Cardiovascular Responses to Mild Laboratory Stressors

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OVERVIEW

In this lab, you will record ECG, finger pulse, forehead and finger-tip skin temperature, and continuous (beat-to-beat) systolic and diastolic blood pressures from subjects undergoing three mild laboratory stressors: 1) a mental arithmetic task; 2) a cold-pressor stimulus; and, 3) photographic stimuli. Each task epoch will last just a few minutes, and the epochs will be separated by 2.5 minute recovery periods. In total, the run should take no more than 30 minutes, but with set-up and clean-up time, you would do well to allow at least an hour per subject.

MATERIALS

- Disposable Ag/AgCl electrodes (3)
- Temperature probes (2)
- Alcohol pad
- Cotton square sections (2)
- Paper tape
- Spectra 360 electrode gel (if needed)
- 80" pinch-clip electrode leads (2)
- 40" pinch-clip electrode lead
- Lightweight headset
- Mental Arithmetic Tracking Sheets (on the bulletin board)
- Cold-pack (leave in the freezer until needed)

EQUIPMENT CONFIGURATION

Bioamplifier (Bio-C 03)

- High pass filter = 10 Hz
- Low pass filter = 30 Hz
- Gain = 1 mV f.s.d. (adjust if necessary)
- Hum filter on
- Calibrate and impedance buttons out (subject side)

The bioamp will be used to measure ECG. The bottom output socket of Bio-C should be cabled to the analog waveform input of interval timer (IT 12). The positive (+) output of Bio-C be cabled to the rectifier to its immediate left (R/I-C).

Rectifier/Integrator (R/I-C)

- Output control = Raw

The rectifier is not used in this experiment, but it is normally connected to the bioamp and will remain in the signal chain for convenience. The output of R/I-C must be cabled to address 3 of the PC32-1 A/D converter. Make sure the R/I-C output control is set to "Raw."

Interval Timer (IT 12)

- Auto trigger adjustment = 3

The interval timer will be used to measure the heart period (or inter-beat interval) from the ECG wave fed to it by the bioamp. A constantly-advancing millisecond timer is reset to 0 (zero) each time the ECG voltage exceeds a threshold value. Normally, he R-wave is the only component of the ECG wave to reach
the trigger voltage, and what is sent continuously to the A/D converter is the interval between successive R-waves. The lower output socket of Bio-C should be cabled to the analog waveform input of IT (12).

**Temperature Couplers (Temp-A 07 and Temp-B 09)**
- Gain = 1.6 °C f.s.d.

The Temp-A coupler will record skin temperature from the subject's forehead, and the Temp-B coupler will record skin temperature from the subject's fingertip. Each coupler sends a voltage through a probe (a thermistor) whose resistance varies with temperature. The coupler translates changes in the probe's resistance into fluctuations in temperature.

**BP Amplifier 13 (BP 13)**
- High pass filter = 0.1 Hz
- Low pass filter = 30 Hz
- Gain = adjust as needed to prevent pulse wave from clipping

The BP amplifier passes the output of the Finapres blood pressure monitor to the A/D converter. A yellow cable from the back of the Finapres should be connected to the input of the BP amp. The output of BP (13) must be cabled to address 13 of the PC32-1 A/D converter.

**Finapres Blood Pressure Monitor**

The Finapres has an automatic alarm that sounds whenever pressures exceed designated values. The subject could exceed this value simply because of the position of his/her hand relative to his/her heart. Therefore, you must disable the alarm so that it won't disturb the run. To do so:

1. Push the "pages" icon on the front panel of the Finapres.
2. When the "Select Pressure Alarm" screen appears, push the top blue circle. A "No Pressure Alarm" message will be displayed.
3. In a few seconds, the monitor screen will reappear. The Finapres is now ready to run.

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**Important Note**

To avoid mechanical damage to the finger cuff, it is critical that the Finapres not be operated without a finger in the cuff. When the Finapres is turned on with the Power switch, it comes up in a safe standby mode with no inflation of the cuff. Cuff inflation begins when the START button is pressed. DO NOT PRESS START UNLESS THE CUFF IS ON THE SUBJECT. The Finapres may be returned to STANDBY MODE (and cuff pressure relieved) by pressing the STOP button.

**Communications Module (COMM)**

- Subject volume (adjust as desired)
- Operator volume (adjust as desired)
- Squelch (adjust to middle value)
- Mode toggle = Norm

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**SUBJECT PREPARATION**

**Disposable Ag/AgCl Electrodes for ECG**

As with Lab 1, you will be recording ECG from modified Lead II sites. You will place electrodes on the following sites: a) at the base of the neck on the right side; b) on the left ankle; and c) on the right ankle.

Clean all sites with the alcohol pad and allow them to dry, and then apply the disposable electrodes. (Note: Examine the contact sponge on each electrode to insure that it is moist, and re-wet it with a drop of
Spectra 360 gel if necessary.) Attach an 80” pinch-clip lead to each ankle electrode and a 40” pinch-clip lead to the neck electrode. Then plug the leads into the following inputs of Bio-C: a) right neck to negative (white); b) left ankle to positive (red); and c) right ankle to ground (black). This arrangement will produce an upward deflection of positive ECG components (i.e., P, R, and T) on the Psylab monitor.

