A Preliminary Analysis of the Physiological Response Generated by Negative Thoughts

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Presenter : Nagore Sagastibeltza

- Degree in Industrial Engineering in Automation and Electronics (from the University of Deusto (Basque Country), 2004).
- Research Personnel Hired by UPV / EHU in project: "Application of automatic learning to physiological signals to facilitate user interaction and device control" since 06/2019.
- My research activity is mainly focused on the area of biomedicine, capture and labeling of biosignals and subsequent processing and analysis of physiological signals.
- Entrepreneur and founding partner of the Inbizi Healthcare cooperative (2019) specialized in the development of biomedical equipment.
- Speaker at the 2019 Basque Electromedicine Forum Meeting, under the slogan "Employment in Industry and Health“.
- Member of the consolidated group ADIAN.
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1. Introduction

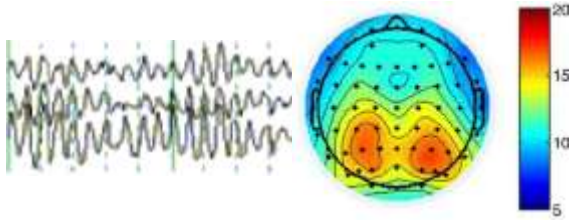
- Positive and negative emotions have a great impact on the human organism.

Negative thoughts

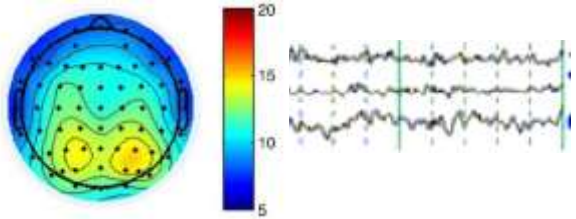
Positive thoughts

SIGNALS

ECG



EEG

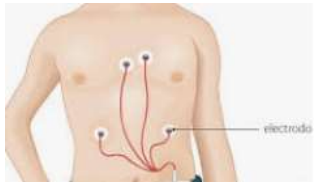


2. Methodology

A. Experimental setup

13 participants (9 males and 4 females) from the Faculty of Engineering in Bilbao of the University of the Basque Country (UPV/EHU), between 19 and 22 years old, were recruited for the following experiment:

1. Place the sensors on the participant



2. The participant chooses a stressful situation

3. The participant watches a relaxing video with the lights off

4. The participant listens to quiet music with the eyes closed

5. The participant is asked to bring back to the previously chosen stressful situation with the eyes closed

6. The participant watches again the relaxing video

7. Finally the participant is given an emotinal evaluation and a personal interview

B. Biosignals and data acquisition system

B.1. Biosignals studied

This work is based on the study of two particular biosignals: HRV & GSR

HRV	GSR
HRV : Heart Rate Variability	GSR : Galvanic Skin Response
It derives from the electrocardiogram (ECG)	It´s representative of the conductive capacity of the skin´s surface
It´s representative of the heart´s activity	It provides information on the body´s thermoregulatory activity
It provides information on the variation in time of heartbeat	It´s widely used in the area of electrophysiology
High variability indicates a healthy heart	It´s variations are indicative of different psycho-logical phenomena: nerves, surprise, anxiety…

B.1. Materials used in the experiment

Biopac MP36

Hardware Biopac MP36 and its associated software Studentlab

Considered a reference experimental equipment for gathering physiological signals

Sampling frequency used : 1000Hz

Electrods

To collect :

ECG signal

GSR signal

Projector

To project the two relaxing videos

PC

To store the signals and process them with Matlab software

MATLAB

3. Results and analysis

- Analysis process of previously captured physiological signals (HRV & GSR)

The target of the experiment was to see whether the participant´s negative memories have an impact on their Physiology. Therefore, the results belong to the discrete domain

Algorithms used in the analysis :

We decided to use algorithms previously developed in the research team that asses both stress and relaxation in a discrete manner : **ALG1 & ALG2**

