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# Using the Stanford EEG Lab

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**A guide to using the EEG facilities in the  
Stanford Psychology Department.**

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This document covers the following topics:

1. Preparing the lab before your participant's arrival.
2. Configuring the data acquisition and stimulus presentation computers.
3. Applying electrodes to your participant.
4. Debriefing and cleanup.

## 1.0 Equipment Checklist

Locate the following equipment:

**Electrodes.** Approximately five feet long, hanging on pegs near the sink. One end is a metal “O” shape, the other end is a cylinder-shaped connector.

**Electrode cap.** White fabric, usually hanging near the electrodes. There are three sizes of electrode cap available for use. Select the size appropriate for your participant.

**Velcro and dome-snap straps.** Used to secure the electrode cap.

**Electrode gel.** White jar.

**Large and small syringes, with small injector ends.** Used to fill electrodes in the cap with gel.

**Round plastic dishes.**

**Long Q-tips.**

**Loose round electrode mounts.** Used for placing electrodes at locations not contained in the cap.

**Double-sided sticky washers.** For sticking loose electrode mounts to the skin.

**Alcohol pads.** Used to clean and abrade the skin.

**Electrode connector boxes.** On a stool inside the participant booth, each with numbered locations for plugging in electrodes.

**Calibration plugs for electrode connector boxes.** These resemble parallel-port plugs with no cords attached. They are normally located beside the connector boxes on the stool.

**List of recording sites corresponding to their locations on the connector boxes.** Taped to the wall of the participant booth.

Make sure to bring with you:

**Consent forms.**

A copy of your experiment code.

A list of the recording sites you will be using.

- 1.1 Approximate timeline** Pre-participant setup: 30 minutes.  
Participant setup: 30 minutes to 1 hour.  
Data acquisition: Length of your experiment session.  
Cleanup: 30 to 45 minutes.

## 2.0 Preparing the lab

Switch on the two amplifiers. These are large beige boxes labeled “Neuro Scan Labs SynAmps”. They are located in a rack on the wall opposite the door.

Prepare the area on top of the equipment cabinet with your supplies, and set your selected electrode cap on the Styrofoam dummy. Note that each of the sixty-four holes on the cap has a written label, like “Fz” or “C3”. Each of these corresponds to a numbered location on one of the electrode connector boxes. For each location on your list of recording sites:

1. Snap the metal “O”-shaped end of one electrode into the desired location on the cap.
2. Find the numbered location of this recording site on the list taped to the wall.
3. Plug the cylinder-shaped end of the electrode into the numbered location on the connector box.

*Make sure to orient the metal “O”-shaped end of each electrode such that the wire runs toward the back of the scalp.*

Attach an electrode to location TP10 on the cap and plug it into its numbered location if you haven’t already.

Select six additional electrodes, and snap the metal “O”-shaped end of each of these electrodes into the loose round electrode mounts. Set them aside. These will be used for referencing the data and removing noise, and will be covered in more detail in section 4.0 on page 9.

The electrode cap has two rectangular plastic rings, located approximately below each ear. Each of the short dome-snap straps has one snap on one end, and two snaps on the other. For each side of the cap, insert the end with two snaps through the ring, and connect them to secure the strap to the cap.

Screw the small injector ends onto the large and small syringes. Open the jar of electrode paste, and use the wide depressor stick to fill the large syringe. Attach the plunger to the large syringe, and use it to inject electrode paste into the small syringe. When you have filled the small syringe, attach the plunger. Hold the syringe pointing upward, and push the plunger slowly to release air.

Squeeze a small amount of gel from the small syringe into one of the small dishes. Set the syringe and the dish aside.

### 3.0 Configuring the lab computers

The Stanford EEG lab uses one computer for data acquisition and another for stimulus presentation.

