list of services offered. Once you have access to Theta (via subscription and/or an access code), you will also see a list of available courses in which you may enroll. Once you add a course to your enrollments, they will show up in the far-right column of your dashboard.

Available services

This section lists the services offered, and information about your current subscription status or access period. If you have access to the service, your end/renewal date is provided as a reminder. If you don't currently have access, you'll see two options for getting access: 1) Checkout via Stripe (a secure 3rd party credit card processing service) and 2) Access codes. If you are paying for the service yourself, you'll most likely purchase a subscription using the "Checkout" button. If you were provided an access code, enter it here, press "Go" and your account will be activated.
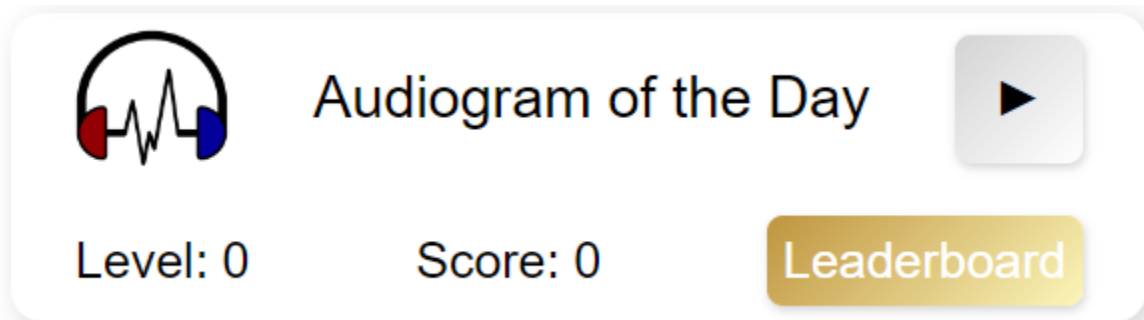

Theta:

Theta is the audiology simulator. Within Theta, you can design and test simulated hearing profiles and cases created for you by instructors.

Diida:

Diida is a calibratable web-based audiometer. With calibration in the settings tab, you can use Diida on your computer to serve as a 2-channel audiometer. Please contact us for more details and help with calibrating. For use with calibrated headphones with known Reference Equivalent Threshold Sound Pressure (and Force) Levels (E.g., HDA 200, Sennheiser HD 280 Pro, TDH-50, B71, etc.)

Note: Diida can present extremely loud sounds via headphones, so proceed with caution.

Audiogram of the Day:

A game mode. Each day there is a random audiogram generated by Theta for you to complete. Users can compete by comparing their scores with all other Theta users or with users in their specific Affiliation and/or Level (using the dropdowns on the leaderboard). You can also view scores for the day, week, month, year, and all-time **Time Frames**. A leaderboard is displayed here and updates depending on your Comparison Group, Level, and Time Frame selected.

There are currently 11 Levels (0-10). As your level increases, so does the difficulty and variety of the audiograms you will encounter.

Players can achieve up to 200 points per audiogram. Points are awarded for correct thresholds (including the correct use of masking) and, starting at higher levels, are deducted for flags generated by the system (see the section on flags later in this user manual). If you get 100% of the thresholds correct with 0 flags, you can get 100 points, which then are subject to a time modifier. If you complete the audiogram quickly enough, you can receive a full 2x modifier, and you can also lose points the longer you take to complete your audiogram!

Available courses

This section of your dashboard shows you courses that are available for you. You enroll in a course by clicking the gold "+" button, which will add the course to your "enrolled courses" list. If you are affiliated with a professional or academic group, you will see two sets of courses offered: 1) Theta default courses and 2) Courses designed by your affiliation. All Theta users have access to the Audiogram of the day, Sandbox, and other featured courses offered just for having a subscription. In addition, affiliates may have custom-made courses and assignments designed by instructors.

Available Courses

Instructor	Course	
Dr. M	Sandbox	+
Dr. M	Community Cases	🔒
Dr. M	Audiogram of the Day	+

Enrolled courses

This section of the dashboard shows you which courses you are enrolled in. If you are enrolled in a course, your user information will appear in the course instructor's roster, and you will have access to all assignments given to that course.

The teal "play" button will take you into Theta so you can get started. The gray "X" will unenroll you from the course. The gold "submissions" button will take you to a user portal where you can see all your submissions for that course.

Enrolled Courses

Instructor	Course		
Dr. M	Sandbox	▶	✕
Submissions			

My submissions viewer

The submissions viewer will allow you to view submissions by assignment name (unassigned submissions will appear in "Other Submissions". In the viewer, you may delete submissions that you no longer wish to keep.

View: You can switch the view between "Submissions" and "Assignments". In the "Assignments" viewer, you will be able to delete cases you have designed as well as share those cases with an instructor.

Home

After pressing the teal "play" button, you'll be directed to the Theta **Home tab**. The **Home tab** on the Navigation panel (left side of the screen) gets you started with three options:

Design	Assess	Explore
Design a profile and use the simulator to test your design.	Choose from pre-made and custom assessments to test your skills	Find pre-designed templates

Design

This option is used to create and design patient profiles that can be added to your list of designed cases for you to use as assessments. Select the case elements you would like included in your case design, and then press "Go" to begin designing each element.

Patient case profiles may be designed as template or fixed cases. Template cases use the categories and features of each element to create a new iteration of the profile each time it is completed. That is, a case designed as a template will be the same general profile, but specific thresholds, images, tymp values, etc. will vary slightly (but will remain within the template). Fixed cases are exactly that – fixed. In a fixed case, the thresholds, images, and so on that you design will be exactly the same as what the user sees as they complete the case.

Most elements have features you can set to design a case as a template or will allow you to manually enter values to be used if you want more control over a fixed case.

