

Habit EEG Instructions

Updated by MM 12/15/22

Needs:

- Pre-scan screen
- EEG run sheet
- Post-scan questionnaire
- Payment certificate
- Vincent card
- Parking validation

Supplies needed at the EEG lab:

- A/D box
- Syringe with special plastic tip
- SignaGel electrode gel
- Sticky washers
- Seven external electrodes
- CMS and DRL electrodes
- Four ribbon cables of electrodes
- Alcohol prep pads
- Tape measure
- EEG cap
- Velcro straps
- Medical tape and coband tape
- Towels and washcloths
- White plastic bin
- EEG cleaning brush + soap

Meeting the subject:

1. Subjects can park at the **Medical Arts Garage, 115 Atwood Street** or **UPMC Presbyterian Garage**, located at **255 Lothrop Street**
2. Have subject call your office phone once they arrive at the building and meet them in the lobby and walk them up to 1st Floor
3. Parents can either wait in the lobby, or can leave Loeffler but would need to be let back in by one of the RA's
4. Have subject leave belongings in control room (132) and then bring them into the testing room (134)
5. Administer the **pre-scan screen** to the subject
6. Have the subject use the restroom and remove any heavy clothing like jackets. They should avoid bringing their cell phone or Apple watch into the shielded room but other metallic objects (belts, etc.) are fine

Setting up the shielded room:

1. Prepare the seven flat external electrodes by placing a **washer** (two-sided sticky circle) on each, with the blue tab facing down toward the cable. Leave the side that will be adhered to the subject's skin covered for now
2. Retrieve the **A/D box** from the control room; it should be plugged into the power supply when not in use so that the battery attached to the bottom of the A/D box can charge
 - a. The A/D box receives signals directly from the electrodes and performs analog-to-digital conversion
3. Locate the **orange fiber optic cable** hanging in the shielded room and plug it into the A/D box. The cable is important and delicate so be careful. Set the A/D box aside for now
 - a. The fiber optic cable transmits data from the A/D box to the receiver box outside of the shielded room, which then transmits data to the acquisition computer via a USB cable
4. Prepare the special syringe(s) by filling with **SignaGel** electrode gel

Fitting the subject with the cap and attaching the external electrodes:

1. Seat the subject in the wooden chair in front of the computer screen
2. Give the participant a rundown of how the visit is going to go:
 - a. First ask the participant if they have had an EEG before
 - b. Regardless of yes or no to previous question explain the set up first:

Script: "So first we will get the cap and electrodes all set up. Set up takes about 20 minutes so you can hang out on your phone during that time. You can also pick out a movie or TV show that you would like to watch while we set you up. The set up consists of us taking measurements of your head so we know which size cap will work best. During the scan we use what are called external electrodes which are little stickers that go on different parts of your face to measure your muscle movement. So if you blink, yawn, etc. we understand what it means in the data. After that we will get the cap on and make sure that it is nice and centered on your head. Then we will fill the cap up with gel and plug in the electrodes. Once the cap is all set up and good to go you will complete the EEG which takes about 45-50 minutes. You will do some eye tracking games, the button glove task, and a couple auditory tasks where you will sit back and listen to some sounds. After those tasks we will come in and get you all unhooked. We will get you a towel and you can use the bathroom sinks to hopefully get most of the gel out of your hair (you may need to go home and take a shower to get it all out. After that we will have just a couple post-scan questions for you and then we will get you paid and get you out of here. Do you have any questions?"

3. Use the tape measure to determine the circumference of the subject's head, using the **nasion** (intersection of the frontal bone and two nasal bones) and **inion** (the most prominent projection of the occipital bone at the posteroinferior part of the skull) as anterior and posterior landmarks, respectively; this will determine the size of the EEG cap to use
 - a. Cap size is given as a range (e.g., 54-58cm) and can be found on the tag inside the cap
 - b. If the subject is between sizes, try the smaller size first; the cap should be snug against the subject's head but not uncomfortably tight
 - c. Record the head circumference and cap size used on the run sheet

- d. **Script:** “First we are going to measure your head to make sure we have a cap that fits nicely for you.”
- 4. Try the cap on the subject to ensure it’s a good fit, then remove it for now
 - a. Let the participant know that if the cap is too tight we can try a larger size, or if the chin strap is uncomfortable we can always put a paper towel underneath to try to cushion it.
- 5. Use the alcohol prep pads to clean off the areas of skin where the external electrodes will be attached (behind the ears, on either side of the eyes, above and below the right eye, and the bridge of the nose)

Script: “Next we are going to have you use this alcohol wipe to wipe down a couple spots on your face to help the external electrodes stick better”

- 6. Attach the **external reference electrodes (1-6):**
- 7.

