Influence of the Stress Components of the Stress+ Application

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Abstract—With the increasing stress-related diseases, there is a high demand for efficient stress monitoring and treatment methods. However, the current stress monitoring process is time consuming and requires a lot of effort by the psychologists or the doctors. "Stress+" application is a stress-inducing tool which helps the doctors to conduct a stress test. This tool was developed to reduce the time and effort required by doctors and participants to complete a stress monitoring test. With this application, the doctors and participants can organise/take part in the test remotely. To achieve this, Stress+ application was built with re-configurable major and minor stress components which play an important role in inducing stress. Research study was performed with multiple participants using different combinations of stress components. Experimental results indicate that these components induces varying levels of stress for the participants (monitored using an ECG sensor). The effectiveness of each of the components is discussed in this report.

I. Introduction

The American Institute of Stress states that about 33% of people report feeling extreme stress, 77% of people experience stress that affects their physical health, 73% of people have stress that impacts their mental health, 48% of people have trouble sleeping because of stress. At times, stress is helpful to boost energy and attention. Most of the times, though, stress is a negative force in a person's life that triggers a host of unwanted effects. Regardless of age, sex, ethnicity and religion, no one is immune to the burdens of stress. Stress affects the entire body and is linked to many co-occurring mental and physical health problems, like heart disease, high blood pressure, diabetes, depression and anxiety. Long-term stress is often a contributing factor in many of the leading causes of death in the United States, including heart disease, cancer, lung disease, accidents, cirrhosis of the liver and suicide[1]. Despite stress being one of the major problems, it often gets overlooked and plays a negative influence on the overall quality of life. Due to its significant public health concern, the demand for a stress test to monitor such an unhealthy state promptly is increasing rapidly.

II. Diagnosing Stress

Typically, stress can be divided into acute and chronic stress. Whilst chronic stress consists of repeated occurrences or chronic existence of stressors over a longitudinal period, acute stress is considered to be created by stressors that occur with a lower frequency. To observe the reaction of the human body to acute stress it is necessary to induce it in a controlled environment and by a standardized stressor. For that reason, several research groups have proposed different protocols for acute stress induction[2]. In 2005, Dedovic et al.[3] proposed the Montreal Imaging Stress Task (MIST) that evokes moderate psycho-social stress by evaluating the performance of a subject in an arithmetic challenge. Based on the Trier Mental Challenge Test (TMCT), a study protocol had been developed with computerized arithmetic challenges which induce failure.

III. General Stress Test Procedure

Generally, when people suspect that they have a stress-related disorder, they schedule an evaluation with a medical professional. Medical professionals can perform a series of tests and assessments to understand and identify the problem. Not only can they accurately diagnosis the disorder, but they can also prescribe helpful treatments to reduce symptoms.

Few limitations of this approach are, it is often difficult for the patient to get an appointment as early as possible, requires a lot of effort, time, and assistance throughout the test procedure. Also, from the Medical professionals' perspective, it is very difficult to monitor, observe and track the patient for a long duration.

IV. Stress+

Stress in a box is a project which aims to develop a tool called "Stress+" that simplifies and overcomes the limitations of the existing stress test process.

Stress+ is a user-friendly tool that allows the participants to take the stress test with their own devices, anytime, anywhere. Based on the Montreal Imaging Stress Task (MIST) protocol, this app sets up a challenging environment that induces the psychological stress to the participants by allowing them to take a mental arithmetic test which is supported by additional components like time constraints, scores, feedback etc. These components can be chosen and ordered flexibly by the doctors. The results of the test are automatically sent to the doctors which aids them to diagnose and plan any further treatment. Stress+ app can also be used by physiotherapist, sports psychologist, stress counsellors and health insurance organisations to assist their processes.