Select Case Elements

| Case History | Otoscopy | Tympanometry | ART/ARD | Audiometry | Impressions |

Go
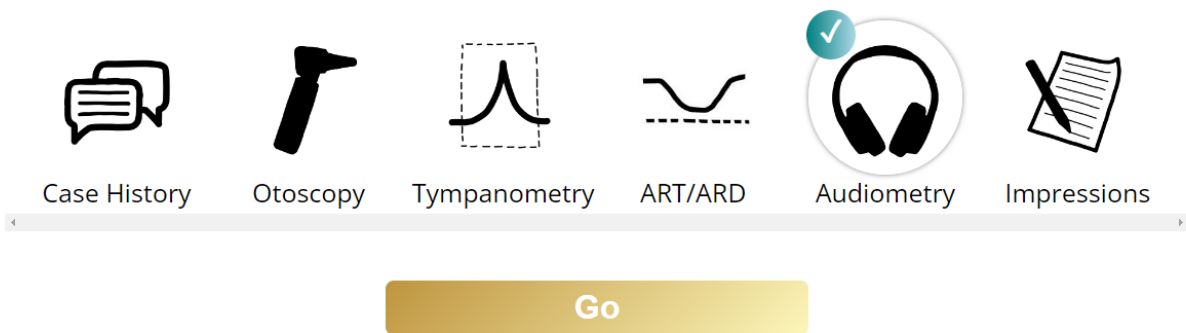
List of available case elements:

Case Information
Include this element to require (or provide) a case history or other information/instructions for learners. This element will be seen first if included in a case, so it can be useful for providing instructions and questions for the learner to think about during the case in addition to a case history. Instructors may also provide pre-written feedback for learners that will appear on the report, but not during the testing using the feedback column.

Otoscopy
This element allows you to select images from our bank of otoscopy photos to accompany your design. Use the dropdowns to pick a specific disorder type. Additional images that have not been categorized are found in the "Other" section. Click on each image name to load the new image. Instructors can provide a description of the tympanic membrane for the learner to see during the case (in the "description" section) or put that information in the "Feedback" sections to provide that feedback to the learner upon submission.

Most of the otoscopy images have been privately solicited and are owned by ATS. Some images of otitis media with effusion, acute otitis media, pressure-equalizing tubes, typical eardrums, and other disorders were retrieved from a publicly available database, with a Creative Commons 4.0 Attribution International license, share-alike, and similar agreements:

Users are welcome to user the "Submit your own" feature to upload a photo for us to review. In this event, the user must release the image, without payment or royalty, to Audiology Technology Solutions, LLC and confirm they have authority to share this image publicly for any use. We review images and if we are unsure about which disorder is shown in the image, we may reach out to you for clarification. Once the image is approved and confirmed to be of sufficient quality, we will add it to our database for use by all Theta members. Thank you for considering contributing to the Theta otoscopy bank!

Tympanometry

Use the dropdown menus to choose a tympanogram type for each ear. When you press a **Run Tymps button (either L or R),** the program generates a random tympanogram specified to the type you choose for the selected ear. If you deselect/select the **show normative range** option, then the normative range box will disappear/appear when the tympanograms are drawn. The program randomly assigns and displays tympanometric peak pressure, static acoustic admittance, equivalent ear canal volume, and tympanometric width (when applicable) for interpretation. If the **Random tymps checkbox** is selected, then two random tymp types will be selected from the list of options and drawn for assessment.

Acoustic Reflex Thresholds

Use the dropdowns to establish ART thresholds for each frequency you would like tested in the case you are designing. If you have included an audiogram in the case design, you have the option to estimate the thresholds based on the audiogram. Otherwise, the values are determined using the templated categories. Some preset conditions are available for users as a starting point ("ART Type" and "Affected ear" dropdowns).

Reflexes can be classified as within normal limits (WNL), elevated (ELE), absent (ABS). If the user did not perform the testing, the value will be "did not test" (DNT). The levels used to define elevated and absent thresholds can be adjusted in the settings tab.

Audiogram

In this tab, you can generate audiograms for the hearing profile. You may manually select the degree, type, and configuration for each ear and then press the **Create Audiogram** to generate a random audiogram that fits the selected template. Alternatively, you can manually enter values to create a fixed audiogram.

> *Note: Some unrealistic degrees/types/configurations will trigger a warning from the system (e.g., severe conductive losses). Additionally, some thresholds are required to estimation of speech performance – errors/warnings may occur if using fixed thresholds.*
>
> *Additionally, before clicking "Create Audiogram" be sure to uncheck the "Template" checkbox found on the last element in your profile design. If you click "create Audiogram" before making the case fixed, your manually entered thresholds will be overwritten in favor of the current template!*

If you are using templates, a new audiogram will be generated each time you press the **Create Audiogram button**. Audiograms are randomly defined and are unique within the constraints you select from the dropdown options, so there is an essentially limitless number of potential hearing profiles you could generate.

Other options for the audiogram are defined using checkboxes. Defaults are provided that will yield a complete and accurate audiogram. The options defined by the checkboxes are detailed below:

Random Audiogram: If this box is checked, the program will randomly choose the degree, type, and configuration in both ears when the **Create Audiogram button** is pressed.
Split Audiogram: separate the left/right ears or combine them into a single plot
Symmetrical: Changes to the dropdown boxes for one ear will be applied to the other
Auto WRS: Provides a somewhat realistic WRS if checked. If unchecked, dropdown boxes will appear to manually set the WRS for each ear.

Pro tip: Once you design the hearing profile, you can save a high-quality photo of it by clicking the small image of a camera in the upper right corner of each image in the program. You can also overlay the speech sounds audiogram and the degrees of loss on your image for educational purposes.

<u>Impressions</u>
Include this module to allow users to provide a written report, impressions, or to answer questions regarding the case. This module can also be used during assignment creation to insert debriefing questions into the assignment and customize the learning outcomes for a specific case you create. Case designers may also include pre-written feedback for users who complete this case using the "Feedback" section.

<u>Auditory Brainstem Response, Otoacoustic Emissions, Wideband Acoustic Immittance, and Acoustic Reflex Decay, Real Ear Measures</u>
Considering/in development – please reach out to discuss desired features and aspects that should be considered!

<u>After you have designed your case</u>
The last case element in the designer will have the following options in the bottom of the right panel:

Template/Fixed toggle

Template cases store the profile parameters, creating unique values constrained by those parameters on each use. Each user who completes the template case gets a different version of the same general profile.

Fixed cases will store the exact values of your designed profile. Each user who completes a fixed case will get the exact same thresholds, images, tymp values, etc.

Note: Case history and impressions are always fixed

Practice/Exam toggle

In practice mode, the user can see the designed case and can overlay the true case design (e.g., audiogram thresholds, tymp normative rages, etc.). Practice mode allows users to check their progress as they go.