Script: “Next we are just going to start placing the external electrode stickers on the places you just wiped down”

- a. Use the syringe to place a small amount of gel in the recessed area of the electrodes; the gel should be flush with the surface of the electrode
- b. Peel off the covers of the washers and place the sticky sides down against the **mastoid bones** behind the subject’s left (**EXG1**) and right (**EXG2**) ears
 - i. The wires of the electrodes are very sensitive, so always hold the electrode by the plastic casing when peeling off the sticker backing
 - ii. The electrodes should be placed in approximately the same spot on each side
- c. Place the **HEOG electrodes (3 and 4)** on either side of the subject’s left (3) and right (4) eyes, roughly in line with but not touching the corners of the eyes
 - i. These will measure horizontal eye movements and are critical for the MGS task
- d. Place the **VEOG electrodes (5 and 6)** above (5) and below (6) the subject’s right eye, roughly in line with the pupil
 - i. These will measure vertical eye movements
- 8. Place the cap back on the subject:
 - a. Place the front of the cap along the subject’s forehead and ask them to hold it there
 - b. Stretch the cap around the back of their head, doing your best to get all of the electrode holders flat against the scalp
 - c. Pull the small tag on the back seam of the cap down so that it’s outside of the cap and not interfering with any of the electrode holders
 - d. **Script:** “Now we are going to get the cap back on for you”
 - i. Ask subject if cap still fits okay
- 9. Adjust the cap so that the **Cz** channel is in the center of the scalp:
 - a. Use the measuring tape to measure across the subject’s head from left to right using the **pre-auricular points** as landmarks; Cz should be in the center. Adjust the cap if it is not
 - b. Use the measuring tape to measure across the subject’s head from front to back using the **nasion** and **inion** as landmarks; Cz should be in the center. Adjust the cap if it is not

- c. Visually inspect the channels along the midline to ensure they are roughly in line with the subject's nose. Adjust the cap if they are not. You may need to measure for Cz again if you make any drastic adjustments
- 10. Fasten the cap's chin strap around the subject's chin, moving their hair out of the way if necessary
 - a. The chin strap will be uncomfortable at first, but the subject will acclimate to it after some time; however, if they find it particularly bothersome, you can place a paper towel between the subject's chin and the strap (per Pete, although it seems counterintuitive to stick more stuff in there, it actually helps)
- 11. Make sure any electrode wires are out of the way, and then have the subject scoot their chair up to the computer desk so that the arms of the chair are against the edge of the table (they may do this later but it's easier at this point, before they have a bunch of additional wires on their head)

Filling the electrode holders in the cap with gel and inserting the electrodes into the cap:

1. **Script:** "Next we are going to start filling up the cap with gel. We will be using these plastic syringes. You will feel us go down to the top of your scalp and swirl our way back up as we fill them with gel. The syringes are plastic so they shouldn't hurt but if we are scratching the top of your head please let us know."
2. Place the syringe inside one of the channels and swirl it around a few times to move hair out the way, until you make contact with the scalp
3. Press the holder around the channel down firmly against the subject's scalp and begin filling the channel with gel by pressing down on the syringe, moving the syringe tip up and out of the channel as you go
 - a. The goal is to create a "column" of gel inside the channel that is making good contact with the subject's scalp
 - b. The channel should be about 75-95% filled with gel; it's important not to overfill the channel, as this may cause the gel to squidge out around the holder on the interior side of the cap and start running down the scalp, resulting in signal carry-over (vs. localization)
 - c. If you get some extra gel on the exterior of the cap, scoop it up with the side of the syringe tip and wipe it off on a paper towel
4. Repeat this process until all of the channels have been filled with gel; it helps to fill the channels in "rows" to minimize the chance of skipping over any of them
5. Once the channels have been filled with gel, begin plugging the ribbon cables of electrodes into their respective locations on the cap
 - a. Electrode names reflect location:
 - i. Odd numbers are on the subject's left
 - ii. Even numbers are on the subject's right
 - iii. "Z" is along the midline
 - iv. C = Central; F = Frontal; P = Parietal; T = Temporal; O = Occipital
 - v. Larger numbers are farther from the midline