Make sure that there is no stress on any of the electrode leads. Clothespins can be used to fix the electrode leads to points on the subject’s clothing that will keep them out of his/her way.

Temperature Probes

Forehead Temperature

The first temperature probe will be placed in the center of the subject's forehead about 3 cm superior to the nasion (the depression on bridge of the nose between the eyes). Clean the site with an alcohol pad and allow it to dry. Hold the probe in place, flat side toward the skin with the lead wire running straight up and across the top of the subject's head. Put a strip of surgical tape across the lead wire near the top of the black insulation to hold the lead in place. Then center a one-quarter section of a cotton pad over the tip of the probe and affix the pad securely with surgical tape. (Note: To clarify the probe position, no tape is shown in the illustration to the right.) The cotton pad will buffer the probe against temperature changes caused by air currents.

Connect this temperature probe to the TMP-A plug on the subject input box.

Fingertip Temperature

The second temperature probe will be placed on the first finger of the subject's right hand. With the subject's hand palm up, place the lead for the probe between the first and second fingers. Loop the lead around the thumb side of the finger and position the probe along the finger so that the tip is centered on the pad of the fingertip. Wrap a piece of paper tape around the lead and the finger to hold the probe in place (see first figure at right). Make sure that the tape is not too tight, or circulation to the finger will be impaired. Next, center a quarter section of a cotton pad over the probe and secure it with another loop of surgical tape (second figure at right). Again, make sure that the paper tape is not too tight.

Connect this temperature probe to the TMP-B plug on the subject input box.

Finapres Blood Pressure Monitor

Finger Cuff Application.

Follow these directions carefully.

1. Select the appropriate size cuff. You will find the cuffs stored in clear plastic tubes in the subject room cabinet.

2. Connect the cuff to the Finapres terminal box. There are two connections: A black electrical plug, which can only be inserted one way; and a clear air tube. The air tube has a tapered friction fitting on the end. Twist and pull the fitting to remove the line from the terminal box, and firmly twist and push the fitting for the new cuff into place. Return unused cuffs to their storage tubes.
3. Loosen the Velcro cuff strap and slide the cuff on to the middle finger of the subject's right hand, as illustrated in the accompanying figure. Align the three colored lines at the bottom of the cuff with the middle joint of the finger.

4. Close the cuff strap around the finger. A correctly-applied cuff will not slide over the middle joint of the finger, but will slip off the finger tip. DO NOT over-tighten the cuff, or it will become uncomfortable when inflated.

5. Strap the Finapres terminal box to the subject's forearm using the attached Velcro strap. The box may rest on any surface of the arm as long as no kinks develop in the air tube leading to the cuff.

6. Ideally, for the Finapres to provide readings comparable to those obtained by auscultation of the brachial artery, the finger cuff should be at the same level as the subject's heart. For most subjects, the arm of the chair is below heart level. The recording situation can be improved by placing a thick pillow on the arm of the chair and having the subject rest his/her hand and arm on the pillow during the run. You will find a pillow in the subject room for that purpose.

**Lightweight Headset**

Place the lightweight headset on the subject with the temperature probe lead under the headset's rubber pad. Connect the headset to the appropriate sockets on the input panel. Adjust the armature on the headset so that the microphone is about 1 inch out from the left corner of the subject's mouth.

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**RUN INSTRUCTIONS**

**Operator**

**Preliminaries**

1. Prepare the subject and help him/her get comfortably seated in the recliner.
2. Turn on all equipment including the subject's monitor and boot the Psylab and Control computers.
3. Launch DirectRT from the Start menu on the Control computer.
4. Choose Select and run an input file from the File menu of DirectRT. Navigate to the Psyc305\Lab2 folder and launch Lab2 run1.csv. (Use Lab2 run2.csv for the second team-member's run, and go back to Lab2 run1 for the third team member's run. You may prefer to spread your runs over two lab sessions, but that's up to you.)
5. Enter the subject's lab ID number in the Subject ID window and click OK.
6. A "Welcome to Lab 2" screen will appear. This screen will persist until you press the enter key to begin the run. DirectRT is now staged.
7. On the Psylab computer, launch the Lab2.pcc measurement program (the full path is C:\cpi\psyc305\lab2\lab2.pcc). Open the lab2\rawdata folder and name the data file xxlab2 (where xx is the subject's lab ID number).
8. When the measurement program begins to run, it will prompt you to enter the subject's ID number. Do so, but DO NOT hit the Enter key. Psylab is now staged.
9. Put on your headset and adjust the send and receive volumes. Tell the subject that you are about to begin. No further talking except as demanded by the experimental tasks.
10. Turn on the Finapres and–assuming the subject is wearing the finger cuff–push the START button to begin cuff inflation.
**NOTE:** Once started, the *Finapres* takes a few minutes to adjust to the subject's blood pressure and finger volume. During this adjustment period, the *Finapres* display will be interrupted by frequent artifacts as the servo mechanism searches for the appropriate set point. After a few minutes, the *Finapres* will stabilize and artifacts will become far less frequent. However, an occasional pulse artifact will occur whenever the *Finapres* re-adjusts cuff pressure. Don't become concerned unless the artifacts become frequent (i.e., every few heartbeats) or prolonged (i.e., lasting for more than 2–3 heartbeats). Frequent or prolonged artifacts indicate that the finger cuff is too loose (perhaps it's the wrong size) or has been applied incorrectly.

