Electrocardiography (ECG) on one Mental Challenge

Technical Note

TN 04102018

PHYSICAL ACTIVITY | TASK DESCRIPTION

The purpose of this technical note is to show how a mental task can influence the heartbeat of a subject.

To that effect, a 5 min paced visual serial addition test was performed by a test subject.

In this test the subject is asked to sum two numbers that are shown on a screen and is used to assess capacity, rate of information processing and sustained/divided attention.

SIGNAL CHARACTERISTICS

Typical Frequency Band:

- 0.5 to 100 Hz [Recommended]

SENSOR AND HARDWARE DESCRIPTION

There were used gelled self-adhesive disposable Ag/AgCl electrodes together with a single-lead local differential bipolar ECG sensor (*Fig. 1*).

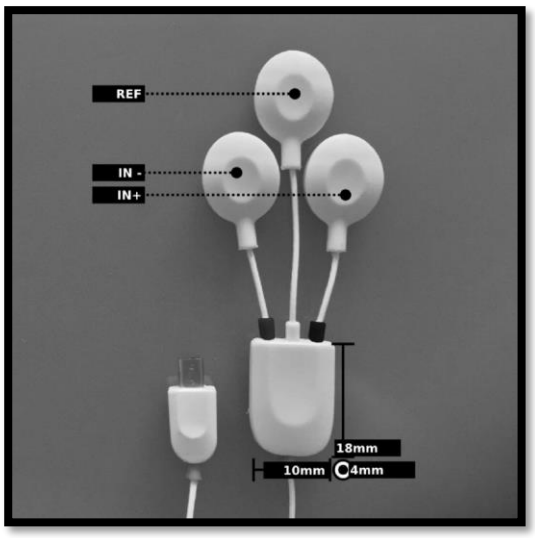

Fig. 1. Sensor Overview

SUBJECT DESCRIPTION

A 24-year-old male subject with no reported heart conditions (height: 1.70 m; weight: 75 kg - *Fig. 2*).

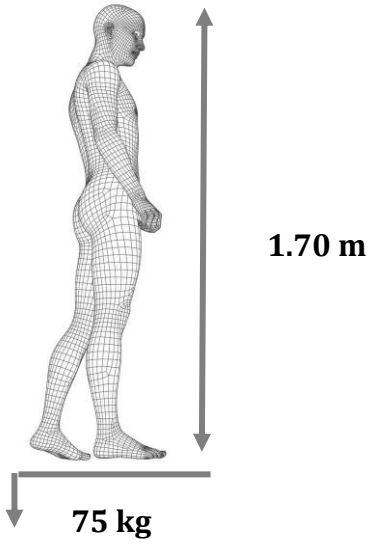

Fig. 2. Anthropometric Measures

PROTOCOL OF ACQUISITION

The subject is comfortably sited before and during signal acquisition.

Steps enumeration:

1. Prepare the skin:
   a. Use a razor to remove any hair from the skin where the electrodes will be placed;
   b. Afterwards, rub the surface of the skin with an abrasive material;
   c. Remove any dirtiness and fat from the skin surface with alcohol.

2. Place the electrodes in the V2 configuration of the 12-Lead ECG scheme (*Fig. 3*):
   a. Positive electrode under the left nipple, near the interception of the 4th rib with the sternum;

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b. Negative electrode over the left nipple, near the interception of the 4th rib with the sternum.

3. Place the ground in a surface bone, like the ankle, the clavicle, or the sternum;

4. Stand in an upright position for approximately 5 minutes;

5. Perform the *Paced Visual Serial Addition Test* (**PVSAT**) for approximately 5 minutes.

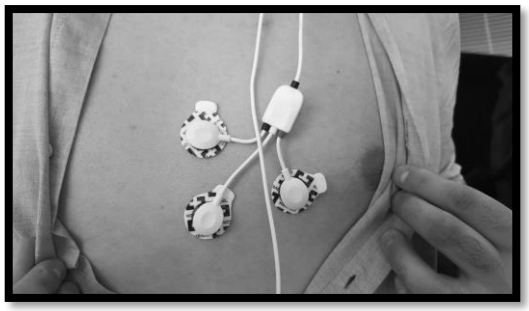

Fig. 3. Sensor Placement (V2 configuration)

NOISE EVALUATION PROCEDURE

For the present protocol, the Noise Evaluation Procedure is similar to the one described in the Technical Note relative to the ECG acquisition at rest.

