PSYCHOPHYSIOLOGICAL EVALUATION OF EMOTIONS DUE TO THE COMMUNICATION IN SOCIAL NETWORKS

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ABSTRACT

The emerging social networks like Facebook and Twitter with their huge popularity produce a strong impact to our life. The study of human emotions by means of bioelectrical signals and psychometrics has a long history, but the data for an influence of Web-based social networks is still scarce and specific methods are lacking. We tried to assemble an ad-hoc methodology for exploring emotions of a Facebook pilot group of users implementing time-frequency spectral analysis (based on S-transform) and rhythm dynamics characteristics representation of a complex set of recorded bioelectrical signals with parallel psychometric tests. The spectral nature of the studied signals suggests correlation with the emotions of the Facebook users. The obtained initial results have shown that the assembled methodology for bioelectrical signals' recording and analysis might be a valuable tool for the study of impact of social networks on human emotions and facilitation of IT developments assessment and control in the information society.

Key words: human emotions, bioelectricity, social networks, spectral analysis, rhythm dynamics

INTRODUCTION

In today's world social interaction is increasingly performed via social networks like Facebook and Twitter related to the huge popularity of modern information technologies (15). However, there is a paucity of studies of human emotions and behavior related to this communication process as well as the hidden threats behind it.

There are two kinds of theories for studying human emotions because of the different understandings of the nature of emotions and their relation to the emotions' stimuli (6): (i) cognitive based (3,7,13) and (ii) somatic factors based (4,11,14). Due to the complex nature of the emotions there are and two approaches for their exploration: (iii) discrete (assuming the existence of a number of basic emotions that are universally displayed and recognized, like: happiness, sadness, anger, fear, disgust and surprise (2), (5), whilst other emotions are expressed as combination of these basic ones) and (iv) continuous (assuming a possibility for multivariate measurement of emotions, like e.g. the arousal-valence model (12).

The present study uses a cognitive based model and continuous approach to evaluate a methodological framework for

studies of emotions in the context of IT threats identification for Facebook social network users.

MATERIAL AND METHODS

We have studied 18 healthy volunteers (15 men and 3 women) aged between 15-18 years. We assembled an ad-hoc methodology for their evaluation as Facebook users, which includes: (i) habits and purposes in using the social network Facebook; (ii) Eysenk's personality questionnaire (both available at web page of TK 02/60: www.cleverstance.com, "Links" section); (iii) 3 minutes monitoring of Facebook navigation of two profiles: (a) the one of the popular singer Shakira and (b) the profile of the scientific project "Cortical Regulation of the Quiet Stance during Sensory Conflict", Grant TK 02/60 of the NSF including popular 39 photos for the standing balance problems.

Here it should be noted that (iii) has been performed by an own software tool "Social Network Activities Recorder" - SNAR v. 1.0 (developed in Borland Delphi® 2008 software environment) for user screen activity recording that encompasses: mouse clicks and X-Y screen position coordinates together with the background changes snapshots (the studied subjects have been instructed to operate with the mouse excluding any keyboard activities for simplification of the study). These experiments has been performed on personal computers during the Cyber security training course at XI Summer School of Mathematics and Informa-

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tics, August 17-19, 2011 in collaboration with the High School Institute of Mathematics and Informatics, Institute of Mathematics and Informatics - Bulgarian Academy of Sciences.

Additionally, a psychophysiological monitoring of 5 male volunteer, aged between 26-42 years has been performed afterward at the laboratory of the Department of Cognitive Psychophysiology at the Institute of Neurobiology, Bulgarian Academy of Sciences, with Mitsar 202 equipment recording: EEG (following 10-20 system - F3, Fz, F4, C3, Cz, C4, P3, Pz, P4), ECG (leads from the hands wrists) and EMG (by bipolar leadings-off from the mimic muscles: m. orbicularis oculi and m. corrugator superscilii) activities during the performance of the tasks (i) - (iii). Finally, only one 42 years experimental subject has been selected as a stable, extrovert representative Facebook user. All data was digitized in 500 Hz sampling frequency.

This experimental monitoring has been performed on HP 6730s laptop machine with Intel Pentium Dual-Core Processor T4200, 3072 MB RAM, 320 GB SATA HDD, ATI Radeon HD 3430 video card with 256 MB dedicated video memory and with WXGA BrightView 15.4" screen. The mimic of face has been also recorded via the build-in web camera and WebCam Max®, v.7.5.3.2 software.