In exam mode, the user is not allowed to view the designed case during testing, resulting in a more realistic testing scenario where the user cannot check their work as they go.

Saving your case

When you save your case, it gets added to **My Cases** in the **Explore** section of the program. You can save the case in practice (default) or exam mode and as a fixed case or a tempalte (default) case for later use (if you are an instructor, you can create assignments for your courses from your list of cases).

You should **always** double check your settings before saving a case – since the current settings (scoring, flags, transducer, etc.) will save with the case.

Begin your case

Alternatively, you can begin your designed case in practice or exam mode and as a template or fixed case

Start over

This will take you back to the designer section of Theta's home tab

Assess

In the **Assess** tab, you can view assessments that have been created for you and assigned to you to complete, as well as some default assessments that help you develop specific skills. Click on the **Select Assessment** dropdown to begin. Pre-made assessments will create a random assignment focused on the skill you selected.

Options:
1. My Assignments: Assessments designed by a course administrator can be found here
2. Hearing Screening: Batch hearing screenings (% positive for HL determined by settings)
3. Audiogram interpretation: Batch audiogram interpretation (random audios generated each time)
4. Audiometry
   a. Air conduction – no masking or bone conduction required
   b. Air and Bone conduction – no masking required
   c. Masking: BC only – Air and Bone required, only BC masking
   d. Masking: AC/BC – Air and Bone required, both with masking
   e. SRT – only SRT is required
   f. WRS – only WRS is required
   g. Random Full Audio (Air/Bone/Speech with masking required)
5. Tympanometry: Batch tympanogram classification
6. Complete Cases
   a. Normal Hearing
   b. Presbyacusis
   c. Otitis Media
   d. Noise-induced Hearing Loss
   e. Neuroma
   f. Menieres
   g. CI candidate
   h. Random (randomly selects one of the above profiles)

Explore

This home tab option is used to preview and modify existing cases that have been created by Theta (**Disorder Templates**) and the user (**My Cases**).

Disorder Templates
Get started with built-in case templates for specific disorders

My Cases
View and edit your saved cases

Disorder Templates:

This option allows you to explore pre-made complete case templates. These cases are intended to be templates (starting points that you customize yourself); however, they may be used as complete cases as well. Select a disorder, age group, and race/ethnicity and then **Preview** to view the template. Once loaded, you can edit the case, or select from the traditional four options: Save as practice, Save as exam, Begin practice, or Begin exam (see Page 10 for more details).

Note: Age group and race/ethnicity are only used when the case history automatically generates, an upcoming feature under development/improvement

My Cases:

This option allows you to explore cases you have previously designed and saved. Select the case you'd like to preview or edit and then click **Preview** for an overview of the case. Once loaded, you can edit the case, or select from the traditional four options: Save as practice, Save as exam, Begin practice, or Begin exam (see Page 6 for more details).

Note: Instructors can turn their cases into assignments via the instructor portal.

Using the simulated audiometer

When you begin a practice or exam case where an audiogram is required, you can access the **Audiometer** tab. This module saves the data generated from the **Audiogram** element as a "true audiogram" and allows a user to use standard techniques (Mod. Hughson-Westlake, masking, masking plateau, etc.) to find and save that audiogram. The program will perform a comparison between the generated audiogram and the saved audiogram created by the user and score different aspects of the user's performance (detailed later).

Whether in **Practice** or **Exam** mode, proceed as you normally would to find and save thresholds using the Modified Hughson-Westlake procedure. Masking can be toggled on and off, Test ear selected (R, L), and Transducer may be chosen (Air Conduction vs Bone Conduction). Speech testing can be turned on or off using the Speech toggle and then set to SDT, SRT, MCL, UCL, or WRS by clicking the associated tab. To "present" a speech stimulus, click on the word in the word list or press the "play" button for "cold running speech". The participant's response will appear in the **Patient's verbal response** box. If the program doesn't respond at the limits of the audiometer for a given transducer and frequency (the **dB level** will blink at you), press **No Response** to save. Individual thresholds may be cleared as well as the entire audiogram, if desired.

In **Practice mode** you can select **show true audiogram** to overlay the true audiogram to check your work. This feature is disabled in **Exam mode**. In both modes, you may choose to view the audiograms split or combined using the **Split Audiogram** checkbox.

After completing a case:

When you are finished with the case, you have two options: Start over and Submit (both found in the bottom right corner of the final case element. This will stop the timer, score the submission, and create a report that is saved to the instructor's portal and your learner submission portal. The user can (and should) always save a copy of their work for their own records just in case the submission is accidentally or errantly removed from their portal.

The report file:
This PDF file contains the true and save values for each scored case element. If you did not require scoring in the settings for a specific aspect or element for a case, then it will not appear in the case report!

For the audiogram element, thresholds and saved thresholds for air conduction and bone conduction for each ear, whether masking was needed, whether masking was used, and a score for each comparison. Users get a point for each correct threshold and each correct use of masking for AC thresholds from 250-8000 Hz and for BC thresholds from 500-4000 Hz. Interoctaves are scored only if required – a learner cannot be penalized for testing an interoctave when it was not required but will be penalized for failing to test an interoctave if it is required. The interval after which an interoctave is required is set to 20 dB or greater, but may be adjusted in the **Settings** tab.

If masking is not scored (see scoring section later), then unmasked thresholds are also scored as correct by the program.

Scoring is also implemented for degree, type, and configuration of the obtained audiogram, WRS classification, as well as the middle ear status, Tymp type, and ARTs.

Settings

Reset Theta Defaults: Resets all settings to the Theta defaults

User Settings

Timer Visible (default: on). When checked, a timer is visible on the audiometer page so users can self-monitor their time spent

Play Stimuli (default: on). When checked – pulsed pure tone presentation stimuli are audible via the computer speakers. When unchecked, you can still monitor the duration of the stimulus presentation by looking at the "Present" button during presentation (range: 0-100).

Play Masker (default: on). When checked – a 1/3rd octave narrowband noise masker with the center frequency of the stimulus will be audible (range: 0-100).

Play Speech (default: off). When checked – the browser will synthesize the speech when for presented speech stimuli and patient verbal responses. Please note that each browser and computer loads a different set of synthesized voices, so the voice characteristics of each patient can't be saved in a case.

Use Carrier Phrase (default: on): When checked, the carrier phrase "Say the word" will be added to the target word.

