PHONLAB ULTRASOUND USER MANUAL

Ultrasound Equipment for Phonetics Research

for George Mason University's Phonetics Lab

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May 2022

Revision Sheet

Release No.	Date	Revision Description	Editor
Rev. 0	8/2/21	User's Manual Created	
Rev. 1	12/1/21	Fixed operations for new lab	Hannah Brennan
Rev. 2	5/5/22	Additional content to all sections	Hannah Brennan
Rev. 3	2/10/23	Modify format	Hannah Brennan

USER'S MANUAL

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1.0 GENERAL INFORMATION

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1.1 Introduction

This document is designed as a manual for researchers working with George Mason University's articulatory ultrasound materials. It will provide information on all of the equipment and software used for the data collection, as well as instructions for setting up and running said equipment. There are visual aids throughout the user's manual for the identification and set-up of various equipment and software. More general help regarding the equipment and the software can be found on the www.articulateinstruments.com website and the Articulate Instruments YouTube Channel.

Ultrasound research is a method of linguistic data collection focusing on the articulatory patterns of the tongue during speech. The ultrasound and accompanying helmet allow for non-invasive data collection with little to no discomfort for the participant.

Articulate Assistant Advanced (AAA) is the program used for ultrasound analysis (Articulate Instruments Ltd, 2012). This allows for a linguistic analysis of ultrasound data focusing on the internal structures of the mouth.

It should be noted that all of these materials are delicate and should be handled with care.

1.3 Materials

This section on materials will include definitions, usage, and tips for set-up for the equipment used in the Phonetics Lab. Further instructions on equipment set-up can be found in ***2.1 Setting up the Ultrasound***.

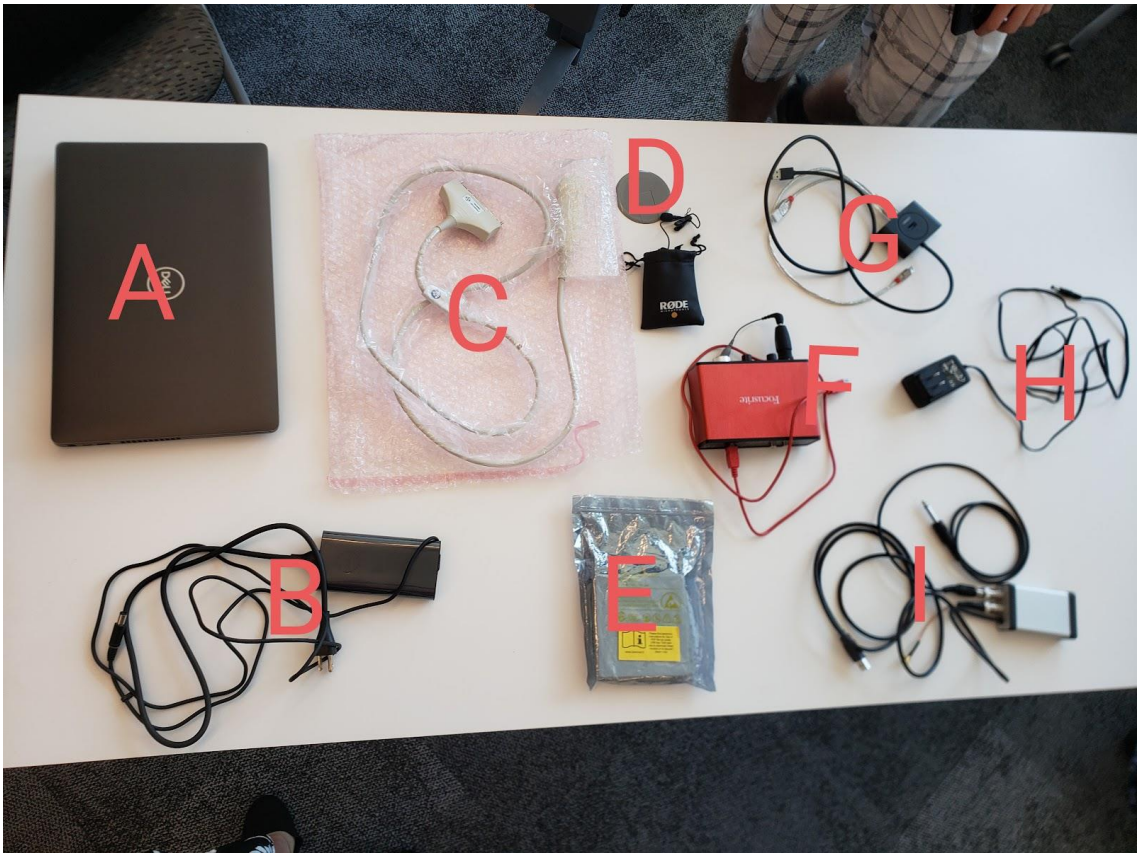
A. **Laptop**. Can be the one in the bag or your personal laptop, keeping in mind that it must have at least 3 USB ports.
B. **Laptop charger**. Must be charging connected to the wall. Specific to which laptop is being used.
C. **Ultrasound probe**. (US probe) Model: *MC4-2R20S-3*. Picks up the articulatory signal. Very delicate and very expensive. Lay it on the pink bubble wrap on the table whenever possible and remember to wrap it before putting it away.
D. **Microphone**. Picks up the acoustic signal. Cord is very thin, so be careful when untangling it. Include the microphone clip in order to affix the microphone to the helmet.
E. **Ultrasound**. (US) Model: *MicrUs EXT-1H*. Interprets the articulatory signal it receives from the *ultrasound probe (C)*. This piece is also very delicate and very expensive, but the ultrasound will be more stationary than the *ultrasound probe (C)*. When connected to the computer, either directly via USB or through the *USB hub (G)* (as depicted in ***1.2.1 Labelled Photos of Equipment*** - E to G), which transmits the articulatory signal from the ultrasound to the computer.
    a. Connected to wall socket with H cord as needed (i.e., if connected to the computer via USB hub).
    b. Connected to the *Communicator (I)* with the gold cord screwed onto the jack labelled "frame strobe."
F. **Focusrite Audio Box**. Interprets the acoustic signal it receives from the *microphone (D)*. Since this does not have an external power source, it must be connected directly to the computer (not to a USB hub).
    a. The *microphone (D)* should be plugged into the far-left jack, marked with a microphone symbol. The *communicator (I)* should be plugged into the middle jack, marked with a