The records of the physiological monitoring have been processed by using Matlab® R2011a. All records have been initially filtered with zero-phase shift digital filter using Chebishev IIR 50 Hz notch filter with slope -18 dB/oct and passband ripple 0.5 dB, $Wn=[47,52]$ Hz. Additionally, Butterworth band pass IIR filter with slope -18 dB/oct, and passband ripple = 0 dB has been also used, as follows: $Wn=[2, 42]$ Hz for the EEG, $Wn=[1, 150]$ Hz for the EMG and ECG.

Finally, time-frequency spectral analysis (using S- transform and the approach presented in (9)) was performed.

RESULTS

Regarding the participants' habits and purposes in using the social network Facebook almost all users (about 90%) are reporting Facebook usage for communication with real people and on-line stay for more than 12 hours daily, having more than 100 friendships. Only 10% of the studied participants report Facebook usage for entertainment and/or other purposes.

The generalized results of the Facebook psychological analysis and item usage validation according to (i) - (iii)
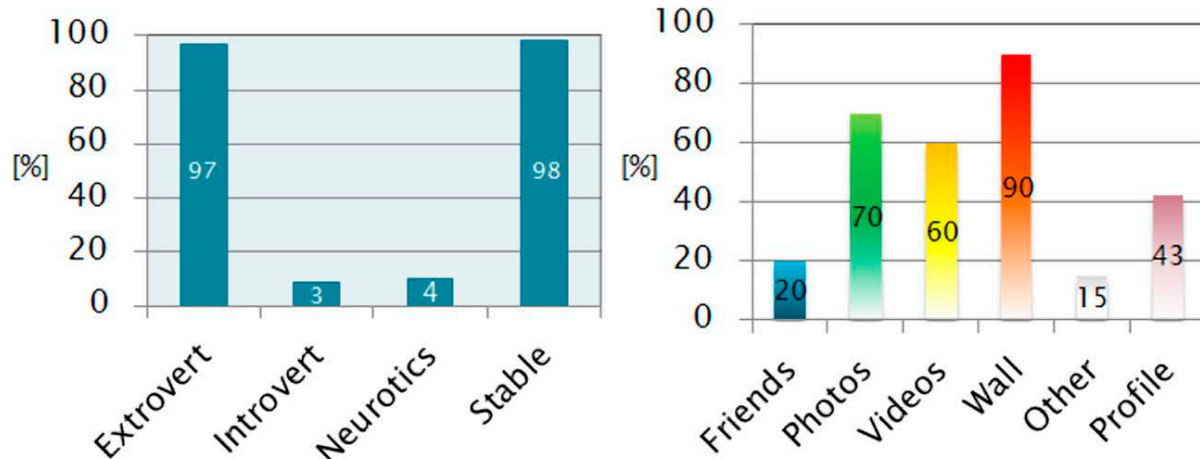

Fig.1. Eysenck's personality test generalized results expressed in percentages of the sample (left) and Facebook item usage (right) expressed in percentages of the coincidence between model predicted and really used items.

The subject's instruction was to operate with the mouse excluding any keyboard activities for simplicity of the study. The SNAR v. 1.0 software has been accomplished for the mouse clicks capturing, by using a short (1 ms duration and 1 kHz frequency) sound signal (produced as a result of left mouse button click) via the standard audio output of the experimental setup

All experiments have been performed in the context of validating the Facebook information flows threats model published in (10) and developed in the framework of EU Network of Excellence in Managing Threats and Vulnerabilities for the Future Internet: Europe for the World - SySSec. This model determines as a critical threat for the Facebook users "Friends" and as hidden threats: "Photos_Videos", "Profile", "Wall" and "Other".

tasks from the previous paragraph are shown for 18 healthy volunteers on Figure 1. As it is clear from Figure 1 (left), the stable and extroverts participants are encompassing almost all of the Facebook users stuff. On Figure 1 (right) the item "Wall" has 90% coincidence between model's predicted and really used items, whilst item "Friends" and "Other" have the lowest coincidence.

