Characteristics of HRV Patterns for Different Yoga Postures
Experimental Protocol

Participants

The participants involved three healthy female volunteers, aged 22 to 23 years. For the purposes of this study, "healthy" was defined as the absence of any physical or psychological conditions that could potentially hinder or interfere with the practice of yoga. To maintain consistency within the group, all participants were recruited based on having no prior experience in yoga.

Moreover, prior to the experiment, all participants had to provide informed written consent in accordance with the CPP (Comité de Protection des Personnes) criteria (cf. Annex). This process ensures that everyone is fully informed regarding the nature of the experiment and any potential risks due to the involved physical activity. Furthermore, participants were explicitly notified of their right to ask questions at any time and the possibility to withdraw from the study at any moment. Upon inclusion, participants were also required to answer demographics questionnaires to document relevant background information.

Posture Sequence

Participants were required to wear comfortable athletic clothing and provided with a yoga mat. The experimental task consisted of performing a sequence of six yoga postures, executed in a specific order of 5-minute blocks (cf. Figure 1).

Figure 1. Successive postures held by the participants

Data recording

Recorded Variables

Two types of physiological data had to be collected throughout the entire sequence:

- **Heart Rate Variability** (HRV): The participant's HRV was recorded via three electrodes placed under the right and left clavicles, with a third electrode positioned on the lower abdominal region which served as a reference to stabilize the signal and minimize electrical noise and motion artifacts.

- **Piezo-Electric Respiration** (PER): Respiratory activity was monitored using an elastic belt placed around the thorax. Prior to the experiment, several adjustment trials were conducted for each participant to ensure the belt is snug yet non-restrictive. This ensured the sensor was securely coupled to the body for reliable motion transmission without constraining the yoga postures.

Recording Setup

All physiological signals were acquired using the Bitalino PsychoBIT kit. The raw data from the ECG (HRV data) and the piezoelectric respiration (PZT) sensors was transmitted in real-time via Bluetooth to a computer.

Data recording was mainly managed through the OpenSignals software, ensuring synchronized capture of all parameters throughout the duration of the yoga sequence. PZT sensor was plugged onto the A1 port of the Bitalino while the ECG was connected through port A4; both were recorded at a sampling rate of 1000 Hz. Furthermore, Lab Streaming Layer (LSL) had to be enabled in the software settings to transmit the signals to MATLAB.

To ensure the portability and stability of the equipment during the postures, the BITalino was kept in a waist-mounted running belt worn by the participant. The device was powered by an external power bank to guarantee an uninterrupted power supply throughout the entire experimental sequence (cf. Figure 2).

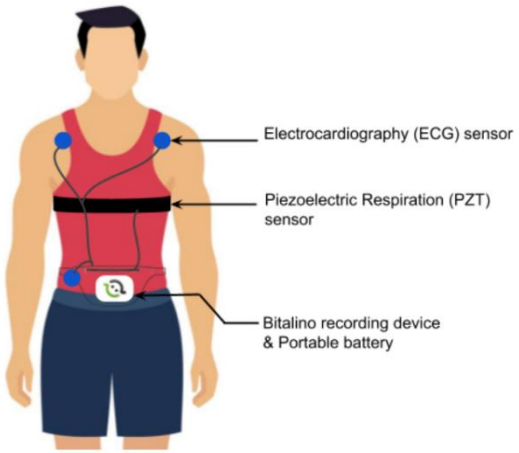

Figure 2. Device installation on the participant

Digital Interface

Throughout the session, a dedicated digital interface served as a dual-purpose tool for both the participants and the research team (cf. Figure 3). It was designed to ensure the protocol was followed as accurately as possible while allowing for real-time supervision of the data.

