Manual - Calibration and Goldilocks

Table of Contents

1 - Introduction to this Document

Calibration and Goldilocks are web applications hosted in the Open Speech Platform software.

This document will explain:

- The relationship between the OSP software, Calibration, and Goldilocks.
- how to set up the OSP software to run these applications.
- how to understand and harness their capabilities.

This document also serves as a continuation to the following guides below, which help you install and gain familiarity with the OSP hardware and/or software.

- “OSP Hardware - PCD Setup for macOS and Linux”
- “OSP Hardware - PCD Setup for Windows"
- “OSP Software Getting Started Guide (macOS installer) - Release 2020b”

1.1 - Background Behind OSP Software

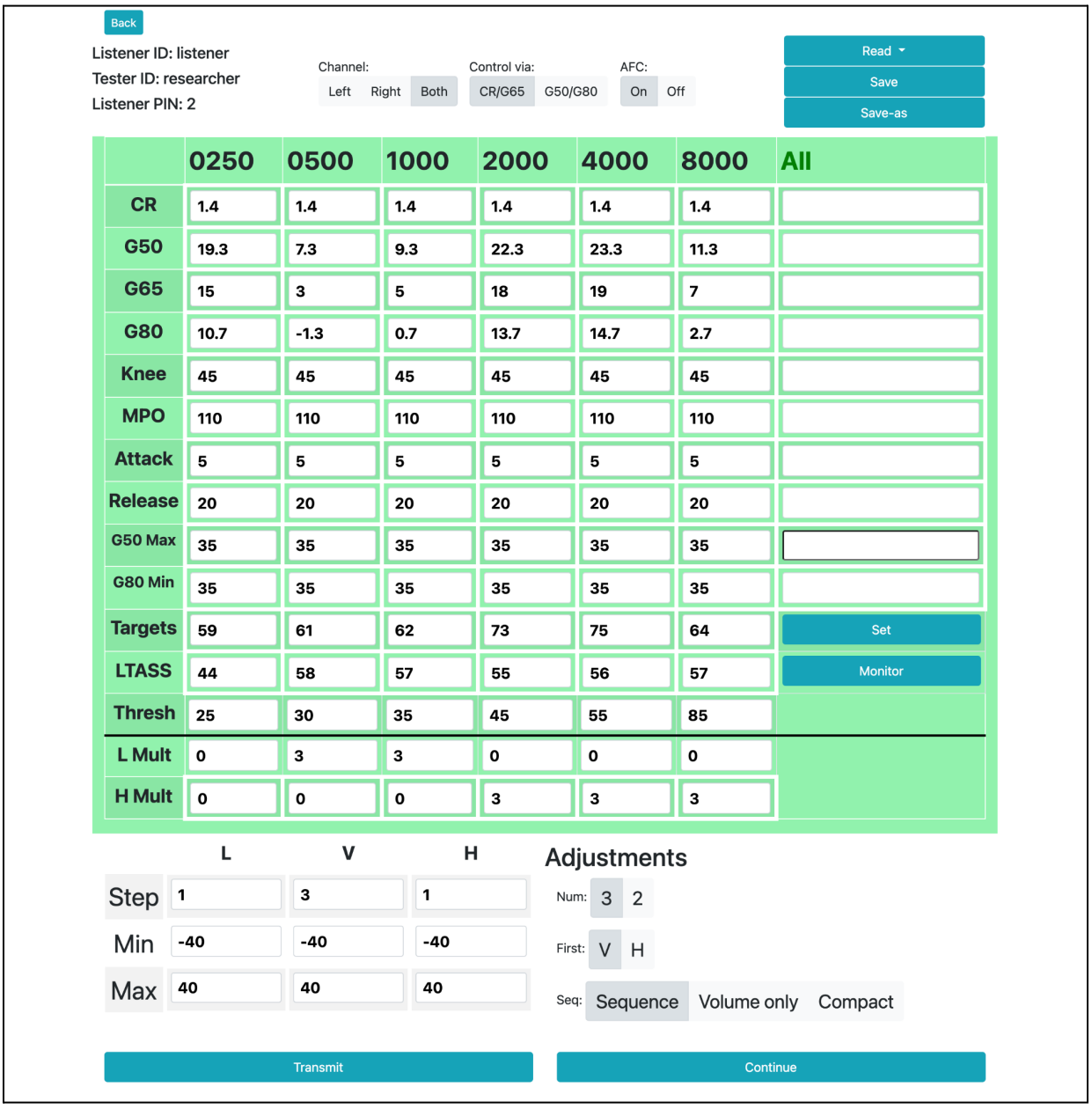
The software of the Open Speech Signal Processing Platform (OSP) that hosts Calibration and Goldilocks consists of two main components:

- **Real Time Master Hearing Aid (RTMHA)** - This is the hearing-aid algorithm which takes the audio from the environment and modifies it to the listener's specific prescription.
- **Embedded Web Server (EWS)** - This is a graphical user interface that can control the RTMHA algorithm, hosted on any web browser-enabled device. There are two versions of EWS, written in two different programming languages: Node.js and PHP/Laravel. The Node.js version is currently being developed and will eventually replace all of the functionality found in the PHP version.

Calibration and Goldilocks are part of the PHP version of EWS. People can use the EWS interface for these applications to manipulate the parameters set in RTMHA.

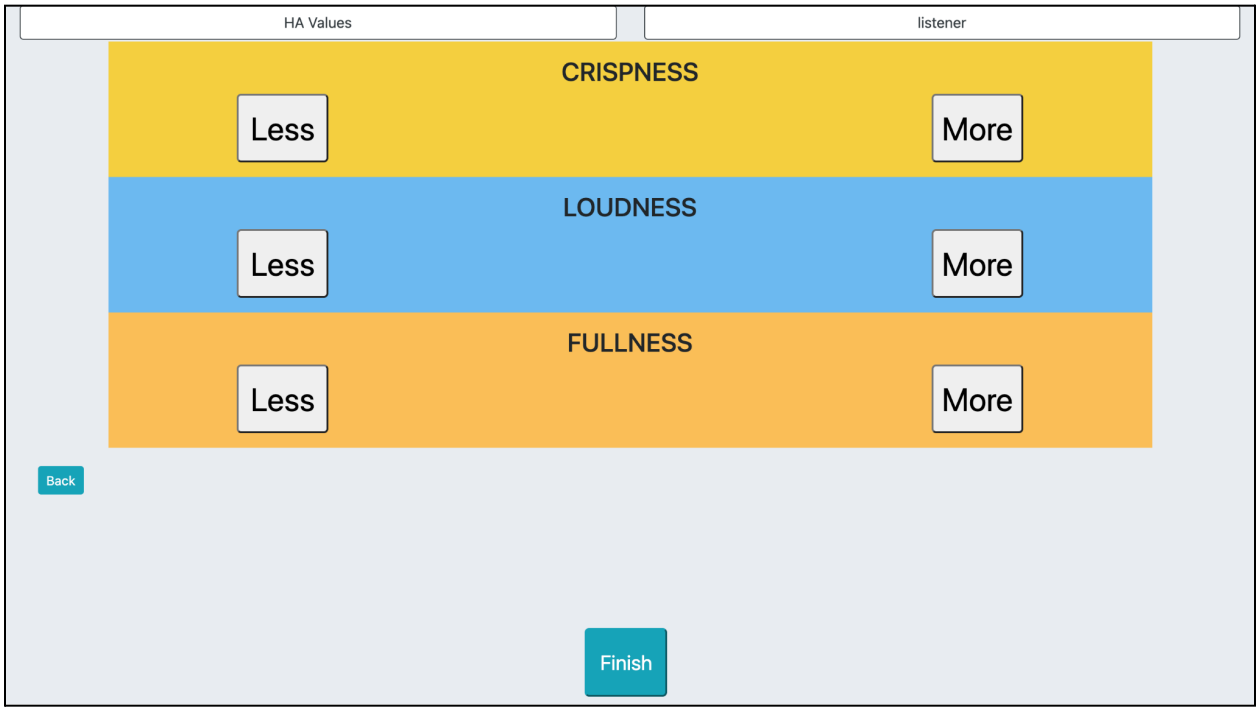
1.2 - Introduction to Calibration and Goldilocks

Goldilocks was intended to enable researchers to change the initial default audio settings through a digital interface, mainly called the “Researcher Page”. The Researcher Page visually represents the parameters in OSP’s main hearing aid algorithm (see the following image).

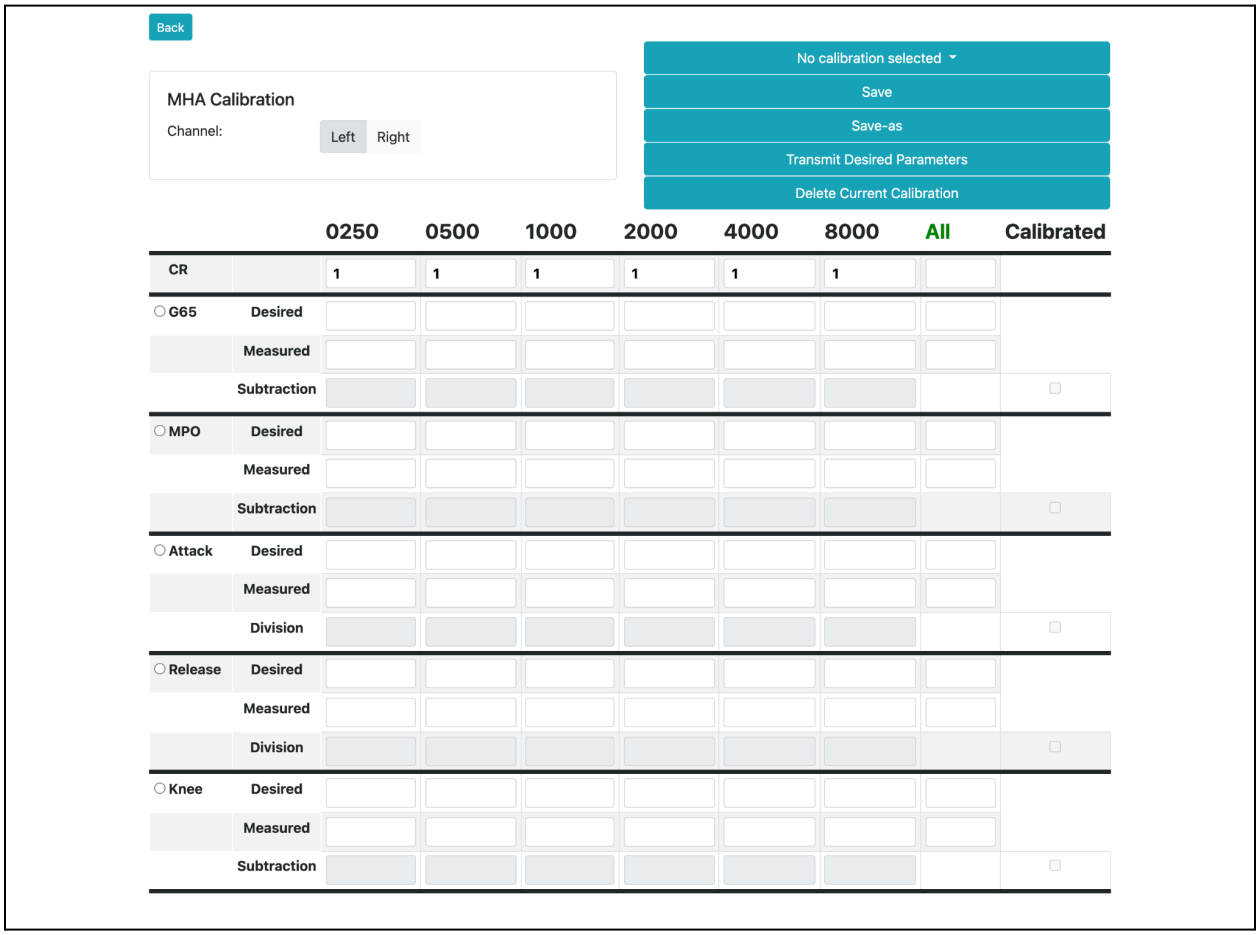


These changes would be reflected in a different listener interface for participants/listeners to make preferred adjustments to their auditory sensation. Participants/listeners can make these adjustments using three simple controls (see the following image):

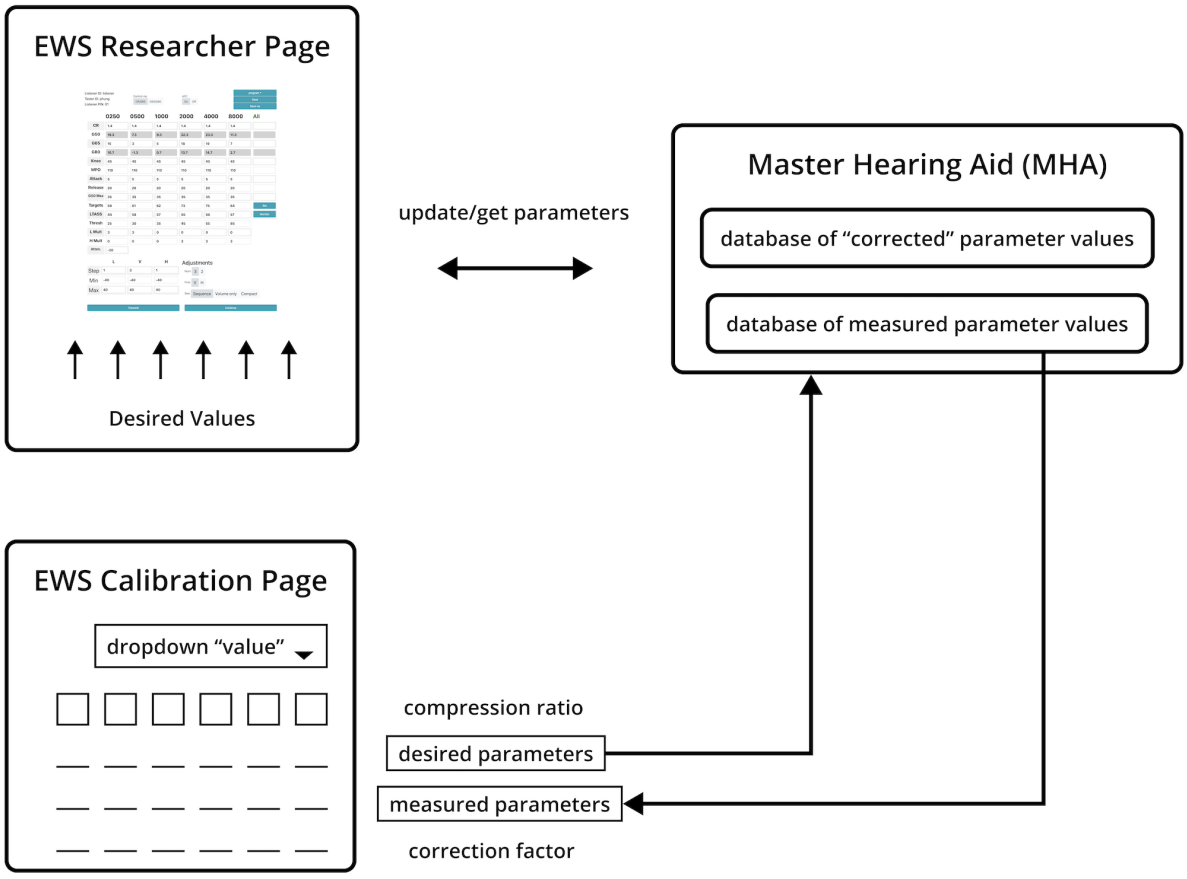
- one control that modifies volume “loudness”
- one control that modifies high frequencies “crispness”
- one control that modifies low frequencies “fullness”



However, using Goldilocks is not as straightforward as being able to enter whatever values you desire, as the measured values retrieved from RTMHA may not reflect your desired values. This is where Calibration comes in to introduce correction factors that will ensure the desired values entered into Goldilocks will be reflected in the measured values from RTMHA (see the image below for the Calibration interface).



See the next image to better understand the relationship between EWS, RTMHA, Goldilocks Researcher Page, and Calibration.



2 - Requirements

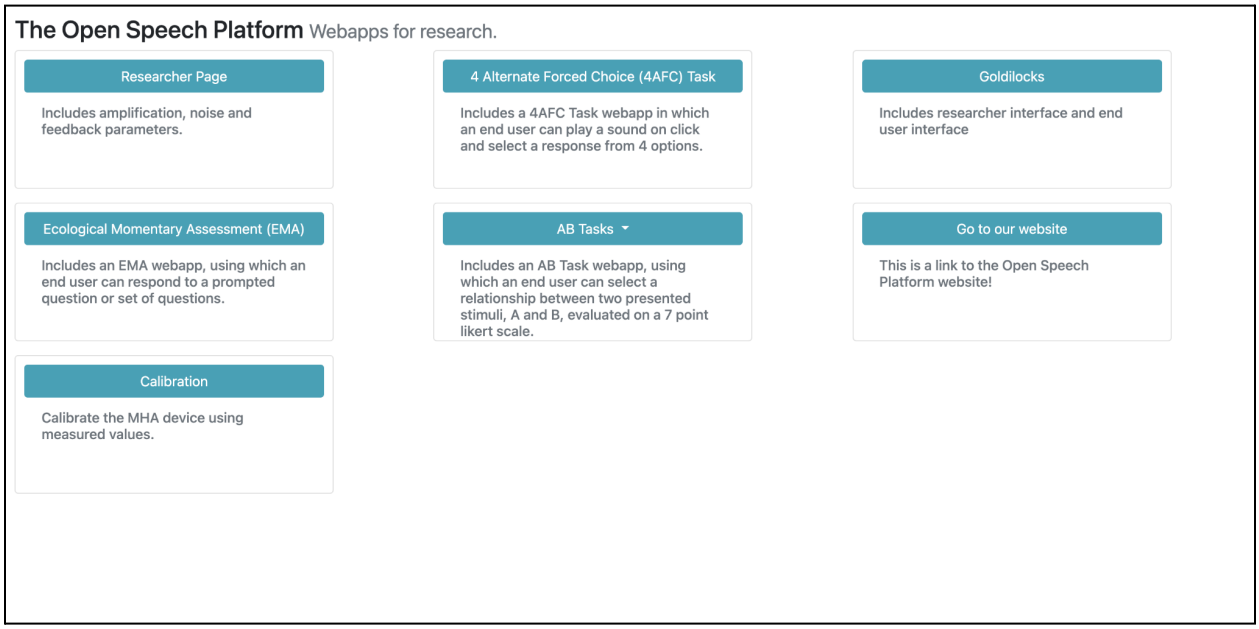
You should have OSP software installed and successfully set up, with or without OSP hardware. These following guides cover additional requirements and installation steps in greater detail.

- OSP Software Getting Started Guide (macOS installer) - Release 2020b - For setting up OSP **without** the hardware (macOS only).
- OSP Hardware - PCD Setup for macOS and Linux - For setting up OSP **with** the hardware.

- OSP Hardware - PCD Setup for Windows - Same as above, but for a different operating system.

Once you have set up your software and/or hardware, you'll see the landing page on a new browser tab or window like the image below.

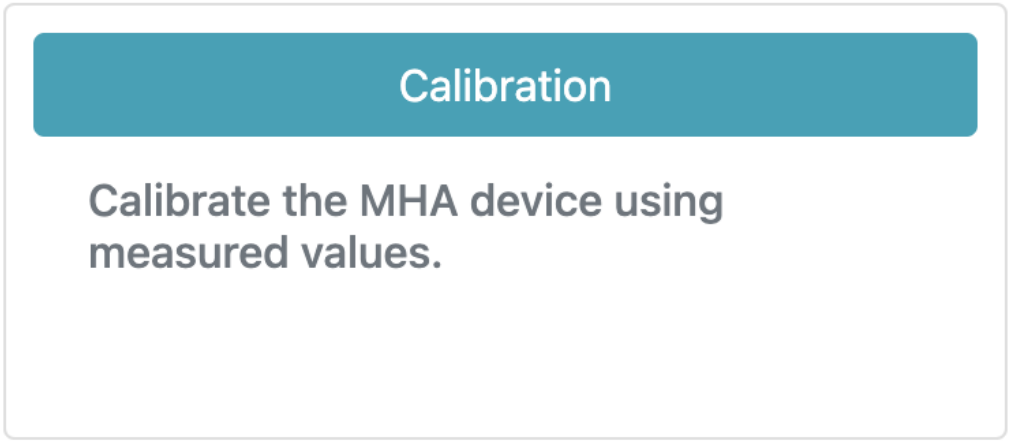
1. If you have OSP software only, the browser search bar should say "localhost:8080".
2. If you have OSP hardware (PCD) set up, the browser search bar should say either "http://ospboard.local" or "http://[YOUR_IP_ADDRESS]".