guitar symbol. If using headphones or a speaker, that should be plugged into the far-right jack, marked with a headphone symbol.
    b. The knob on the left, by the microphone symbol, controls the power of the signal picked up by the microphone. Twiddling with it will increase or decrease the amplitude of the waveform on AAA.
    c. The knob in the middle, by the guitar symbol, controls the pulses.
    d. The big silver knob on the right controls the volume of the playback.
    e. When it's receiving a signal, the microphone volume knob (see *F.-d.*) should light up green in response to noise.

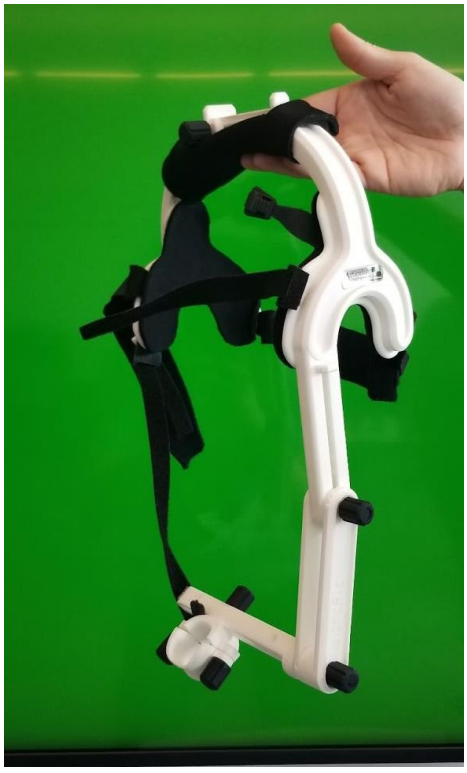
G. **USB hub**. Connects all USBs to the laptop that cannot connect directly. The setup will depend on which laptop you are using and how many USB ports it has, but the one pictured is based on the laptop that comes in the bag. *See **1.2.1 Labelled Photos of Equipment***.
    a. Do NOT connect *Focusrite audio box (F)* and *communicator (I)* to the USB hub, as they require a direct connection to the computer in order to have enough power to function.
H. **Ultrasound power cord**. Connects the *ultrasound (E)* to the wall.
I. **Communicator**. Allows the *Focusrite audio box (F)* and the *ultrasound (E)* to communicate with each other in order to sync audio and video. Since it doesn't have an external power source, it must be connected directly to the computer (not to a USB hub).
J. **USB key**. Allows access to the AAA software. Can be connected to the computer either directly via USB or through the USB hub.
K. **Helmet**. Holds the *ultrasound probe (C)* in the same position on the participant's neck, avoiding shifting that might skew data. See ***2.4 Helmet Set-up and Usage*** for more information.
L. **Ultrasound Gel**. Regular Bottle and small tip Squeeze Bottle for usage while participant wears the *helmet (K)*.
M. **Headphones/Speaker**. Used to review the acoustic data and check to make sure the ultrasound image and audio is synced.
N. **Auxiliary Materials.** These include Paper Towels, Sanitizer Wipes, Hand Sanitizer, Masks, Gloves. Auxiliary Materials may change depending on COVID-19 restrictions and the participant's comfort.