#### 3.1 Acquisition computer setup

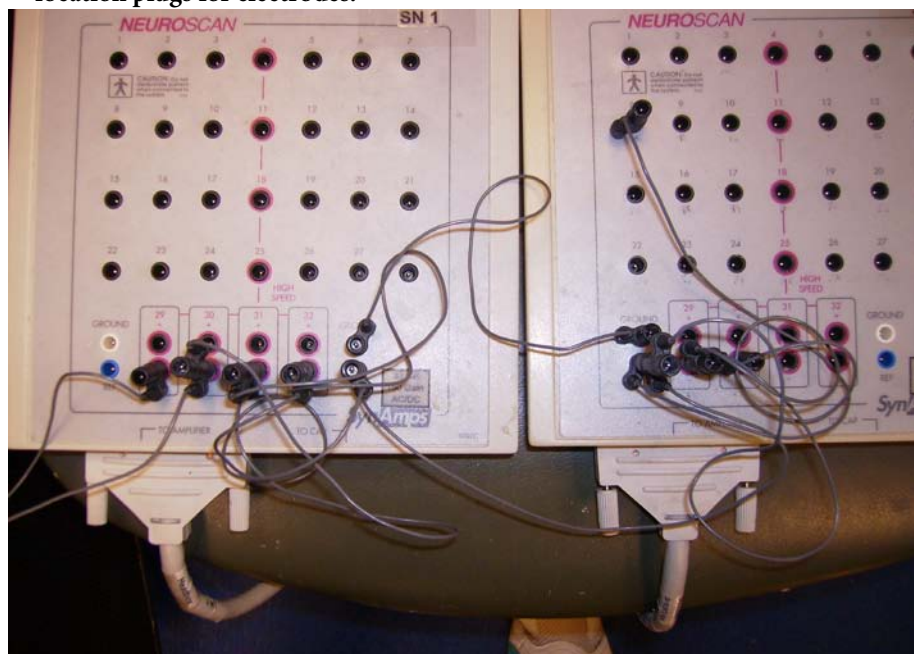
The data acquisition computer is the computer on the left. Reboot it after you switch on the amplifiers but before you configure your session. Open the program labeled “Scan 4.3”. Select Acquire, the recording function, by clicking the button with a blue triangle.

In Acquire, load the configuration file (extension “.ast”) for your experiment by selecting the “Load channels” command from the “File” menu.

Attach the calibration plugs to the electrode connector boxes, shown in Figure 1. Select the “Calibration” command from the “Acquisition” menu. Accept the default settings by clicking OK. The screen displays a numerical value for each of the recording sites arranged topographically, and asks if you would like to accept the current settings. Click “Yes” to accept the settings if the displayed values are all between 0.95 and 1.05. Otherwise, click “No”, and select the “Calibration” command again to generate new values. Repeat until displayed values are all between 0.95 and 1.05.

Remove the calibration plugs from the electrode connector boxes.

**FIGURE 1. Top view of the electrode connector boxes, showing numbered location plugs for electrodes.**



Select “Start acquisition” from the Acquisition menu, or click the green triangle button in Acquire to see the output of the electrodes. The software will not save data until you select the “Record” command or click the red circle button. Details of data recording are discussed in section 4.0 on page 9.

### 3.2 Presentation computer setup

The stimulus presentation computer is located to the right of the data acquisition computer on the wall opposite the door. It sits horizontally on the tabletop, and shares a monitor with a different computer through a KVM switch. Locate the KVM switch and select channel 2. Log into this computer using the username and password supplied (EEG:lorentz). Start Matlab from the desktop shortcut or the Start menu, and navigate to the directory containing your experiment’s M-file.

*If your experiment uses Psychtoolbox, start Matlab from the shortcut found in C:\RT\Psychtoolbox.*

This computer should be connected to the data acquisition machine through a parallel port connector. If you do not see a parallel-port cable connected to the back of the computer, check the computer located on the ground to your right. Squeeze the side releases on the connector and pull to remove it. Holding the side releases, plug it into the parallel port of the computer on the table.

