

Procedure of HRV data record:

1. Pre precaution:

Firstly, explain the entire HRV testing procedure to the participant. Introduce the devices that will be used and describe their functions. Request that the mother and any other family members keep the area quiet and calm until the measurement is complete. Ensure that the mother does not have any electronic devices or materials that could interfere with the test. If the mother has any such items, ask her to remove them before starting the procedure.

2. Before Acquisition

Ask Questions: Ask the mother about the time elapsed since the child's last nap and feeding. Inquire if the child has shown any signs of illness, such as cold, fever, or respiratory issues. Also, assess the noise level in the living environment by asking whether it is quieter than usual, louder than usual, or at a normal level.

3. Procedure:

- Clean the bodyguard attachment area using an alcohol wipe on the upper right chest, just below the mid-point of the collarbone, and on the side, just below the bottom rib. Ask the participant to holding their clothing to facilitate the cleaning and electrode attachment process.
- Dry the skin carefully and allow it to air dry for a few minutes before attaching the electrodes. Attach the bodyguard devices with electrodes by removing the covers and affixing them to the prepared skin areas below the collarbone and left rib. Ensure the ground end of the cable is connected to the electrode.
- Verify that the heart monitor is functioning correctly by checking for a green light, which indicates that the measurement has started.

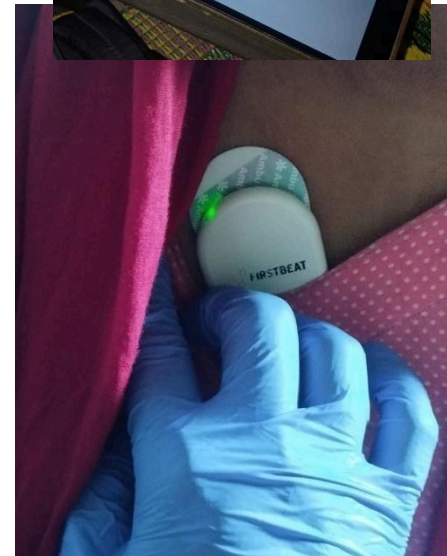
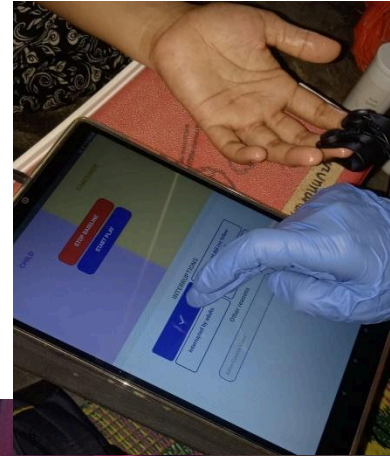


3.1. eSense

- Select the non-dominant hand and clean the fingertip using a non-alcoholic wet napkin. Provide the mother with clear instructions and attach the eSense electrodes to the left hand. If there are any issues with the left hand, such as physical injury or jewelry, request that the mother remove these items. Ensure that the mother can put them back after the measurement is completed. If the mother cannot or does not agree to remove the items, use the right hand instead.
- Apply isotonic paste to the index and middle fingers. Instruct the mother to rub her fingers with the isotonic paste to ensure proper contact.
- Attach the finger clips to the first phalange of the index and middle fingers, with the button side on the pad of the finger and the flat side on the fingernail. Plug the eSense cable into the audio port of the tablet.
- Open the eSense app, select "eSense Skin Response," and tap "Open Training" to prepare the app for data recording. Simultaneously, open the Mirage app, tap "Launch a Packet," and then press the play button to assign the assessor ID. Enter the assessor ID, choose the participant ID, and then tap "Start Exercises." Afterward, tap "Done" and "UTCMarker" to access the Mirage start screen.