1.3.1 Labeled Photos of Equipment

This section contains images of the materials required for setting up the ultrasound.
Below is an image with the materials A-I indicated in ***1.2 Materials***.



Below is an image with the *helmet (K)* used for holding the *ultrasound probe (C)*.



2.0 GETTING STARTED

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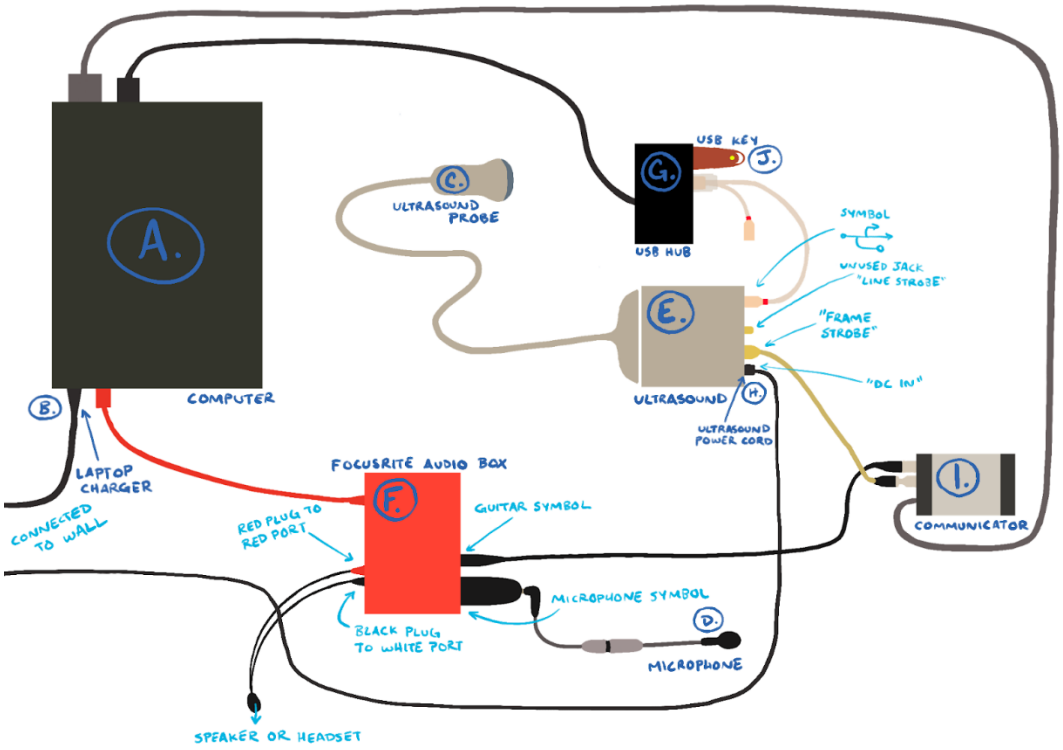


*Diagram of the completed set-up for all equipment. See **1.2 Materials** for references of material names and labels.*