- b. The electrodes should easily “snap” into the holders; if they don’t snap, you may need to add some extra gel to the channel to make sure the electrode is seated properly
- c. As you plug in the electrodes, try to keep the electrode wires organized (i.e. angled backward) so that they can easily be gathered at the back of the subject’s head and the ribbons can be plugged into the A/D box
- d. The two grounding electrodes (**CMS and DRL**) are located on individual wires and can be plugged into the cap last
- e. Attach the remaining **external electrode (7)**:
 - i. Repeat the process of filling each recess in the electrode with gel and removing the sticker backing for the remaining five electrodes
 - ii. Place **electrode 7** on the bridge of the nose and tape it down with a bit of medical tape, as it has a tendency to slide off
 - iii. When attaching the electrodes, make sure all of the wires are organized neatly (i.e., angled down and backward) and that neither the electrodes themselves or the wires are interfering with the subject’s vision

Setting up the A/D box:

1. Organize the cables to be plugged into the box:
 - a. Gather the four bands of ribbon cables at the back of the subject’s head and stack them in the order in which they will be plugged into the A/D box, from A-D, with A on the bottom and D at the top
 - b. Remove the plastic covers from the ends of the ribbons and set aside
 - c. Gather the individual electrode wires and wrap this bundle around the four ribbons; this helps stabilize the cables as well as reduces noise by allowing the opposing magnetic fields to cancel
 - d. Wrap a couple of black velcro bands around the entire bundle for extra support
2. Position the green swivel chair behind the subject’s chair, with the backs of the chairs touching one another
3. Drape the bundle of cables over the back of the swivel chair, leaving some slack on the other side in case the subject moves their head forward. Tape the bundle to the back of the swivel chair
4. Place the A/D box on the seat of the swivel chair and plug the cables into the appropriate spots

Troubleshooting the electrode connections:

1. In the control room, visually inspect the channels using the **ActiView705** software
2. If there is global, high-frequency noise, this indicates that there is not a closed circuit inside the shielded room; ensure that the subject’s feet are flat on the floor, they do not have a cell phone with them, the fan is unplugged, etc.
3. Note down any individual channels that look noisy; usually filling the channels with a little extra gel will be sufficient to fix this. You can also use the prep gel to clean out tricky channels with a q-tip and then add more gel.

4. If you are having problems getting a good signal from CMS and DRL (either indicated by a blinking blue light on the A/D box, or a solid blue blue light but noisy channels):
 - a. Tear off a few inches of medical tape and pull the tape taut across the two channels; fasten the tape on either side. This can help put a little pressure on the electrode holders and get them closer to/flatter against the scalp
 - b. If the pressure from the medical tape is not sufficient, tear off a piece of the stretchy coband tape that is long enough to wrap around the subject's entire head at least once or twice; wrap the tape turban-style around their forehead and the back of the head, placing the tape over top of CMS and DRL at the back

General data collection instructions:

1. Click start (>>>)
2. Start the file
3. Insert the file name three times
4. Unpause the recording (the tasks will do this automatically)
5. Stop the recording at the end of each task (if the task does not trigger this automatically); open a new file for the next task by repeating the steps above

Running the scan:

1. EOG calibration

- a. On the acquisition computer, create a file named **[Luna]_[Date]_eyecal**
- b. On the presentation computer, open the **eeg eye_cal** application on the desktop
- c. Enter **[Luna]_[Date]** in the subject ID field
- d. Let the subject know that they will see a series of dots appear on the screen; they should look at each dot until a new one appears
- e. Press the space bar to begin the task; this should also trigger the acquisition software to begin recording

Sample Script: "So to get started we are going to first have you put your chin in the chin rest. Is that still a good height for you? Secondly, the camera in front of you is not recording anything. It is just there because when the task starts I am going to shut the door here so if you need anything in the middle of the task feel free to wave your hand in front of the camera. Each task is about 2-3 minutes and I'll be checking in in between each task but if you do need something in the middle please let me know. Finally, if you can just keep your feet as flat on the floor as possible during that task. If you need to wiggle your toes or move your feet you can do that during the breaks in between the tasks but if can stay as still as possible during each task that would be great."

Sample Script for EyeCal: "For this task we will have you look at the white cross at the center of the screen then a yellow dot will appear and you will look directly at that dot. Then the white cross will reappear and you will look back to the white cross and wait for another dot to appear. We will repeat that cycle for about two minutes. Any questions?"

f.