11. Hit *<Enter>* on *Psylab* to begin data acquisition. **Make sure you give the *Finapres* time to adjust and that the pulse and blood pressure channels are returning clean signals before starting the *DirectRT* run.**

12. When you are satisfied with data display on *Psylab*, switch to Control and hit *<Enter>* to launch *DirectRT* stimulus presentation.

**Adaptation Period.** The run will begin with a 2.5 minute adaptation phase, during which the subject should relax (but remain awake!) and the operator should monitor the equipment and make any adjustments that might be necessary.

1. Locate the *Mental Arithmetic Tracking Sheets*. You'll need them for the next phase.
2. At the end of the adaptation period, *DirectRT* will automatically initiate the . . .

**Mental Arithmetic Phase.** In this task, the subject will repeatedly subtract 17 from a starting number and report the results as rapidly as possible. The task will continue for a total of 20 calculations while the subject's speed and accuracy are monitored. The operators' tasks will be: 1) to time the subject by pressing *<Enter>* when he/she completes the series of calculations; b) to monitor the subject's progress on the tracking list provided for that purpose; and, c) to correct the subject's errors.

1. Two lists are provided on the *Mental Arithmetic Tracking Sheets*, so that when one of the operators assumes the subject role (i.e., Lab2 run2), the task will be fresh for him/her.
2. Watch the Control monitor. *DirectRT* will present a starting number to the subject. When the subject begins to perform the calculations, you must follow his/her progress carefully on your tracking list. Keep your finger on the "Talk" button on the microphone box. If you note an error, *immediately* push the button and interrupt the subject with the correct number. The subject must then repeat the correct number and continue from there. You should regard every deviation from the list as an error.
3. As soon as the subject reaches the final calculation (#20. on the list), press *<Enter>* to register the subject's calculation time and start the 2.5-minute recovery period.

**Cold-Pressor Phase.**

1. At the end of the recovery period, *DirectRT* will prompt you to get a cold-pack from the freezer in the cleanup room and to place it on the milk crate in front of the subject's chair. *DirectRT* will pause at this prompt. **Don't get locked out of the lab when you go to get the cold-pack!**
2. When the cold-pack is in place, close the door, return to the control room, and hit *<Enter>*. The cold-pressor phase will run automatically from that point.
3. When the cold-pressor phase has ended and the next recovery period has begun, retrieve the cold-pack and return it to the freezer.

**Picture Show Phase.**

1. At the end of the recovery period, *DirectRT* will display instructions for the Picture Show phase. A moment later, you will be prompted to turn off your monitor so that you aren't pre-exposed to the stimuli and to hit *<Enter>*. (If the operators have already served as subjects, they need not turn off the monitor.) Hitting *<Enter>* is critical: The program will not advance if you don't.
2. At the end of the run, *DirectRT* will terminate data acquisition and reboot the *Psylab* computer. The *End of Experiment* screen can be cleared from the Control computer by hitting the *Esc* key.
3. After all subjects have been run, terminate DirectRT by pressing Ctrl-Q or selecting Exit from the File menu.

4. Put the Finapres on STANDBY before removing the finger cuff from the subject.

**Switching Subject & Operator Roles.**

1. Unless the Finapres has been turned off between subjects, it will not be necessary to disable the pressure alarm again.

2. Launch the second run by clicking the Lab2 Run2 icon. From there, the procedure is the same as described above.

**Subject**

1. **General:** Remain still during the tasks and the intervening recovery periods. Both the ECG and blood pressure recordings are vulnerable to movement artifact, so if you need to adjust your position, try to do so just after completing one of the task epochs (i.e., at the beginning of a recovery period). Between tasks, relax but don’t nod off. Do NOT talk to the operators except as called for by the experimental tasks (speaking increases blood pressure).

2. **Mental Arithmetic Task:** Both speed and accuracy are important here. Do your best. If the experimenter tells you you've made an error, restate the correct number before continuing.

3. **Cold-Pressor Phase:** Roll up the cold-pack and grip it firmly (see illustration) in such a way as to insure that your palm and fingers are in full contact with the cold-pack. Maintain this grip for as long as you can–preferably for the entire one-minute epoch. If you must remove your hand, do so briefly and then return it to the cold-pack.

4. **Picture Show Phase:** Attend closely to each photograph as long as it remains on the monitor.

**CLEANUP**

1. Leave the ECG leads temperature probes plugged in, but consolidate the lead wires and place them on the back of the chair so that they don't get sat on.

2. Turn off the Finapres. Leave the cuff plugged into the black box on the Finapres line.

3. Check the lab calendar. If no one is scheduled to use the lab within the next 30 minutes, shut down both computers in the approved manner, power everything down, and lock up the lab.

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