The app mainly consists of the following stress-inducing components:

- Math task
- Message screen
- Wait screen
- Chatbot
- Current time
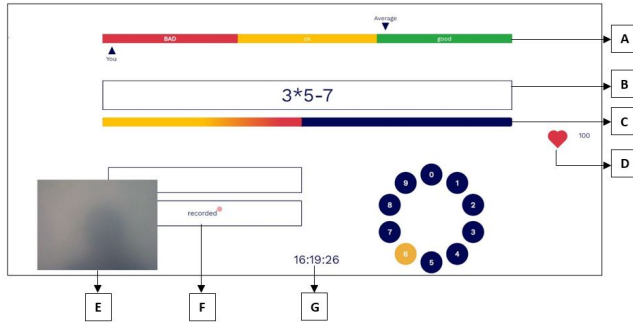- Screen freeze
- Webcam
- Heartbeat

Fig. 1. Stress components: A - Performance Indicator, B - Math Task, C - Progress Bar, D - Heartbeat, E - Webcam, F - Recording, G - Current Time
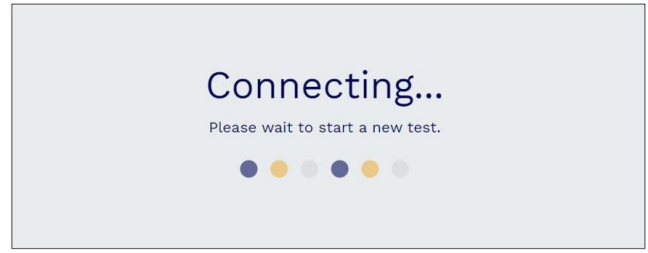

Fig. 2. Chatbot

Fig. 3. Message Screen

Fig. 4. Wait Screen

Fig. 5. Screen Freeze

V. STRESS COMPONENTS

The effectiveness of each of the components is discussed in this report.

A. Math Task

The principal component of the Stress+ app is a math task which displays a the mental arithmetic task with a couple of performance indicator labelled "You" and "Average" (Fig. 1-A). To the participant it creates a perception that the "You" bar indicates their performance on the test and the "Average" bar indicates the average performance of all the previous participants. In reality, these bars are also designed to induce stress. The basic idea is to indicate that the participant is performing poorly by strongly penalising the wrong responses and increasing the score only very slightly for correct responses in the "You" bar, and the "Average" bar is programmed to be random, with a very high chance of strong increases and low chances to decrease (that too, only by marginal values).

During the test, a time limit is also enforced for each question and the elapsed time is indicated by a progress bar (Fig. 1-C) along with a jarring background sound. The sound used here is very unpleasant in order to stress the participants. The doctors can choose different time limits under "Answer timeout" for each participant. In addition, it also displays a recording symbol during the session. Similarly, recording symbol (Fig. 1-F) is only displayed to make the participants feel that they are being monitored during the session.

B. Chatbot

The chatbot (Fig. 2) is one of the most customizable components of the Stress+ app. The doctors can set up any number of predefined conversations with the participants during the
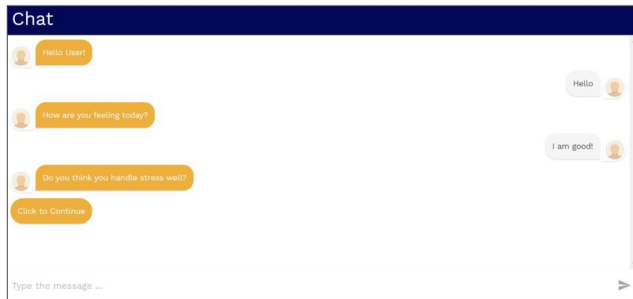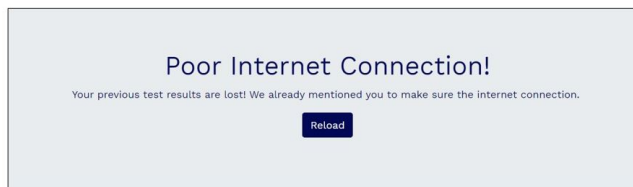
session. The idea behind this component is to chat about things which would strongly demotivate or disturb their calm state of mind.

C. Heartbeat

Stress+ app also provides a component to display the heartbeat rate (Fig. 1-D) to the participants on the arithmetic screen. The idea behind this is to display a random number (usually high) with a heartbeat image next to it and thereby letting the participants believe that they are really stressed.