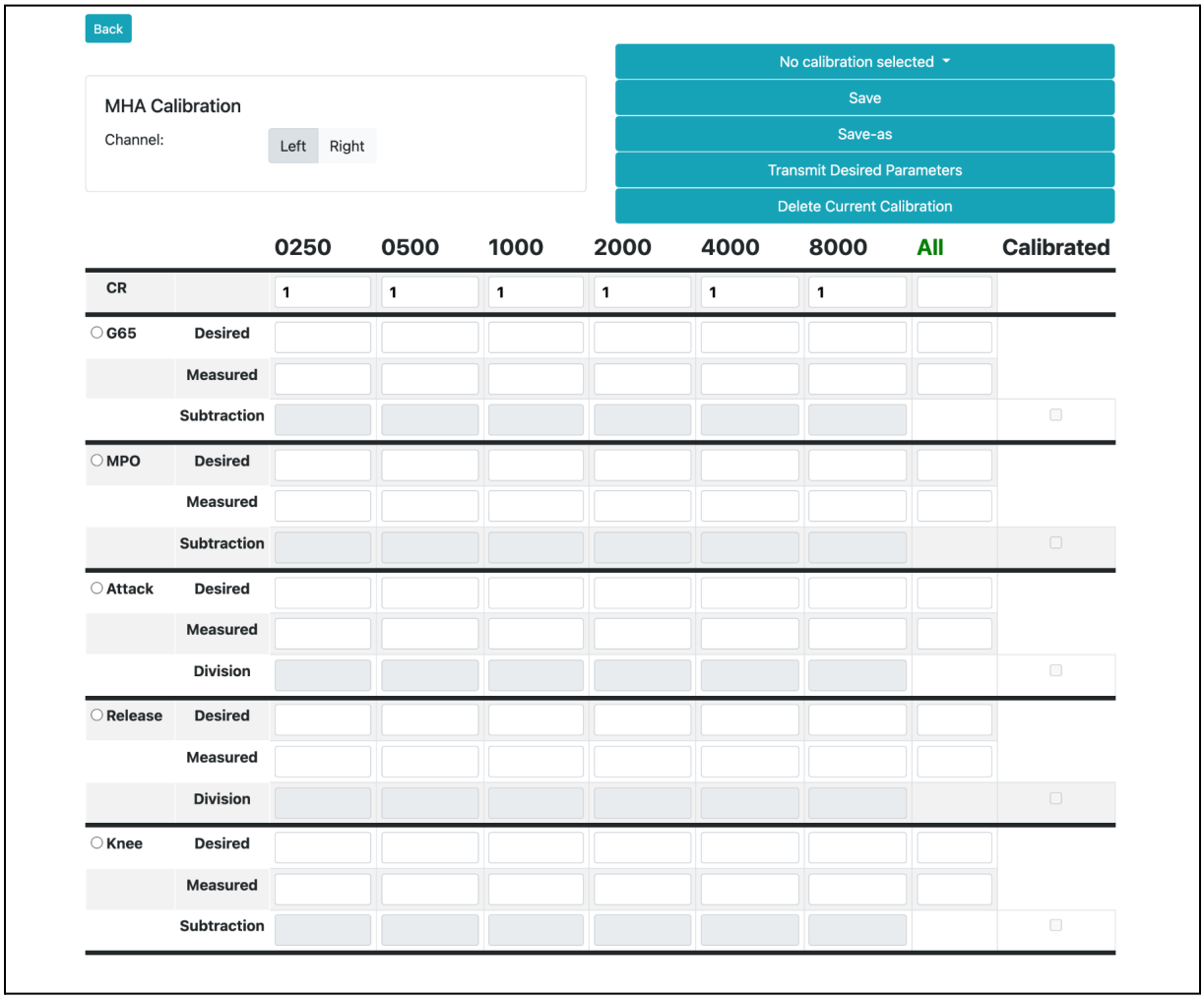
3 - Using Calibration

Calibration ensures that your future desired changes made to the parameters in the Goldilocks Researcher Page will be reflected in the measured values from RTMHA, which also affects the default settings made in the Listener Interface.

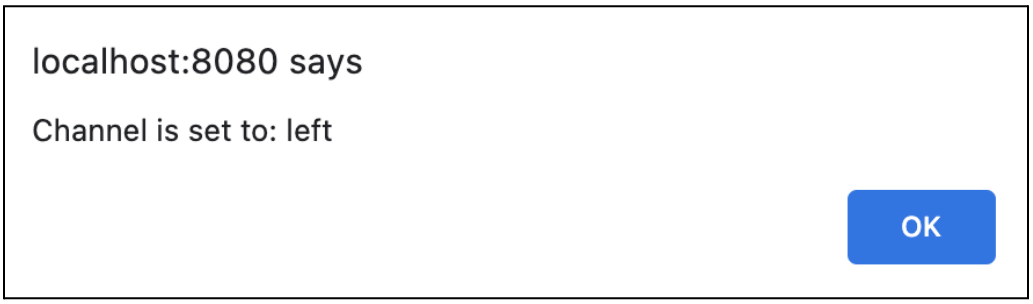
To access Calibration from the landing page, simply select the button labeled “Calibration”.



You should see the following interface for Calibration.



You may also see a popup message that says the current channel.



3.1 - Quick Set Up

1. Select the left or right channel to calibrate the parameters.
2. Select the toggle button next to G65.
3. Input any “Desired” values into the boxed cells for any and/or all frequency bands that you want to modify.
4. Input any “Measured” values into the boxed cells for any and/or all frequency bands that you want to modify. You will automatically see “Subtraction” values.
5. Select the “Transmit Desired Parameters” button.
6. Repeat steps #2-4 for “Knee”.
7. Repeat steps #2-4 for “MPO”.
8. If you want to, you may repeat steps #2-4 for “Attack” time and “Release” time.
9. Select the “Save-as” button to save your parameters as a new calibration.
10. Select the “Save” button.
11. If you want to calibrate the other channel, select either the “Left” or “Right” toggle buttons and repeat steps #2-8 and #10.

3.2 - Interface Components of Calibration

The Calibration interface features the following:

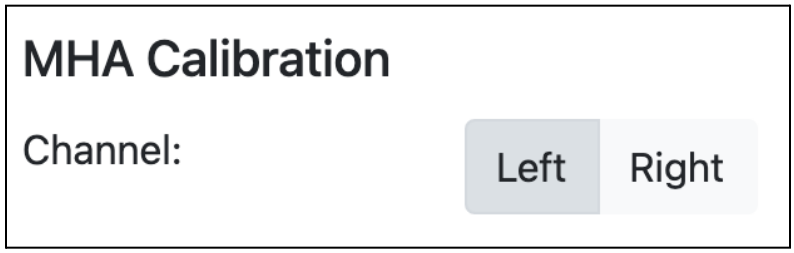
1. **“Back” button**

   Located in the upper left-hand corner of the screen, this will exit out of the Calibration interface and return to the landing page of the PHP version of EWS.

2. **Left and right channels**

   By default whenever you open Calibration, a popup message that says the current channel that you’re currently calibrating.

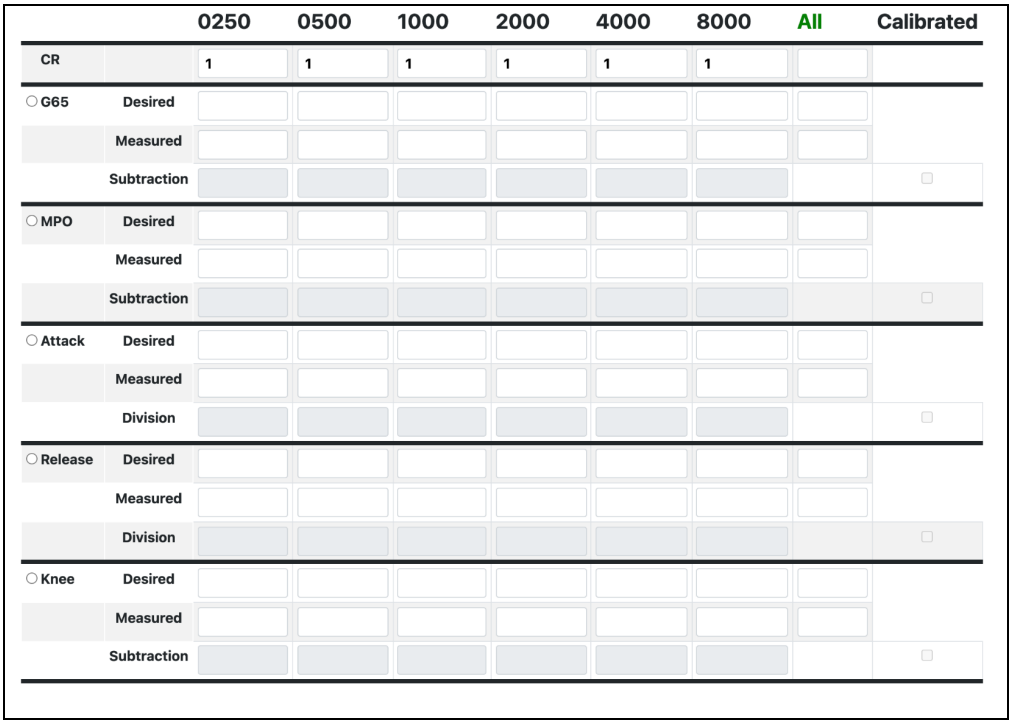
   In the upper left-hand corner of your screen you will see a label called “Channel” and toggle buttons “Left” and “Right”.



   When selecting the toggle buttons, you can switch between the two channels that you’re calibrating. **Note that values for the**

parameters and bands are separate for both channels.

3. Table of 6 frequency bands and audio parameters

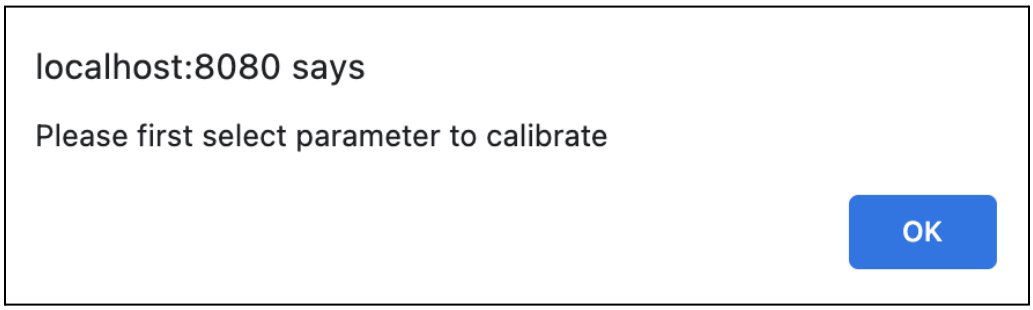


		0250	0500	1000	2000	4000	8000	All	Calibrated
CR		1	1	1	1	1	1		
○ G65	Desired								
	Measured								
	Subtraction								☐
○ MPO	Desired								
	Measured								
	Subtraction								☐
○ Attack	Desired								
	Measured								
	Division								☐
○ Release	Desired								
	Measured								
	Division								☐
○ Knee	Desired								
	Measured								
	Subtraction								☐

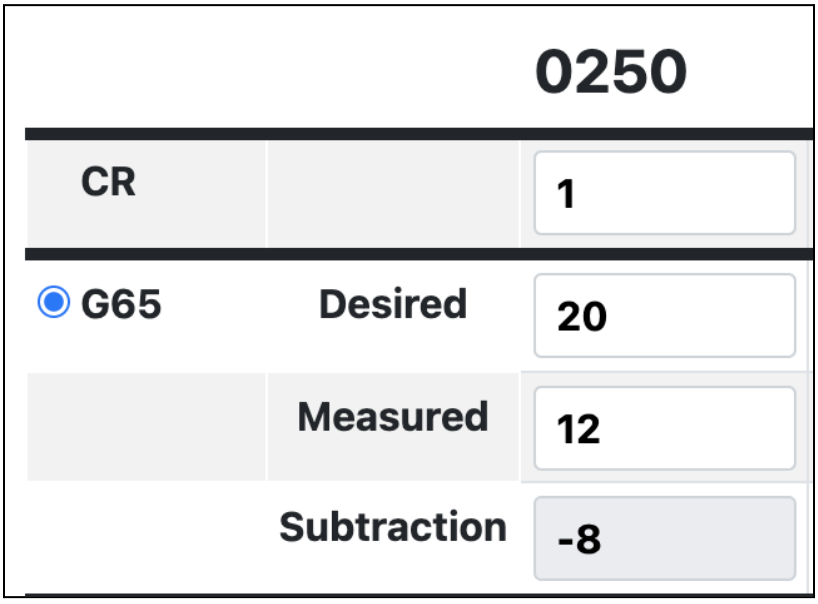
A majority of what you'll see in calibration are:

a. Six frequency bands (units in Hertz) as headers: 250, 500, 1000, 2000, 4000, 8000
b. Six audio parameters: compression ratio (CR), G65, maximum power output (MPO), attack time, release time, and knee point (knee). There are small circled toggle buttons that enable selection and editing of a single parameter.

You must select a parameter first before editing, otherwise the “Please first select parameter to calibrate” pop-up message will appear.



c. Boxed cells for inputting values for each frequency band and audio parameter. For each parameter, you'll find three additional rows of cells. Any cells in the "Desired" row are values that you want to input for Goldilocks. Any cells in the "Measured" row are the values that would be measured by Verifit or any other hearing aid measuring aid device. For each band, the value in the "Subtracted" cell is automatically calculated based on the difference between the value in the "Measured" cell and the value in the "Desired" cell.

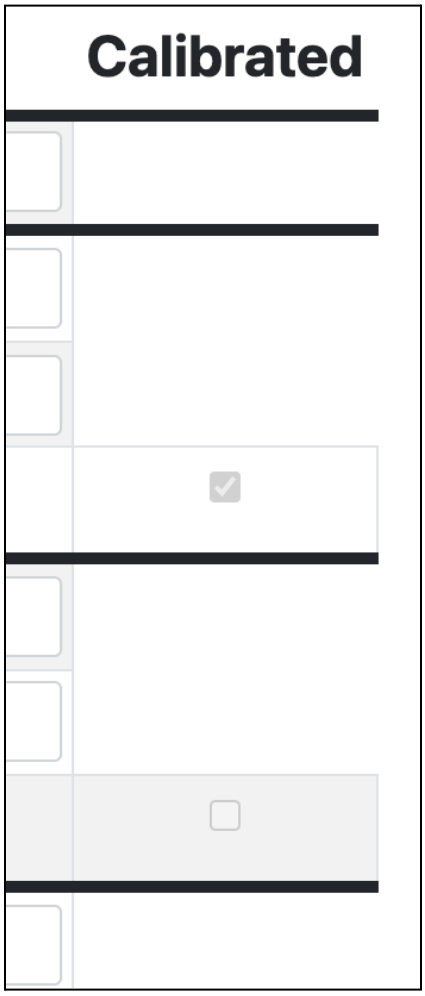


Setting a value in any cells under the “All” column will set the same values in a row of cells for a given parameter across ALL bands.

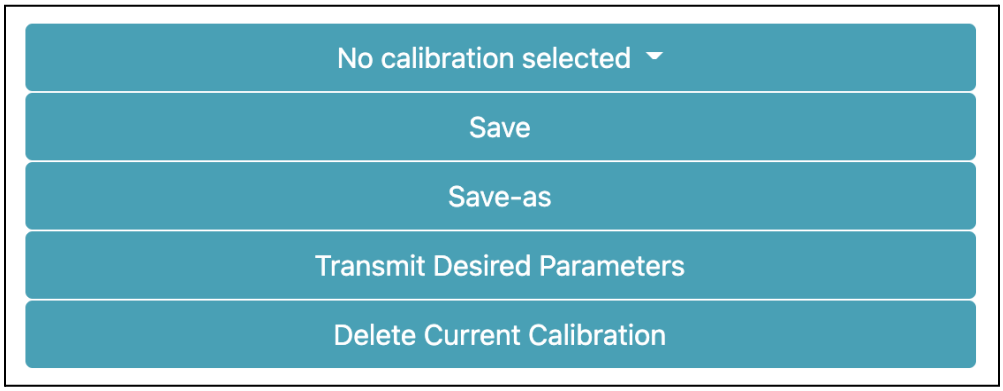
For example, setting “20” in the cell for the “Desired” row and “All” column for G65 will set all desired values to 20 across all the frequency bands. Similarly, setting “12” in the cell for the “Measured” row and “All” column for G65 sets all measured values to 12 for all the bands, thus setting all the subtraction values to -8 for all the bands (measured minus desired, 12 - 20).

		0250	0500	1000	2000	4000	8000	All
CR		1	1	1	1	1	1	
G65	Desired	20	20	20	20	20	20	20
	Measured	12	12	12	12	12	12	12
	Subtraction	-8	-8	-8	-8	-8	-8	

d. “Calibrated” column to indicate which audio parameters have already been calibrated (as checkmarked boxes).



4. **Series of Buttons**

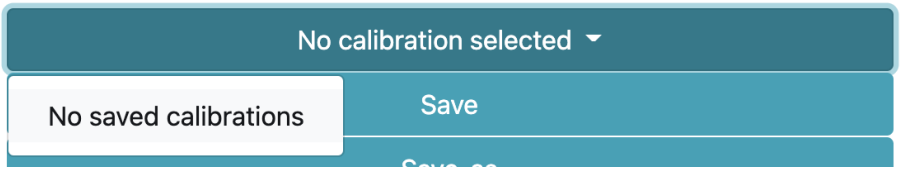


Located in the upper right-hand corner, each of these buttons do the following.

a. *Calibration dropdown menu button*

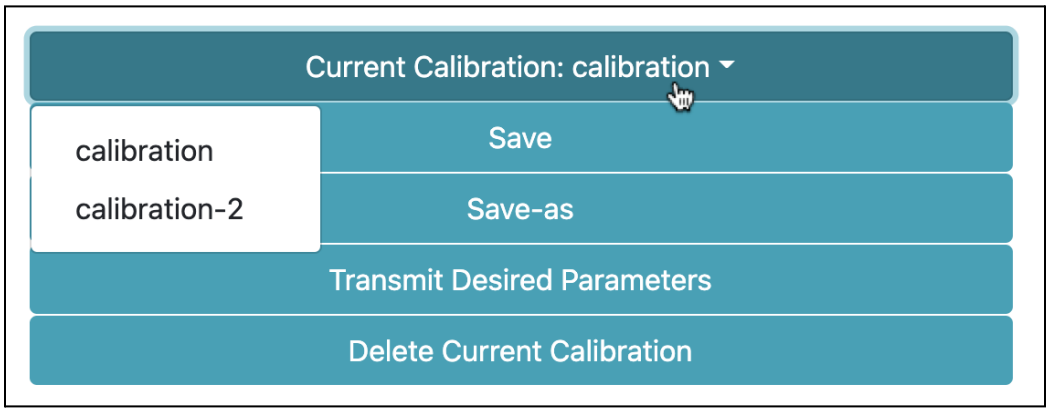
   This shows your last set of parameters, which consists of all the previously saved values within the boxed cells for each and every parameter and band.

   By default, if there are no calibrations selected or saved, the label would be *“No calibration selected”*. When you select it with no saved Calibrations, it would say “No saved calibrations”.



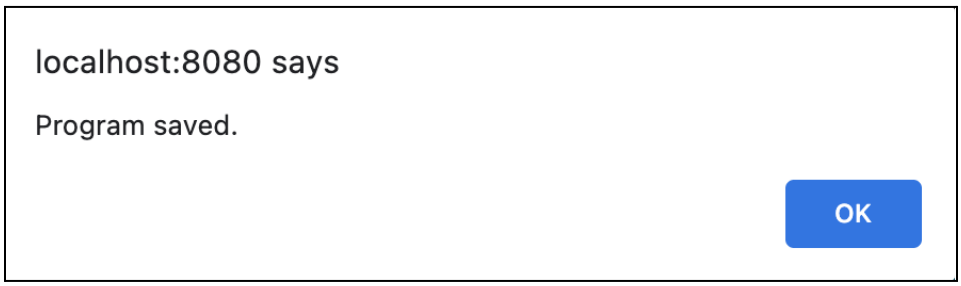
   When there is a calibration selected, the label will change to show the current calibration’s name. When selected, you’ll be

able to switch between different calibrations.

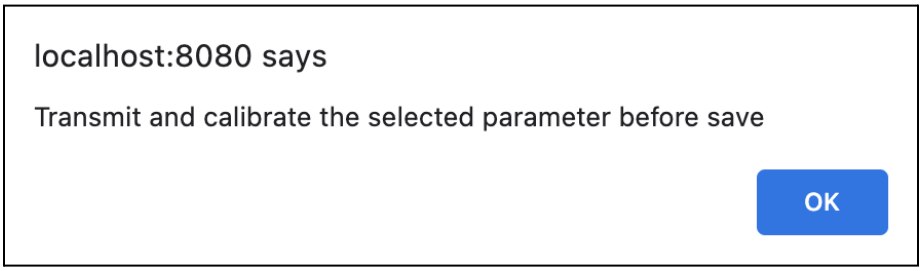


b. "Save" button

This saves and stores all current values set for each and every parameter and band for the current calibration, as shown in the pop-up message that appears every time you select this button.

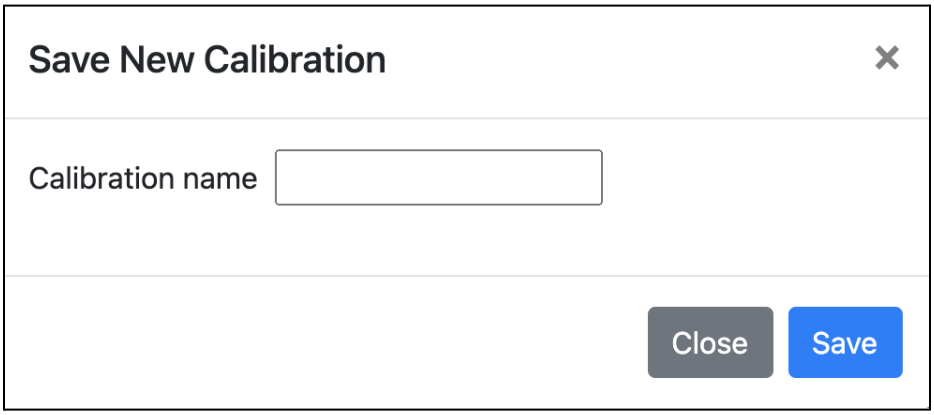


However, If you try to select this button without transmitting and saving the parameters as a calibration, you will get the "Transmit and calibrate the selected parameter before save" pop-up message instead.



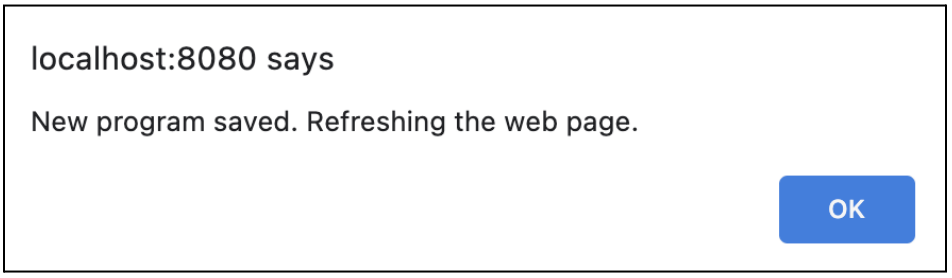
If you transmit the parameters via the *"Transmit Desired Parameters" button* and select this button with no existing calibration selected, you'll see the "No setting selected. Click Save As." pop-up message instead, meaning that you have to first save your values as a new calibration or select an existing calibration.

c. *"Save-as" button* - This saves all of the values in the cells for future retrieval and usage. You would need to enter a name for your new calibration.