This computer should also be connected to the monitor, keyboard, and speakers in the participant booth. Check that the monitor in the booth mirrors the monitor outside, that the keyboard input is accepted, and that the speakers play sound. If the devices are not connected to the computer on the tabletop, locate their connectors on the Dell computer on the ground to your right. Remove the long monitor cable, and plug it into the IOGear monitor splitter on the table. Remove the long USB cable, and plug it into one of the USB ports on the front of the computer on the table. Remove the audio cable (terminating in a 1/8” mini male connector) and plug it into the audio port on the back of the computer on the table.

Run a brief test session of your experiment, with Acquire displaying data (but not recording) to check that the equipment is functioning correctly.

- The monitor in the booth should display identically to the monitor of the stimulus presentation computer outside the booth.
- The keyboard in the booth should input to the stimulus presentation computer.
- The speakers in the booth should play sound if the experiment requires it.

- Acquire's scrolling display should mark any triggers that you have placed in your experiment code.

Stop the Acquire recording and your experiment procedure until your participant arrives.

## 4.0 Participant setup

Brief your participant on the experiment, and obtain his or her informed consent, if you have not already done so.

Secure the long Velcro strap around the participant's torso, under the arms, making sure that the two dome-snaps are approximately centered on the front. The strap should be snug, but not uncomfortable.

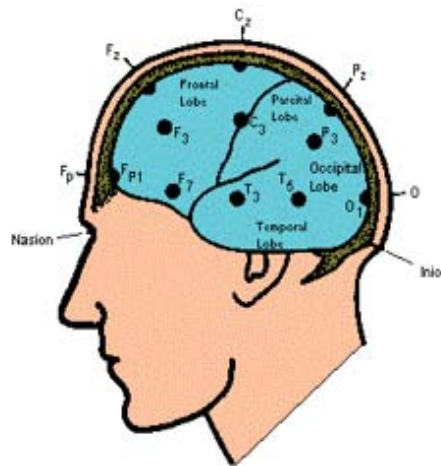
Seat the participant in the black leather chair, and take the electrode cap off the Styrofoam dummy. There should be enough slack in the wires coming from the cap to eliminate the risk of accidentally pulling any electrodes out. Move the electrode connector boxes or the chair as necessary to accomplish this.

Place the cap on the participant's head, and pull it down snugly. Make sure that the participant's hair is secured, and that it does not interfere with vision. Use a tape measure to determine the distance from the nasion to the inion, illustrated in Figure 2 on page 9. Make sure you are using an electrode cap of the appropriate size.

Position the cap so that electrode Cz is on the midline of the skull, equidistant between nasion and inion. Locate the desired Cz point on the participant's scalp. Hold a Q-tip at this point, and bring the cap down over the Q-tip. The outer rim of electrodes including FP1 and FP2 should be aligned just above the eyebrows. Individual differences in participants' head shapes may not allow you to align both of these points. In this event, use your best judgment to determine placement.

*Alignment failure may indicate that you are using the wrong cap size.*

FIGURE 2. Side view of labeled scalp locations.



With the dome-snaps, attach the short straps on each side of the cap to the long Velcro strap on the participant's torso. Ensure that the cap is symmetrical to the left and right.

The electrodes not contained in the cap are applied to the following locations:

- Left mastoid, the bony area behind the left ear (TP9)
- Centered on the back of the neck, just below the hairline (GROUND)
- Centered above the left eyebrow (VEOG)
- Centered on the cheekbone below the left eye (VEOG)
- Left temple (HEOG)
- Right temple (HEOG)

Gently abrade the skin at each location with an alcohol pad. Plug the connector end of an electrode into the appropriate space of the electrode connector box. Peel a double-sided sticky washer off its backing, and stick it to the plastic mount of the electrode. Wait for the skin to dry of alcohol, peel the secondary backing from the washer, and apply the electrode to the skin using moderate pressure.