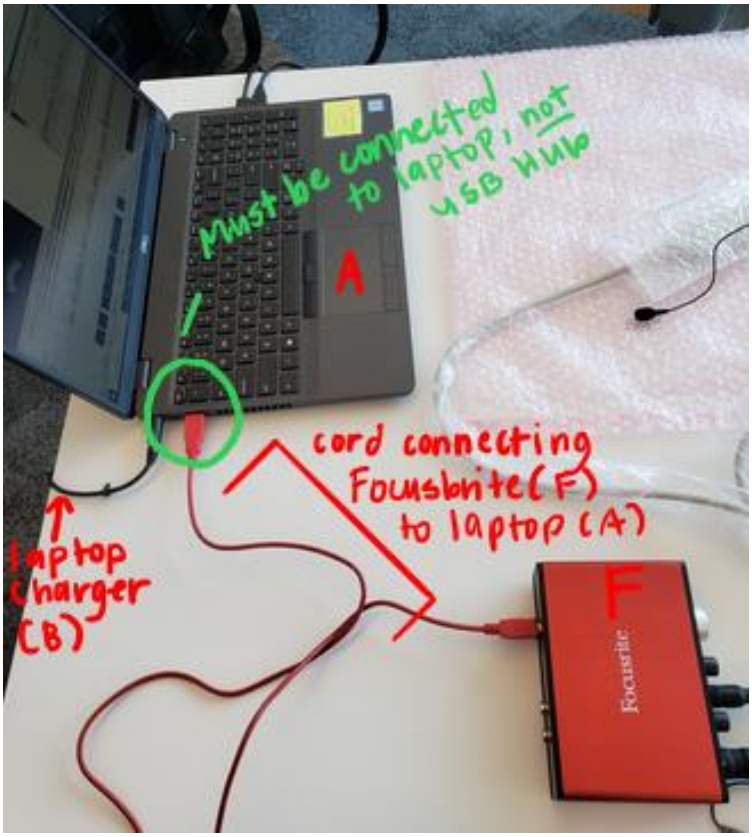
2.1 Set up the Ultrasound

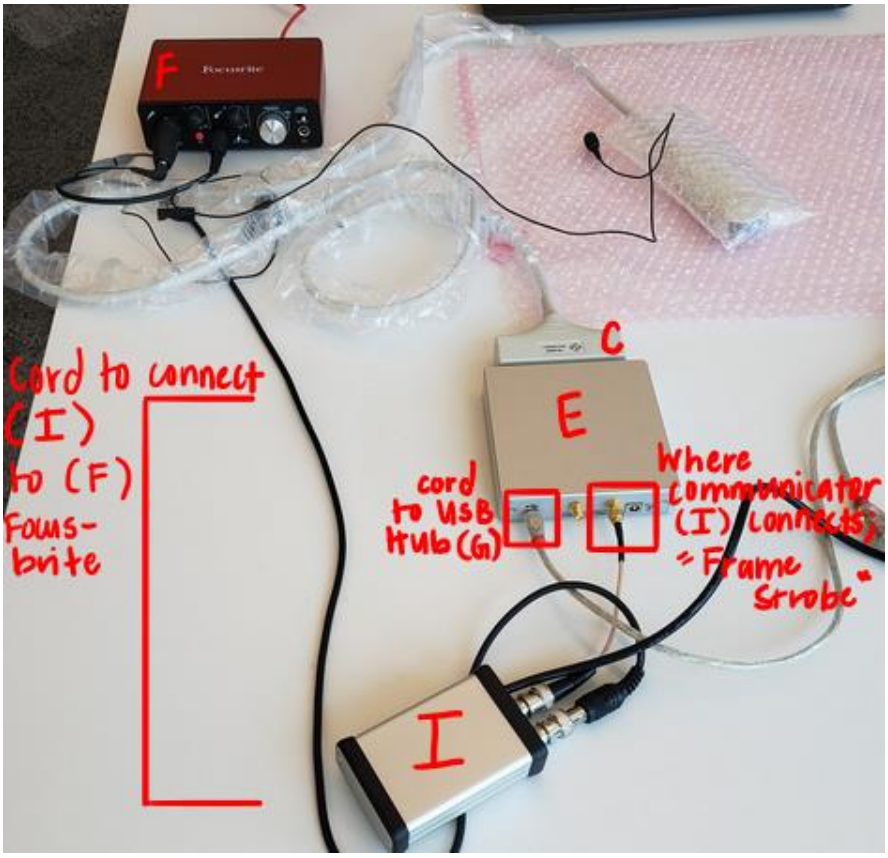
The ultrasound set-up is required to be the first task completed before a recording can begin. Without the competed ultrasound set-up, AAA will be locked to use.

1. Connect the Ultrasound (E) to the US Probe (C).
2. Connect USB Hub (G) (small end) splitter to Ultrasound's (E) USB port.
    a. If the computer being used has enough USB ports, connect everything directly to the computer and do not use the USB Hub. See step 4a.
3. Connect communicator (I) input to Ultrasound (E) at "frame strobe."
    a. This will enable the video/imaging from the ultrasound machine to communicate and sync with the computer and the Focusrite Audio Box (F).
4. Connect Ultrasound Power Cord (H) between Ultrasound (E) and the wall (if using a USB Hub).
    a. The computer will have limited USB ports. If the equipment does not have a charger, then it should be prioritized for laptop USB ports. If equipment has a charger, then the USB should be connected to the USB Hub rather than the computer. The USB Hub does not provide enough energy to power the ultrasound, and the other equipment does not have wall chargers.

2.2 Set up the Audio

1. Connect communicator (I) output to the Focusrite Audio Box (F).
2. Connect Microphone (D) to Focusrite Audio Box (F) at microphone (symbol).
3. Press 48V on Focusrite Audio Box (F) to turn on sound recording (will light up when on).
4. Connect the speaker's output cord to Focusrite Audio Box (F) at "line outputs" - red to red and black to white.
    a. "Line outputs" are located on the back of the Focusrite Audio Box.
5. Connect headphones or speaker to Focusrite Audio Box (F) speaker at the silver audio adapter and insert headphone jack.





