Denis Smolin, Deniz Oruç Çelik 29.04.2024

Measuring Stress with a Plant and Predicting Exam Performance - Research Proposal

1 Abstract

According to literature, there is no consensus on whether stress enhances or decreases human task performance, especially in exam situations. We propose an alternative way of capturing stress through measuring electromagnetic waves captured by a basil plant. Thus we want to conduct a field experiment where participants attend to a short exam that does not require any special prior knowledge. Avoiding a survey we try to capture unbiased signals and in first step analyze if there is a correlation between captured signals and participants self-estimation of their stress level. In a second step we want to build a machine learning model that uses only the captured electromagnetic waves to predict exam performance.

2 Experiment Design and Terms

The experiment involves a small room with the experiment supervisor, a table and a chair, a paper-based short exam, a basil plant, a BYB SpikerBox sensor attached to the plant, and a laptop. Participants are acquired randomly from the campus. Aim is to gain 30-40 participants for the control group and 30-40 participants for the test group. The incentive for participants is defined as follows:

- 10€ prize money for best exam result for participant from control group
- 20€ prize money for best exam result for participant from test group

The only difference between control and test group is the additional time restriction for the exam and the prize money. Participants will not know that there are two different experiment setups as they also will be conducted on different days. At the end of the written exam participants will be asked to fill out a form where they need to estimate their stress, experienced time pressure, tiredness, and overall health state. No demographic data will be collected. There will be a separate list where supervisors will write down the names of participants to ensure nobody will take part twice. This list will be destroyed immediately after field experiment is finished. Participants will be informed that the plant will be used as a measure instrument for stress without further technical details. The recording software captures electromagnetic waves that the basil plant emits. This data is saved as WAV files as does not contain any person-related information. The participation is voluntarily and to be eligible to win the prize money participants must be older than 18 years, leave their email address, and fill out all of the questions after finishing the exam. The emails and all communication with winners will be destroyed immediately after prize money was given away. Participants will be informed prior to experiment with all conditions and they must provide a valid document to confirm their age. Document details will not be collected or stored in any way. If participants want to cancel during participation they are free to do so. All collected data will be destroyed immediately. In case the participants want to withdraw their participation after the experiment, they will get our email address and with a free form request with no further explanations they can cancel their participation and collected data will be destroyed from our side immediately. This also applies to the winners, but in that case the prize money must be returned.

3 Ethical Considerations

We value the well-being of participants and therefore we will discuss possible negative aspects that participants may experience:

- Experienced time pressure
- Bad feeling in case of bad test performance
- Desperate need for money
- Discomfort during exam participation

We assume that the above mentioned criteria cover most of the negative feelings that may occur, but we are aware that there might be unforeseeable aspects that have to be dealt with spontaneously. However, we also assume that the above mentioned aspects occur in everyday life and will not have a significant long-term impact on our participants. There is no direct impact, neither physical nor psychological that is resulting directly from the experiment itself. The exam questions will be held neutral with no political, religious, sexual, national, or other sensitive topic content.

4 GDPR Considerations

We value the GDPR guidelines. Our first principle is the anonymization of collected data. We collect the following person-related sensitive data for temporal usage (not longer than six months):

- Full name (name and surname) of participant
- Email address of participant
- Age (not stored)

The collected names will be destroyed immediately after field experiment is finished and emails after the prize money was distributed. Age will be not stored at any point of time, it is just to ensure that our participants are adults. The collected sensor data and estimation of stress, time pressure, health status, and tiredness have afterward no relation to the participant. We are aware of the issue that trough data triangulation a single person may be identified but in our case this is very unlikely possible due to the fact that the collected data is ambiguous and may be a result of any person. We will store all data on a private cloud that is hosted by Denis Smolin in Düsseldorf, Germany. The cloud is not accessible for unauthorized users through the internet and utilizes only HTTPS protocol for data transmission. It is a Nextcloud instance, a open-source cloud server software that is also used by the German Federal Administration and Sciebo, a file-sharing service for universities in North-Rhine Westphalia. Data processing and machine learning will be held on local machines and will be not accessible through the internet. No third-party cloud services will be used for storage or processing of data.

5 Contact

In case any open questions are left, we kindly ask to write us an email via:

- dsmolin@smail.uni-koeln.de (Denis Smolin, application submitter)
- deniz-oruc.celik@stud.uni-bamberg.de (Deniz Oruç Çelik, research partner)
- pgloor@mit.edu (Peter A. Gloor, professor and project supervisor)