Examiner Voice: Choose the speech synthesis voice for the examiner

Patient Voice: Choose the speech synthesis voice for the patient
   *note – speech synthesis options vary by device and so saved voices won't be available on all devices

1.5-channel audiometer console (default: off). When checked, the audiometer interface is simplified to a 1.5 channel console instead of having all options available for a 2-channel setup.

Invert up/down dB (default: off). When checked, the hotkeys become inverted (e.g., an up arrow press actually decreases the dB HL presentation level, which agrees visually with the location of the crosshairs on the audiogram in the audiometer tab).

Advance frequency on save (default: off). When checked, the program will automatically advance your frequency upon saving the threshold for pure tone testing.

Adjust level on save by (dB) (default: off; default value: 10). When checked, the program will automatically raise the presentation level by the specified amount upon saving the threshold for pure tone testing.

Case Settings

Response Variability (default: none).
   Choose between four levels of response variability. None, Low, Medium High.
   None: Thresholds are exact. No false positives or false negatives. Timing of responses are also consistent.
   Low: Reduced chance of false negatives and false positives, response delay increases as you approach threshold
   Medium (default): Realistic occurrence of false positives and negatives, response delay increases as you approach threshold
   High: Used only to demonstrate functional, non-organic, etc. hearing loss. Very frustrating and inconsistent responses. Many false positives and negatives.

Custom: You can manually enter values to determine the response rate for thresholds that are -10, -5, 0, +5, and +10 dB relative to the true threshold. A value of 0 indicates that the simulator will never respond at that level, and a value of 1 indicates that the simulator will always respond at that level.

Time limit (mins); default: off; default value: 10). When checked, practice and exam cases will automatically submit after the given time.

AutoFill Audiogram (default: off; default value: "Complete"). When checked, the program will pre-fill the audiogram with the information specified.

Complete: The masked audiogram is pre-filled.

Useful for designing WRS practice cases or using all elements for case synthesis.

Unmasked: The unmasked audiogram is pre-filled.

Useful for practicing masking.

Batch Size (default: 1). All cases can be designed in batches so users can complete a specified number of repetitions for that case. You know what they say – repetition is good for a developing brain!

Audiogram/Audiometer:

Expected transducer: This setting determines which transducer is expected for masking purposes

- ◉ Supra-aural Headphones (TDH-50)
- ○ Insert Earphones (ER-3A)
- ○ Circum-aural Headphones (HDA 200)
- ◉ Bone Oscillator (B71)

Masking:

Minimum plateau size (dB; default: 10): The minimum plateau width required for automated masking scoring. Default is 3 virtual patient responses (two after increasing the masker level).

Safety pad (dB; default: 10): Size of the anticipated safety pad that should be used for masking. This setting affects how regularly masking dilemmas are encountered.

Overwrite unmasked thresholds (default: on). When checked – masked thresholds will replace unmasked thresholds on the audiogram.

Interaural Attenuation (dB; defaults in figure):

Interaural attenuation values may be supplied as a single value or a comma-separated list of 10 values (one for each test frequency from .25-8kHz, including interoctaves). If frequency-specific IA is used, the user should note that whether or not masking is required by the program will be determined based on the smallest value in the comma-separated list. In other words, if you teach your learners that IA is variable, but that they should always mask if the difference between two ears is > 40 dB, then the smallest of your listed IA values must be 40.

☑	TDH-50 ⌄	40
☐	EAR3A ⌄	60
☐	HDA200 ⌄	40
☑	B71 ⌄	0

Occlusion Effect (dB; defaults in figure):

Adjustable values for the occlusion effect, which are used in determining initial masking levels and presentation responses for bone-conduction signals.

| Transducer	250	500	750	1000
TDH-50	30	20	20	10
ER-3A	20	10	10	5
HDA200	30	20	20	10

Audiometer and listener limits (dB; defaults in figure):

No response, psychophysical, and physical limit values may be provided as a comma-separated list of 10 values. For MCL and UCL, you can prevent values from populating by omitting values from the comma separated list (but you have to leave the commas in there). Defaults for NR limits are the values for each transducer for the GSI AudioStar Pro.

TDH-50	105,120,120,120,120,120,120,120,115,100
ER-3A	110,115,120,120,115,115,115,115,105,105
HDA200	105,110,115,120,120,120,120,115,100,90
B71	45,65,70,75,80,80,75,75,50,45
Right MCL	,55,,55,,55,,55,,
Left MCL	,55,,55,,55,,55,,
Right UCL	,100,,100,,100,,100,,
Left UCL	,100,,100,,100,,100,,
Vibrotactile	40,60,70,75,80,85,120,120,120,120

Enable puretone MCL (default: off). When checked, users can toggle between "THR" (threshold) and "MCL" testing using the audiometer console (see screenshot below).

Enable puretone UCL (default: off). When checked, users can toggle between "THR" (threshold) and "UCL" (aka LDL, ULL, etc.) testing using the audiometer console (see screenshot below).

Original console interface   Console with THR, MCL, and UCL testing
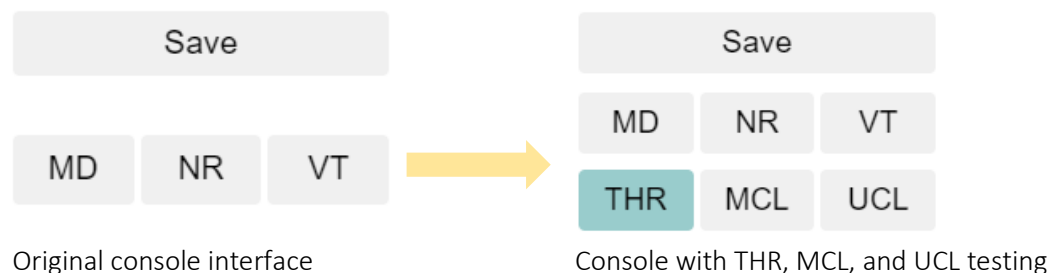
Estimate tonal MCL and UCL from Audiogram (default: on). When checked, the UCL will be estimated from the speech UCL value in the Audiogram Designer and the MCL will be approximately half the dynamic range between UCL and threshold for each frequency.

Enable vibrotactile (default: off; *currently disabled*). When checked, a proportion of high-level BC responses will be vibrotactile. The program alerts the user with a response that indicates the tone was not heard but was felt.