2.3 Connect Computer

*See **3.0 Getting Started** for a diagram of the completed set-up.*

1. Connect Laptop charger (B) from the wall to Laptop (A).
2. Connect USB Hub (G) to a USB slot in Laptop (A).
3. Connect Focusrite Audio Box (F) USB to a Laptop (A) USB slot using the red USB cord.
4. Connect communicator (I) to USB at Laptop (A).
5. Connect USB Key (J) to USB Hub (G).

2.4 Helmet Set-up and Usage

The helmet is made to be non-restrictive and comfortable to wear but will regardless be a nuisance for participants to wear. The participant should be allowed the opportunity to read over the stimuli prior to putting on the helmet (if the study permits) in order to limit the amount of time in the helmet.

1. Secure the probe into the helmet. The vertical line, indicating the back of the tongue, should be nearest to the participant's neck, and the horizontal notch, indicating the tip of the tongue, should be facing away.
    a. Knob to adjust the probe left-to-right should be pointed away from the participant's neck, with the US Probe (C) closest to their chin and neck.
2. Sanitize probe and helmet.
3. Explain to the participant how the headset works and how it will fit on their head.
4. Ask the participant to pull up hair/remove glasses, etc.

5. Put the helmet on, ask the participant to hold it to head at a comfortable tightness and adjust the top.
    a. Put glasses back on before tightening the helmet.
    b. The helmet should not wobble, or else the ultrasound image will be compromised.
    c. If needed, ask the participant if they can hold the probe as you adjust the helmet
6. Tighten the back strap.
7. Tighten the front strap.
8. Center the ultrasound probe to bisect the face. Use the black knob located nearest the participant's throat.
9. Put gel on the probe.
10. Make sure the US image on AAA is visible to you but not the participant for adjustment. Raise probe to neck and adjust left/right, up/down, forward/backward for a good image.
    a. "*Can you move your head around and say 'aah?'"*
11. Attach the Microphone (D) to the microphone strap so that it is not touching anything and adjust as needed. If it is touching their skin or hair when on the strap, attach it to the participant's shirt.

2.4.1 Adjust Ultrasound Image

1. The ultrasound probe should be centered under the face. The vertical line, indicating the back of the tongue, should be nearest to the participant's throat.
2. The image should show the shadows for both the mandible (right) and the hyoid (left). To adjust the image, rotate the probe using the lowest black knob on the arm of the helmet.

    Note: It is preferred to see more of the tongue tip than of the tongue back, so, if necessary, prioritize having the mandible shadow in view.

2.4.2 Reapply Gel

1. Ask the participant to grimace/smile and tilt their head slightly upwards without skewing the image.
2. Apply Ultrasound Gel (L) with a small tip "squeeze bottle".

2.4.3 Remove Helmet

1. To begin, remove the microphone from the microphone strap or the participant's shirt and undo the Velcro microphone strap.
2. Unscrew the length arm of the helmet - this will allow the participant to no longer have the pressure of the US Probe (c) on their chin/jaw.
    a. Have the participant or another researcher hold the probe while working to undo the rest of the helmet.
3. Loosen the lowest screw on the arm to allow the US probe to rotate. This will prevent the probe from hitting the participant in the face when removing the helmet.
4. Undo the front (forehead) and back straps.
5. Move to the top of the head and unscrew the top adjustment.
6. At this point, lift the helmet up and over the head, keeping a hand moving with the probe.
    a. If the participant had placed their glasses back on, it is recommended to have them remove them again before lifting the helmet off their head to avoid hitting the glasses.
7. Offer the participant paper towels to wipe the ultrasound gel off their chin.
8. Wipe down the probe with a paper towel and sanitize it as well.

4.0 ARTICULATE ASSISTANT ADVANCED

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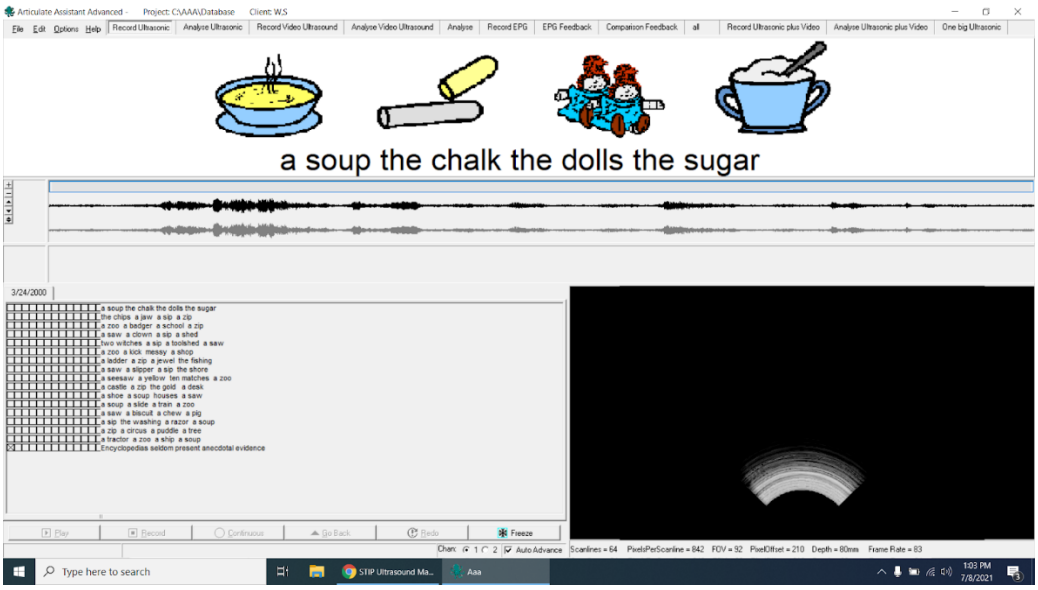
3.1 Set up the Software