ALG1

- **"A realtime stress classification system based on arousal analysis of the a nervous system by f-state machine"**
- It detects arousal of the Autonomic Nervous System (ANS) caused by a stressful experience.
- The **Outputs of ALG1** varies discretely from 0 to 6 according to the intesity and duration of arousal :
  0 → there is no stressful arousal
  1, 3, 5 → respectively correspond to the detection of a short-duration arousing alert of low, medium and high-intensity
  2, 4, 6 → correspond to the detection of ANS activation that last for longer than 30 s.(they stand for susteined stressful activations)

ALG2

- **"A Self-paced Relaxation respomse Detection system based on galvanic skin response analysis"**
- It detects the inhibition of the ANS or a relaxing response.
- The **Outputs of ALG2** varies discretely from -3 to 0 :
  0 → there is no relaxing response.
  -1, -2, -3 → respectively correspond to low, medium and high-intensity relaxation responses.

- Results obtained after applying both algorithms

In the results obtained after applying both algorithms to the physiological signals of all participants, **two distinct physiological patterns are distinguished**:

Group A

- This group represents those **subjects that could recall a negative memory** which had a physiological impact on the organism.
- **Subject 12:** this subject's results represent the general pattern of this group.

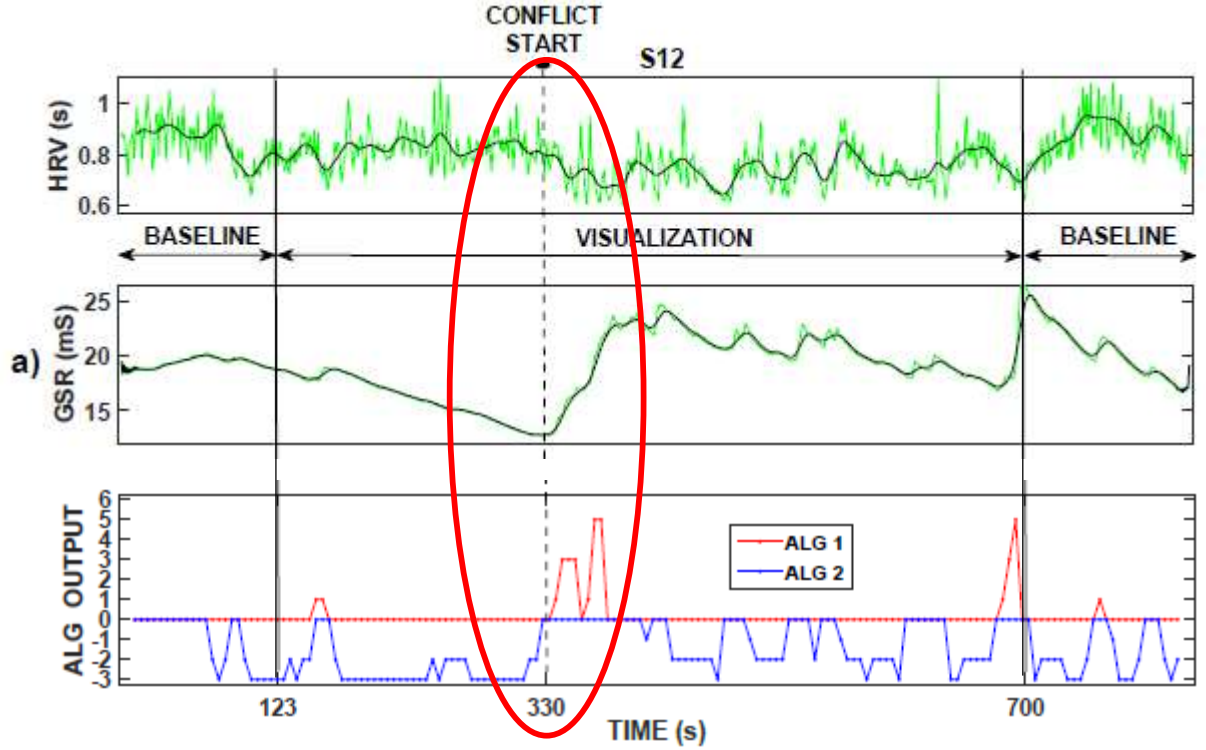
Group B

- This group represents those **subjects that did not get involved or could not recall a negative memory .**
- **Subject 5 :** this subject's results represent the general pattern of this group.