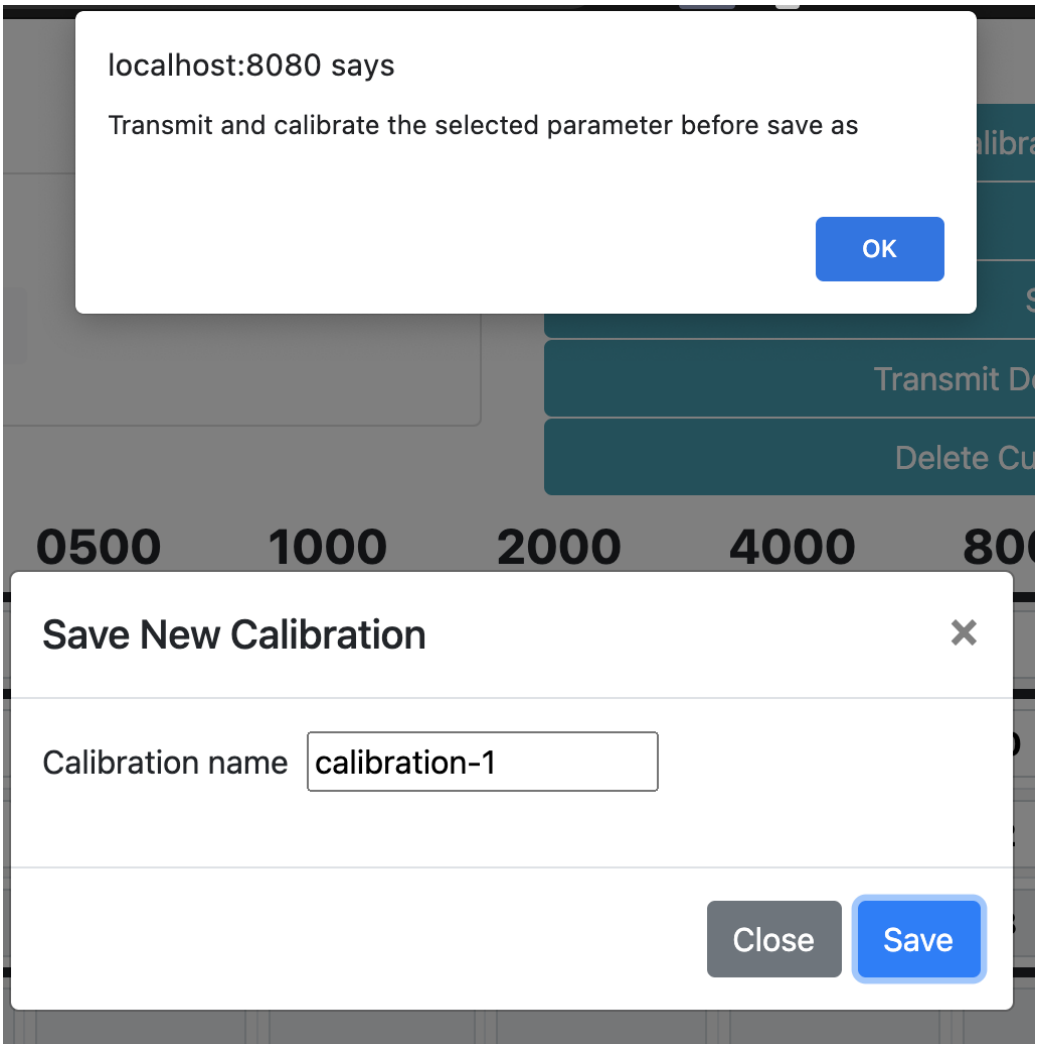


Select the blue “Save” button to confirm your calibration or the “Close” button/”x” icon to not save the calibration and return to the interface.

You will see a pop-up message to confirm that your calibration is saved and that your browser will refresh to update the current calibration shown: “New program saved. Refreshing the web page.”



However, If you try to save a new calibration without transmitting the parameters to RTMHA, you will get the “Transmit and calibrate the selected parameter before save” pop-up message instead.



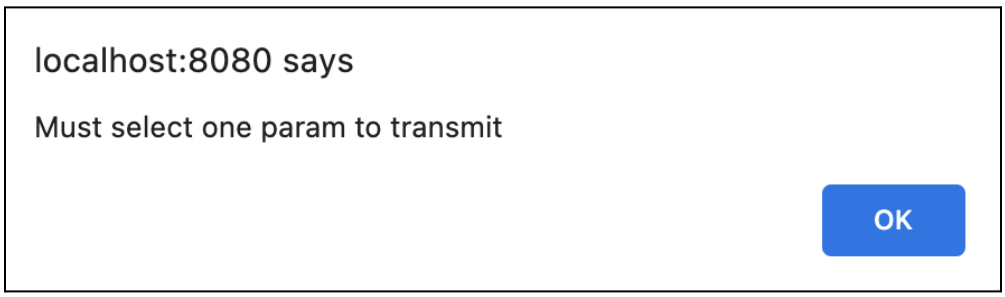
You will see a change in the label for the *Calibration dropdown menu button* that will reflect the current calibration selected.

d. *"Transmit Desired Parameters" button*

When selected, this would transfer all values shown in the

boxed cells for every band in the selected parameter into RTMHA.

If you haven't yet selected a parameter (CR, MPO, etc.), then you will see this "Must select one param to transmit" pop-up message instead.

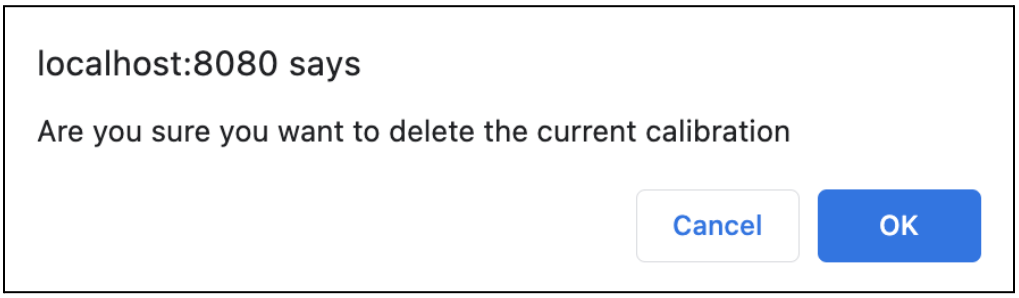


Otherwise, if you have selected a parameter via the toggle button, you will see this pop-up message that confirms values associated with that select parameter have been sent to RTMHA.

e. *"Delete Current Calibration" button*

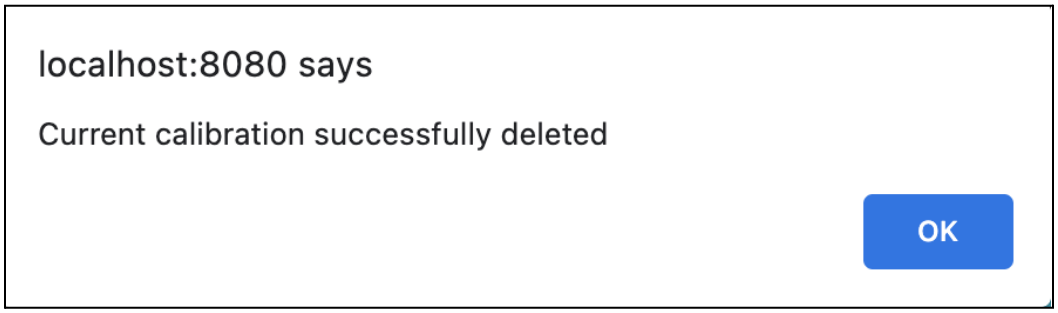
When selected, you will see a pop-up message asking you to

confirm your choice. **Deleting the selected calibration would be an irreversible action.**



Select “OK”to confirm or “Cancel” if you don’t want to delete the calibration.

Should you select “OK”, you will see the “Current calibration successfully deleted” pop-up message.

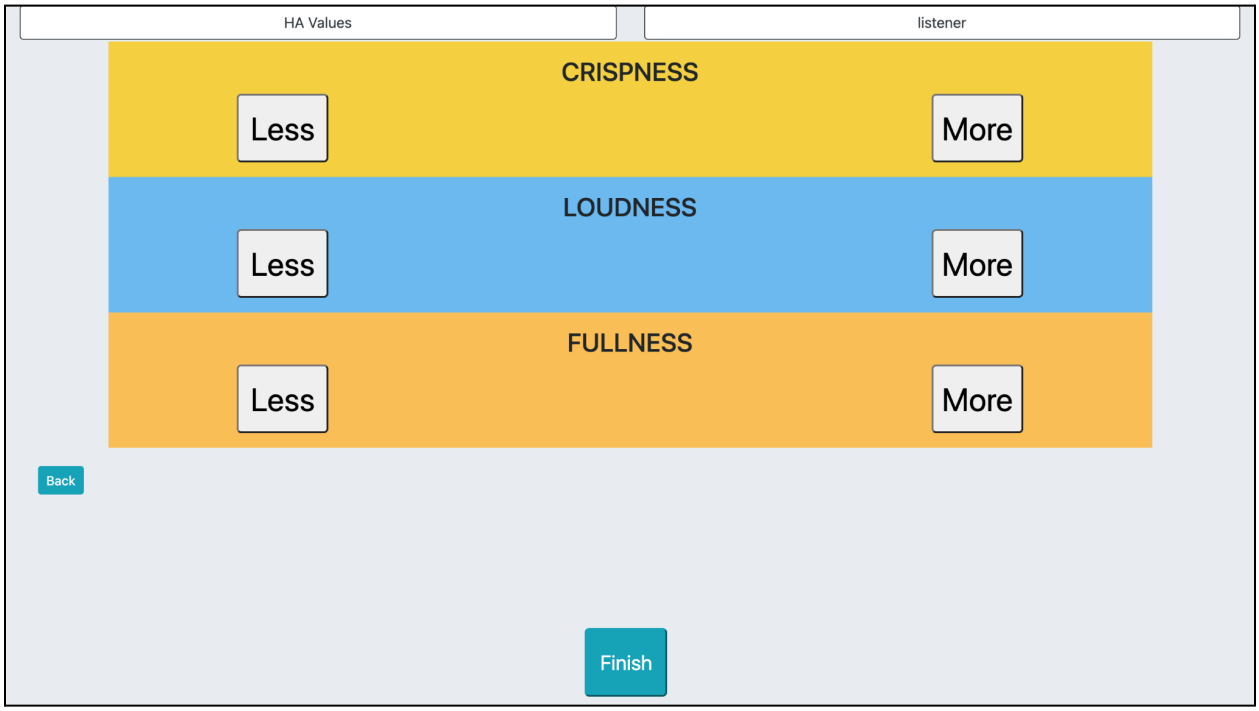


4 - Using Goldilocks

4.1 - Summary of Capabilities

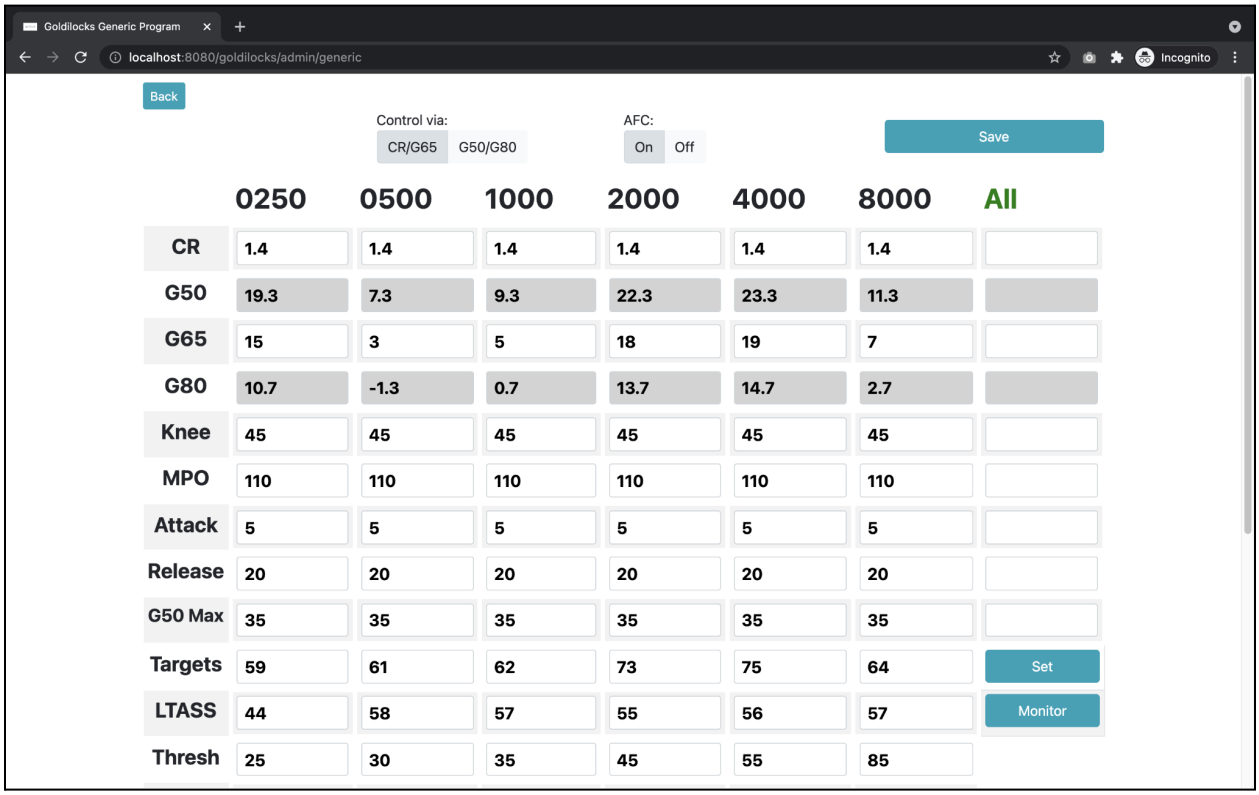
Goldilocks enables you to do the following.

- You can create and manage digital profiles of researchers and listeners.
- You can edit the parameters from RTMHA and create programs tailored to each listener.
- You can select one of these programs and preview the listener interface to test how the selected program will behave across the three different button controls:
    - one control that modifies volume “loudness”
    - one control that modifies high frequencies “crispness”
    - one control that modifies low frequencies “fullness”

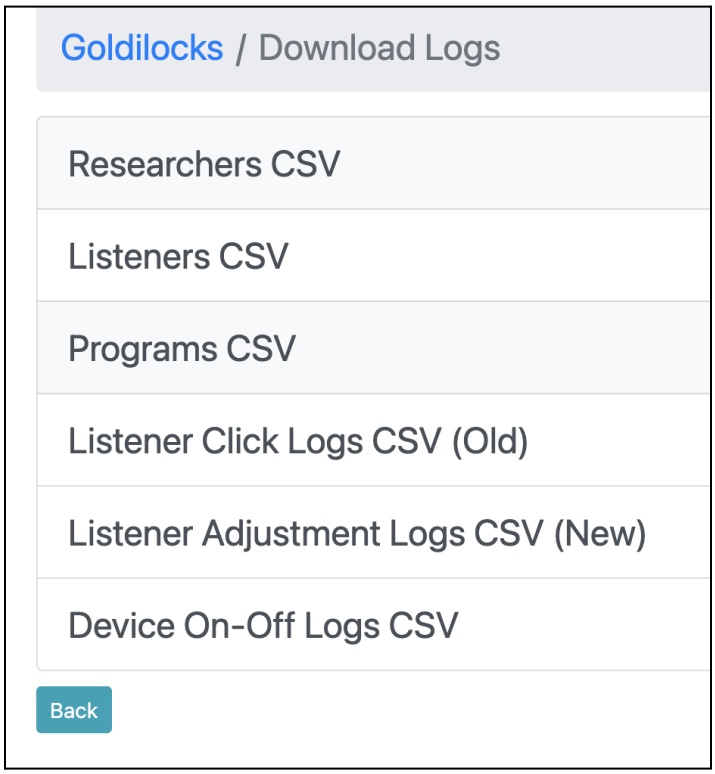


Based on the interactions in the listener interface and adjustments made to the parameters of the listener's program, you can also view logged data of each and every interface interaction and adjustment made to the listener's program.

You can even make adjustments to the default parameters set by RTMHA.



Finally, you can export .csv files of researcher profiles, listener profiles, and logs made from adjusting the listener program(s).



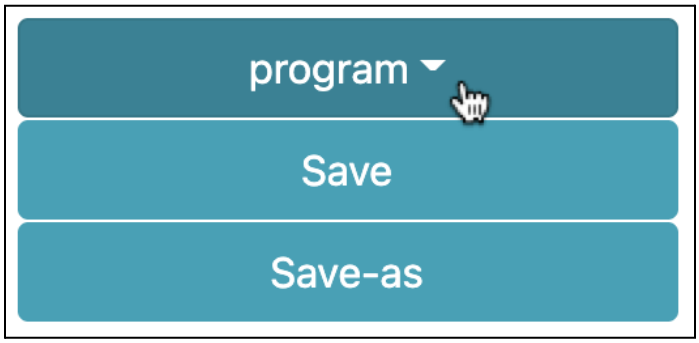
4.2 - Quick Set Up with Goldilocks

Follow these steps to get started:

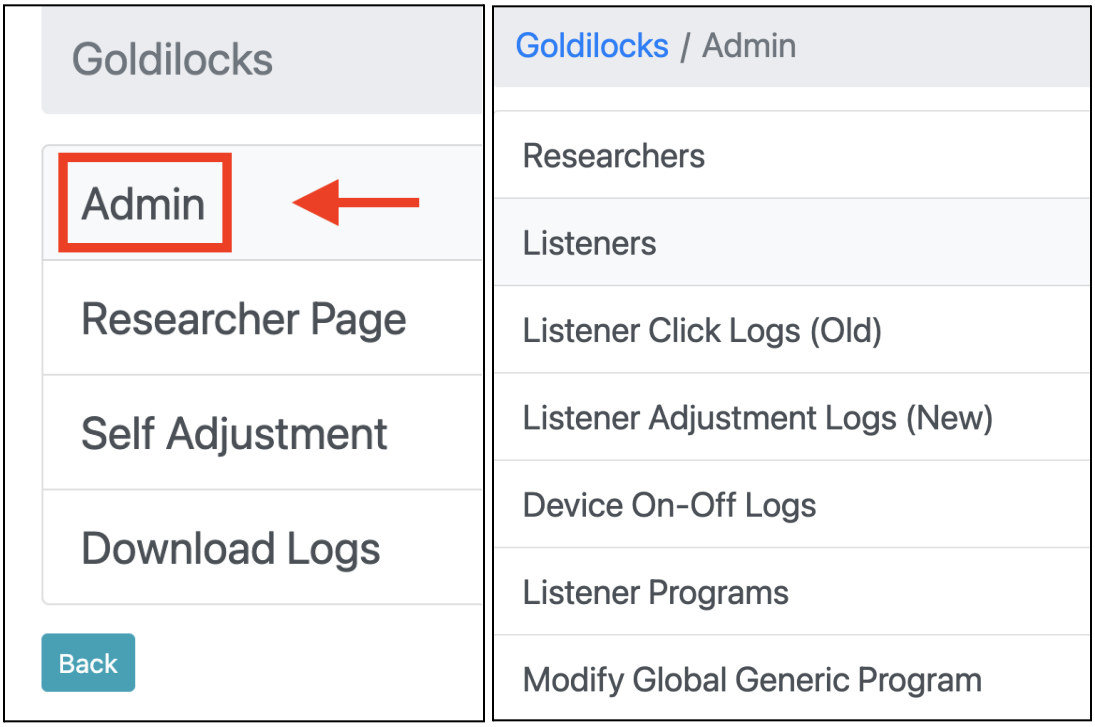
1. From the landing page, select the button in the upper right-hand corner labeled “Goldilocks”.
2. Select “Admin”, followed by “Researchers”. Create a new researcher profile by selecting the “Create New” button.
3. Enter a name and select “Create”.
4. Return to “Admin”, then select “Listeners”. Create a new listener profile by selecting the “Create New” button.

5. Enter a name and select “Create”.
6. Return to “Goldilocks”, then select “Researcher Page”.
7. In the search text box, type in the researcher profile that you created and select the desired listener profile.
8. In the upper right-hand corner, you should see three sets of buttons. Select the bottom-most button, labeled “Save-as”.

9. Save the program as a new name, and select “Save”. You’ll see a pop-up message confirming that your program is saved.
10. You may see the browser refresh the page. Check that your new program name is labeled in the top-most button on the upper right-hand corner of the page. Otherwise, you may need to select the “Read” button again and select your program name.



4.3 - Admin



Admin consists of several parts:

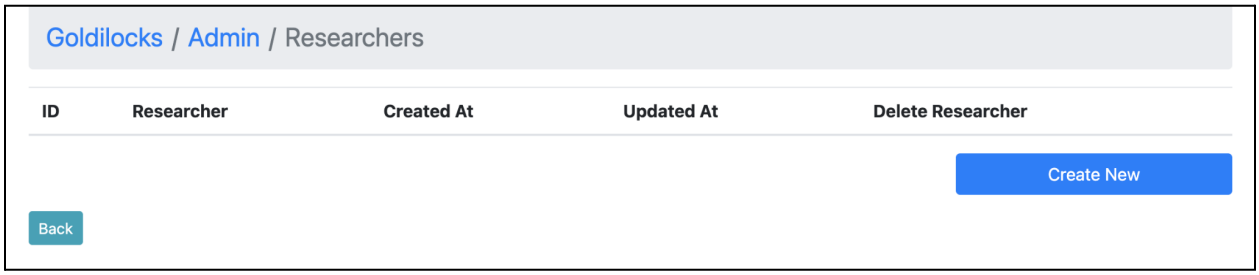
- **“Researchers”** - You can create, manage, and delete researcher profiles.
- **“Listeners”** - You can create, manage, and delete listener profiles.
- **“Listener Click Logs (Old)”** - You can view logged data of the interactions made to the listener interface for each listener profile.
- **“Listener Adjustment Logs (New)”** - You can view logged data of adjustments made to corresponding listener programs.
- **“Device On-Off Logs”** -

- **“Listener Programs”** - You can manage and delete listener programs.
- **“Modify Global Generic Program”** - You can change the values of the default parameters set by RTMHA.

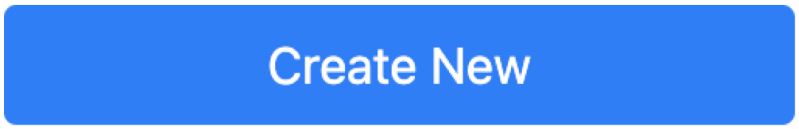
4.3.1 - Researchers

How to navigate: Select “Admin”, then “Researchers”.