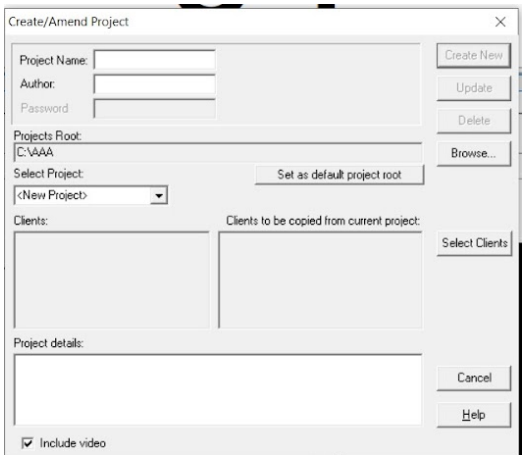


This is the screen that will appear when Articulate Assistant Advanced (AAA) is opened. You will not be able to record yet.

3.1.1 Create a New Project

1. Open AAA
2. "File" > "Create/Copy Project"
3. "Select Project" dropdown box must be on "<New Project>"
4. Input necessary information in white boxes
5. "Create New" > New pop-up box will appear to create first client
6. "Family Name" is the only required box
7. Click "OK"

   View this video for additional help in both opening a new project and understanding the general interface (Articulate Instruments, 2015).

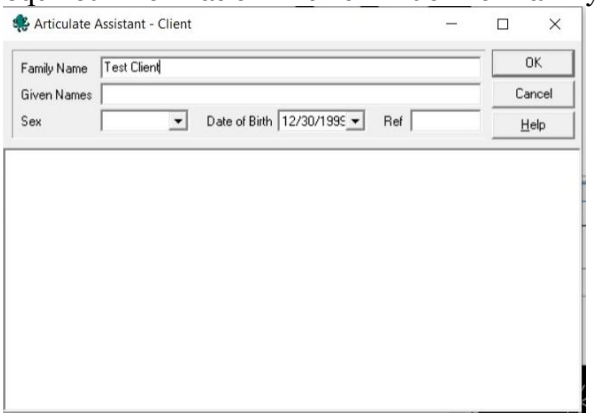


3.1.2 Create a New Client

Each participant will require their own "client" or profile under the selected project.

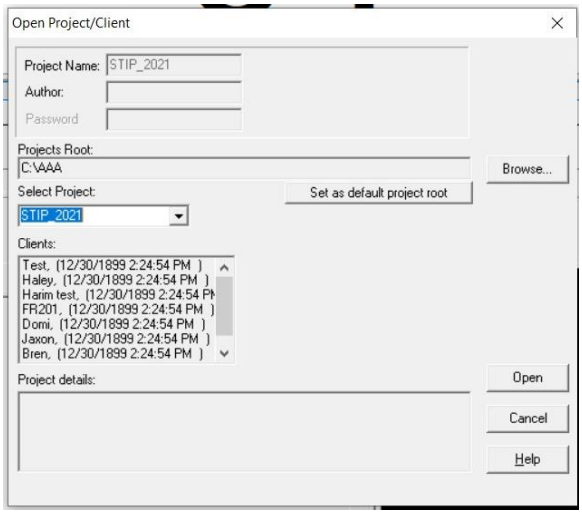
1. Open the current project using the instructions in the section above
2. File > New Client
3. Input the necessary information (i.e., participant's code or another identifier)
4. "OK"

Note: the only required information in this window is "Family Name."



3.1.3 Open a Project

1. Open AAA.
2. Select "File" > "Open Project/Client".
3. Under "Select Project", where it says "Database", choose your current project.
4. Under "Clients", select the participant's name/ID code.
5. Click "Open".