- Subject 12 results

Stages of the experiment carried out

Physiological signals (HRV and GSR) and algorithms outputs



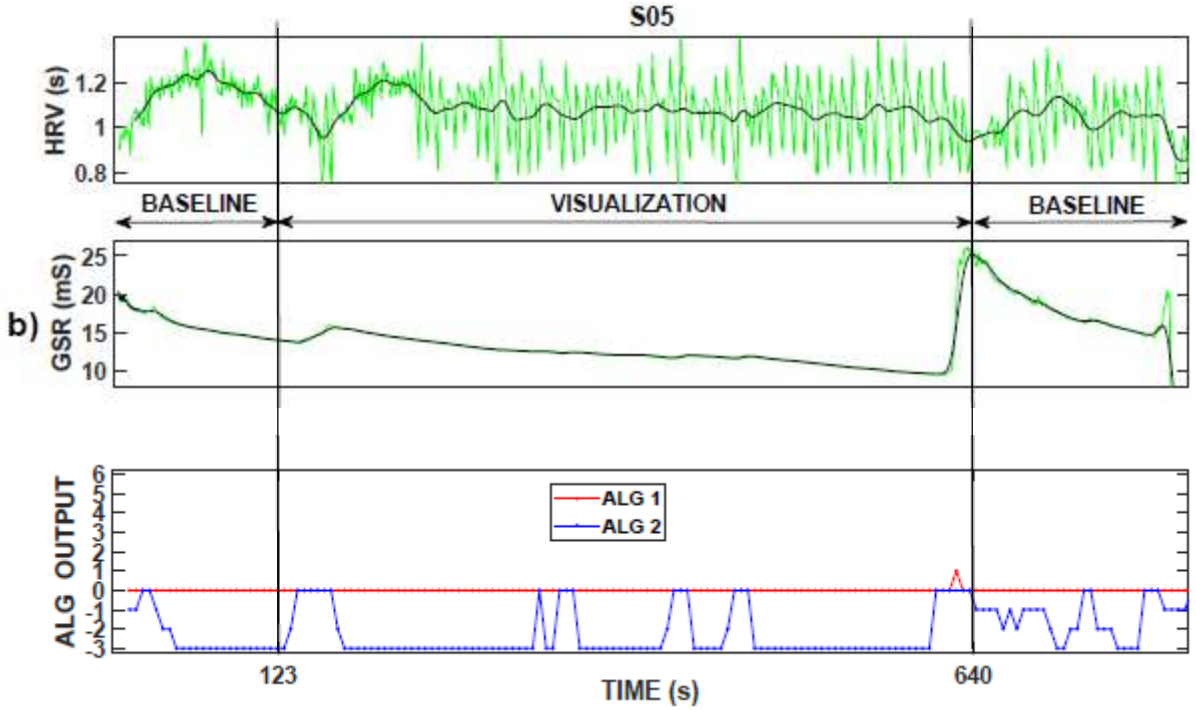
- **HRV** and **GSR** signals of **subject 12**
- **green** signal: **raw** signal
- **black** signal: **low-pass filtered** signal

- He **was able to relax** during the begining of the visualization stage
- His **ANS activated** when he started remembering his **conflict** producing:
  - **decrease of HRV** (acceleration cardiac rhythm)
  - **increase of sweating**