2. Habit

- a. Give the subject the ear inserts before continuing with the habit task:
 - i. The red side will go in the subject's right ear
 - ii. The blue side will go in the subject's left ear
 - iii. The ear inserts are similar to those we use for the MRI; they can be squished a bit so that they fit comfortably but should not be rolled
 - iv. Use the clips attached to the ear inserts to affix them to the collar of the subject's shirt; this will help prevent them from being tugged out if the subject moves
- b. On the acquisition computer, create a file named **[Luna]_[Date]_habit**
- c. On the presentation computer, open the **habit** application on the desktop
- d. Enter the subject's **Luna ID** in the subject ID field
- e. **Date** should be automatically populated in the date ID field (in the format YYYYMMDD)
- f. Make sure that the instructions box is checked and that the eyetracker (mr) box is unchecked (these are default settings but please double-check)
- g. Read through the instructions with the participant, pressing the space bar to advance through each of the screens which explain the task step-by-step. Let the subject know that the images that may or may not appear behind the dot don't really matter right now; they don't need to pay super close attention to them, but they should be aware of them because we might ask them about the images later
- h. Press the space bar to begin the task; this should also trigger the acquisition software to begin recording
- i. The subject will complete 4 runs of MGS; at the end of each run, they will see a screen that says "Finished N/4." At this point, check in with the subject and offer them a short break if they need it
 - i. When the subject is ready to continue, press the space bar to begin the next run
 - ii. Note that all 4 runs will be acquired in a single EEG file, so we should not pause or stop the recording in between the runs

3. VGS

- a. On the acquisition computer, create a file named **[Luna]_[Date]_vgs**
- b. On the presentation computer, open the **vgs+anti** application on the desktop
- c. Select "**vgs**" from the drop-down menu (this should be the default setting, but please double-check)
- d. Enter the subject's **Luna ID** in the subject ID field
- e. **Date** should be automatically populated in the date ID field (in the format YYYYMMDD)
- f. Read through the single screen of instructions with the participant
- g. Press the space bar to begin the task; this should also trigger the acquisition software to begin recording

Sample Script: "This next task will be very similar to the eye calibration you did at the beginning. For this task we will have you look at the white cross in the center of the screen. Then you will get ready

when you see the cross turn green. Then a yellow dot will appear and, again, we want you to look directly at the yellow dot. Then the white cross will reappear and we will repeat that sequence for about 2-3 minutes. Do you have any questions?"

4. Dollar Reward

- a. On the acquisition computer, create a file named [Luna]_[Date]_dr
- b. On the presentation computer, open the **dollar reward** application on the desktop
- c. Enter [Luna]_[Date] in the subject ID field
- d. Read through the single screen of instructions with the participant
- e. Press the space bar to begin the task; this should also trigger the acquisition software to begin recording

Sample Script: "This next task is going to be the opposite of the last task you just completed. For this next task we will have you look at the white cross in the center of the screen. Then you will get ready when you see the cross turn red. Then a yellow dot will appear on the screen, do not look at the dot. Your job is to look in the opposite location of wherever that dot appears. So if the dot appears on the far left of the screen, you would look to the far right. If the dot appears on the near right, you would look to the near left. There is another important thing to note about this game. When you see the green dollar signs surrounding the white cross that means you will get points for correctly looking in the opposite location of the dot. Other times you will see blue hashtags surrounding the cross. The blue hashtags mean you do not get points for those trials but we still want you to continue looking in the opposite location. Here is what the dollar signs and hashtags will look like. We will do 2 rounds of this game and each round will take about 5 minutes. I will check in with you in between each round."

5. Auditory steady state

- a. On the acquisition computer, create a file named [Luna]_[Date]_ss
- b. On the presentation computer, open **Auditory Steady-State** (Presentation)
- c. The subject will complete 3 runs of steady state: one run at 20 Hz, one run at 30 Hz, and one run at 40 Hz; the order in which the blocks are run should be randomized across subjects
 - i. Select the first of the three runs you will administer to the subject from the drop-down menu
 - ii. Enter the subject ID as [LunaID]
 - iii. Click "Run Scenario"
 - iv. When each run is finished, click "Continue"
 - v. Repeat steps i-iii for the remaining two runs
 - vi. Note that all 3 runs will be acquired in a single EEG file, so we should not pause or stop the recording in between runs

Sample Script: "Great job! We only have two tasks left before you are all done. These next two tasks are going to be auditory tasks. For these two tasks you do not need to keep your chin in the chin rest, but you can if it is more comfortable for you. We may have you put your chin back in the chin rest if we notice any issues with the electrode signal."