PVSAT EVALUATION

In *Fig. 4*, the (near) 10-minute recording is shown.

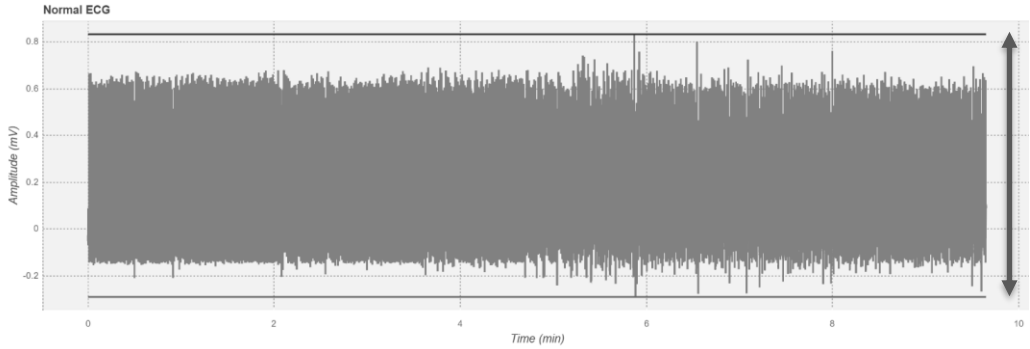

Fig. 4. ECG signal defining graphically the peak to peak amplitude (V_{pp}^{signal})

To get the heart rate, the Pan and Thompkins algorithm for R Peak detection was used.

Afterwards, a rolling mean of **40 points** was performed in order to easily assess the influence of the test on the subject's heart rate.

Finally, the mean heart rate of before and during the test was calculated (*Fig. 5*)

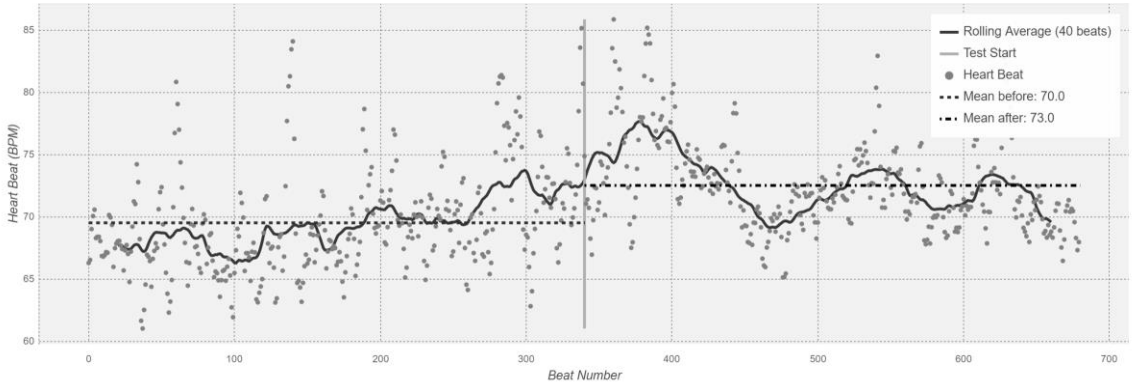

Fig. 5. Evolution of heart rate and representation of the average values before and after test starts

Right before the start of mental test, the subjects heart rate starts to increase in preparation for it. Then, a quick spike in the heart rate is formed, which starts to go down after the “initial shock” from the test, stabilizing around the mean value.

Comparing both means, the heart rate during PVSAT is slightly higher, which is expected, since stress causes an increase in heart beats.