D. Webcam

The webcam component (Fig. 1-E) allows the webcam to be switched on and displays the video on the screen throughout the session. The idea of a webcam component is to provide the participants with a conscious environment and to make them feel that they are being monitored during the session.

E. Current Time

Current time component (Fig. 1-G) displays the current time (HH: MM: SS) on the arithmetic screen. The idea is to support and further increase the stress by allowing the participants to be conscious about the time.

F. Message Screen

Like the chatbot component, Message screen (Fig. 3) is also one of the customizable components of the Stress+ app. The doctors can phrase their messages to be displayed to the participants during the session. Also, doctors can set up any number of messages and decide the sequence of screens. The idea is to write messages about things which would demotivate or disturb their current state of mind, thereby inducing stress.

G. Wait Screen

Stress+ app provides a component to make the participants wait for quite some time (Fig. 4). The idea here is to make the participants impatient with a longer waiting time.

H. Screen Freeze

As the name states, screen freeze component (Fig. 5) freezes the screen and does not allow the participants to answer any of the math task, but this does not freeze the time to answer the question. This is to create a sense of panic to the participants. The doctors can easily set up the time limit for screen freeze.

VI. Results

	P1	P2	P3	P4	P5	P6	P7
Math	X	X	X	X	X	X	X
Message		X	X	X	X	X	X
Sound		X	X	X	X	X	X
Internet		X		X	X		
Wait screen		X	X			X	X
Chatbot		X				X	X
Time		X		X	X		
Screen Freeze		X		X	X		
Webcam		X	X			X	X
Heartbeat		X		X	X		

To investigate the influence of stress components of the Stress+ app, a study was conducted with 7 participants. In the study, all the participants were young, healthy students of age between 21 and 27. Prior to the study, 7 tests were created with different combination of stress components as shown in the table. Especially, Participant 1 (P1) was provided with only one component (Math test), whereas Participant 2 (P2) was provided with all the existing components to get a clear picture of the overall influence of stress components (Tab. I), (Fig. 7) and (Fig. 9). Inferences made from the study are discussed in this section.

A. MAJOR STRESS COMPONENTS

This section categorizes the components which have a major influence on participants.

- *Influence of Math Task*

  Based on the research study with the Stress+ app, it clearly shows that math test (Arithmetic + Sound + Time limit + Recording + Performance indicator) has the major influence on the participants. To assess the math task, Participant 1 was provided with a math task without the time limit and sound; Participant 2 was provided with a math task including time limit and sound.
  Participant 1 (Fig. 7) recorded ECG reading of up to 100 – 110, whereas Participant 2 (Fig. 9) recorded up to 115 -120 with short peaky waves.

- *Influence of Chatbot Screen*

  For the research study purpose, participants 2, 3, 6 and 7 were provided with chatbot component in their session. Some of the chatbot messages used: "Hello! Are you facing any trouble with the test?", "We are asking you because you are under performing", "Other participants have performed better than you", "Don't disappoint us" (Fig. 2).

From the results of the ECG readings, these participants had clearly shown a high level of stress with maximum recordings of up to 120 – 135 with peaky waves (Fig. 9), (Fig. 11), (Fig. 17), (Fig. 19). Also, from the survey results, participants had mentioned that the messages were disturbing and demotivating, which stressed them a lot for the next math task. This way chatbot plays a major role in inducing stress.

- *Influence of Heartbeat*

  In comparison to the results of participants without heartbeat component, the other participants with heartbeat component have shown better results with very short and more peaky waves on the ECG readings. Based on the study results and survey, it clearly shows that the heartbeat component plays a major role in inducing stress (Fig. 9), (Fig. 13), (Fig. 15).

B. MINOR STRESS COMPONENTS

This section categorizes the components which have only a minor influence on participants.

- *Influence of Webcam*

  Based on the study and survey results, participants have mentioned that being monitored via webcam make them feel a bit uncomfortable. However, compared to other stress components, the webcam seems to induce more stress when it is working along with a different major component than when it is the only component during the session (Fig. 9), (Fig. 11), (Fig. 17), (Fig. 19).