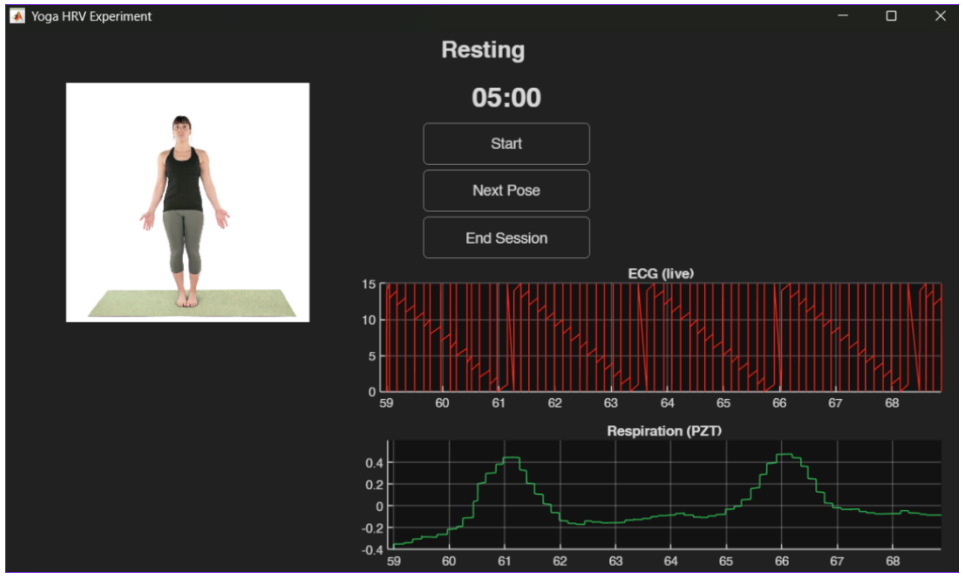

Figure 3. User interface: An example is shown for the posture, and the participant can indicate when they want to start holding the pose. The real-time ECG and PZT recording are also indicated.

- **For the participants** (guidance)**:** The interface provided visual cues which included images of the current posture to have as well as a countdown timer for each 5-minute block. To prevent any disruption of focus or body alignment, an automated voice system providing time-remaining alerts was also implemented.

- **For us** (monitoring and labeling): Thanks to the LSL, the interface displayed a live feed of the physiological signals (ECG and PZT). Furthermore, the person assisting the experiment could use "Start Session," "Next Posture," and "End of Session" buttons to insert event markers directly into the data stream. This ensured that the heart rate and respiratory data were synchronized with each specific posture for post-experimental analysis.

Note: Unfortunately, real-time transmission of the signals using LSL was not successful due to coding errors. In this case, the interface served only to assist with pose guidance and timing, while the raw signal files for post-processing were saved directly from OpenSignals.

Ultimately, the experiment (installation + recording) lasted about 45 minutes for each participant.

Annex: Consent Form

WRITING CONSENT FORM

Study Title: Characteristics of HRV Patterns for Different Yoga Postures
Assisting Team Member: [Name]
Contact Information: [Email]

Purpose of the Study:
The purpose of this study is to compare physiological markers (e.g., heart rate, respiration) between experienced yoga practitioners and beginners.

Procedures:
Participants will perform a yoga sequence lasting **up to 45 minutes** while wearing sensors (BITalino) to record physiological data. They will be guided through the sequence using a visual and audio interface while the assisting person may press a button to mark the start and end of each posture.

Risks and Discomforts:
- The study involves physical activity. There is a small risk of injury, strain, or discomfort during yoga postures.
- Participants should perform only postures they are comfortable with and may stop at any time if needed.

Benefits:
- Participants may gain insight into their physiological responses to yoga.
- The study will contribute to scientific understanding by comparing biological markers between experienced and novice yoga practitioners.

Duration:
- Each session will last **up to 45 minutes**.

Confidentiality:
- All data will be anonymized using an identification number.
- Data will be stored securely on password-protected computers.
- Data will be used solely for this study and scientific publications; personal information will not be shared.

Voluntary Participation:
- Participation is voluntary. You may withdraw at any time.

Contacts:
- For questions about the study: [Team Member Email]
- In case of any concerns regarding ethical issues: [Institutional CPP contact]

Consent:
By signing below, you acknowledge that:

1. You have read and understood the information above.
2. You confirm that you are healthy and do not have any condition that could make yoga practice unsafe.
3. You understand the potential risks and agree to participate voluntarily.
4. You understand how your data will be collected, stored, and used.

Participant Name : _____
Participant Signature: _____
Date: _____

Team Member Name : _____
Team Member Signature: _____

Date: _____