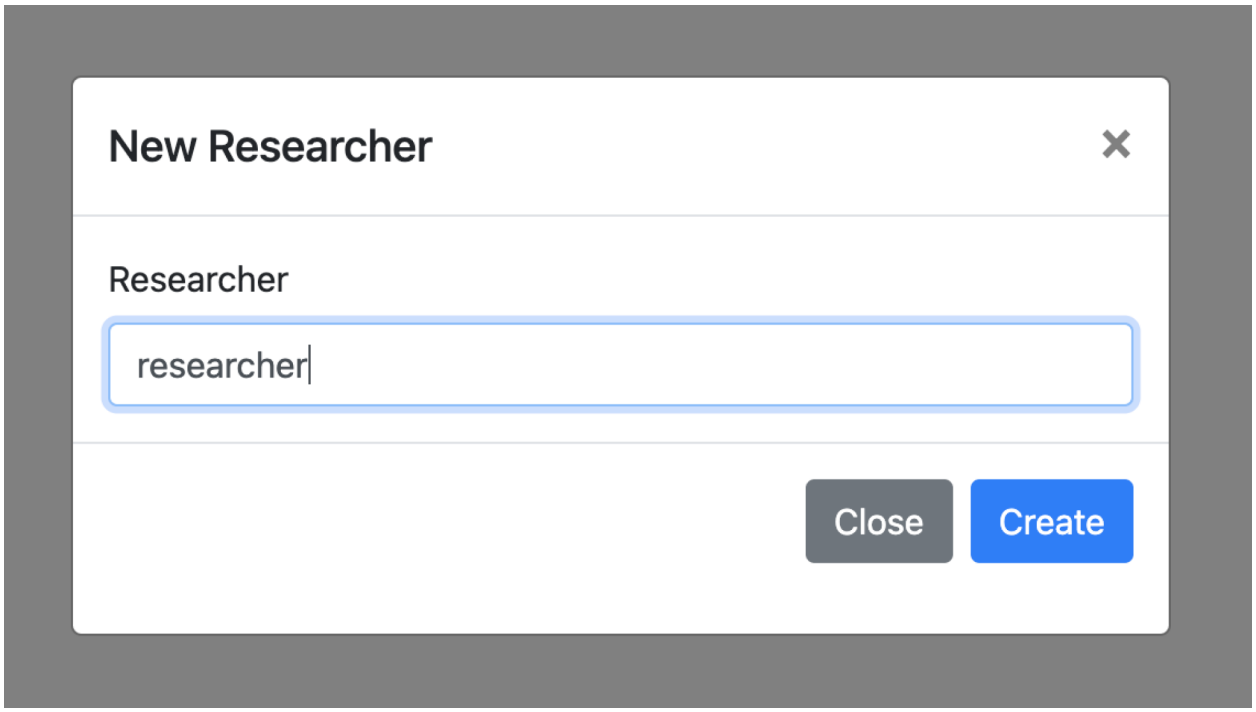
When you navigate to “Researchers” from opening the PHP version of EWS for the very first time, you will see this default interface with no researcher profiles shown.



The blue “Create New” button allows you to create a new researcher profile.

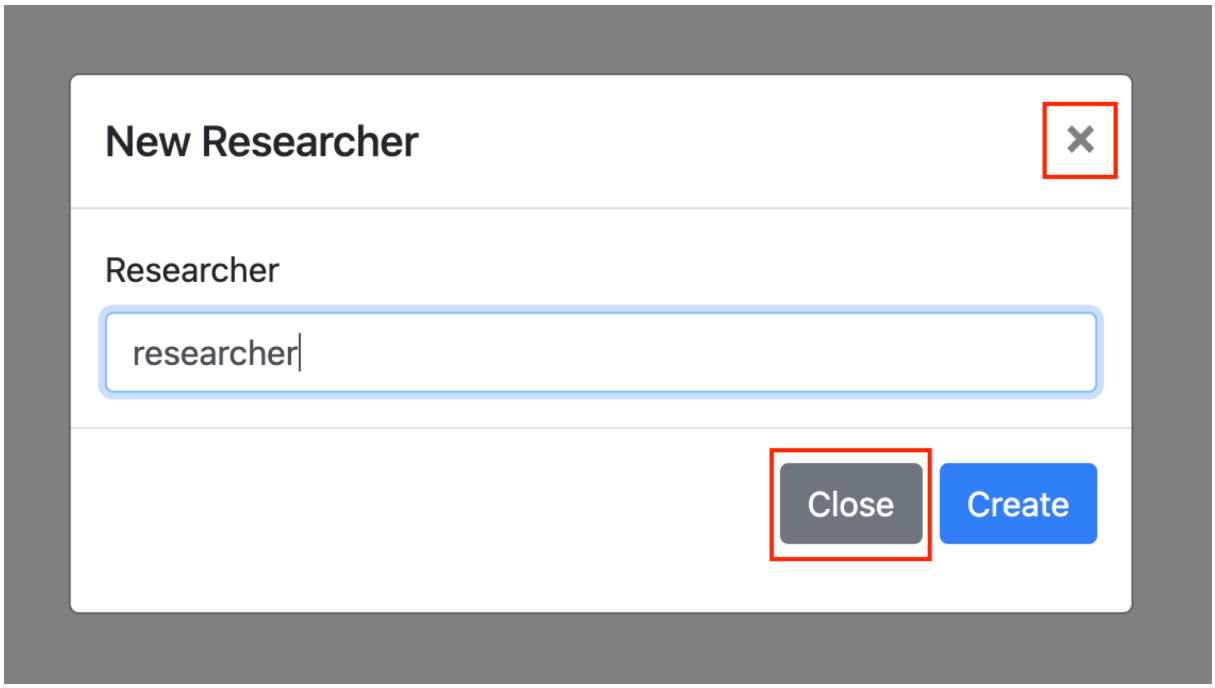


There would be a window with a text field for you to type in a new name for the researcher profile.

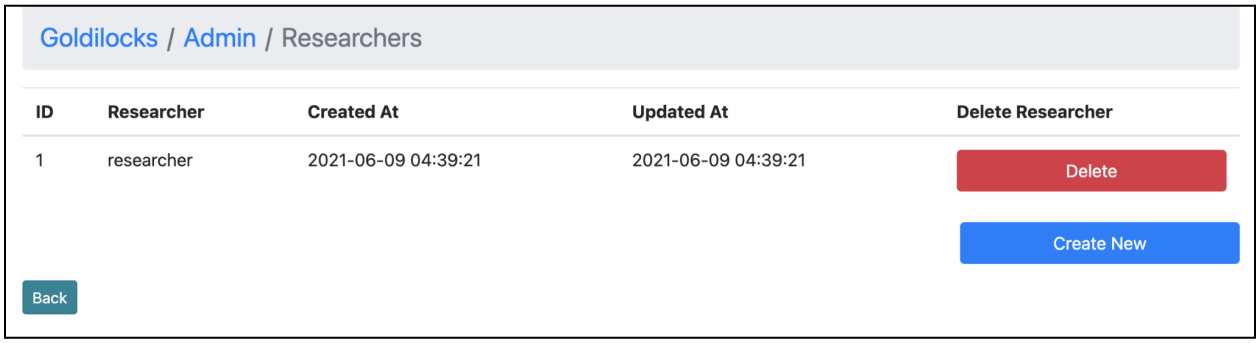


To confirm creation of the new researcher profile, select the blue “Create” button.

Otherwise, if you wish to not make a new researcher profile, select the “Close” button, the “X” icon in the upper right-hand corner, or anywhere in the outside gray area.



The new researcher profile will be created with the following information.



- *ID* - represented as a number unique to the researcher profile
- *Researcher* - name of the researcher profile
- *Created At* - Date and time that the researcher profile was created, formatted as yyyy-mm-dd hh:mm:ss.
- *Updated At* - Date and time that the researcher profile was last changed, formatted as yyyy-mm-dd hh:mm:ss.

If you wish to remove a researcher profile, you can do so by selecting the “Delete” button.

You can do one of the following to exit out of the interface:

- Select the “Back” button. This will return to the “Admin” interface.

- Select “Goldilocks” or “Admin” in the top portion of your screen.

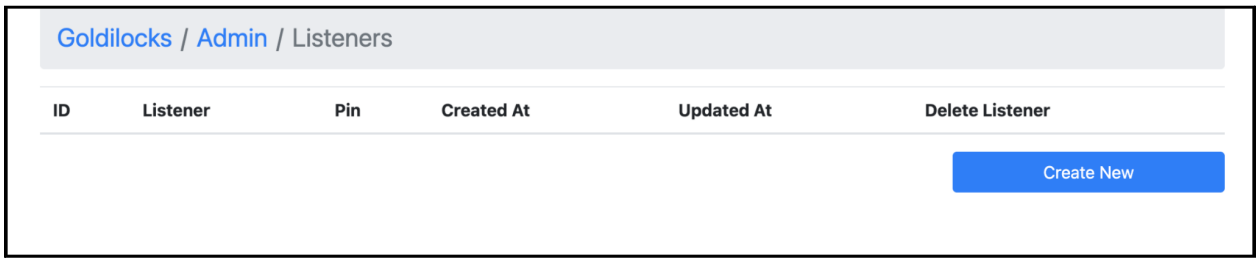
- Change the URL in the browser search bar, some examples include:
  - “http://localhost:8080/” or “http://[WIFI_IP_ADDRESS]:8080/” to go back to the landing page
  - “http://localhost:8080/goldilocks/” or “http://[WIFI_IP_ADDRESS]:8080/goldilocks/” to go back to Goldilocks.

- “http://localhost:8080/goldilocks/researchers/” or “http://[WIFI_IP_ADDRESS]:8080/goldilocks/researchers/” to go back to “Goldilocks” > “Researchers”.

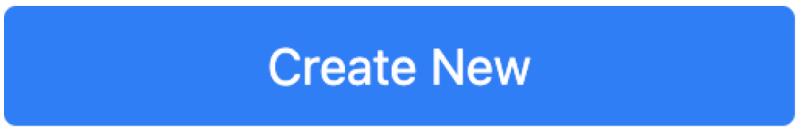
4.3.2 - Listeners

How to navigate: Select “Admin”, then “Listeners”.

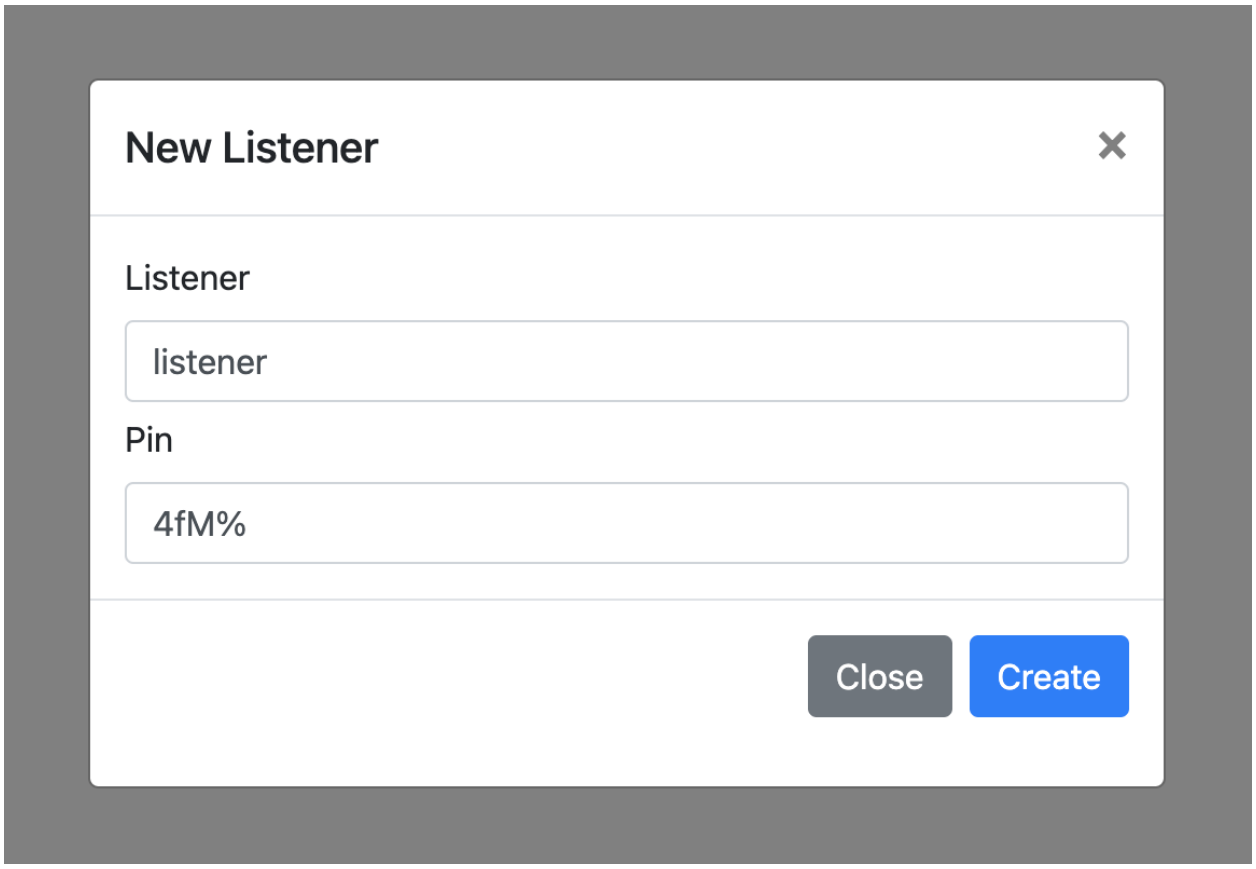
When you navigate to “Listeners” from opening the PHP version of EWS for the very first time, you will see this default interface with no researcher profiles shown.



The blue “Create New” button allows you to create a new researcher profile.



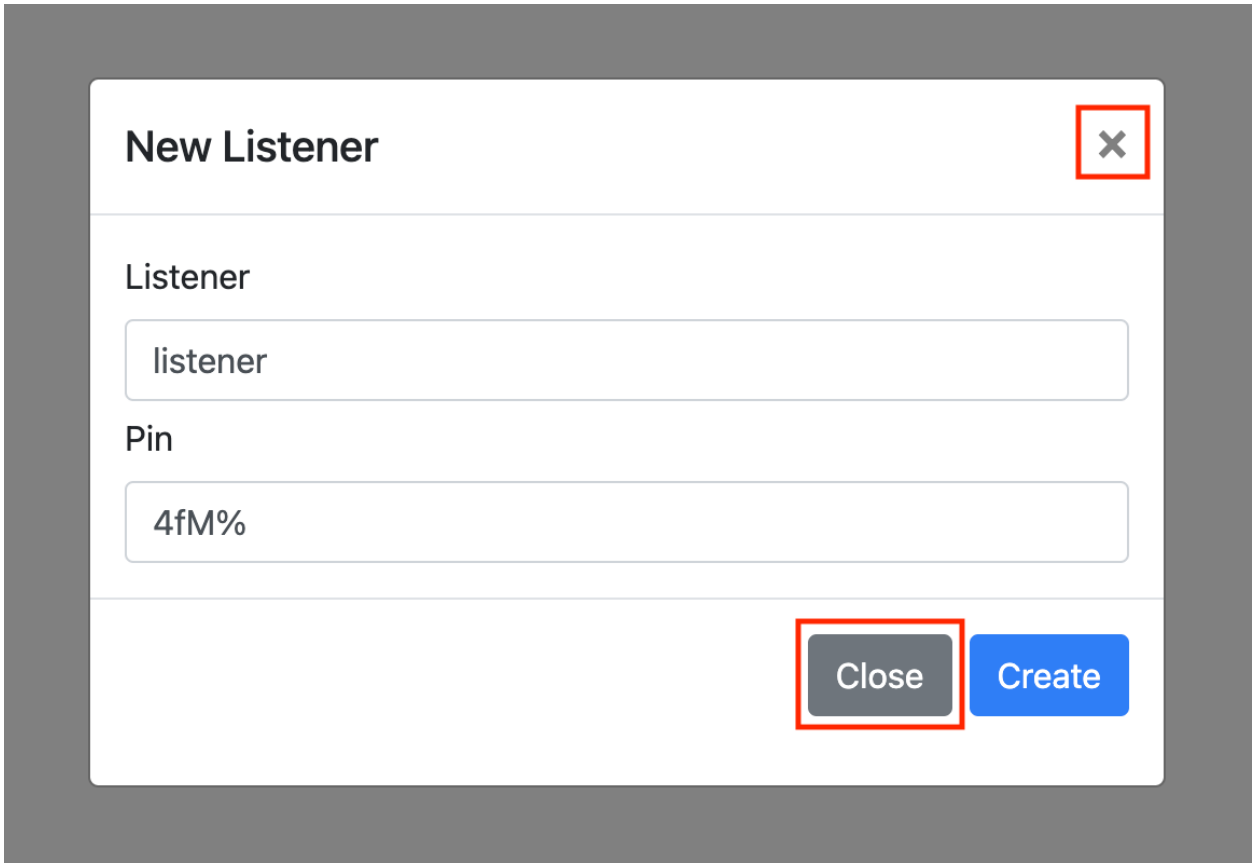
There would be a window with a text field for you to type in a new name and pin for the researcher profile.



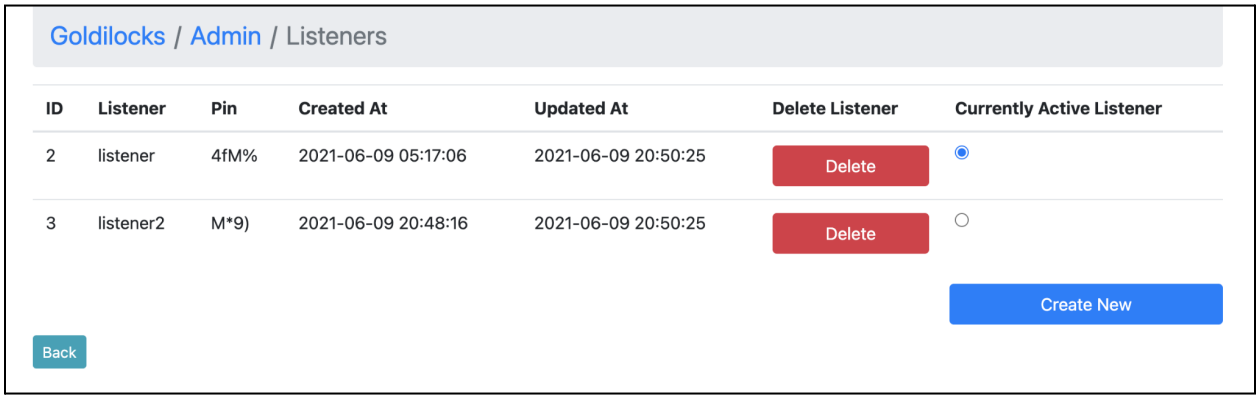
To confirm creation of the new researcher profile, select the blue “Create” button.

Otherwise, if you wish to not make a new researcher profile, select the “Close” button, the “X” icon in the upper right-hand corner, or anywhere in

the outside gray area.



The new researcher profile will be created with the following information.



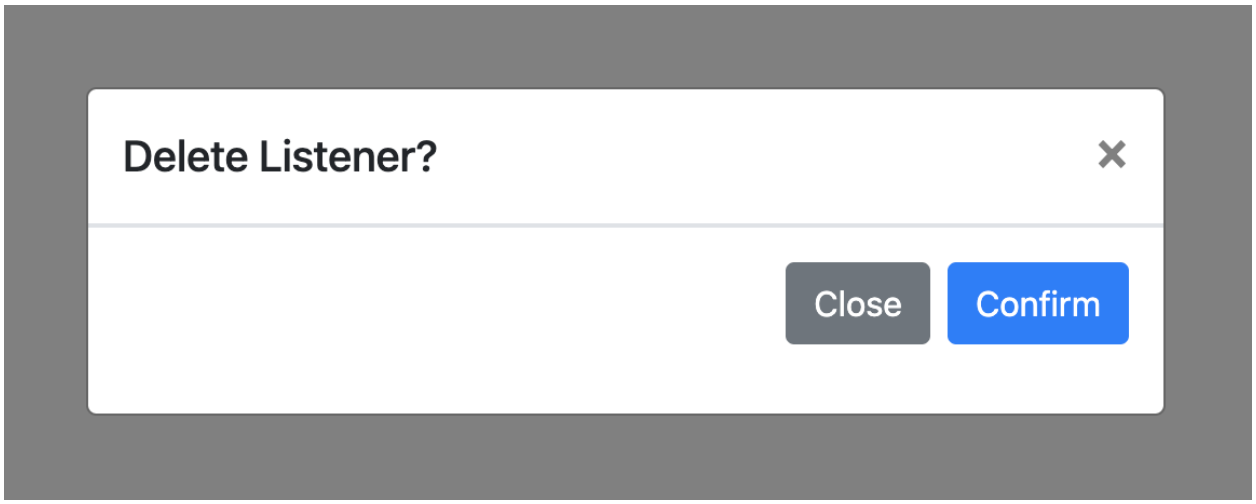
- *ID* - represented as a number unique to the listener profile
- *Listener* - name of the listener profile

- *Pin* - assigned to the listener
- *Created At* - Date and time that the researcher profile was created, formatted as yyyy-mm-dd hh:mm:ss.
- *Updated At* - Date and time that the researcher profile was last changed, formatted as yyyy-mm-dd hh:mm:ss.
- *Delete Listener* - There would be a red “Delete” button for you to choose to remove the available listener.

- *Currently Active Listener* - This is the listener profile that would be selected in the Self Adjustment page. Clicking on a toggle button that is not selected will change the selected listener profile.

If you select the “Delete” button to delete the listener profile, you will be asked to confirm your choice.

- To proceed, select the “Confirm” button.
- Otherwise to cancel deletion of the profile, select the “Close” button, the “X” icon in the upper right-hand corner, or anywhere in the outside gray area.



You can do one of the following to exit out of the interface:

- Select the “Back” button. This will return to the “Admin” interface.