For this first auditory task you will be listening to a sound at 3 different frequencies. Each frequency will play for about 2-3 minutes. The sound that you will hear is very faint so you will need to concentrate to hear it. It sounds like a drilling/woodpecker noise. If you cannot hear anything at all please wave your hand in front of the camera, but again it is very faint so you'll need to concentrate to hear it. Your job for the task is to sit still and listen to the sound while you stare at the blank computer screen. After the first frequency I will come in to check to make sure you could hear it alright and then I will play the next two frequencies without checking in. Do you have any questions?"

6. Resting state

- a. On the acquisition computer, create a file named **[Luna]_[Date]_rest**
- b. On the presentation computer, open **Resting Baseline** (E-Prime)
 - i. Enter the subject ID as **[Luna ID]** and session as **"1"**
- c. The subject will complete 8 runs of rest, each one minute long, alternating between eyes open and eyes closed (4 of each condition)
 - i. Note that all 8 runs will be acquired in a single EEG file, so we should not pause or stop the recording in between runs

Sample Script: "Great job! This is the last task for today! This is a resting task that is going to measure your brain's activity while it is not engaged in any challenging task. *Read through instructions*. I will come in and check in with you after the first trial just to make sure you could hear the beep and then after that I will play the remaining trials without checking in."

Finishing up with the subject:

1. When the subject has finished resting state, unplug the electrodes from the cap and remove the cap from the subject's head; also remove the seven external electrodes from around their face
2. Give the subject some washcloths and a towel and direct them to the restroom so that they can clean up their hair
3. Let the subject know that after they get cleaned up, we have one more computer game and a questionnaire for them to complete then they will be all set for the day
4. Only need to collect the **hair sample** if we did not get it at the office visit for whatever reason
5. **Administer the recall task:**
 - a. Seat the subject in front of the computer in the shielded room; you may move the chin rest if it is seriously obstructing the subject's vision or ability to reach the key board
 - b. Open the **recall** application on the desktop of the presentation computer
 - c. Select your subject's files to pull images from
 - d. Read through the instructions with the participant and make sure their hands are positioned over the correct keys on the keyboard (L middle on 1, L index on 2, R index on 9, R middle on 0)
6. Administer the **post-scan questionnaire** to the subject

Cleaning up after the scan:

1. Unplug the electrodes from the A/D box
 - a. The ribbon cables can be removed using the levers on either side
 - b. The individual wires can be removed manually, but be careful not to tug at the cords
2. Unplug the orange fiber optic cable from the A/D box and hang it back up on the wall in the shielded room
3. Move the A/D box to the control room and plug it back into the charger in the corner
4. Place the small plastic covers back on the ends of the ribbon cables; it's very important that these connections **do not get wet** during clean up
5. While the subject is still wearing the cap, unplug the electrodes from the holders
 - a. Use your fingernail to pop the plastic casing of the electrode out from the channel
 - b. **Do not to tug on the wires** to loosen them as they are very delicate, particularly at the junction between the wire and the plastic casing
6. Remove the cap from the subject's head
7. Remove the external electrodes from the subject's face and discard the stickers on the electrode surface
8. Give the subject a towel, washcloth, and baby shampoo, and direct them to the restroom so that they can clean the electrode gel out of their hair
9. The electrode cap can be cleaned with **soap and water**
 - a. If you are particularly concerned about a subject's hygiene, the cap can also be cleaned with the hydrogen peroxide found in the shielded room
 - b. Place the electrode cap inside the white plastic bin, soak and rinse it twice with soap and water
 - c. Once the cap has been cleaned with soap and water, use the brush to clean out each button on the cap from both the front and back sides, making sure that no dried out gel remains in the channels
 - d. The cap can then be hung on the railing in the control room to drip dry, with a bin underneath to catch any water droplets
10. The electrodes must be cleaned with **water only**
 - a. Drape the electrode cables over your shoulder with the connections on your back to minimize the risk of getting them wet
 - b. Gently clean the electrodes with water and use your fingernail to help remove any leftover gel; the gel is water-soluble so it should come off fairly easily
 - c. When the electrodes have been washed off, use a washcloth to very gently dry them off, again being careful not to tug on the junctions between the cables and the plastic casings

Transferring the data:

1. Behavioral data can be transferred from the presentation computer to a USB and then filed back at the lab
2. EEG data will be uploaded to **Box**:
 - a. On the acquisition computer, navigate to **C:\Data**

- b. Log in to your Box account and locate the **Luna EEG** folder
- c. Create a folder for your subject in the format **[LunaID]_[Date]**
- d. Copy over the 6 files acquired during the scan