3.1.4 Modify a Project

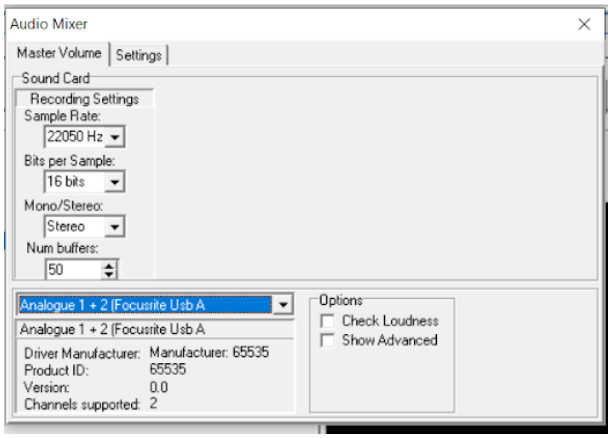
1. Select "File" > "Create/Copy Project".
2. Select the project you wish to modify in the "Select Project" dropdown box.
3. Edit necessary information and click "Update".
4. A confirmation pop-up will appear, select "Yes".
5. A new pop-up will appear: "Do you want to copy all your prompt lists from this project as well?" Click "Yes" to have all prompt lists remain consistent with previous project.

3.2 Recording

3.2.1 Before Recording

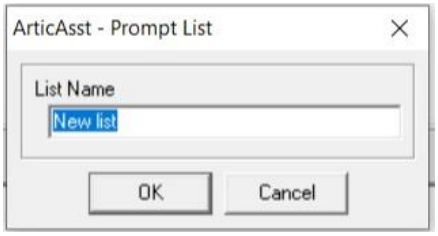
Add Pulse to the recording.

1. Select “Options” > “Audio”.
2. On the bottom left dropdown menu, select “Analogue 1 + 2 [Focusrite Usb A]”.
3. Once selected, you can close the “Audio Mixer” window.



Edit Prompt List.

1. Select “Edit” > “Prompt List”.
2. Once the list is open, edit the numbers/prompts as needed.
3. Select “Add” and then “OK”.
4. “Save” in pop-up box.
5. Close the window.



Create New Prompt Lists.

1. Select “Edit” > “Prompt List”.
2. Select “List” > “New”.
3. Change List Name in pop-up window.
4. Select “OK”.

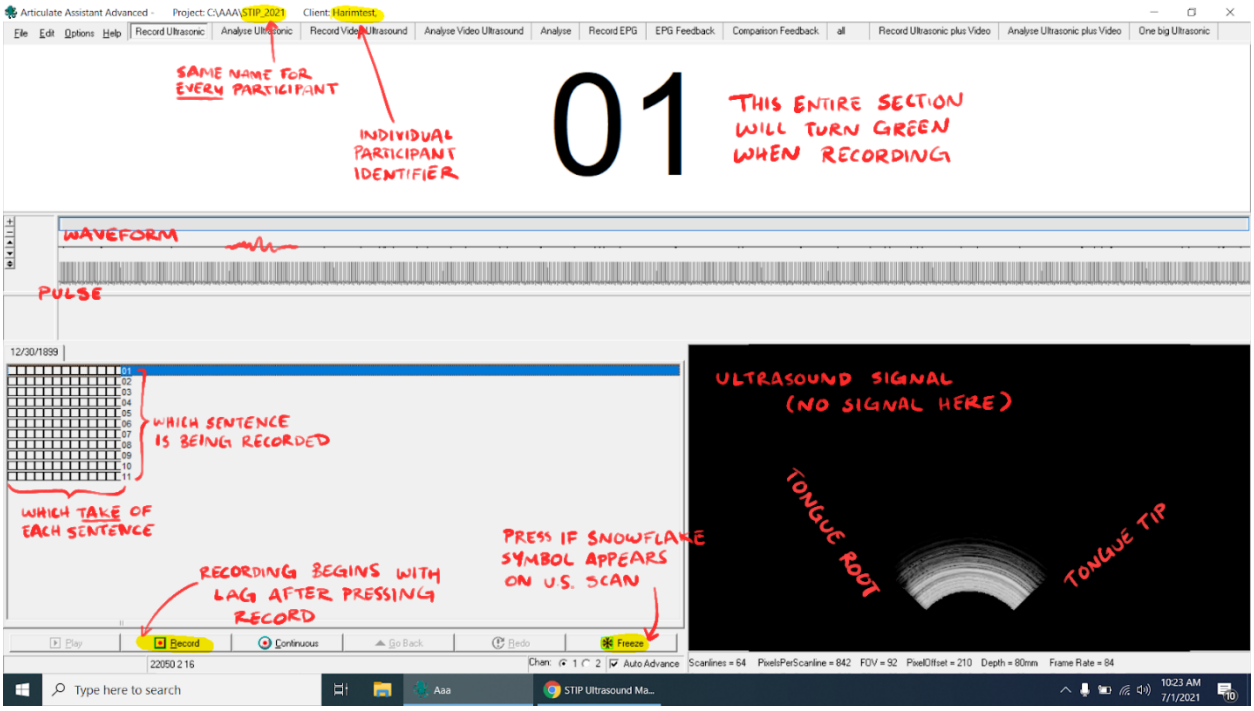
    Note: with more than one prompt list, individual clients can have different prompts within one project. This is a useful tool if stimuli randomization is necessary.