- *Influence of Message Screen, Current Time, Screen Freeze and Wait Screen*

  From the research study and survey, it clearly shows that these are minor stress components, which act as a supporting component in inducing stress. Comparatively, these components when added to the tests with other major stress components, supports in increasing the stress levels marginally (Fig. 9), (Fig. 13), (Fig. 15).

VII. CONCLUSION AND DISCUSSION

The results presented in this paper leads us to propose the Stress+ app as a useful and versatile tool for inducing stress, which helps the doctors with further investigation of the effect of stress on the participant.

However there are quite a few potential scopes for updates in this application. As discussed already, ECG sensors were used to measure the heart rate of the participants. In future, the application could be updated to facilitate the usage of Stress+ using smart devices. Also, there is an argument that someone with good arithmetic skills can always perform better, and

this leads to a question of whether the arithmetic tasks have an equivalent scale of measuring stress across all the participants. With this application, repeatability is also a good point to explore in future, as participants might get familiar to the test pattern after their first session and this might impact the results, we thereby recommend also the physicians to change the order and settings of each of the components with every test for the same individual.

REFERENCES

[1] Stress Facts and Statistics https://www.therecoveryvillage.com/mental-health/stress/related/stress-statistics/. Last visited: 10/09/2020 (2020)
[2] Zenkner, J.: Assessment of Cold Face Test for Stress Reduction. (2019)
[3] Dedovic, Katarina et al.: The Montreal Imaging Stress Task: using functional imaging to investigate the effects of perceiving and processing psychosocial stress in the human brain. Journal of psychiatry neuroscience : JPN vol. 30,5 (2005): 319-25.
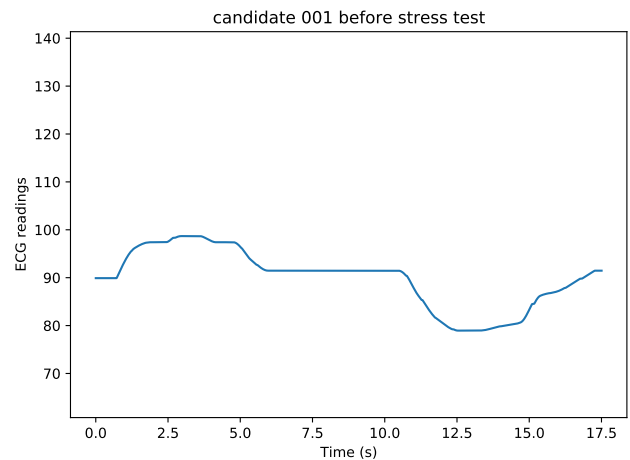
APPENDIX

ECG RECORDINGS

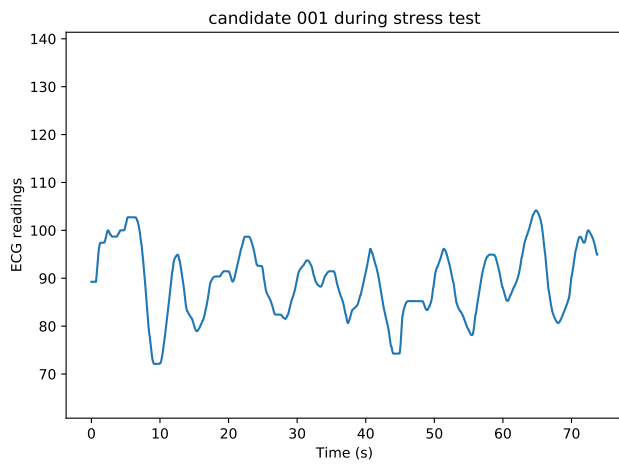Fig. 6. Participant P1 - Before Stress+ test
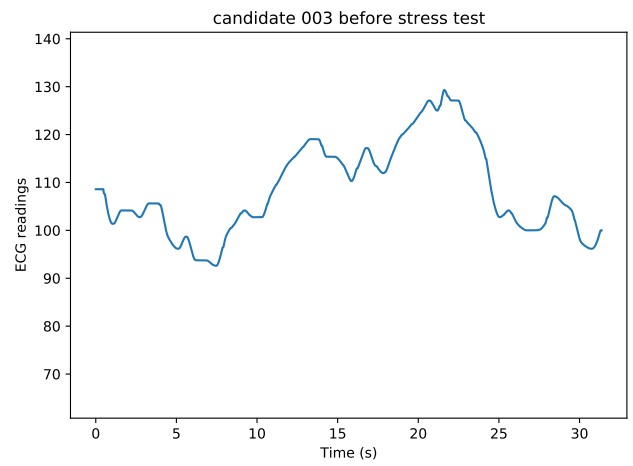
Fig. 7. Participant P1 - During Stress+ test