- Subject 5 results

Stages of the experiment carried out

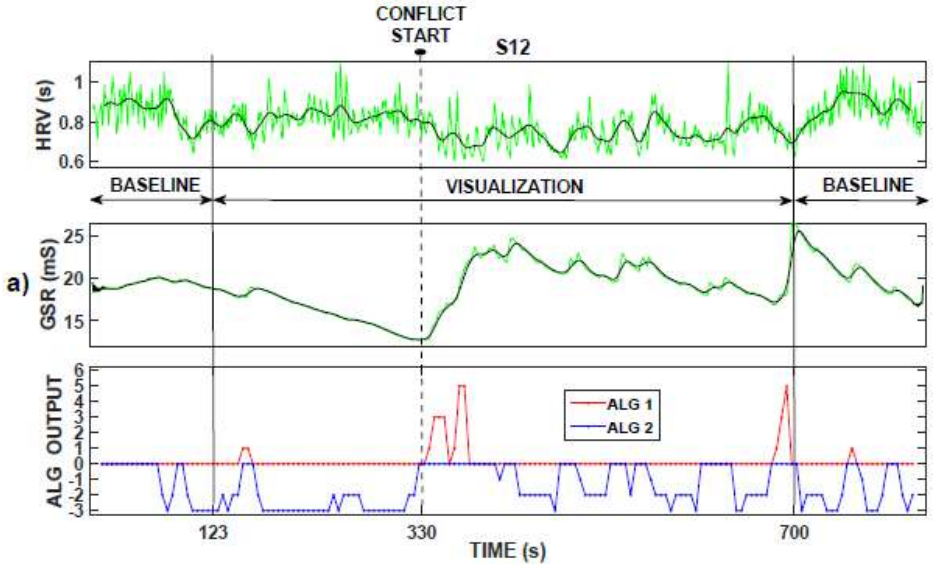
Physiological signals (HRV and GSR) and algorithms outputs



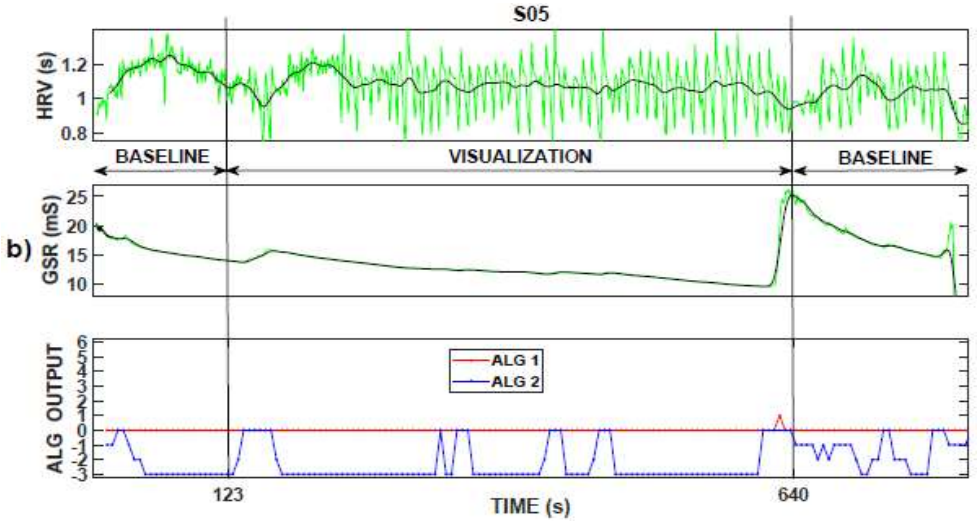
- **HRV** and **GSR** signals of **subject 5**
- **green** signal: **raw** signal
- **black** signal: **low-pass filtered** signal

- He **was able to relax** during the begining of the visualization stage
- He could not remember any personal conflict, and so, **no negative memories were recalled**
- The algorithms indicate high levels of relaxation during the conflict evoking stage.

Subject 12



Subject 5



This study corroborates the hypothesis that **negative thoughts generate** similar **physiological variations** to the ones that stress produces **on the organism**.

All the subject that thought about and recalled a **conflictive situation** suffered from **ANS activations**, getting a **100% accuracy** for the used **detection algorithms**.

4. Conclusions

- Not all the participants coud recall a negative situation

- It´s not the stimulus the one which produces the emotional reaction on the organism, but the person´s cognitive perception of the stimulus.

- In the case of all the participants that could evoke a past conflict, their organism reacted in the same manner as if they were going through a stressful situation.

- The algorithms offer 100% accuracy in detecting the activation of the ANS in negative thoughts.

THANKS FOR YOUR ATTENTION

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