3.2. Acquisition Mom solo

- **Instructions to Mother:** Before starting the mom solo baseline, inform the mother that you will be recording her heart activity. Explain that she needs to be comfortable and relaxed, should avoid talking, and must close her eyes and breathe calmly. Tell her that the recording will last for 5 minutes and that she should keep her eyes closed until instructed otherwise.
- **Manage the Environment:** If there are children or other people in the room, ask them to leave or to sit quietly without causing any disruptions.
- **Start the Recording:** Press "Start" in the eSense app, then switch to the Mirage app and press "Start Baseline" to begin the 5-minute timer. Return to the eSense app to monitor the skin conductance line and ensure the signal remains intact. During the 5 minutes, address any interruptions, such as disturbances from children or adults, failure to follow instructions, disconnections of electrodes or devices, overcrowding, or external noise. If an interruption occurs, use the Mirage app to press the "Interruption" button, then return to the eSense app. If the connection is lost, stop the baseline recording in the Mirage app, inform the mother that you need to clean her fingers with a new wet napkin, reattach the clips, and restart eSense. If the contact issue persists, take time to explain the situation to the mother, clean the dominant hand, reattach the finger clips, and restart eSense.
- **Complete the Recording:** After the 5-minute recording period, go to the Mirage app and press "Stop Baseline." Then, go to the eSense app and press "Pause" to end the mom solo baseline.



3.3. Acquisition Mom + Child Join Baseline

- Clean the areas where the bodyguard device will be attached using a wet wipe. Focus on the upper right chest, just below the mid-point of the collarbone, and the side of the child, just below the bottom rib. Be sure to clean these areas carefully to ensure proper contact with the electrodes.
- With someone help, transfer the child to the mother's lap. Ask the mother to sit comfortably on the floor with the infant positioned on her lap. Instruct the mother to remain quiet and avoid moving either herself or the infant during the acquisition period to prevent any data disturbance.
- Before starting the "Join Baseline" (mother and child recording together), repeat the instructions given during the mother's solo baseline session. Tell the mother she should be comfortable, relaxed, avoid talking, close her eyes, and breathe calmly. Inform her that the heart activity and skin response will be recorded for 5 minutes, and she should keep her eyes closed until instructed otherwise.
- Open the Mirage app and press "Start Baseline" for the 5-minute joint recording. Return to the eSense app and press "Resume" to restart eSense. Monitor the skin conductance

data as before. If there are any interruptions—such as distractions from children, adults, device disconnections, or noise from outside (e.g., street hawkers)—note the interruption in the Mirage app by pressing the "Interruption" button, and then return to the eSense app.

- After the 5-minute joint baseline recording, go to the eSense app and press "Stop." Then, return to the Mirage app and press "Stop Baseline" to finalize the data collection for this session.
- In the eSense app, press the download key located at the bottom of the application. Navigate to the "Archive" section, select the recorded file from the current date, rename the file using the participant's ID from the Mirage app, and save it for further analysis.
- Once the recording is complete, carefully remove the bodyguard monitor, finger clips, and electrodes from the mother. Provide the mother with a wet napkin to clean the areas where the electrodes were attached. Ensure that all equipment is properly stored for future use.

3.4. Acquisition Child Solo Baseline

- Place the infant on a soft, comfortable pad in the supine position (lying on their back). Ensure that the child is calm and in a stable, quiet state before starting the baseline recording. It's acceptable to begin the recording while the infant is sleeping, as long as they are in their best condition for accurate data collection.
- Instruct the mother to maintain a neutral expression and avoid any verbal or auditory interaction with the baby during the recording. This helps ensure that the child remains undisturbed.
- Begin the baseline recording for three minutes using the Mirage app. If needed, you can provide the baby with a soundless toy to focus on, allowing them to move, wiggle, or roll slightly to stay calm during the session.
- If the child becomes excessively restless, distressed, or upset, stop the recording to avoid inaccurate data. Excessive movement, restlessness, or crying may disrupt the recording, so monitor the child's state closely.
- After the three-minute baseline session is complete, go to the Mirage app and press "Stop Baseline" to end the recording.
- Once the recording is finished, carefully remove the bodyguard monitor and electrodes from the child. Use a wet napkin to clean the areas where the electrodes were attached, ensuring that the skin is free of any residue.
- In the Mirage app, tap the menu bars at the top left and select "Skip." A comment box will appear, where you should enter details about the start and end times of all three baseline sessions (mother solo, mother and child, child solo). Also, type in any notes about unusual events or interruptions during the sessions. After completing the notes, tap "Next," then tap the Home icon to finish.

4. Things to note after acquiring (infant):

- (Awake state/Sleep/fussiness (Predominant* states) Eyes closed, regular breathing, no spontaneous activity except startles or jerky movements at quite regular intervals.
- Eyes closed, irregular respiration, small movements, eye-opening may occur briefly at intervals. Drowsy or semi-dozing; eyes may be open but dull and heavy-lidded, or closed, eyelids fluttering; activity level minimal.
- Some infants may also show fuss/cry vocalizations in this state. When this happens. Eyes likely to be open; considerable motor activity, with thrusting movements of the extremities, and even a few spontaneous startles; reactive to external stimulation with

an increase in startles or motor activity, but discrete reactions are difficult to distinguish because of general activity level.