On the data acquisition computer, select "Impedance" from the Acquisition menu. You will see a labeled topographic display of all electrode sites, each with a colored square. Note the scale displayed on the right side of the screen, going from black (0 kOhm) to bright pink (>20 kOhm). Since there is no conductive gel at the electrode sites, the squares should all be bright pink, corresponding to high impedance.

Apply conductive gel to each electrode in turn, beginning with the electrode at the left mastoid (REF), with the following steps:

1. With the uncovered end of a long Q-tip, gently push aside the participant's hair. Use your finger and thumb to steady the electrode, and apply pressure to hold the hair against the scalp. Stop pushing hair aside when you can clearly see the participant's skin through the ring of the electrode.
2. Pick up a small amount of conductive paste from the plastic dish using the covered end of the long Q-tip. Holding the electrode firmly against the scalp, insert the Q-tip through the ring. Take two or three seconds

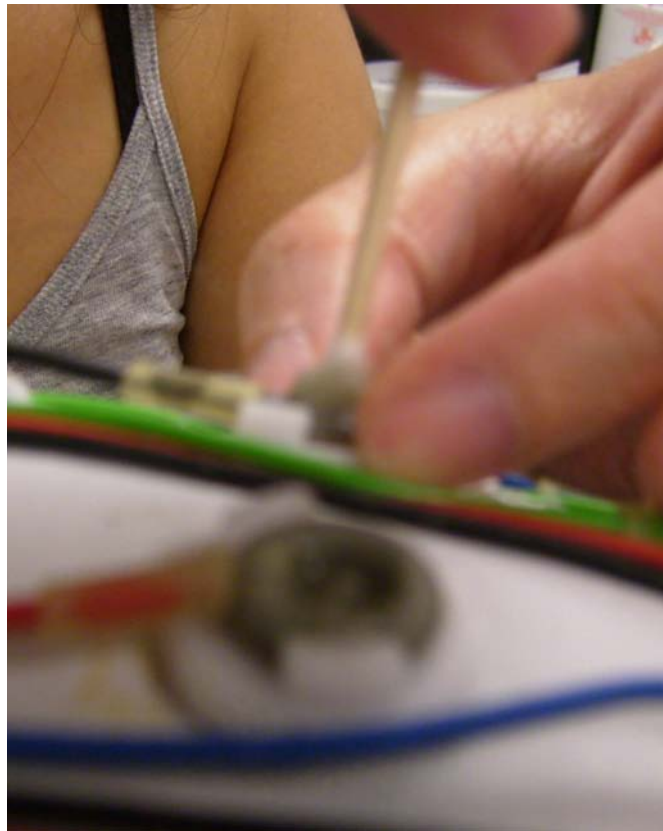
to gently abrade the skin with a twisting motion of the Q-tip. Remove the Q-tip from the electrode.

**Caution: Take special care in abrading non-scalp electrodes, especially those on the face. Facial skin and the skin behind the ears is delicate, and easy to irritate or injure. Abrade gently.**

**Be aware that participants are usually very reluctant to report discomfort. You must firmly insist throughout the session that the participant communicate with you. Remind the participant that you have no other way of monitoring his or her comfort and safety.**

3. Continue holding the electrode. Retrieve the small syringe, and insert the injector end into the electrode ring, close to the scalp. Carefully push the plunger to fill the electrode with conductive gel. Remove the syringe.