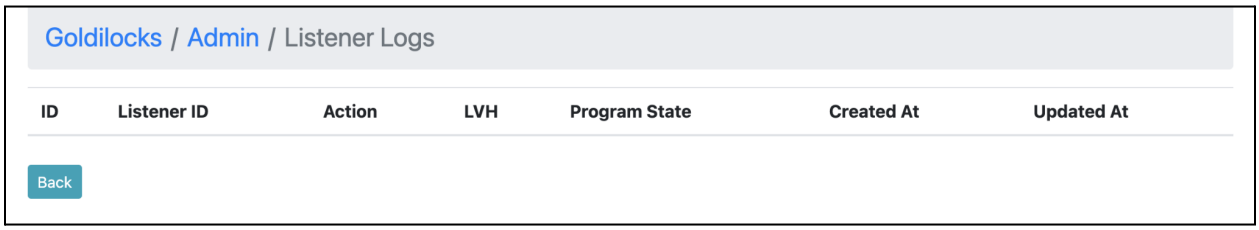
- Select “Goldilocks” or “Admin” in the top portion of your screen.

- Change the URL in the browser search bar, some examples include:
    - “http://localhost:8080/” or “http://[WIFI_IP_ADDRESS]:8080/” to go back to the landing page
    - “http://localhost:8080/goldilocks/” or “http://[WIFI_IP_ADDRESS]:8080/goldilocks” to go back to Goldilocks.
    - “http://localhost:8080/goldilocks/admin/” or “http://[WIFI_IP_ADDRESS]:8080/goldilocks/admin” to go back to “Goldilocks” > “Admin”.

4.3.3 - Listener Click Logs (Old)

How to navigate: Select “Admin”, then “Listener Click Logs (Old)”.

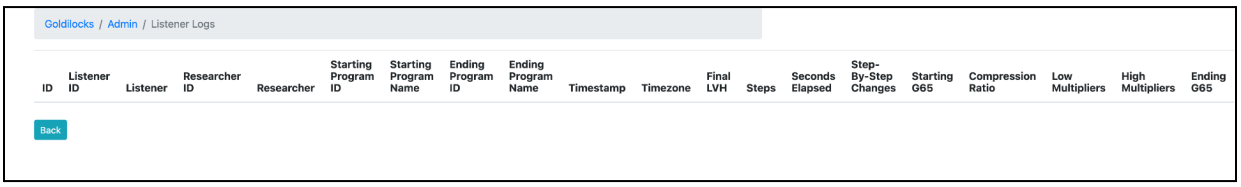
When you open this page for the very first time, you will see this default interface with no logs shown.



4.3.4 - Listener Adjustment Logs (New)

How to navigate: Select “Admin”, then “Listener Adjustment Logs (New)”.

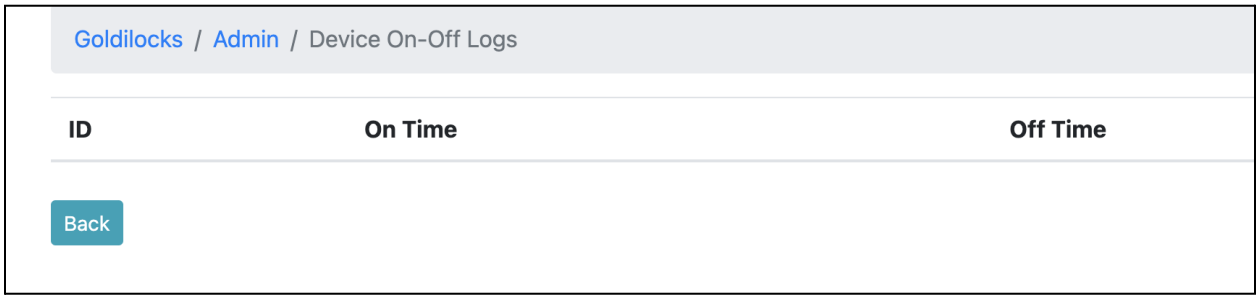
When you open this page for the very first time, you will see this default interface with no logs shown.



4.3.5 - Device On-Off Logs

How to navigate: Select “Admin”, then “Device On-Off Logs”.

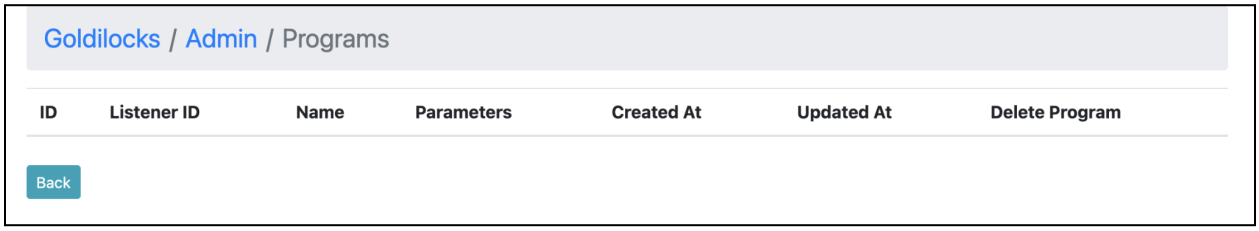
When you open this page for the very first time, you will see this default interface with no device logs shown.



4.3.6 - Listener Programs

How to navigate: Select “Admin”, then “Listener Programs”.

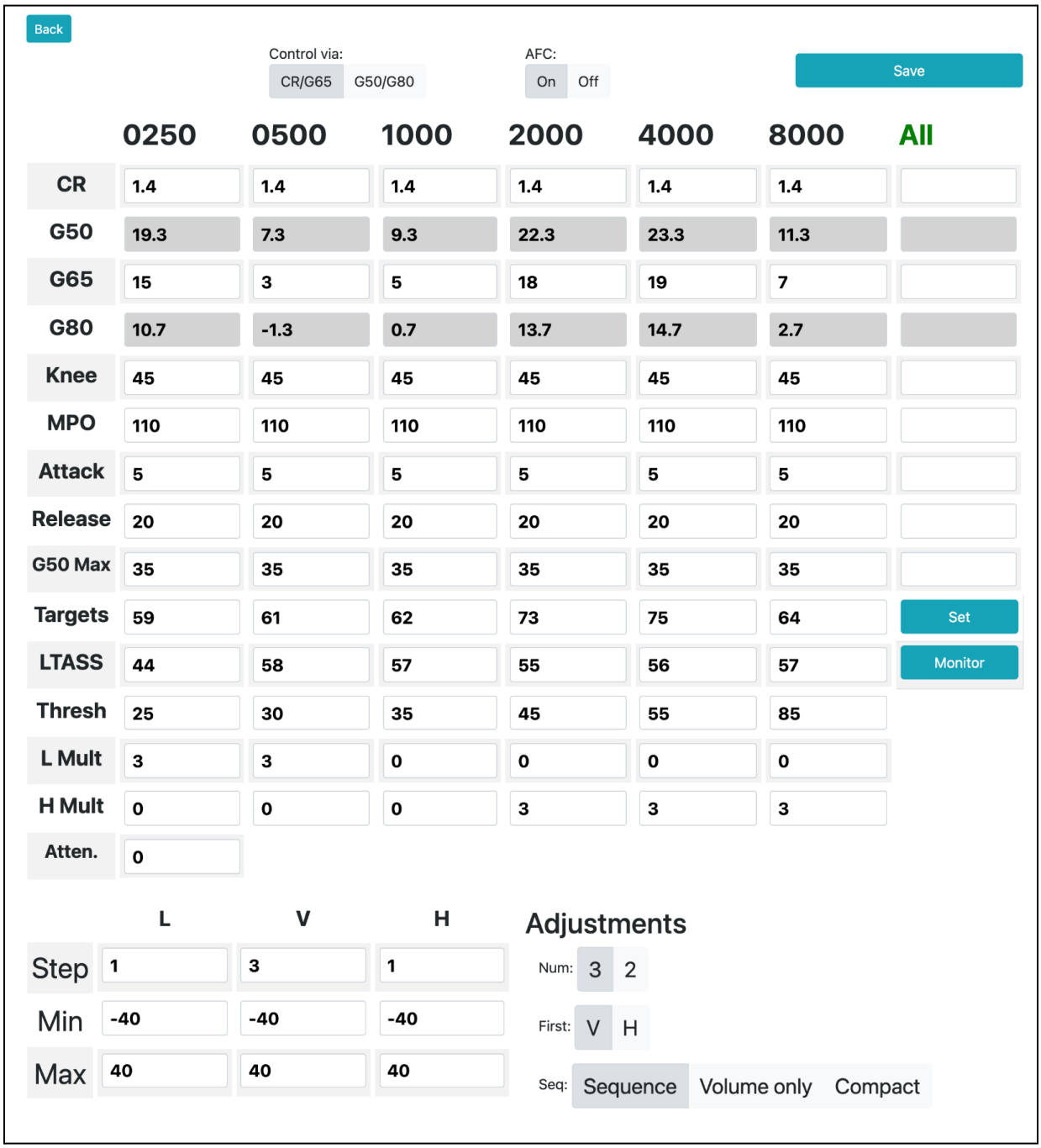
When you open this page for the very first time, you will see this default interface with no listener programs shown.



4.3.7 - Modify Global Generic Program

How to navigate: Select “Admin”, then “Listener Programs”.

When you open this page for the very first time, you will see this interface with default values for all of the parameters and frequency bands set by RTMHA.



Any changes saved into this interface will be reflected in the Researcher Page when you view the default parameters for a listener profile with no assigned program.

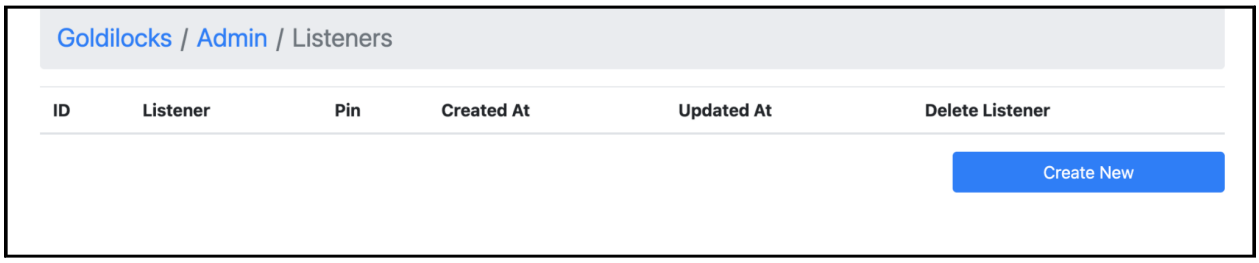
Explanation of the parameters and settings are explained in the next section “4.4 - Researcher Page”.

4.4 - Researcher Page

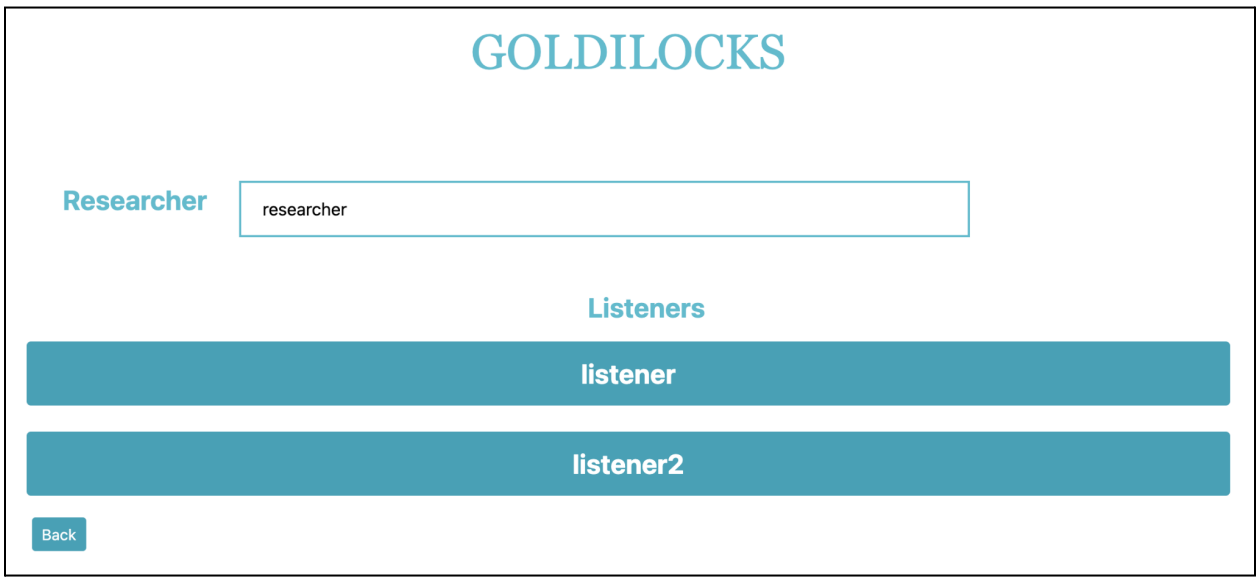
How to navigate: Select “Goldilocks”, then “Researcher Page”.

When you open this page for the very first time, you will see this interface with no listeners available. You will need to create at least one researcher profile and one listener profile, as covered in the previous sections.

When selecting the gray “Click Here to Create Listener” button, you will be taken to the “Listeners” page in “Admin” to set up a listener profile. To set up the profile, refer back to section 4.3.2 - Listeners.



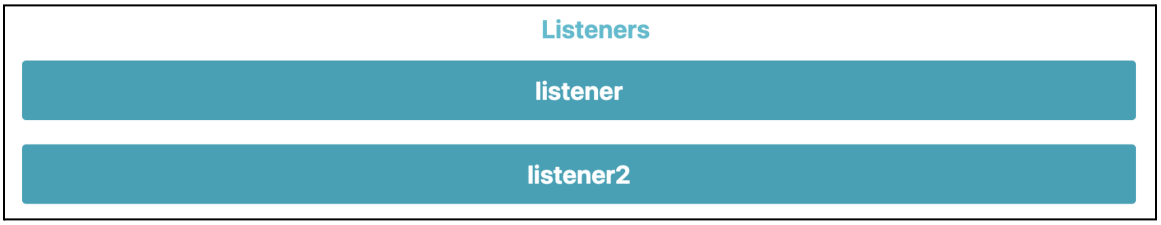
Once you create a listener profile, you'll be able to see available listener profiles.



To get started:

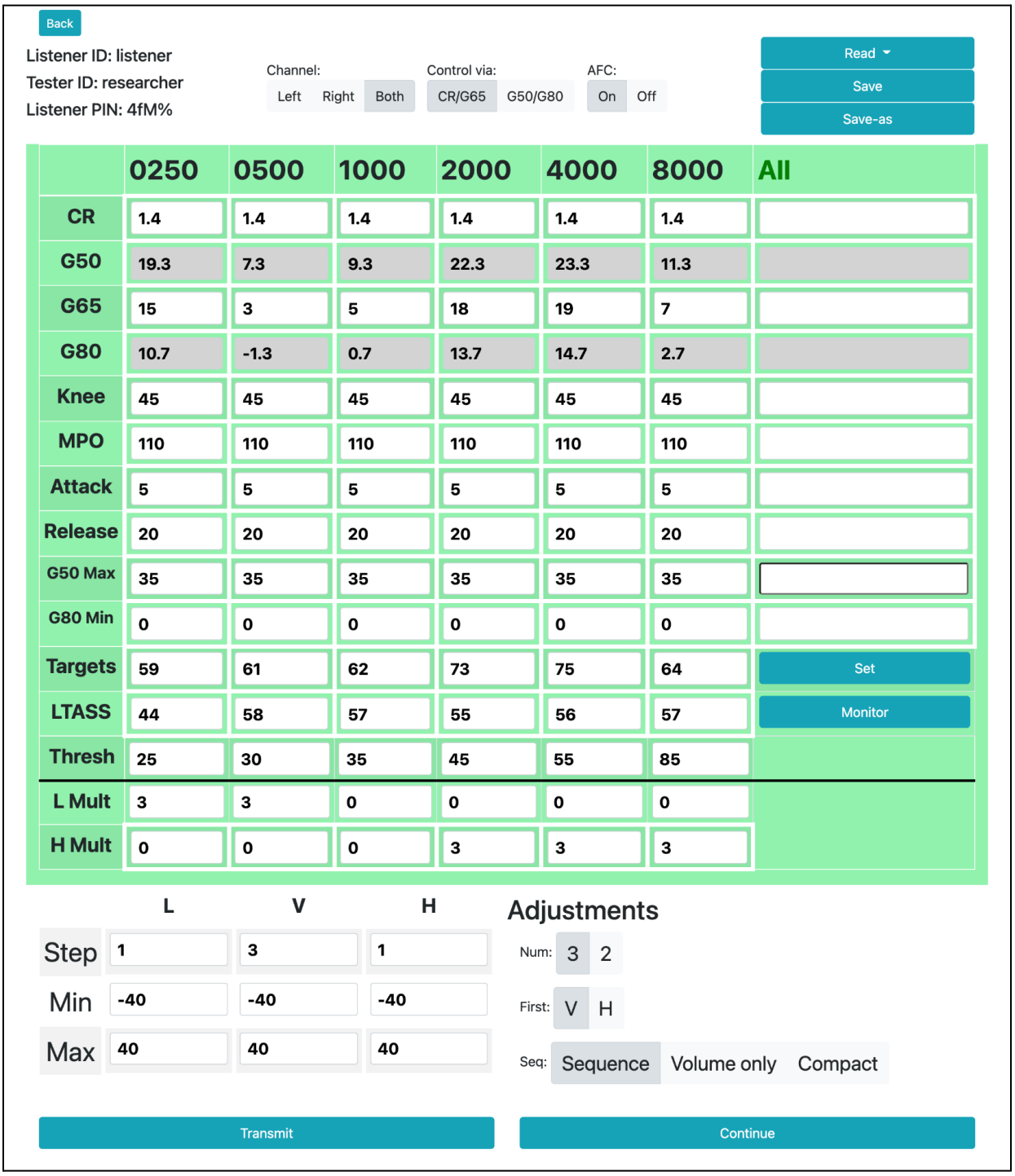
1. In the rectangular text input field, type in the name of your desired researcher profile. If you haven't created a researcher profile, refer back to section "4.3.1 - Researchers" in "Admin".

2. Select one button of the name of the listener profile that you want.



If you try to select an available listener without entering the researcher name (in the previous step), you will see this error message “Please input Researcher ID”, preventing you from continuing to the Researcher Page.

You’ll see the interface in the next page, with the default values for each parameter set by the generic program from RTMHA.



All values initially shown for a given listener are based on the values set in the Global Generic Program.

The Researcher Page consists of the following components.

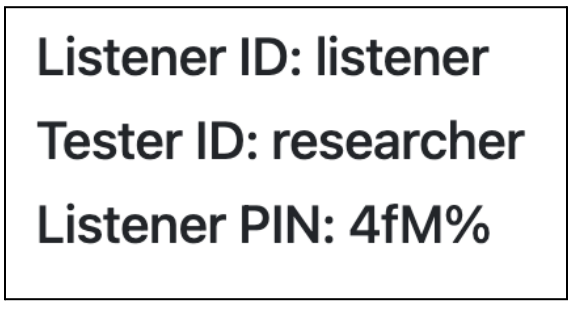
4.4.1 - “Back” button

Located in the upper left-hand corner of the screen, this will exit out of the Researcher Page interface and return to the default Goldilocks page.

4.4.2 - Listener ID, Tester ID, and Listener PIN

Located in the upper left-hand corner of the screen:

- “Listener ID” shows the name of the selected listener profile.
- “Tester ID” shows the name of the selected researcher profile.
- “Listener PIN” is the listener’s PIN.



This information is created and viewable via “Goldilocks” → “Admin” → “Researchers” or “Listeners”.

4.4.3 - Table for Center Frequencies and RTMHA Parameters

This consists of:

- *7 column headers*

  6 center frequency bands (0250, 0500, 1000, 2000, 4000, 8000) and “All”

0250	0500	1000	2000	4000	8000	All

  The boxed cells under the “All” column enable you to set the same value for a given parameter across all frequency bands.

	0250	0500	1000	2000	4000	8000	All
CR	2	2	2	2	2	2	2

- *15 parameters (applied to the frequency bands)*

Parameter Name	*Description*
Compression Ratio (CR)	Shows (and, if enabled, sets) compression ratio in each band. Values measured from RTMHA for this

CR	parameter may be subject to prior calibration of this parameter.
G50 G50	Shows (and, if enabled, sets) band gain for a 50 dB SPL input. Values measured from RTMHA for this parameter may be subject to prior calibration of the G65 parameter.
G65 G65	Shows (and, if enabled, sets) band gain for a 65 dB SPL input. Values measured from RTMHA for this parameter may be subject to prior calibration of this parameter.
G80 G80	Shows (and, if enabled, sets) band gain for a 80 dB SPL input. Values measured from RTMHA for this parameter may be subject to prior calibration of the G65 parameter.
Knee Knee	Sets the SPL band input level above which compression will be applied. Values measured from RTMHA for this parameter may be subject to prior calibration of this parameter.
Maximum Power Output (MPO)	Sets the maximum SPL output level in each band.

MPO	Values measured from RTMHA for this parameter may be subject to prior calibration of this parameter.
Attack (time) **Attack**	Attack time of compression, which only becomes relevant when CR is greater than 1. Values measured from RTMHA for this parameter may be subject to prior calibration of this parameter. Note that values of attack and release time are dependent on definitions of “reach” and “return”. ANSI published definitions in terms of size of the adjustment and proximity to completion (in dB). They have, however, dropped this definition.
Release (time) **Release**	Release time of compression, which only becomes relevant when CR is greater than 1. Values measured from RTMHA for this parameter may be subject to prior calibration of this parameter. Note that values of attack and release time are dependent on definitions of “reach” and “return”. ANSI published definitions in terms of size of the adjustment and proximity to completion (in dB). They have, however, dropped this definition.
G50 Max	Sets an upper gain limit to prevent excessive acoustic feedback.