- Crying; characterized by intense, loud, rhythmic, and sustained cry vocalizations that are difficult to break through with stimulation; motor activity is high

5. Things to note while acquiring (mother)

- Rocking the baby
- Repetitive moments like tapping
- Stroking the baby
- Kissing or talking to the baby
- Other

6. Data extracting procedure:

- 6.1. **eSense Data Handling and Transfer:** Access the Archive section in the eSense app and long-press the relevant file to select it. Compress the selected file into a ZIP format and share it via Gmail to the designated account. Ensure the Med Tech sends the data from their individual tablet daily. Download the daily data and organize it into a specified folder, then upload the folder to the NYU Box.
- 6.2. **Bodyguard Data Download and Export:** Upon receiving the Bodyguard device from the field, connect it to a computer using the USB-C cable provided with the Bodyguard 3 device. Open the Firstbeat Bodyguard 3 Exporter software, click "Download Measurement," and select the path and folder where the files will be saved. Before Acquisition data, ensure the export columns include "Machine-readable time" and that the "Merge data series threshold (minutes)" is set to 20. Verify that all relevant data items (ECG, ACC, RRI) are selected and marked correctly. Download and rename the file with the participant ID, organize it into date-wise folders, and upload the files to the NYU Box folder.
- 6.3. **Mirage Data Synchronization:** In the Mirage app, log in using the assign email and password to access the dashboard. Open the menu bar at the top left and navigate to "Upload Data." Select "Synchronize" to begin the data upload process. Once the synchronization is complete, verify that the data has been successfully uploaded, as indicated within the app.

Supervision for HRV Data Recording

We developed a QC form to supervise the entire procedure of HRV data recording, ensuring protocol adherence at every step.

1. Pre-Precaution Supervision:

- 1.1 **Ensure a Quiet Environment:** As the supervisor, begin by explaining the entire procedure clearly to the participant, emphasizing the need for a quiet and calm setting during the measurement. Request the mother and any family members to keep the area quiet throughout the recording session.

- 1.2 **Remove Electronic Devices:** Make sure the mother is not carrying any electronic devices or materials that could interfere with the recordings. If any are present, kindly ask her to remove them before starting.
2. **Pre-Acquisition Supervision:**
 - 2.1 **Verify Pre-Acquisition Questions:** Oversee that the data collector asks essential questions regarding the child's last nap, feeding, any signs of illness (e.g., cold, fever, respiratory issues), and the noise level in the home. These pre-acquisition steps are critical to ensuring accurate data.
 - 2.2 **Bodyguard Monitor Setup:** Ensure the proper placement of the bodyguard HRV monitor on the mother's chest. The area should be cleaned and dried before attaching the electrodes. Verify that the bodyguard device is securely clipped, and the green light is blinking, indicating it is functioning correctly.
3. **Procedural Supervision:**
 - 3.1 **eSense Setup:**
 - **Isotonic Paste Application and Finger Clips:** Confirm that isotonic paste is applied properly to the mother's fingers, and the eSense finger clips are securely attached to the correct fingers. If the non-dominant hand cannot be used, ensure the correct procedure is followed for the dominant hand.
 - **App Setup:** Ensure both the eSense app and the Mirage app are set up correctly for recording. The eSense app should be prepared to collect skin conductance data, and the Mirage app should have the correct assessor and participant IDs entered.
 - 3.2 **Mom Solo Baseline:**
 - **Provide Proper Instructions:** Make sure the mother understands that she should remain relaxed and quiet, with her eyes closed, for the duration of the 5-minute recording. Instruct her to avoid interacting with others or moving during this period.
 - **Monitor for Interruptions:** Stay vigilant for any disruptions during the recording, such as noise, device disconnections, or the mother failing to follow instructions. If any interruptions occur, ensure that they are logged in the Mirage app and resolved promptly, including restarting the baseline if necessary.
 - 3.3 **Mom + Child Baseline:**
 - **Monitor Setup for Child:** Ensure the bodyguard monitor is correctly attached to the child's chest. Oversee that the child is transferred to the mother's lap without disturbance and both are comfortable and calm.
 - **Ensure Proper Conduct:** Instruct the mother to remain still and quiet, similar to the solo baseline. Ensure the child stays calm and the recording proceeds for 5 minutes without interruptions. If interruptions occur, log them and follow the appropriate steps to address the issue.
 - 3.4 **Child Solo Baseline:**
 - **Child Positioning and Condition:** Ensure the child is in a stable and quiet state (preferably sleeping or quietly alert) for the solo baseline. The child should be placed on a soft pad in the supine position. Carefully observe the child's state throughout the recording (e.g., awake, asleep, fussy, regular breathing, eye movements).
 - **Recording Interruption:** If the child becomes excessively restless or upset, pause the recording and note the situation. Be prepared to stop the recording if the child is crying intensely or not in a calm state.
 - 3.5 **Observations During Recording:**