Bone Conduction:

Require BC at 250 Hz (default: off). When checked, bone conduction testing will be required at 250 Hz.

Require only one ear if <= 10 dB ABG. Used to only score the better-hearing ear for bone conduction, unless an air-bone gap requires testing in the non-test ear. Useful if you don't require

learners to test both sides in BC. We recommend always having learners test both sides because practice makes perfect!

Which ear to require (default: "poorer ear"). Bases ear to be required on the poorer of the two ears

Better ear determined by (default: maximum degree). Method for determining the better and worse ear.

> *Max degree:* The ear with the lowest degree of loss (i.e., best hearing)
> *PTA*: The ear with the lowest PTA

Require masking for all BC (default: off). Forces user to always mask BC

Hide BC thresholds (default: off). When checked, only AC thresholds will be visible on the audiogram

Interoctaves:

Interoctaves required interval (dB; default: 20). Any interoctave is automatically required when adjacent frequencies are separated by the amount entered in this box.

Require 3k and 6k AC (default: on): When checked, the program will require thresholds at 3kHz and 6kHz for air conduction

Require 3k BC (default: on): When checked, the program will require thresholds at 3kHz for bone conduction.

Symbols: Select the symbols you wish to use for the audiogram. Email us to add a symbol!

Screening:

Screening frequencies only: Check to limit scoring and testing to screening frequencies.

Screening Threshold (dB). The levels at each frequency where you expect users to screen at (default: 25,20,20,20 dB HL)

Screening Frequencies (Hz). The frequencies where you expect users to screen (default: 500,1000,2000,4000 Hz)

Hearing Loss Prevalence (%; default: 20). The percentage of batch screenings that will warrant a referral when screened at the level above.

Speech and pure tone average:

PTA Options (default: 3-frequency; options in figure): Manually select different calculation methods for PTA
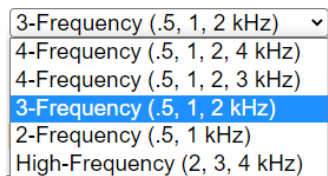
SRT/PTA agreement: Define the anticipated SRT/PTA agreement between ears.

WRS sensitivity (default: 25-word list): Select whether a 25- or 50-word list is required to obtain accurate WRS measures. This also adjusts the potential WRS score (4% increments if 25-word list, 2% increments if 50-word list). Future releases are working toward including an adaptive test list (10 hardest words, 25 if >1 missed, 50 if >3 missed, etc.)

WRS Presentation Level: Choose your method for scoring how users should determine their presentation level for WRS testing. Note "Acceptable Level" accepts any WRS presentation level

between the UCL-5 and the 2000 Hz + buffer method. The SRT+30 or SRT+40 approach will typically fall between these levels, except for severely sloping or rising hearing losses.

WRS rollover (default: Negative):

       Negative: PI-function increases to PBmax and remains there at higher levels

       Positive: PI-function increases to PBmax and decreases to 0% at the UCL

At this time, scoring is not available for rollover, so it is provided as a demonstration tool. If rollover scoring would be valuable to your group – please let us know so we can prioritize this.

Immittance:

Tympanometry and Acoustic Reflexes (defaults in figure):
Use default norms, or enter your own norms for tympanometry normative range.

Lower pressure (daPa):	-150
Upper pressure (daPa):	100
Lower compliance (mL):	0.2
Upper compliance (mL):	1.7
Lower ECV (mL):	0.5
Upper ECV (mL):	2

Normative ranges were established after a review of literature and discussion with many practitioners and instructors.

Artifact On/off (default: off): When checked, tymps may contain artifact at the level determined by the artifact level value

Artifact Level (default: None): Determines how many instances of artifact could be present for any given tymp.

       None: No artifact will be present

       Low: 0-1 artifacts may be present

       Medium: 0-2 artifacts may be present

       High: 0-3 artifacts may be present

ART variables:
Elevated level (dB; default: 100). ARTs below this level will be considered within normal limits

Absent level (dB; default: 115): This level sets the maximum output of the ART module in the Immittance element

Estimate from Audiogram: Use the audiogram module when available to dictate ARTs

Scoring
Check what part(s) of the audiogram/testing you want to score for this submission.

Puretones and Audiogram scoring
- *Pass/Fail (screening):* triggers screening with a pass/refer options instead of requiring a threshold search. Go to "screening" settings to adjust the level that is considered a "pass" or "refer"
- *AC thresholds (unmasked):* scores for each required unmasked air conduction threshold, regardless of final (masked) value
- *AC thresholds (unmasked):* scores for each final listener threshold (including masking for thresholds that required masking).

- *AC masking required:* gives points when masking was performed and it was required or when masking was not performed if not required.
- *AC effective masking:* gives points if masking level saved was not over- or under-masking. Note that masking is still considered undermasking if the user is effectively masking, but does not achieve the required masking plateau width determined in the "Masking" settings
- *BC thresholds (unmasked):* scores for each required unmasked bone conduction threshold, regardless of final (masked) value
- *BC thresholds (unmasked):* scores for each final listener threshold (including masking for thresholds that required masking).
- *BC masking required:* gives points when masking was performed and it was required or when masking was not performed if not required.
- *BC effective masking:* gives points if masking level saved was not over- or under-masking. Note that masking is still considered undermasking if the user is effectively masking, but does not achieve the required masking plateau width determined in the "Masking" settings
- *PTA value:* scores for the pure-tone average calculation entered by the user. Values are integers, so be sure to either have users round to the nearest integer, or allow scoring tolerance of 1 dB to account for rounding.
- *Audiogram interpretation:* If checked, audiogram interpretation (min degree, max degree, type, and configuration) will appear on the audiometry element and each will be scored.