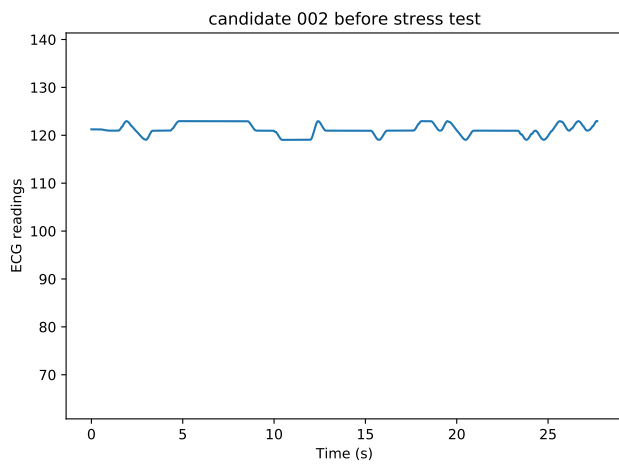Fig. 10. Participant P3 - Before Stress+ test

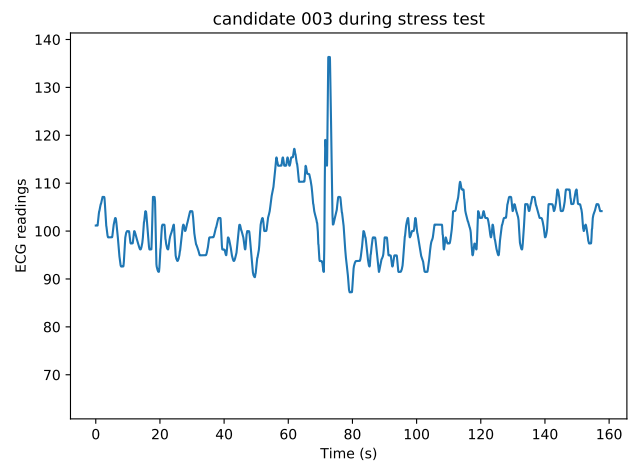Fig. 8. Participant P2 - Before Stress+ test

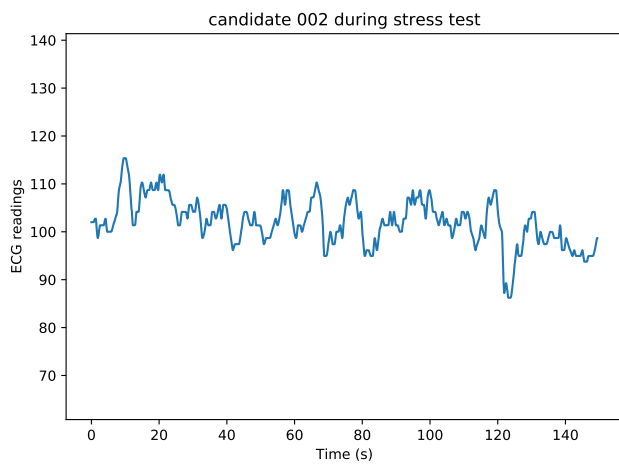Fig. 11. Participant P3 - During Stress+ test