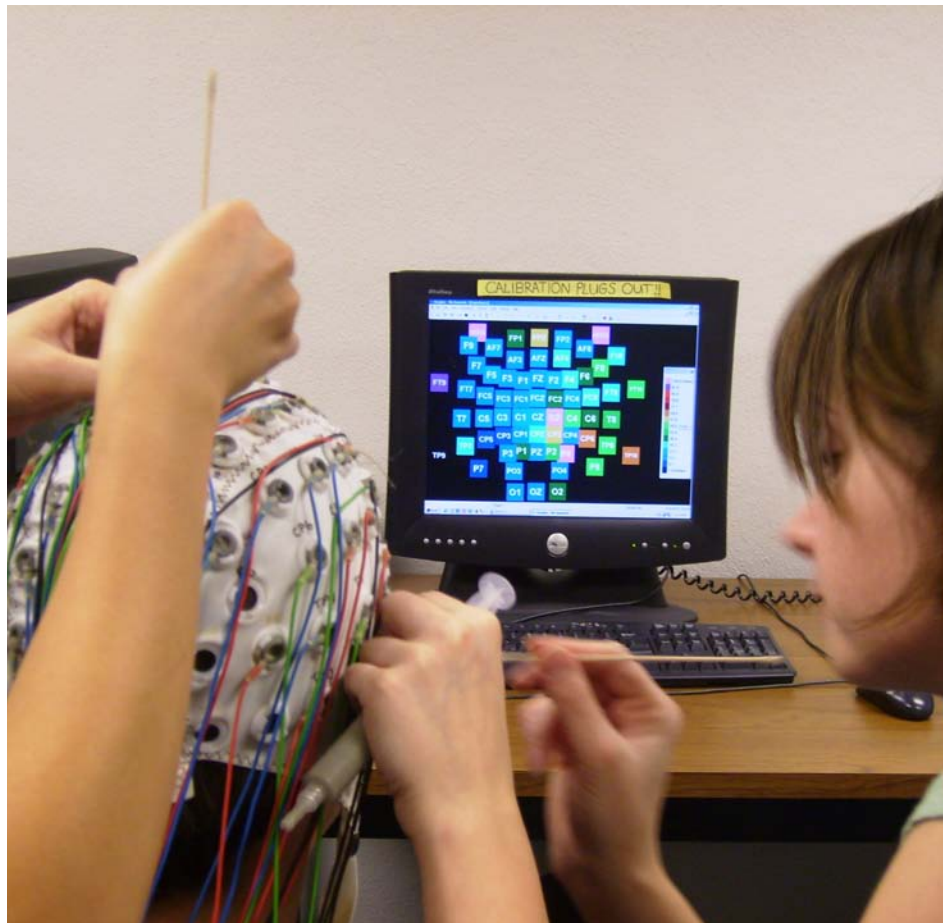
**FIGURE 3.** An experimenter holds an electrode to the scalp between finger and thumb while she abrades the location with a Q-tip.



A short time after each electrode is filled, its corresponding square on the computer screen will begin to change color down the scale towards dark blue. After all electrodes have been filled, check the impedance graph. All electrodes that you have filled with conductive gel should have an impedance of at most 5 kOhm, and their squares should be colored blue or dark green. Repeat the steps of abrading and filling with gel any electrodes that still show high impedance.

*If all squares are showing pink after abrading and filling, make sure you filled the mastoid first.*

**FIGURE 4.** View of the impedance graph in Acquire. Most of the electrode sites are colored blue, showing low impedance.



Hold the bundle of electrode wires in one hand, and make sure to have the electrode connector boxes within reach. Turn the chair so that the participant is facing the door of the booth, watching for any taut wires. If necessary, move the electrode connector boxes nearer to the participant. Instruct the participant to stand up from the chair, and walk slowly into the booth, remaining on guard for any taut wires.

Seat the participant in the booth, and hang the bundle of wires from the hook in the ceiling. Secure the wires to the hook with a strip of Velcro or a rubber band. Ensure that the participant is comfortable and unlikely to pull any wires taut. Ask the participant to test the available range of motion by moving back and forth.

Shut the door to the booth, and return to the data acquisition computer. Ensure that all electrodes are still in place by checking the impedance graph for any drastic changes. Repeat the abrasion and filling procedure in the booth for any electrodes with highly increased impedance ( $>5k\Omega$ ).

Stop the impedance graph. From the “Acquisition” menu select “Start Acquisition”. As in section 3.0 on page 6 when you tested the equipment, the computer will display a scrolling graph of activity from the electrodes. Use the zoom tools to look for any unusually noisy signals.