- **Mother's Behavior:** Closely watch for any interactions such as the mother rocking, tapping, stroking, kissing, or talking to the baby during the recording. These actions should be logged as they can interfere with data accuracy.
- **Child's Behavior:** During the child solo baseline, observe and document the child's behavior, including whether the child is sleeping, awake but calm, fussy, or crying. Note if there are spontaneous movements or eye-opening during the recording.

4. **Data Completion:**

- 4.1 **Ensure Timely Recording Completion:** Oversee that the recording sessions for both mom and child are completed within the designated time. Ensure all data is saved correctly in both the eSense and Mirage apps.
- 4.2 **Remove Equipment:** Once the recordings are finished, supervise the proper removal of the bodyguard monitor and eSense electrodes. Ensure the mother and child are given wet wipes to clean the areas where electrodes were attached.

HRV Training

The training for HRV data collection is designed to ensure proficient in the testing procedure, device usage, and managing field challenges. The training is comprehensive and hands-on, allowing trainees to practice the protocol in a controlled environment before moving to field settings.

1. Introduction to HRV and Its Importance

- 1.1 Began with a theoretical overview, explaining why HRV (Heart Rate Variability) is important for understanding physiological responses to stress and its application in research. HRV measures the variation in time between successive heartbeats and serves as a key indicator of autonomic nervous system function and overall cardiovascular health.
- 1.2 Discuss the importance of HRV in assessing the autonomic nervous system, particularly in relation to stress and emotional regulation.

2. Device Introduction and Usage

- 2.1 Introduce the devices used for HRV measurement, including bodyguard monitors, electrodes and eSense.
- 2.2 Provide training on related applications like the eSense app and Mirage app, covering:
 - a) How to set them up
 - b) Proper apps handling and synchronization
 - c) Troubleshooting common issues
- 2.3 Emphasize device care to ensure accurate measurements and equipment longevity.

3. Expert-Led Training

- 3.1 Supervisors and enumerators will benefit from expert guidance, receiving direct training from **Professor Paul D. Hastings, Ph.D.** (University of California, Davis) and **Elisa Ugarte, Ph.D.** Their expertise in HRV research provides foundational knowledge on both technical and procedural aspects.

4. Practical Lab Sessions

- 4.1 The training includes hands-on practice in a lab setting, starting with a detailed walk-through of the entire HRV protocol.

- 4.2** Trainees will practice the HRV procedure on mothers and children from the host community, ensuring they experience the full process of data collection in a controlled environment.
- 4.3** Trainees will take turns going through the procedure in front of a supervisor while other data collectors observe. This helps to familiarize everyone with the entire testing process and fosters peer learning.

5. Managing Field Challenges

- 5.1** Special focus is placed on how to manage field challenges that may arise during HRV data collection, including:
 - o Dealing with difficult child behavior (e.g., crying or fussiness)
 - o Handling environmental noise or distractions
 - o Troubleshooting technical issues with devices or applications
- 5.2** Supervisors will be trained on how to address any issues related to HRV testing procedures or data recording inconsistencies. If a supervisor identifies any concerns, they can provide additional training to the enumerator as needed to ensure protocol adherence.

6. Debriefing and Feedback

- 6.1** To continuously improve the data collection process, we arrange weekly twice debrief sessions, where the team can discuss issues encountered in the field.
- 6.2** During these sessions, supervisors provide feedback both practically and theoretically, offering solutions for common challenges and ensuring that all team members feel confident in executing the protocol.

7. Continuous Learning and Improvement

- 7.1** Throughout the project, ongoing supervision and retraining are provided if any team members are found to have difficulties or make errors during data collection.
- 7.2** The goal is to ensure that all enumerators perform the HRV testing procedure smoothly and consistently, maintaining high data quality.