Masking Plateau scoring
- *Initial Masking Level:* The level of the masker for the first masking presentation
- *Initial Stimulus Level:* The level of the stimulus for the first masking presentation
- *Plateau Start:* The masking level at the saved value – the expected plateau
- *Plateau End:* The masking level at the saved value

Speech scoring
- *SRT/PTA agreement:* If checked, SRT/PTA agreement dropdowns appear for users to describe the agreement (see Speech settings for options to force SRT/PTA disagreement).
- *SRT value:* Saved SRT value
- *SRT masking required:* gives points if masking was attempted when required (regardless of if it was done correctly)
- *SRT effective masking:* gives points if masking was performed correctly (i.e., no under/over masking)
- *WRS value:* Saved WRS value
- *WRS presentation level:* gives points if the user presented WRS at the correct presentation level (defined in Speech settings)
- *WRS classification: under construction*
- *WRS masking required:* gives points if masking was attempted when required (regardless of if it was done correctly)
- *WRS effective masking:* gives points if masking was performed correctly (i.e., no under/over masking)
- *SDT value:* correct speech *SDT* value
- *MCL value:* correct speech *MCL* value
- *UCL value:* correct speech *UCL* value

Immittance Scoring

- *Tympanogram type:* The correct Tymp type was selected
- *Reflex Thresholds:* Scores for correctly measured ARTs
- *Threshold classification:* scores for correctly assigning thresholds as WNL, DNT, Elevated, and Absent

Scoring tolerance (defaults: various): Thresholds or values saved that are within this tolerance from the true threshold will be scored as correct. For SRT/PTA – this is the allowable dB difference between SRT and PTA.
- *AC/BC/PTA/SRT/SDT/MCL/UCL:* sets the allowable deviation from the true threshold that will be considered "Correct". Testing should always converge on "true" thresholds (i.e., you shouldn't need this setting), however, some users feel more comfortable with a 5 dB tolerance (which is admissible in practice). We would recommend a 1 dB tolerance for PTA to allow for rounding errors.
- *WRS (%):* We would recommend a 2% tolerance for 50-word lists and 4% tolerance for 25-word lists, which allows 1 accident/error in measuring WRS to be still counted as correct.
- *SRT/PTA:* this is the distance between SRT/PTA that is considered "in good agreement". If the SRT/PTA are > than this many dB apart, users would need to select "poor agreement" to be scored correctly.

Flags:

Include flags in report (default: on): When checked, flags will be tracked and included in the report following the settings below.

Flag scoring (default: do not contribute): Determines how flags will contribute to scoring.
- Flags do not contribute to score: Flags don't affect the user's score
- *-n points per occurrence:* Users lose the specified number of points for a given flag each time that flag happens (multiple penalties)
- *-n points per flag type:* Users lose the specified number of points if a flag happens, but not for each occurrence of that flag (1 penalty)

Case designers can manipulate the point values next to each flag to create custom weighting for how each flag will affect a user's score. For example, you can make too short of a stimulus presentation worth 2 points per occurrence and too long of a stimulus presentation worth .5 pts per occurence to emphasize the importance of not presenting a stimulus for too short vs too long.

Flags (default: all on): Choose which flags you would like included in the report and scoring

Submission:
Lock submission (default: off). When selected, learners will not be able to access their copy of their cases in the learner feedback portal. The report is still accessible in the instructor portal.
Hide percentage on submission (default: off). When selected, the % score won't appear on reports
Hide flags from learners (default: off). When checked, flags generate only on the instructor's copy of the report

Instructor Portal

If you are registered as an instructor, then you will have access to the instructor portal. The portal has three primary views: Roster, Submissions, and Assignments. A separate guide for instructors detailing basic tasks and information can be found at: https://audiologysimulator.com/instructor

Roster:

The roster feature provides a list of all learners at your affiliation who are registered in your courses. You can also view learners who are registered under other instructors at your same institution, but you may not change institutions without manually requesting to do so.

Use the dropdowns to select the instructor, course, assignment, learner, user status (active vs inactive), enrollment status, and or sort parameters and you should see an updated list of learners who meet that criteria. On the righthand side of the list, you should see how many learners are enrolled in that particular course for that particular instructor. We encourage all instructors to check and make sure that all learners are registered in advance of the first assignment to make sure their submissions are correctly routed to the correct instructor's portal.

In the roster, you can manually enroll learners in courses by checking the "enrolled" box.

Submissions:

Instructors have access to a dedicated cloud storage of all learner submissions and data for rapid batch viewing and grading.

Use the dropdowns to select the instructor, course, assignment, and learner submissions you wish to view. Click on the submission name to load the PDF for review. You can download the PDF report or the .txt data file for your records or delete files you have already graded or no longer wish to save. The instructor portal will keep submissions by course for 6 months – after which time they are purged in preparation for the next-year's submissions.

Flagging: To aid in debriefing each submission, the program automatically assesses learner performance and logs flags when learner actions do not follow recommended procedures. Flags are displayed at the end of the learner report and include not following the Modified Hughson-Westlake procedure, using too few stimuli for SRT testing, presenting a stimulus for too short or too long of a duration, using an inappropriate WRS level, and so on. **Appendix 3** has a list of all the current flags.

Assignments:

Use this view to make assignments to learners. Assignments can be made by course (all learners registered to that course have access to the assignment), or by individual (only visible to the assigned learner). The assignments section of the portal also allows you to delete cases you have made that are no longer in use and share cases with other instructors rand learners.

Help & Resources

User Manual: https://audiologysimulator.com/manual
Privacy Policy: https://audiologysimulator.com/privacy
Terms and Conditions: https://audiologysimulator.com/terms
Quick Start Guide: https://audiologysimulator.com/quickstart
Instructor Guide: https://audiologysimulator.com/instructor
Theta Academy Lesson Manual: https://audiologysimulator.com/learn
YouTube Channel: Audiology Simulator - YouTube

Appendix 1: Program Hotkeys/Shortcuts

Keyboard shortcuts are intended to model the Astera PC-based audiometer to maximize translation to real-world testing scenarios. You can also find the shortcut function for any button on the audiometer tab by hovering over the button with your mouse.