When you are satisfied with the output, select “Record” from the Acquisition menu, or press the red circle button. The program will prompt you to save the data to a file. Enter the name of a new file, and click “OK”. All further data is saved immediately to that file.

*All data should be stored in your directory on the F:\ drive.*

Move to the stimulus presentation computer, and start your experiment.

*The booth is not sound-proof. Keep talking and other noise to a minimum.*

It is advisable to have breaks at intervals of not more than fifteen minutes during an EEG experiment. At a break, you can stop the recording on the data acquisition computer to separate the data into multiple files. If the session is particularly long, check the impedance of the electrodes. Open the door to the booth and ask how the participant is feeling. Only after the participant affirms that he or she is ready to go on should you continue the session. Close the door to the booth, and restart recording data to a different file on the data acquisition computer. Continue the experiment on the stimulus presentation computer.

## 5.0 After the session

### 5.1 Debriefing the participant

In Acquire, select “Stop” from the Acquire menu, or click the black square button to stop data recording. Open the door to the booth, and tell the participant that the experiment is over. Holding the bundle of electrode wires with one hand, have the participant stand and walk carefully to the black leather chair. Gently peel all non-scalp electrodes from the participant’s neck, mastoid, and face, and place them on the cabinet top.

Detach the short dome-snap straps from the long Velcro strap around the participant’s chest. Lift the cap from the participant’s head, and place it on the Styrofoam dummy. Remove the long Velcro strap from the participant. Use a paper towel to wipe away excess gel from the participant’s scalp and face. Offer the use of the sink for rinsing the participant’s hair, and stand by with a towel.

Read the participant any de-briefing material for your experiment, answer any questions, and thank the participant for his or her time.

Turn off the amplifiers if you have no further appointments.

### 5.2 Cleaning the electrode cap

Peel the sticky washers from each of the non-scalp electrodes’ mounts and dispose of them. Keeping the bundle of wires in one hand, push each electrode out of its slot in the electrode cap. Pull the cylinder-shaped end of each electrode out of the electrode connector boxes. Hang the disconnected electrode wires over the door to the participant booth, or around your shoulders.

Place the electrode cap in one of the blue bowls, and fill it with warm water. Agitate the cap in the water to loosen the remaining gel. Use a long Q-tip to clean the remaining gel from all of the sites you used. Empty the bowl and rinse the cap under running water. Refill the bowl with warm water and one to two pumps from the bottle of disinfectant solution. Place the cap in the bowl and allow it to soak for five to ten minutes.

Place the metal “O”-shaped end of the bundle of electrodes into the other blue bowl, and fill it with warm water. Use a long Q-tip to clean the remaining gel from each electrode. For non-scalp electrodes, remove the round plastic mounts and set them aside. Be sure to remember where you place these, as they are easily lost. Rinse the electrodes under running water and check each for any remaining gel, scrubbing with a toothbrush if necessary. Hang the bundle to dry.

Empty the bowl you used to clean the electrodes. Place in it the round plastic electrode mounts and the small dish of excess gel. Squeeze any remaining gel out of the large and small plastic syringes. Unscrew the small injector ends and place them in the bowl. Pull the plungers out of each syringe and place them in the bowl. Fill the bowl with warm water. Using a long Q-tip if necessary, clean and rinse each piece of equipment. Set each piece and the bowl on the cabinet top beside the sink to dry.

Retrieve and empty the bowl in which the electrode cap is soaking. Rinse the cap under running water. Squeeze the fabric gently to remove excess water and hang the cap to dry. Rinse the bowl and set it on the cabinet top to dry.

### 5.3 Cleaning up the lab

Close the jar of electrode gel. Turn off the monitor in the participant booth. Quit all programs and log out of the experiment presentation computer. Quit Acquire and turn off the monitor of the data acquisition computer.

Make sure that both amplifiers are turned off.

Turn off the lights and close the door of the lab when you leave.