G50 Max	In the listener interface, if any requested band gain is above this value: • The “More” button will be disabled and its label will be changed to “MAX”. • The listener will be informed that a maximum has been reached for “L”/“Fullness”, “V”/“Loudness”, or “H”/“Crispness”.
G80 Min **G80 Min**	Sets a lower gain limit to prevent further reductions of gain when sound level in the ear canal is dominated by leakage through or past the earmold or receiver dome. In the listener interface, if any requested band gain is below this value: • The “Less” button will be disabled and its label will be changed to “MIN”. • The listener will be informed that a minimum has been reached for “L”/“Fullness”, “V”/“Loudness”, or “H”/“Crispness”.
Targets **Targets**	This is where you can input your desired values for real-ear band outputs for a 65 dB SPL broad-band speech input level. The targets you enter may be based on any desired prescriptive formula or prescription, such as: • The National Acoustic Laboratories second formula for Non-Linear amplification (NAL-NL2) • The Desired Sensation Level formula

	from Western Ontario University (DSL) Note that any available prescriptive formulae are not an exact prescription for the individual/listener, which may influence the targets that you may set. Rather, the targets that you set provides the individual/listener a starting response that matches the average preference for people with a similar audiogram. This would influence the default starting response for the listener interface.
Long-Term Average Speech Spectrum (LTASS) **LTASS**	Note that the *"Set" button* computes the difference between target and LTASS and enters the result for G65. Set
Threshold (Thresh) **Thresh**	This is a parameter that is still a work in progress. This would calculate the NAL-NL2 targets from thresholds without needing Verifit to obtain/establish targets.
L Mult **L Mult**	The band-specific value for this parameter would be multiplied with the value in the boxed cell for "Step" and "L"/"Fullness" to set the step size for changes of Low-frequency output ("L"/"Fullness") for the corresponding frequency band. Ultimately, this value would impact the difference heard for the corresponding

	frequency band when a listener selects the “Less” or “More” button for “Fullness” in the listener interface. 
H Mult 	The band-specific value for this parameter would be multiplied with the value in the boxed cell for “Step” and “H”/“Crispness” to set the step size for changes of High-frequency output (“H”/“Crispness”). Ultimately, this value would impact the difference heard for the corresponding frequency band when a listener selects the “Less” or “More button for “Crispness” in the listener interface. 

- *100 boxed cells*
    - Each of the 90 cells set the values for the corresponding parameter and frequency band.
    - Each of the 10 cells in the “All” column sets the same value for all boxed cells in each corresponding row.
- *“Set” button*

  This button computes the difference between target and LTASS and

enters the result for G65.

- *“Monitor” button*

  This button retrieves values for each parameter and frequency band currently set within RTMHA and displays them in the Researcher Page. Doing this replaces the current values shown.

4.4.4 - Relationship of Parameters

Some of the parameters can be better explained with the following.

4.4.5 - Table for Step, Min, Max, and LVH

	L	V	H
Step	1	3	1
Min	-40	-40	-40
Max	40	40	40

When used in conjunction with the “L Mult” and “H Mult”, this table will provide you with a wide range of control over what will happen when the

listener makes changes with the listener interface via the “More” and “Less” buttons.

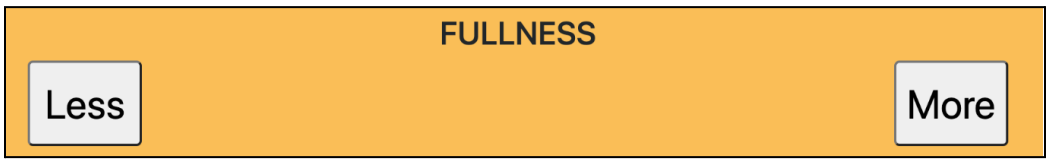
Below is a table defining “L”, “V”, and “H” for the column header.

Parameter Name	*Definition*	*Name Used in Listener Interface*
L	Low-frequency output (cut or boost)	“Fullness” FULLNESS
V	overall output/Volume	“Loudness” LOUDNESS
H	High-frequency output (cut or boost)	“Crispness” CRISPNESS

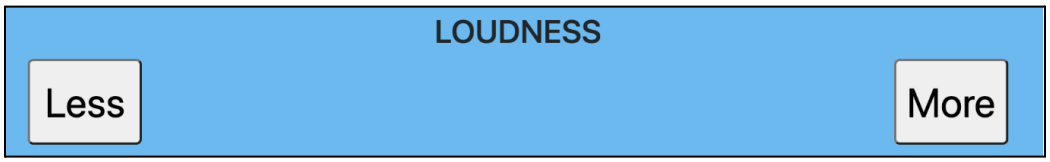
“Step” has different meanings with the column headers:

	L	V	H
Step	1	3	1

- “Step” with “L”
    - The value for this parameter would be multiplied with the value in the boxed cell for “L Mult” to set the step size for changes to Low-frequency output (“L”/“Fullness”) for the corresponding frequency band.
    - Ultimately, this value would impact the difference heard for the corresponding frequency band when a listener selects the “Less” or “More” button for “Fullness” in the listener interface.



- “Step” with “V”
    - Step size in dB for user-adjustment of overall output (Volume)
    - Ultimately, this value would impact the difference heard when a listener selects the “Less” or “More button for “Loudness” in the listener interface.



- “Step” with “H”
    - The value for this parameter would be multiplied with the band-specific value in the boxed cell for “Step” and “H”/“Crispness” to set the step size for changes to High-frequency output (“H”/“Crispness”) for the corresponding frequency band.
    - Ultimately, this value would impact the difference heard for the corresponding frequency band when a listener selects the “Less” or “More button for “Crispness” in the listener interface.

“Min” for “L”, “V”, and “H” sets the lower limit on output decrease from a starting response in the listener interface based on the number of steps taken rather than requested gain.

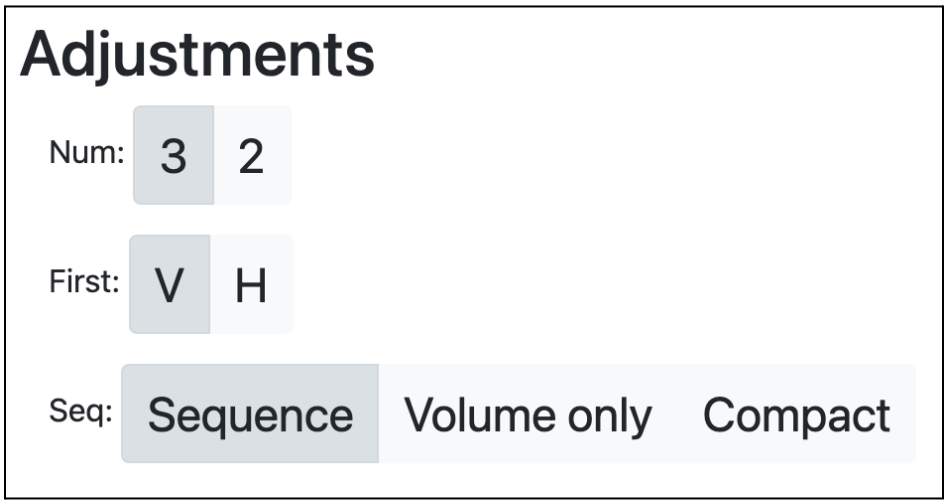
In the listener interface, this is best represented as buttons that are labeled “MIN” and that cannot be selected until a “More” button is selected one or more times.

“Max” for “L”, “V”, and “H” sets the upper limit on output increase from a starting response in the listener interface based on the number of steps taken rather than requested gain.

In the listener interface, this is best represented as buttons that are labeled “MAX” and that cannot be selected until a “Less” button is selected one or more times.

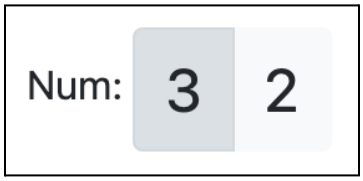
4.4.6 - Adjustments

These settings affect the available controls, usage, and behavior of the listener interface.



“Num: ”

- “3”



When this is selected, three separate sets of button controls will appear for “H”/“Crispness”, “V”/“Loudness”, and “L”/“Fullness”.

- “2”

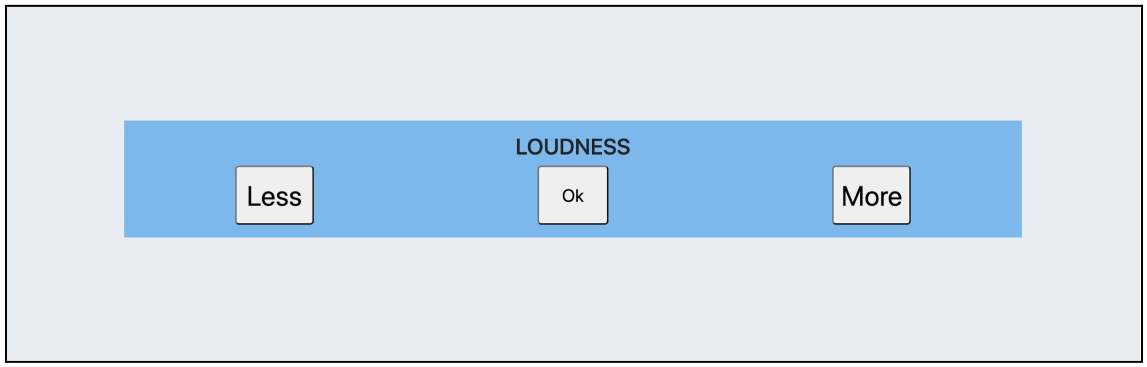
When this is selected, “L”/“Fullness” and “H”/“Crispness” are combined. In the listener interface, this would appear as one set of button controls, named as “Crispness”. Thus, button controls for are only shown.

Any increase of “H”/“Crispness” is accompanied by a reduction of “L”/“Fullness” (the exact spectral tilt is determined by “L Mult” and “H Mult”).

“First: ”

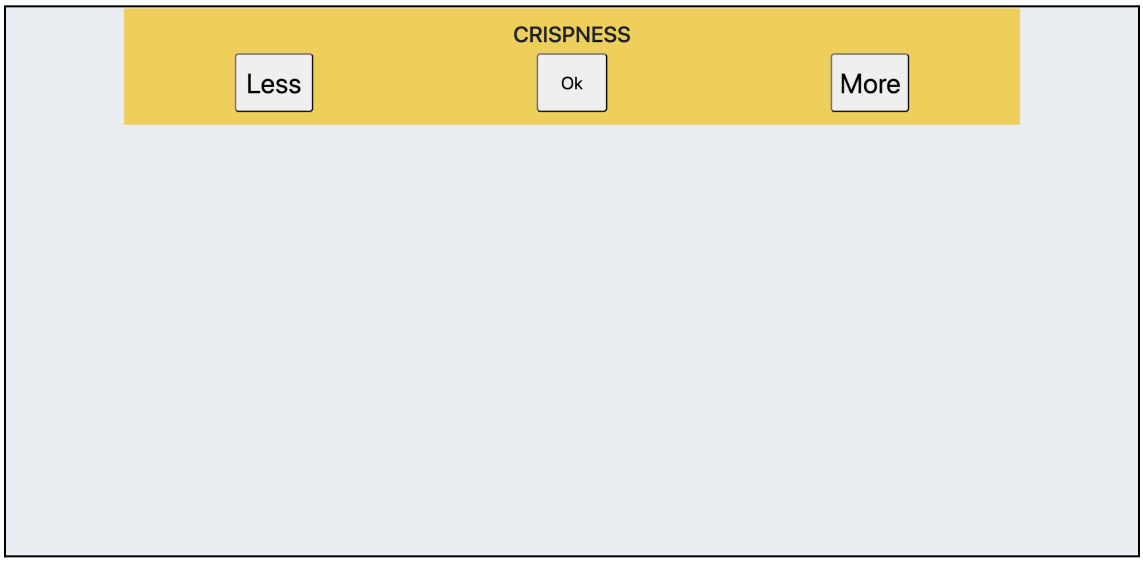
- “V” (“Loudness”)

In the listener interface, only button controls for “V”/“Loudness” are shown first, followed by controls for “L”/“Fullness” and “H”/“Crispness”.



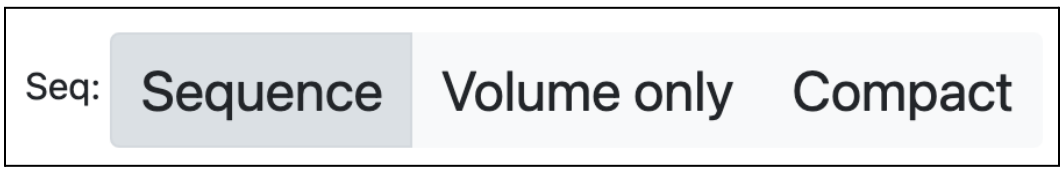
- “H” (“Crispness”)

In the listener interface, only button controls for “H”/“Crispness” are shown first, followed by controls for “V”/“Loudness” and “L”/“Fullness”.



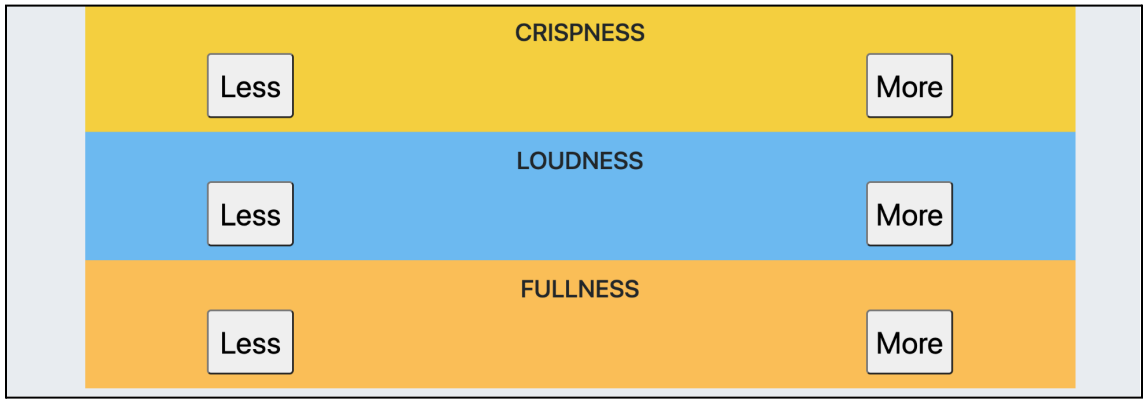
“Seq: ”

- “Sequence”



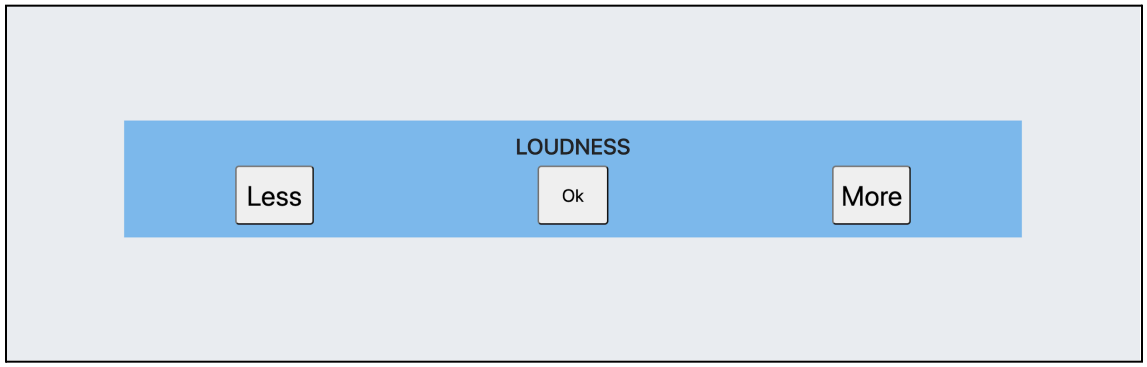
In the listener interface, this shows each set of button controls, one at a time, before presenting all three sets of controls at once.


CRISPNESS
Less
Ok
More
LOUDNESS
Less
Ok
More
FULLNESS
Less
Ok
More



- “Volume only”

In the listener interface, this only presents button controls for “V”/“Loudness”, analogous to the volume control on a traditional hearing aid.



- “Compact”

In the listener interface, all three sets of controls are presented at once for “H”/“Crispness”, “V”/“Loudness”, and “L”/“Fullness”.

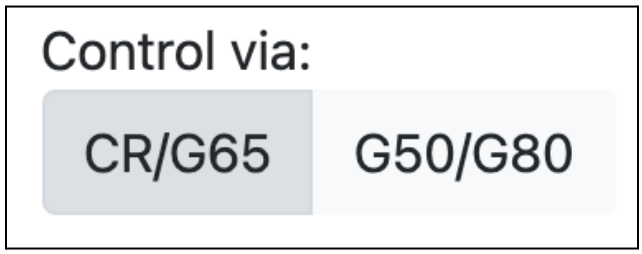
4.4.7 - “Channel:” Buttons

There are three buttons, labeled “Left”, “Right”, and “Both”. When one of them is selected, all values for the parameters and bands would be shown for the corresponding channel(s).

You may witness color changes as well.

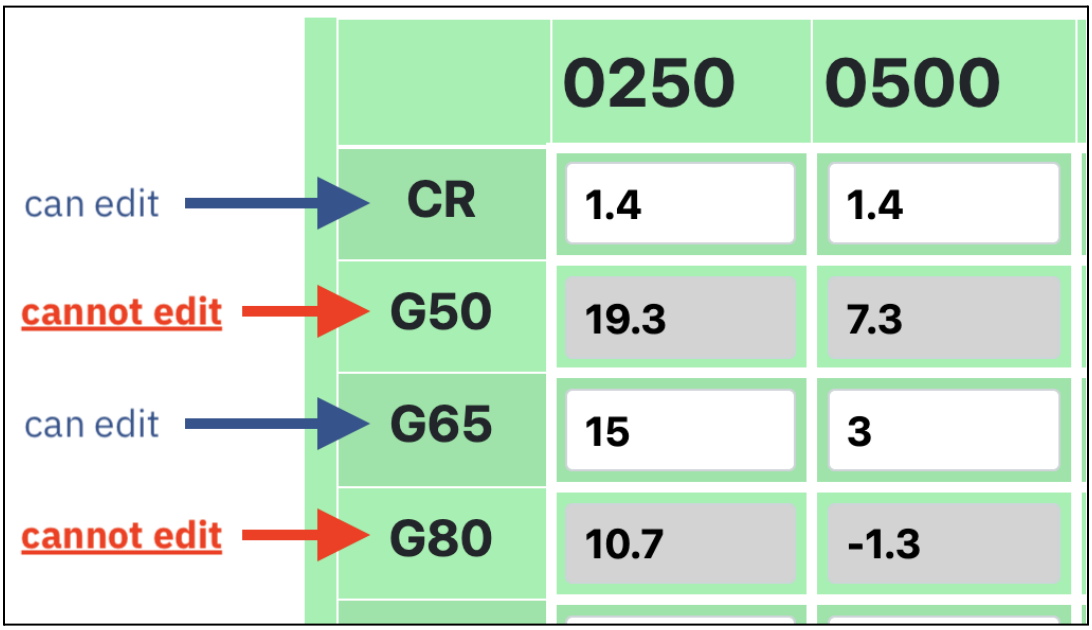
- When “Left” is selected, you’ll see a blue color for the table for the parameters and frequencies.
- When “Right” is selected, you’ll see a red color for the table.
- When “Both” is selected, you’ll see a green color for the table.

4.4.8 - “Control Via:” Buttons



There are two buttons, labeled “CR/G65” and “G50/G80”:

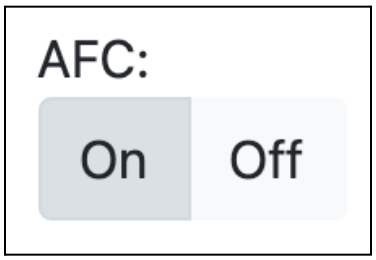
- “CR/G65”: When selected, this allows you to edit values within the boxed cells for CR and G65 parameters. This will also prevent you from editing values for G50 and G80 parameters (the boxed cells that can’t be edited will have a gray fill color).



- “G50/G80”: When selected, this allows you to edit values within the boxed cells for G50 and G80 parameters. This will also prevent you from editing values for CR and G65 parameters (the boxed cells that can’t be edited will have a gray fill color).

4.4.9 - Adaptive Feedback Cancellation (AFC)

The parameters of the algorithm are set on the general researcher page.



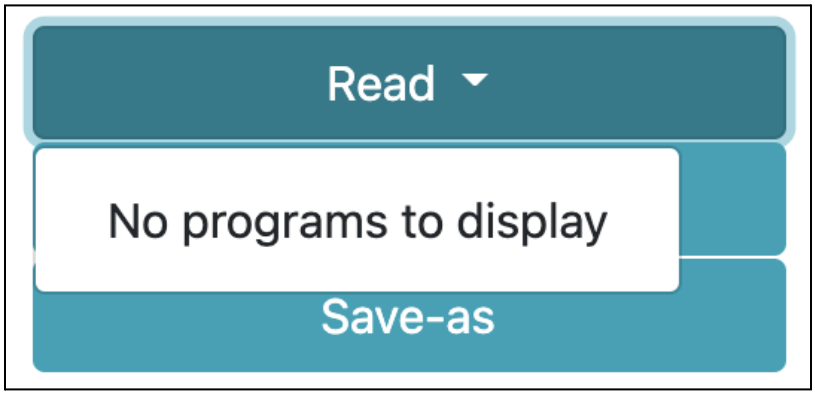
- When turned “On”, this tracks the variations in the acoustic feedback path and cancels the feedback signal as a result of the physical placement of the microphone and receiver in a HA device.
- When turned “Off”, this does nothing to the acoustic feedback path and feedback signal.

4.4.10 - Program Button, “Save” and “Save-as” Buttons

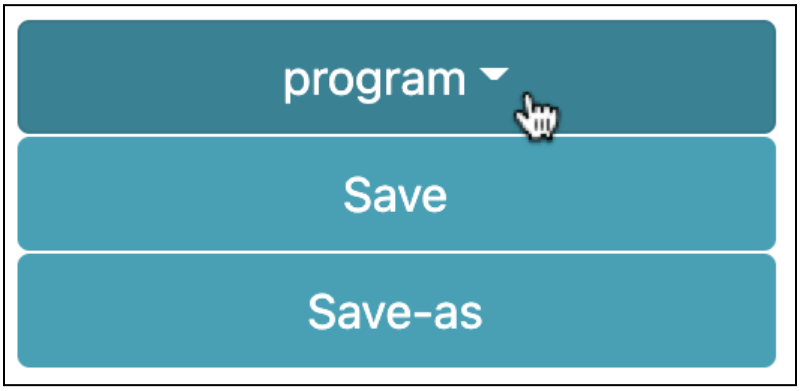
Located at the upper right-hand corner of the screen, each of the buttons does the following:

Program button

By default, if there is no program available and assigned to the selected listener, the button label will show “Read”. When you select it, it will show “No programs to display”, meaning that you will have to select the *“Save-as” button* to save the values for the parameters and bands as a new program.