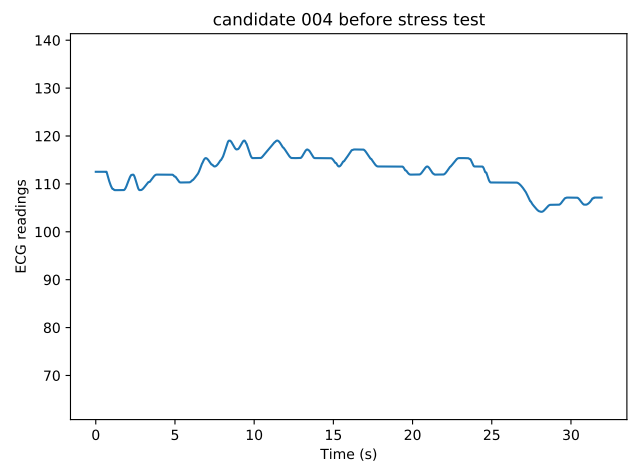Fig. 9. Participant P2 - During Stress+ test
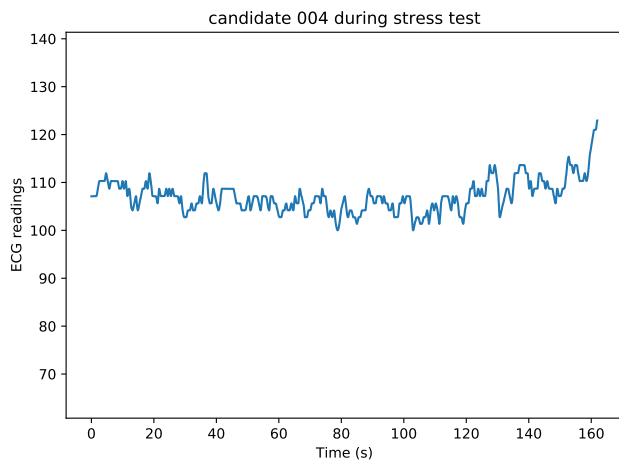

Fig. 12. Participant P4 - Before Stress+ test
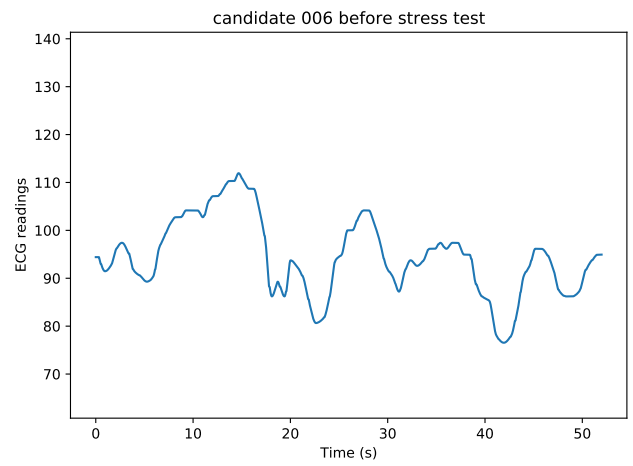
Fig. 13. Participant P4 - During Stress+ test
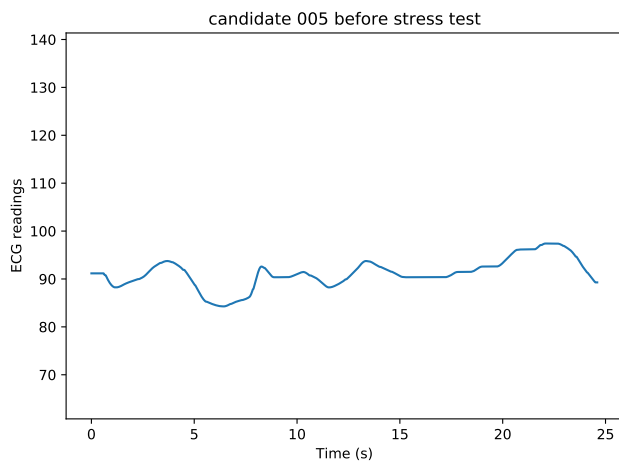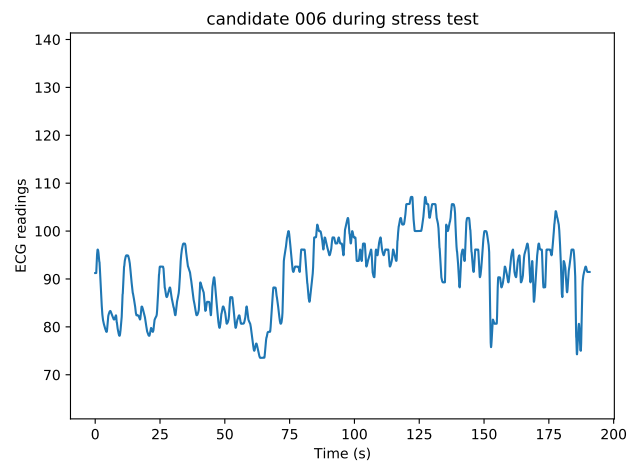