These hotkeys are defined below with their function:

A: Change transducer to air conduction
B: Change transducer to bone conduction
T: Toggle transducer (between A and B)
R: Change test ear to Right
L: Change test ear to Left
E: Toggle test ear (between R and L)
M: Toggle masking (between "on" and "off")
N: Save a threshold as "No Response"
V: Save a threshold as "Vibrotactile"
D: Save a threshold as "Masking Dilemma"
Spacebar (hold down): Present stimulus
Enter/return: Save threshold
Delete: Clear the current threshold/measure
C or "=" or "+": Mark WRS patient response as Correct
I or "-": Mark WRS patient response as Incorrect
1-5: select stimulus options 1-5 for Channel 1
6-7: select transducer options 1-4 for Channel 1

Up arrow: increase the stimulus level by 5 dB
Down arrow: decrease the stimulus level by 5 dB
Page up: increase the masker level by 5 dB
Page down: decrease the masker level by 5 dB
Left arrow: decrease the test frequency
Right arrow: increase the test frequency

Note: Holding the "SHIFT" key will apply the shortcut to Channel 2

Appendix 2: Formulas used by the program

Masking:

AC masking

If a BC threshold is measured (i.e., 500-4000 Hz + 250 Hz if specified in the settings), then AC masking is required if:

$$AC_{TE} - IA_{AC} \geq BC_{NTE}$$

If a BC threshold isn't measured (i.e., at 6000-8000 Hz + 250Hz if specified in the settings), then AC masking is required if:

$$AC_{TE} - IA_{AC} \geq AC_{NTE}$$

BC masking

BC masking is required if:

$$AC_{TE} - best\ BC + IA_{BC} > 10$$
(i.e., if there is a significant air-bone gap)

Exceptions:
> *If no response is anticipated without masking.*
> *If a masking dilemma is detected ($BC_{TE} \leq AC_{NTE} + safetyPad + plateau - IA_{AC}$).*

SRT masking:

Masking is required if:
$$SRT_{TE} - IA_{AC} \geq Best\ tested\ BC_{NTE}$$

WRS masking:

Masking is required if:
$$Presentation\ level - IA_{AC} \geq Best\ tested\ BC_{NTE}$$

Occlusion effect:
Occlusion effect values are based on a review of literature, then selecting the most conservative values among all studies (based on Yacullo, 1996; Katz textbook; and other resources). The learning manual details the occlusion effect values used and lists references for how we chose our values in Theta

Speech testing :

WRS estimates:

Automatically assigned WRS scores are determined based on the test ear's 3-frequency BC PTA. This PTA is adjusted to account for psychometric performance at varying levels of severity to give a fairly real estimate of WRS ability.

WRS Presentation Level:

WRS estimates are of the maximum performance on the P-I/psychometric function. Presenting at levels that are insufficient to yield the maximum performance results in incorrect answers and thus being scored incorrectly for WRS testing.

In general – the program follows guidance by Guthrie and Mackersie (2009), who recommended either the UCL-5 method for determining the presentation level or using the 2000 Hz threshold plus a buffer (which varies depending on the severity of the 2000 Hz threshold).

2000Hz + SL method:
2000 Hz Threshold <50 dB HL: 25 dB SL
2000 Hz Threshold 50–55 dB HL: 20 dB SL
2000 Hz Threshold 60–65 dB HL: 15 dB SL
2000 Hz Threshold 70–75 dB HL: 10 dB SL

Guthrie, L. A., & Mackersie, C. L. (2009). A comparison of presentation levels to maximize word recognition scores. Journal of the American Academy of Audiology, 20(6), 381- 390

The SRT+40 method was found to be unreliable for obtaining the max performance for more severe losses, and this was not recommended. Thus, the Theta program will give correct results using the SRT + 40 method for mild-to-moderate sensorineural losses, with underestimated performance for more severe/complicated losses.

For accurate results in the program, we recommend using the UCL-5 method or the 2000 Hz + SL method (except for rising losses) detailed above.

No Response/ Vibrotactile responses
Limits of the audiometer are set to simulate the GSI AudioStar Pro (see user manual for reference). No response limits can now be edited in the program Settings.

Note: If you are interested in allowing these variables to be modified to emulate different audiometers, please send me an email at audiologysimulator@gmail.com with the type of audiometer you'd like simulated, and values that could be used for NR and VT at each of the octave and interoctave frequencies.

Appendix 3: Flags

**NOTE: Flags in orange are currently being investigated and will be added to Theta 3 as we feel confident in their implementation.*

Flag	Reason
Not enough data to complete an analysis at _____ Hz.	If the threshold was required, but there were fewer than 2 data points in the threshold search. Indicative of prior knowledge of audiogram.
User did not test the required _____ Hz threshold.	Octaves are generally required from .25 - 8kHz. Interoctaves are optionally required based on settings.
Threshold never identified at ____ Hz.	User attempted to find threshold, but never presented the stimulus at the threshold level
Threshold identified only once at ____ Hz.	Threshold is defined as the lowest level where the listener heard the tone at least 50% of the time - the program requires at least 2/2 correct responses (or 2/3 correct) at threshold
M H-W flag: User went down by ____ dB instead of 10 dB at ____ Hz.	M H-W procedure recommends going down in 10 dB intervals
M H-W flag: User went up by ____ dB instead of 5 dB at ____ Hz.	M H-W procedure recommends going up in 5 dB intervals
M H-W flag: User went down by ____ dB, but the patient did not respond at _____ Hz.	If the patient doesn't respond, the examiner should increase the test level in 5 dB increments until a response is observed
M H-W flag: User went up by ____ dB, but the patient responded at ____ Hz.	If the patient responds, the examiner should decrease the test level by 10 dB until no response is observed

User switched transducers during testing to _____. IA and OE values may be compromised.	Cases are developed with a single IA and OE value set in mind. Switching mid-testing can be useful for demonstration purposes, but will sometimes yield incorrect scoring for masking (which is based on IA and OE).
Stimulus too short (<3 pulses) at ____ Hz in the ___ ear.	pulses should be presented for at least 1 second (i.e., 3 pulses @ 200 ms/pulse + 200ms ISI). With variability turned on, this will increase the likelihood of false negatives.
Stimulus too long (>5 pulses at ____ Hz in the ___ ear.	pulses should not be presented for more than 2 seconds (temporal integration). With variability turned on, this will increase the likelihood of false positives.
Vibrotactile response detected by patient at ____ Hz.	high-level BC can result in vibrotactile responses (web page alerts) for BC testing.
Audible level was not sufficiently above the 2kHz threshold in the ____ ear.	Maximum performance for WRS testing is obtained only at appropriate levels (see Appendix 1 for how those levels are determined).
User presented at or above the UCL.	If persistent, user presented WRS at levels that were too high for the simulated patient.
_____ WRS was heard by the non-test ear!	If crossover hearing occurs with WRS testing, the response will be determined by the ear with the higher SL.
WRS levels have changed during testing! Presentation Level: _____,	Estimates and performance for WRS are based on a psychometric function –