Once you save at least one program and have it selected, the button will change to show the currently selected program. The example image below shows “program” as the selected program.



When selected, you would see a list of previous programs saved that can

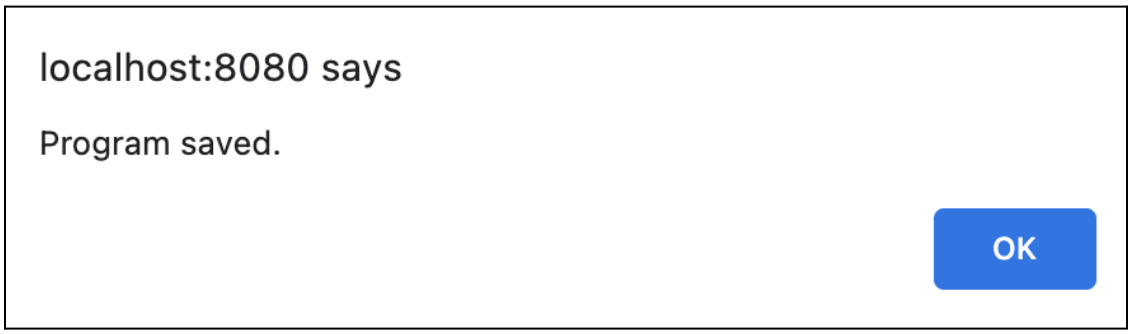
be selected instead (from the image, “program” and “program2” are shown).

“Save” button

By default, if you select this button while there is no program available and assigned to the selected listener, this pop-up message will appear: “No setting selected. Click Save As.”

You will have to select the *“Save-as” button* to save the values for the parameters and bands as a new program.

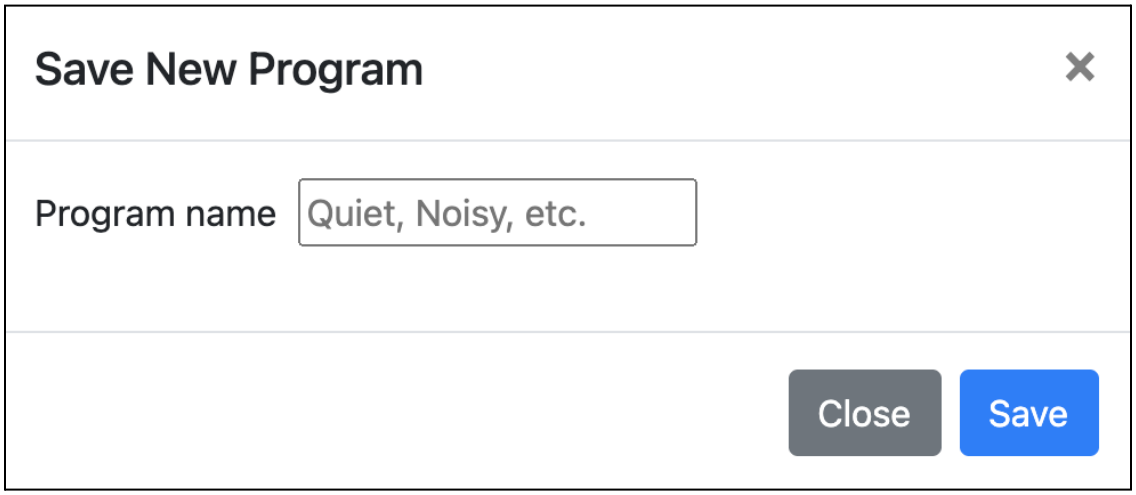
Otherwise, this pop-up message appears whenever you save your values: “Program saved.”



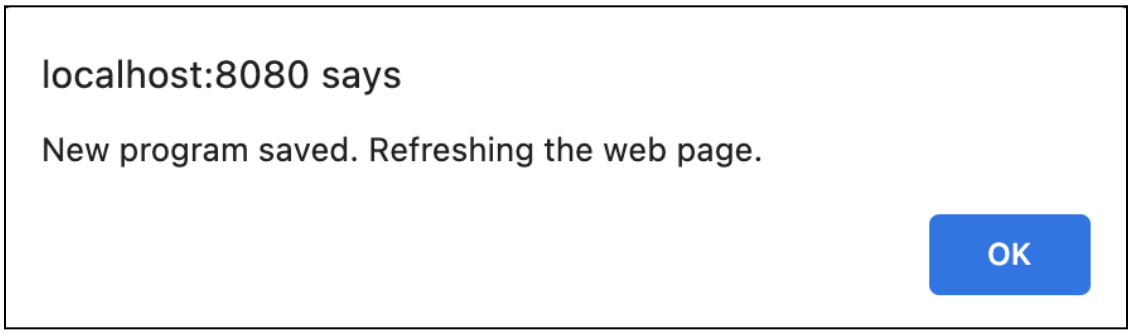
“Save-as” button

When selected, this allows you to create a new listener program that saves all current values for the parameters and bands as well as the current settings shown in the Researcher Page.

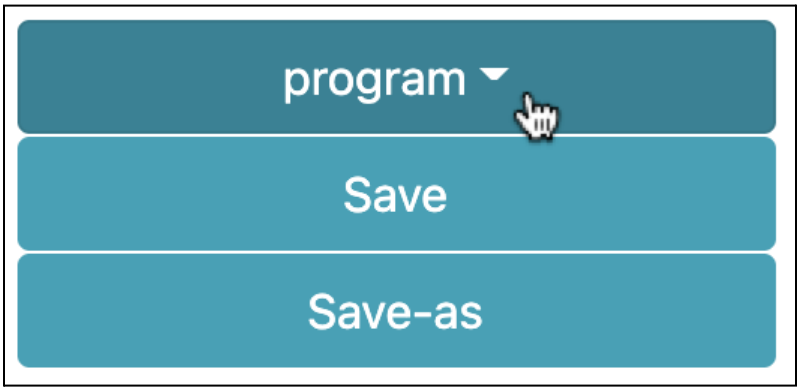
Simply enter a new name for the new listener program and select the blue “Save” button to confirm. Otherwise, you may cancel saving the new program by selecting the “Close” button, the “X” button, or clicking anywhere else on the screen.



Once you select “Save”, you’ll see this pop-up message confirming that your program is saved: “New program saved. Refreshing the web page.”. The browser page will reload to load the program that you just saved.



You will also notice that the *Program button* will change its label to show the name of the program that you just saved.

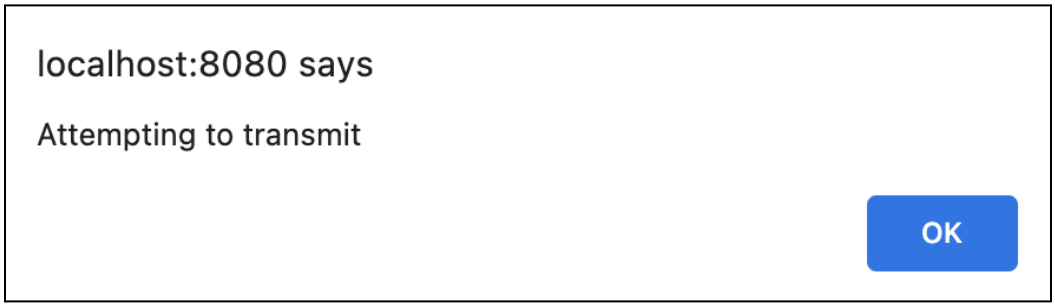


4.4.11 - “Transmit” and “Continue” buttons

“Transmit” button

When selected, this takes all the current values from the parameters and bands and sends them to RTMHA.

This pop-up message also appears. “Attempting to transmit”

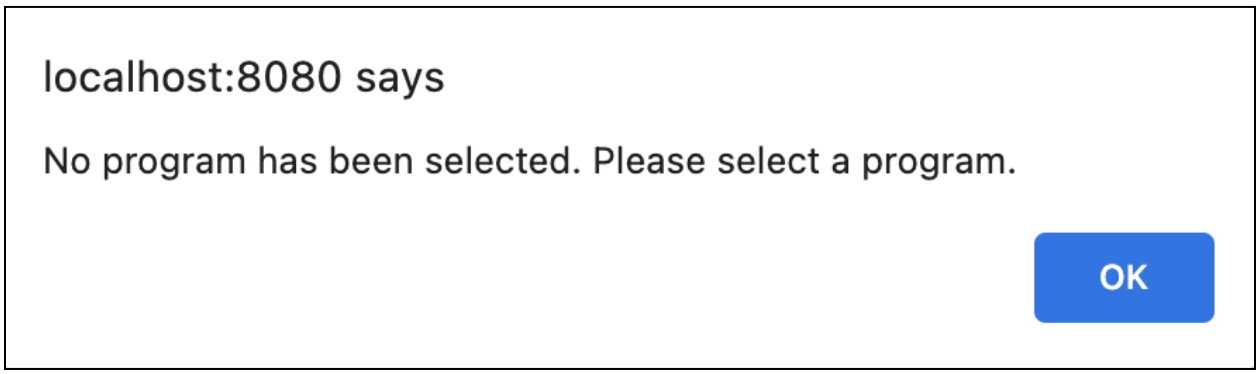


It is recommended to also save the program by selecting the *“Save” button*.

“Continue” button

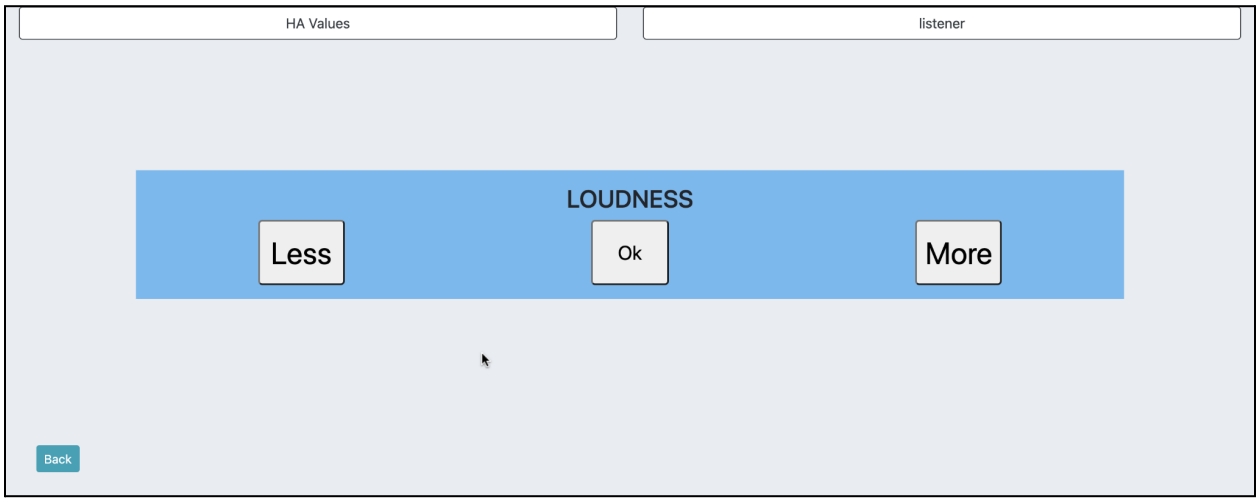
With a selected program, when this button is selected, you will navigate to a preview of the listener interface.

By default, if there are no listener programs available or currently selected for a given listener profile, you will see this pop-up message: “No program has been selected. Please select a program”. You will need to select the *“Save-as” button* to create a new listener program.



Depending on the selected settings within “Adjustments”, the previewed button controls and behavior in the listener interface will be different. You

should see the listener interface somewhat similar to the example image below.



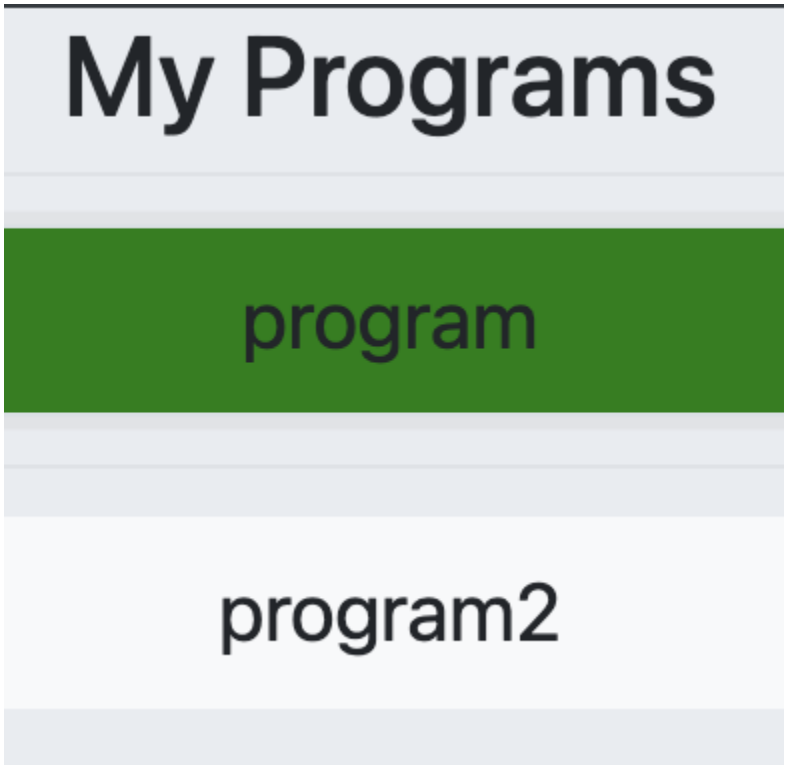
4.5 - Self Adjustment

How to navigate: Select “Goldilocks”, then “Self Adjustment”.

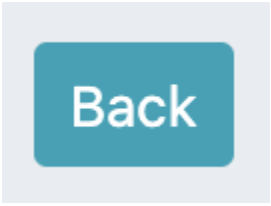
Once you have one or more listener programs created, you will see this interface in which consists of the following:

- Most recently selected listener profile, with its name shown.
- List of listener programs, with their names shown. By default, the most recently selected program from the Researcher Page would be

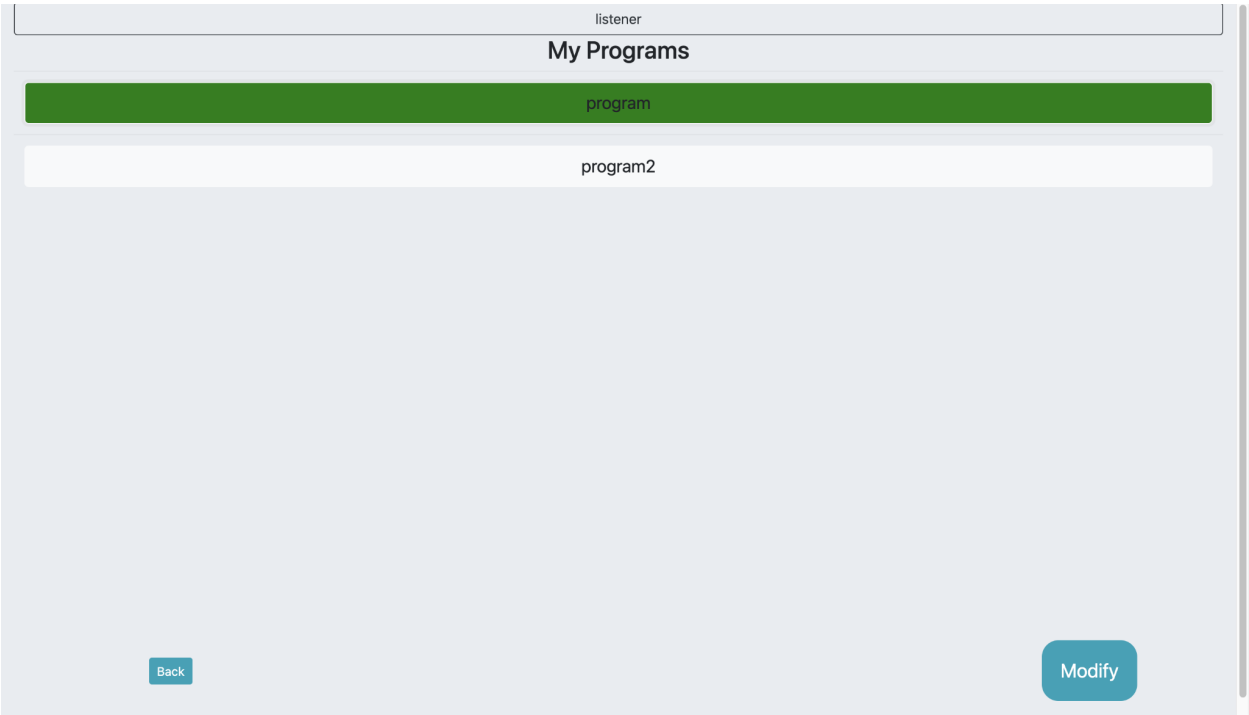
in dark green.



- A “Back” button in the lower-left corner that navigates back to the main page for Goldilocks.



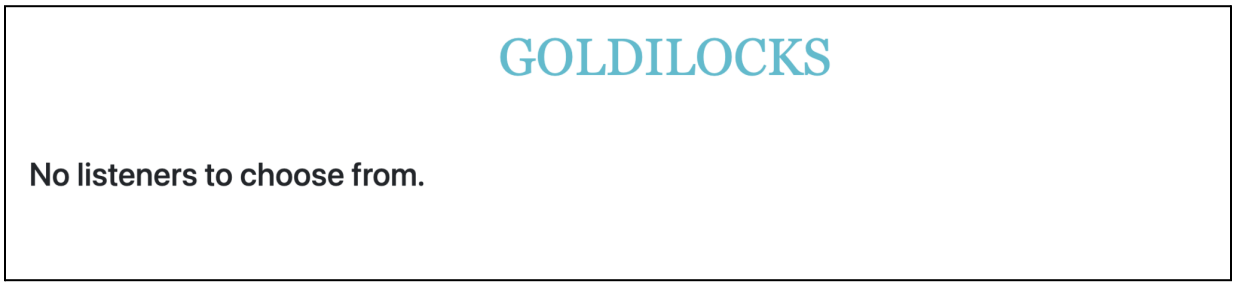
- A “Modify” button in the lower-right corner. When selected, this would show one or more set of button controls based on the settings created for the selected listener program from the Researcher Page.



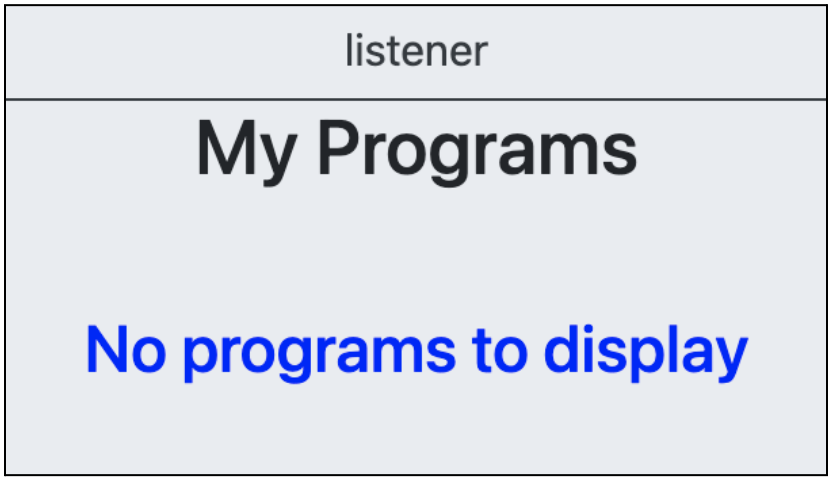
Default Self-Adjustment interface with an available listener profile and programs.

When you open this page for the very first time, you may instead see this interface with no available listeners. This is because you need to have created at least one researcher profile (covered in section "4.3.1 -

Researchers"), and at least one listener profile (covered in section "4.3.2 - Listeners").



If you have created a listener profile, but no listener program, you will see the message "No programs to display".