Check that the audio is working using the knobs on the *Focusrite Audio Box (F).*

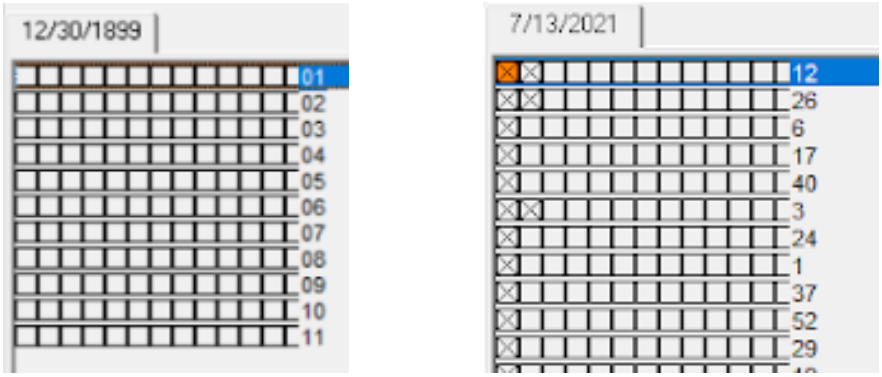
1. The left-most knob (near the microphone symbol) should light up green when speaking into the mic (the AAA waveform should also change when speaking into the mic)
2. The middle knob (near the guitar symbol) controls the pulse on AAA. Keep it in the middle (so the pulse on AAA isn’t too big or small)
3. The large silver knob on the right labelled “monitor” controls the playback volume. Turn it up and see if there’s a static sound coming through the headphones; that means it’s working.

Remember to turn it back down before you start recording, or else the static may interfere with the recording.

3.2.2 Recording



1. Select the first empty box from the row labelled with the stimulus you are recording.
   Note: AAA won't highlight the box that's selected! If you select a used box it'll be highlighted in orange.
2. When you're ready to begin recording, press "record." The white area around the large prompt number at the top will turn green when recording. If the participant completes the sentence before the 9 seconds are up, press "stop;" if not, it will stop on its own.
3. When you stop recording, AAA will automatically move to the first box of the next prompt. If you want to record another take for the previous prompt, manually select the next empty box in that previous row.
   a. *Spaces containing a recording will have an X in the box.*



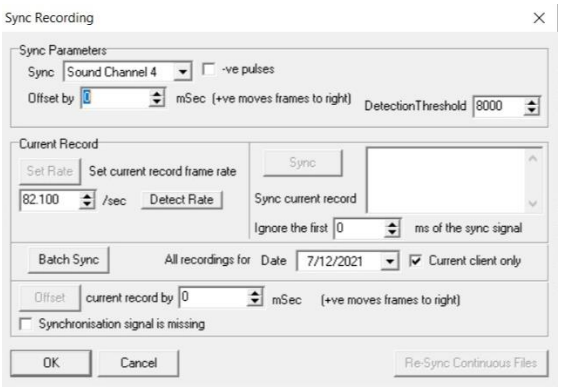
3.2.3 Troubleshooting

Error Message about not having USB Key connected.
USB Key may not work depending on the USB slot it is connected to. On the USB Hub, it would be best to switch it around. USB Hub prefers that slot 2 is filled before slot 3. If the USB Key is plugged in correctly and the program still does not recognize it, try restarting the program and/or the computer.

Ultrasound probe signal not going through.
Here are a couple of things to try:
Switch the USB dongle connected to the USB hub from the ultrasound. The cord has two "heads," but it will only work if the middle "head" is used, and the final "head" is not. There should be a cap on the USB that won't work.
Close AAA and open the program back up again.

Ultrasound Frames do not match up with the audio.
The ultrasound frames need to be synced with the Focusrite audio.

1. Right click the ultrasound image/video in the top left of the screen
2. Ultrasonic Setup > Sync Recording
3. Under "Current Record", click on "Detect Rate" and then "Set rate"
4. Click "OK"



Microphones do not collect sound.
If the microphone does not seem to be working, check that it is fully plugged into the Focusrite Audio Box, and that the Focusrite Audio Box is turned on (the 48V button next to the microphone port should be glowing red).