Fig. 16. Participant P6 - Before Stress+ test

Fig. 14. Participant P5 - Before Stress+ test

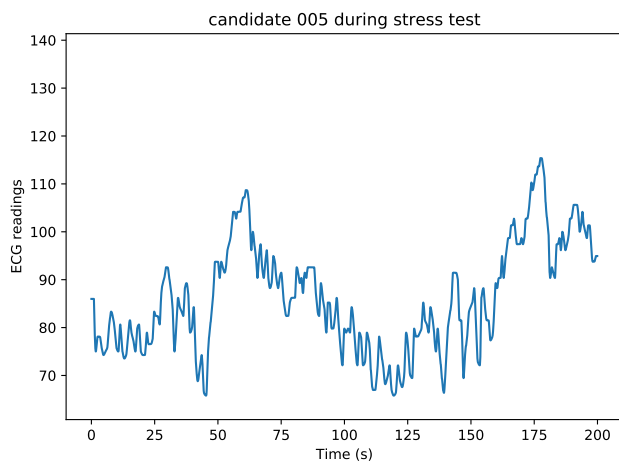Fig. 17. Participant P6 - During Stress+ test

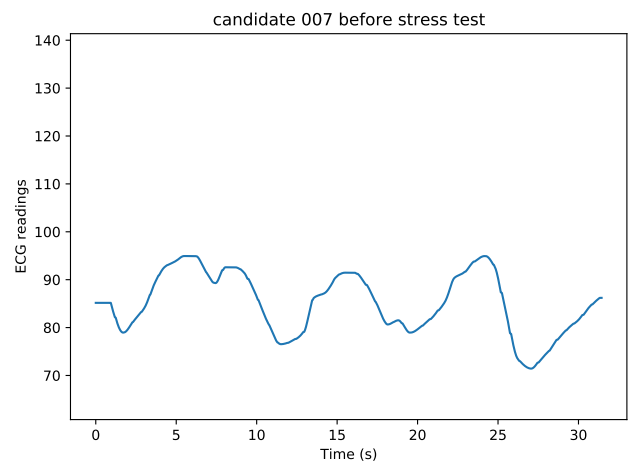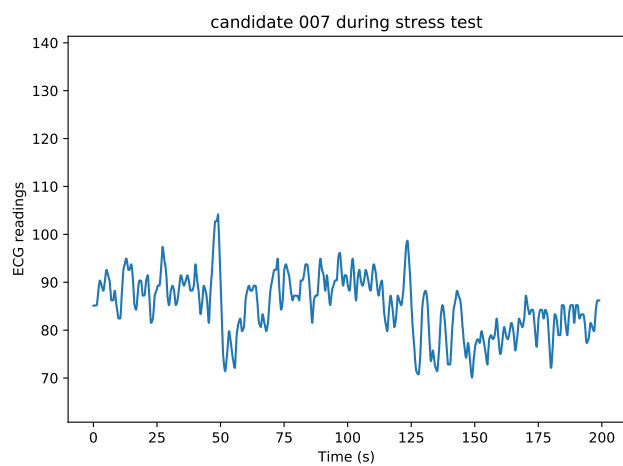Fig. 15. Participant P5 - During Stress+ test

Fig. 18. Participant P7 - Before Stress+ test

Fig. 19. Participant P7 - During Stress+ test