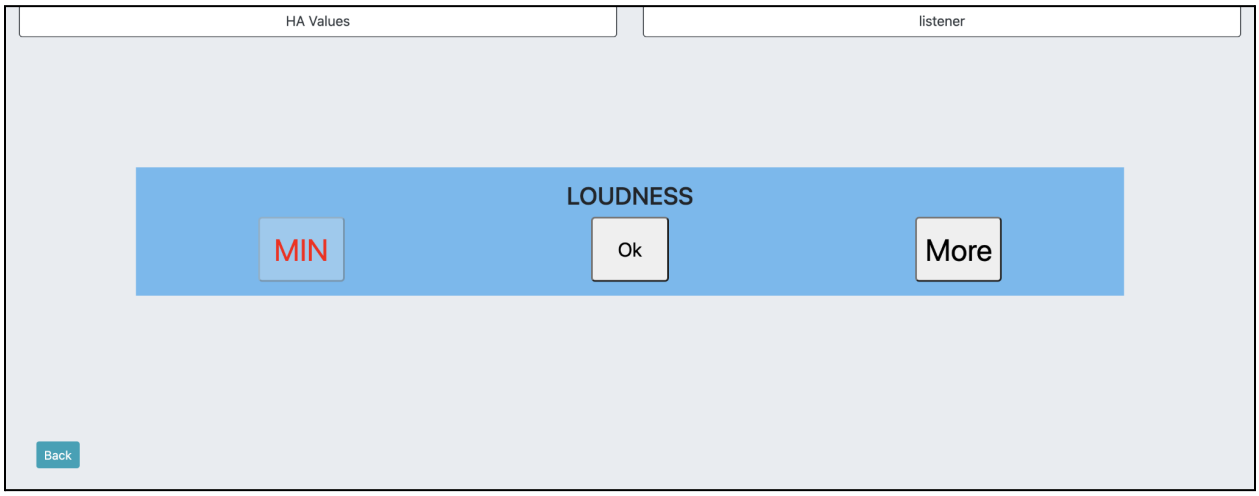


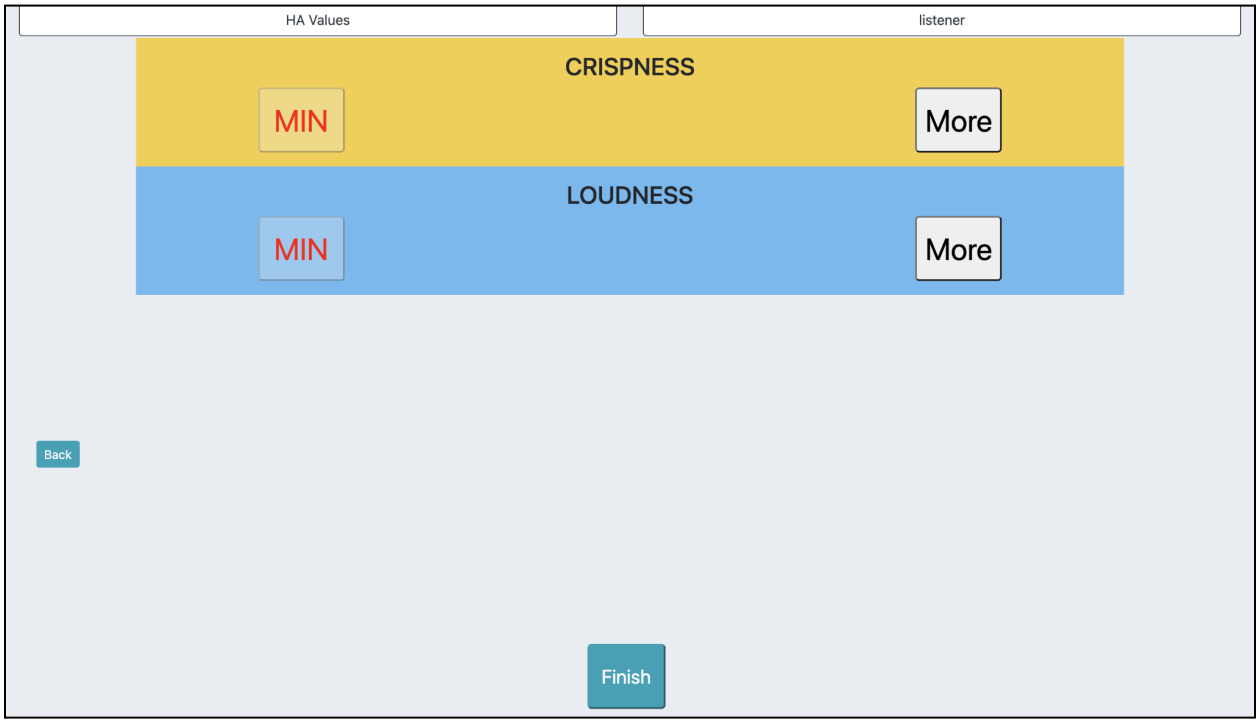
If you try to select the *"Modify" button* without selecting a listener program, you will see this error message "Please select a program".

For both cases, this means you will have to go to the Researcher Page and select the *"Save-as" button* to save the values for the parameters and bands as a new program.

4.5.1 - The Listener Interface

Once you select the "Modify" button from the main "Self Adjustment" page for a selected listener program, you will be taken to an interface that looks similar to one of the image examples below.




HA Values
listener
CRISPNESS
MIN
More
LOUDNESS
MIN
More
Back
Finish


HA Values
listener
CRISPNESS
Less
More
LOUDNESS
Less
More
FULLNESS
Less
More
Back
Finish

Note that from the Researcher Page, you can also preview this listener interface by selecting the corresponding listener program from the program button and selecting the "Continue" button.

Button Controls - Crispness, Loudness, Fullness

The three main button controls are grouped as "Crispness", "Loudness", and "Fullness", as substitutes to the parameters "L", "V", and "H" respectively.

The three main button controls are labeled as:

- "Crispness" (yellow) = Low-frequency output (cut or boost)
- "Loudness" (blue) = overall output/Volume
- "Fullness" (orange) = High-frequency output (cut or boost)

Each set of button controls usually contains two buttons that a listener can select, labeled "Less" and "More". The third one, labeled "Ok", may or may not appear, depending on the program's settings.

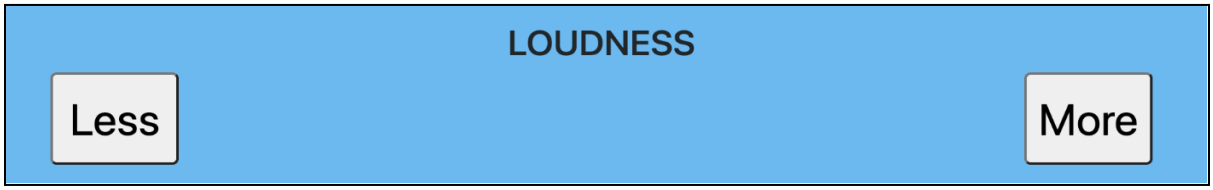
- "Less" button - decreases the low-frequency output, high-frequency output, or overall output
- "More" button - increases the low-frequency output, high-frequency output, or overall output

- “Ok” button - confirms the current low-frequency output, high-frequency output, or overall output and proceeds to the next set of button controls

“Crispness”

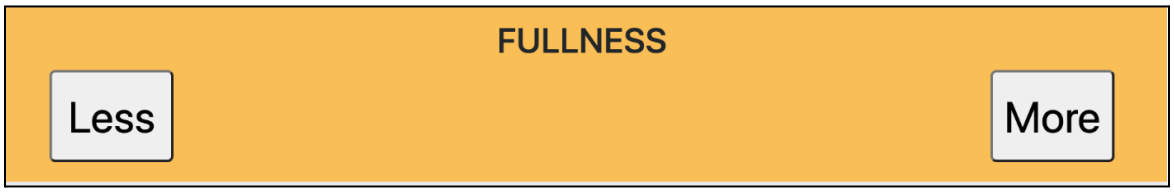
Definition	*Corresponding Parameter(s) in Researcher Page*
High-frequency output (cut or boost)	“H” and “H Mult” 

“Loudness”



Definition	*Parameter(s) in Researcher Page*
overall output/Volume	“V” V

“Fullness”

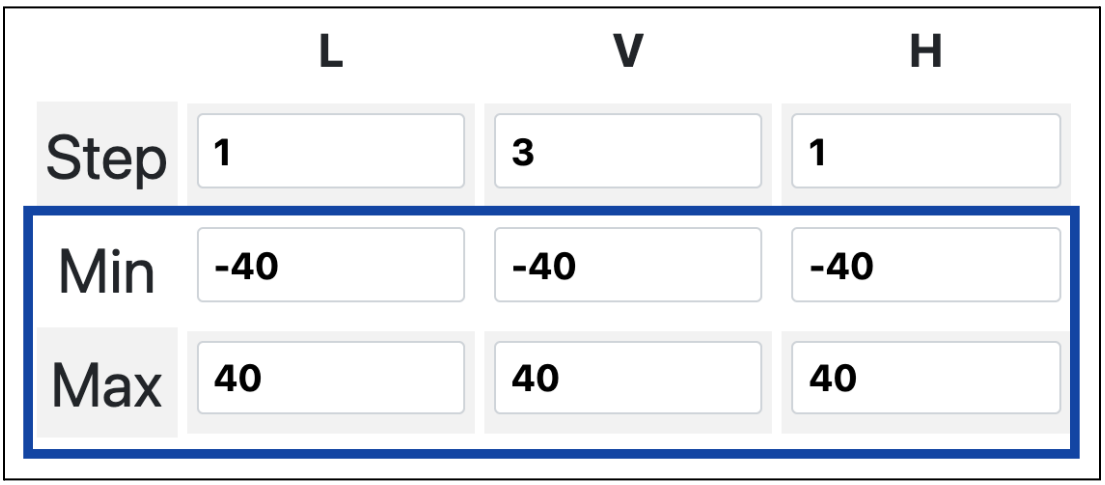


Definition	*Parameter(s) in Researcher Page*
Low-frequency output (cut or boost)	“L” and “L Mult” L L Mult

At some point, pressing the “Less” button enough times will change the button label to “MIN” and disable it, which can affect more than one set of buttons at the same time. Once disabled, the button cannot be selected until a listener selects a “More” button one or more times.

Likewise, pressing the “More” button enough times will change the button label to “MAX” and disable it, which can affect more than one set of buttons at the same time. Once disabled, the button cannot be selected until a listener selects a “Less” button one or more times.

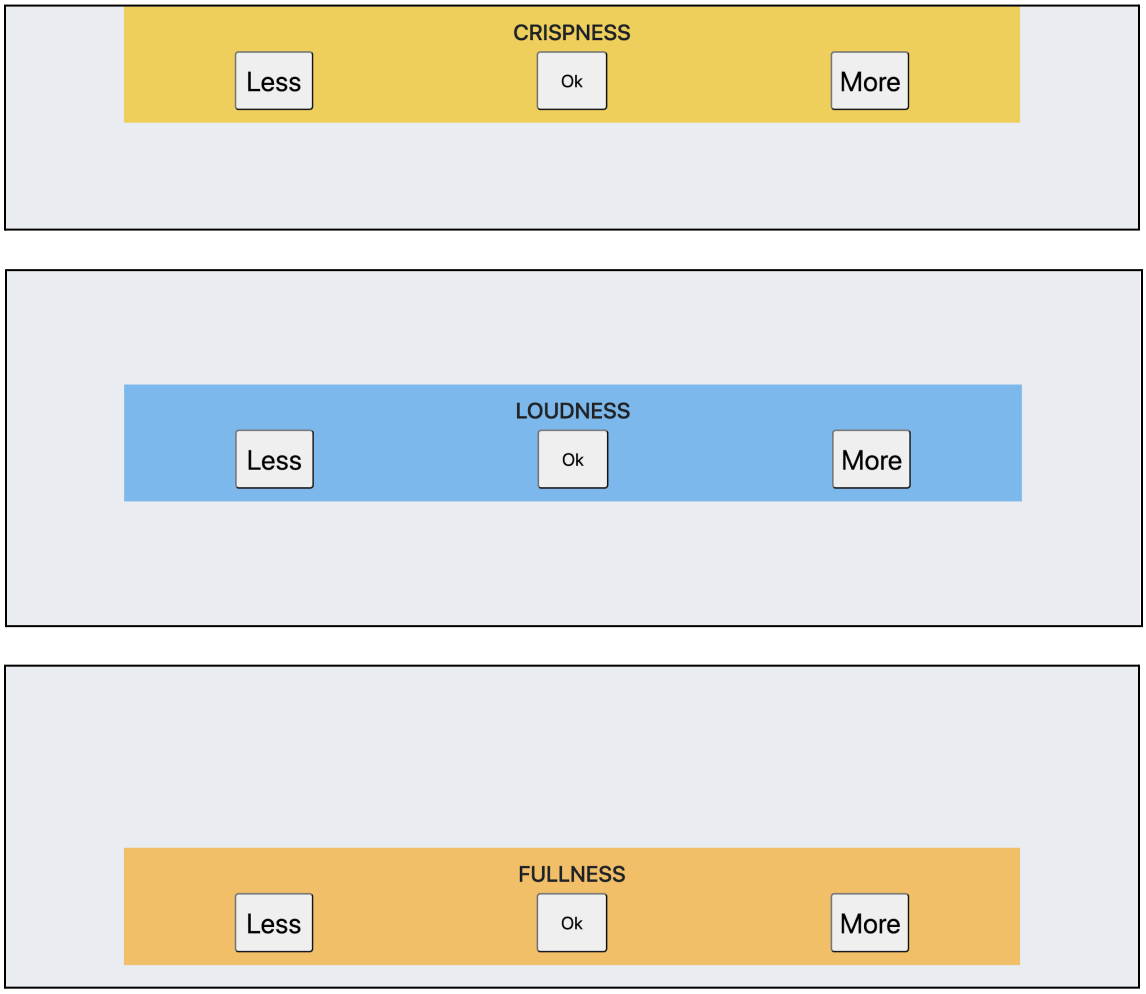
This behavior is affected by the “Min” and “Max” parameters for setting the minimum and maximum gain thresholds for “L”, “V”, and “H” in the Researcher Page. Increasing or decreasing the values will affect the listener’s ability to repeatedly select the “Less” or “More” buttons to increase or decrease in gain for “L”/Crispness, “V/Loudness”, and “H/Fullness”.



4.5.2 - Behavior of Button Controls

Depending on how the program is set, the experience of adjusting each set of button controls will be different. You may experience one of the following behaviors:

- You will see the button controls only appear one at a time. Usually, buttons for either “Crispness” or “Loudness” will appear first, followed by other button controls. In some cases, you may only see button controls for “Crispness” and “Loudness” only.

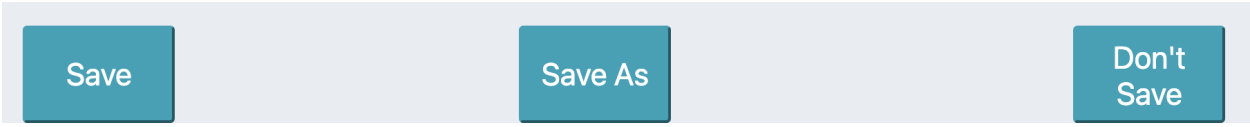


- You will be able to see and select all available button controls at once, without the “Ok” button and without having to select subsequent button controls. You may see “Loudness” only; both

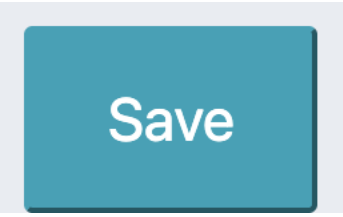
“Loudness” and “Crispness”; or all three button controls.

4.5.3 - Saving Listener Programs

You would continue selecting the buttons until the “Finish” button is selected. Once it is selected, three buttons will appear for different options for (not) saving the program.

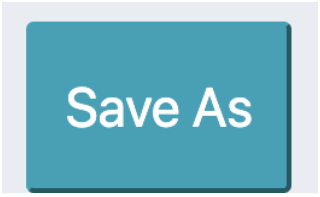


- “Save” button

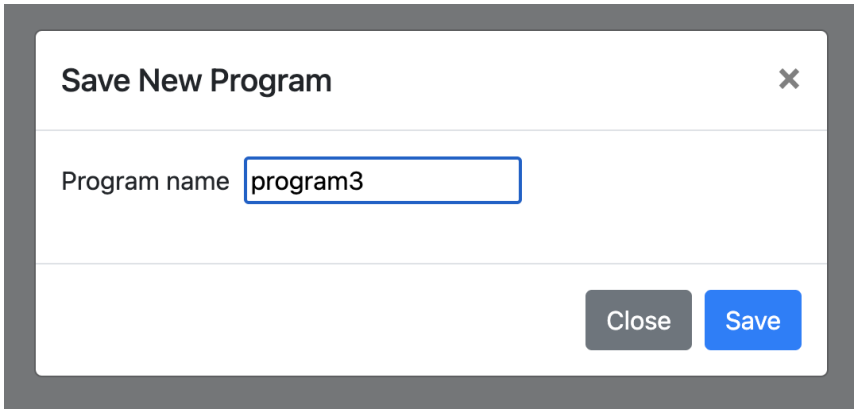


When selected, your program will be saved based on adjustments to the program from selections of the button controls. An alert message will appear confirming that the adjustments to the program have been saved.

- “Save As” button

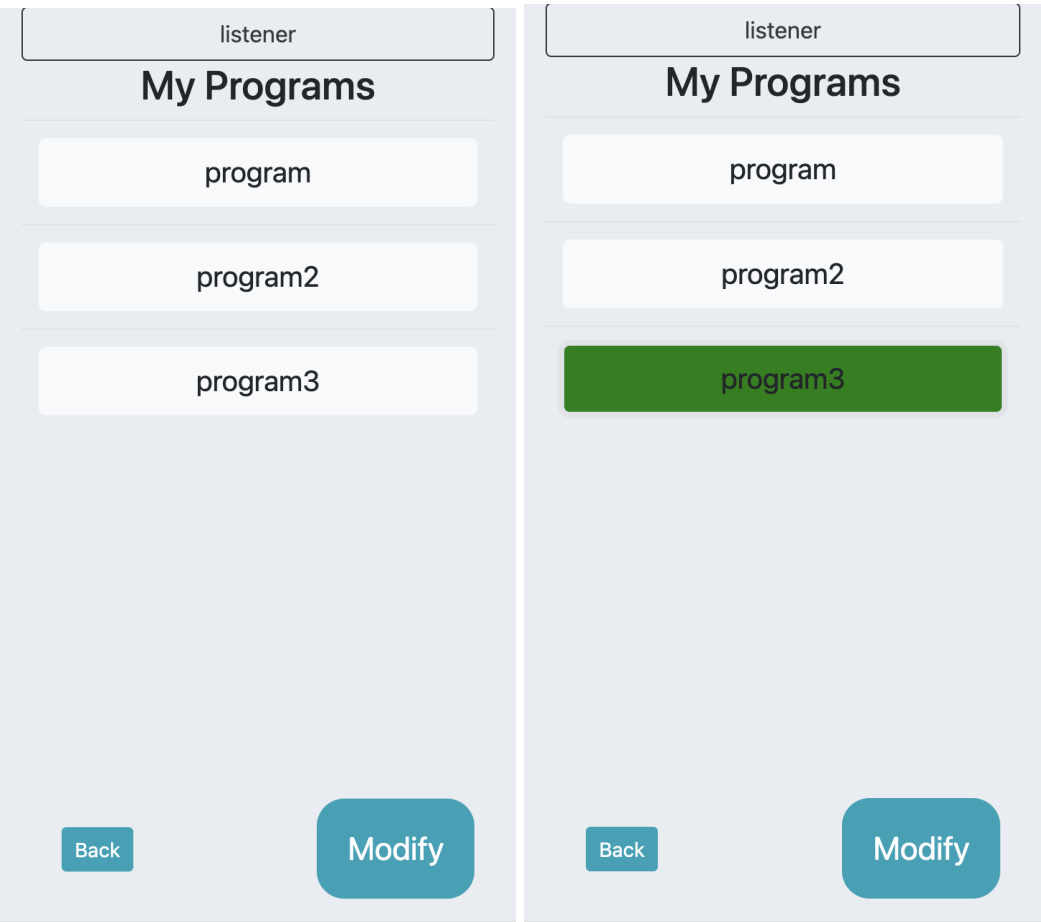


When selected, this allows you to save the program as a separate new program with a new name.



Selecting the “Save” button will take you back to the program

selection interface, with the saved program selected for use (shown in green).



Selecting the “Close” button or the “X” icon will cancel saving the new program.

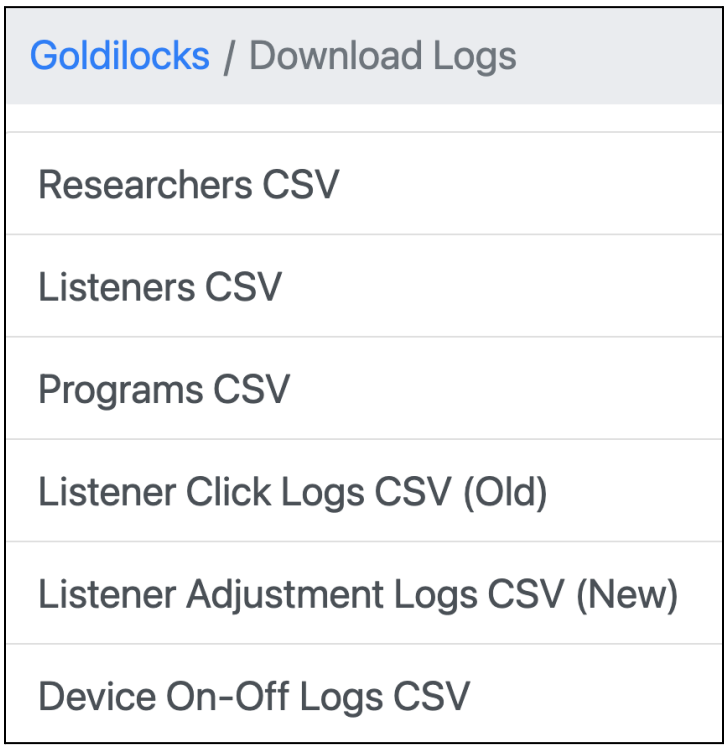
- “Don’t Save” button

When selected, the program selection interface will be shown again with the used program selected (shown in green).

4.7 - Downloadable Logs

How to navigate: Select “Goldilocks”, then “Download Logs”.

When you open this page for the very first time, you will see different types of logs available for download as .csv files.



Below explains what information is available to download.

- “Researchers CSV” - You are able to download all researcher profiles.
- “Listeners CSV” - You are able to download all listener profiles.
- “Programs CSV” - You are able to download all listener programs.
- “Listener Click Logs CSV (Old)” - You are able to download data associated with which interactions each and every listener performed within the listener interface.
- “Listener Adjustment Logs CSV (New)” - You are able to download data associated with changes that each and every listener made to their parameters within their listener program. These changes would occur from the interactions performed within the listener interface.
- “Device On-Off Logs CSV” - ...

5 - Resources

Below are hyperlinks to OSP-related resources:

- OSP Website - General information of OSP.
- OSP Forum - Community discussion of issues and suggestions for improving OSP.
- "Releases" folder in Google Drive - You will find downloadable .zip and installer files for OSP hardware and software setup. README documentation for each .zip file is included.

Installation steps for OSP hardware are covered more comprehensively in these separate guides below.

- “OSP Hardware - PCD Setup for macOS and Linux”
- “OSP Hardware - PCD Setup for Windows"

There are separate hardware guides for doing the sanity checks on the software. Below are more hyperlinks to hardware guides for installing:

- OSP Hardware Sanity Check Guide - Node.js Version of EWS - Guide to testing that the Node.js version of the embedded web server (EWS) within the PCD works as intended.
- OSP Hardware Sanity Check Guide - PHP/Laravel Version of EWS - Guide to testing that the PHP/Laravel version of the embedded web server (EWS) within the PCD works as intended.

If you want to simply download OSP software without the device, you may refer to the Software Getting Started Guide, which is a combined version of the following list of separate guides.

- Installation Requirements and Steps (included in the Software Quick Start Guide)
- Software Troubleshooting Guide - Covers steps for possible issues during OSP software installation.
- Software Sanity Check - Audio Input and Output Sources - Guide to checking that your audio input and output sources are connected for OSP software usage.
- Software Sanity Check - Node.js Version of EWS - Guide to testing that the Node.js version of the embedded web server (EWS) works as intended.
- Software Sanity Check - PHP/Laravel Version of EWS - Guide to testing that the PHP/Laravel version of the embedded web server (EWS) works as intended.

6 - Acknowledgments and Bibliography

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- The Qualcomm Institute

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