Masker Level: _____	performing at different levels may invalidate your testing and result in unreliable estimates and data.
User did not test the Left/Right SRT/WRS	SRT/WRS testing was required, but not attempted
Not enough data to complete an analysis for the Right/Left SRT/WRS	The test was required, but there were fewer than 2 data points to consider. Indicative of prior knowledge of test result.
M H-W flag: SRT never identified in the ____ ear.	User attempted to find SRT, but never presented the stimulus at the threshold level
M H-W flag: SRT identified only once in the ____ ear.	SRT is defined as the lowest level where the listener gets at least 50% of the spondees correct - the program requires at least 2/2 correct responses (or 2/3 correct) at threshold
MHW flag: User went down by ____ dB for the ____ SRT.	M H-W procedure recommends going down in 10 dB intervals
MHW flag: User went up by ____ dB for the ____ SRT.	M H-W procedure recommends going up in 5 dB intervals
User only used ____ spondees during the ____ threshold search.	Users are required to use a list of at least 6 different spondees. Ideally, the learner would familiarize the virtual patient to 8-10 words, and then present randomly from that list.
User presented < 6 spondees resulting in a better-than-expected ____ SRT	Presenting too few spondees will make the task easier than it should be for listeners.
SRT/WRS in the Right/Left ear was presented via Bone Conduction.	Only Air Conduction is supported at this time for WRS and SRT testing

_____ Hz Masking: Initial masking level was not saved	If a threshold was required, and masking was required for that threshold, but no initial masking level was determined.
_____ Hz Masking: Initial masking level was _____ dB but should've been _____ dB	Threshold required, masking required, saved IML was incorrect
_____ Hz Masking: Initial stimulus level was not saved	If a threshold was required, and masking was required for that threshold, but no initial stimulus level was determined.
_____ Hz Masking: Initial stimulus level was _____ dB but should've been _____ dB	Threshold required, masking required, saved ISL was incorrect
_____ Hz Masking: No plateau start was identified	Threshold required, masking required, plateau never started. Indicative of undermasking
_____ Hz Masking: Saved plateau starting level was _____ dB, but should've been _____ dB	Threshold required, masking required, plateau started, but incorrect
_____ Hz Masking: No plateau end was identified	Threshold required, masking required, plateau never ended. Indicative of overmasking
_____ Hz Masking: Saved plateau ending level was _____ dB, but should've been _____ dB	Threshold required, masking required, plateau ended, but incorrect
Conductive loss in the Right/Left ear may be unrealistic: (AC thresh TE – IA) > BC thresh TE. Consider changing the IA or severity of the loss	Large conductive losses are typically audible at some point via bone conduction in the test or non-test ear.

Appendix 4: Troubleshooting guide

Given the vast number of possible configurations in user technology, it is impossible to anticipate every issue that could arise from using the simulator. We have attempted to summarize the most common complaints into this troubleshooting guide to assist you in trying to figure out why things may not be working out for you.

Issue	Possible Cause	Solutions
I don't hear any audio when I present a stimulus	Browser incompatible	Ensure you are using Google Chrome
	Sound muted	Unmute and turn up your computer volume
	Sound disabled in settings	If you have access to settings in Theta, make sure that the "play stimulus" and "play masker" boxes are checked in your user settings section. If you do not have access, consider verifying the settings with your instructor or administrator.
The case won't submit	Browser compatibility	Ensure you are using Google Chrome
I can't view my report in the submission portal	Report is locked by instructor/admin	Case designers have the ability to prevent you from viewing the results of your assessment in your submission portal by "locking" the submission. Contact your instructor/administrator for your course to obtain a copy of your report
The simulator's responses are inconsistent	Patient response variability is turned on	When patient response variability is turned on, it affects the likelihood of false positive and false negative responses. This is an intentional feature. Contact your instructor to discuss the patient response variability settings for your case/course.
I don't see any flags in my report	Flags are not included in the report	Case and course designers can turn flagging on and off for their case/course settings. Contact your instructor/administrator to ask about turning on flags.
I need a copy of my receipt	Email receipt went to junk mail	Check your junk/spam folder for an email receipt from stripe.com. If that is unavailable you can access the Billing Portal on your dashboard (bottom left corner) where you can manage your account information, view receipts and invoices, and cancel your subscription
I don't see a gold bar flash when I present a tone	You have SimuHear turned on	SimuHear is a feature that allows you to test a simulated hearing loss another person. If SimuHear is turned on, the gold response bar doesn't light up since you should be getting responses from the person you're working with. Make sure you uncheck "SimuHear" in Case Settings in the Theta Settings tab.
I edited a case I designed but nothing changed	Edited case was not re-assigned to the course	When you assign a case to a course or a learner, it makes a copy of the case in that course or learners folder. Editing cases only modifies the case file in **your** folder. Once you edit a case design, you must remember to delete the old case design from any courses or students and then reassign the edited case to the course or students.

Appendix 5: Audiogram of the Day

Level	Score	Skill
0	0	Normal hearing
1	500	Basic configurations
2	1000	Basic configurations
3	2000	Configurations – no WNL
4	3000	BC masking
5	4000	AC/BC masking
6	5000	No response (BC)
7	6000	Conductive/mixed
8	7000	Masking dilemmas
9	8000	anything goes – limited options
10	9000+	anything goes – all options

The minimum and maximum degrees of loss and the configurations of each audiogram change and expand to include more severe losses and different configurations as you progress.

Additional info:
- All audiograms are sensorineural until Level 7
- Levels 1-4 and Level 8 are all symmetrical losses
- Response variability
  - None: Levels 1-4
  - Low: Levels 5-8
  - Medium: Levels 9-10

Scoring:
Scoring is based on accuracy and timing.

Accuracy: You're scored on finding the correct masked and unmasked thresholds.

Timing: You get a time bonus/penalty based on how long you take to complete the audiogram. Your accuracy score is multiplied by this bonus/penalty to determine your final score.

The time multiplier you receive is:

$$multiplier = 20/n$$

Where "n" is the number of minutes it took you to complete the audiogram of the day.

The multiplier has a maximum of 2x multiplier and minimum of 0.

That means completing the audiogram between 0-10 minutes, you'll receive the 2x points; 15 minutes gives you a 1.3x bonus; 40 minutes gives you .5x points, and so on.