The pilot results of the polyphysiographic monitoring demonstrate that changes in the heart rate variability coincide with the S-transform variability of m. corrugator superscilii and/or m. orbicularis oculi (Figure 2 A). These results con-

firmed that heart rate variability can be connected with different kind of emotions (8).

sults of the threats coincidence of Facebook social network for the "Wall" item and the differences for "Friends" and
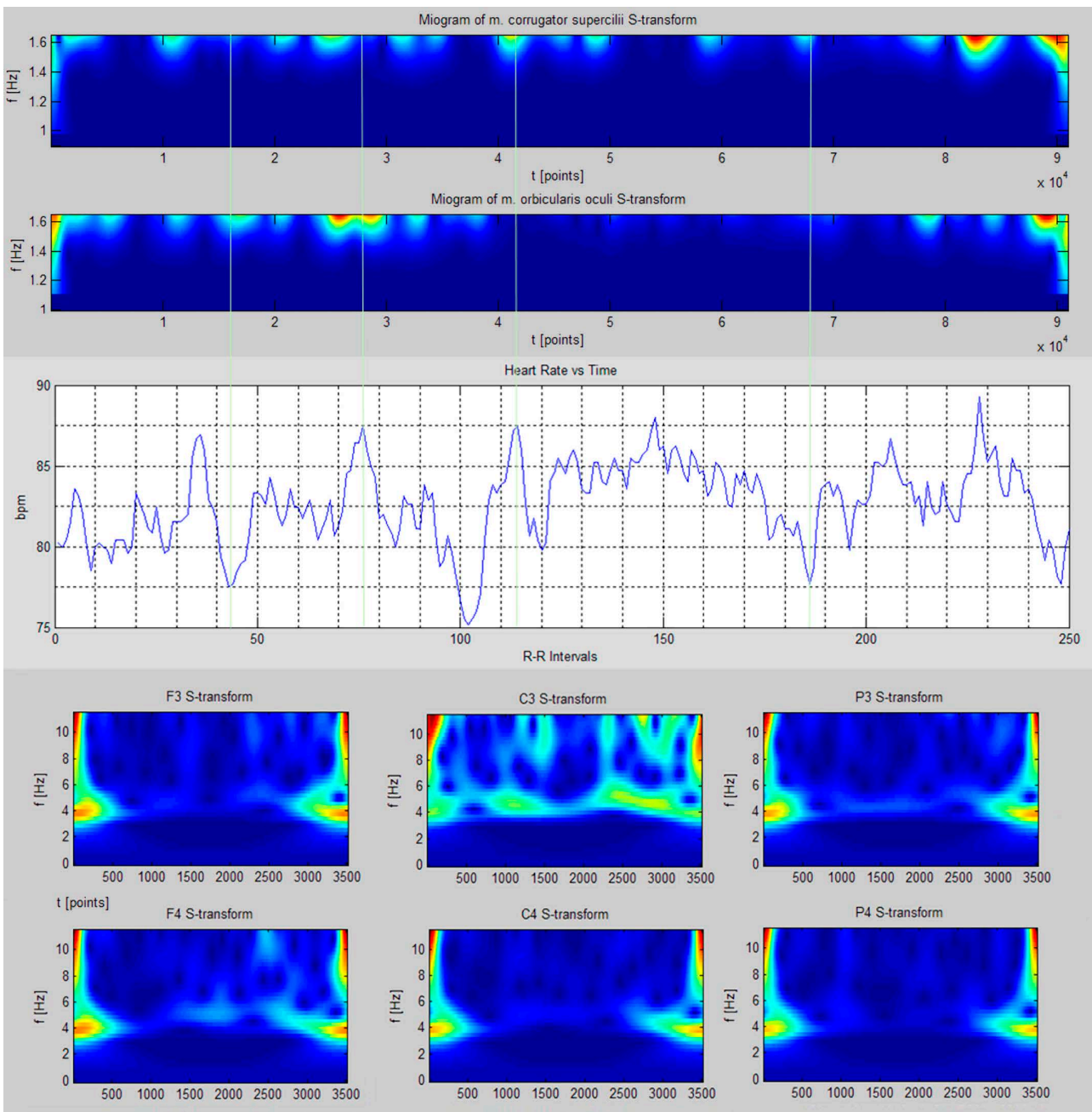

*Fig.2. **A**: parallel changes in EMG envelope S-transform of m. corrugator superscilii (top), m. orbicularis oculi (middle) and hear rate variability (bottom) during 3 minutes gallery items navigation of Facebook profile for standing balance problems; **B**: left-right EEG asymmetry in left (F3, C3 P3 - top) vs right (F4, C4, P4 - bottom) during 7 second epoch evaluated by S-transform.*

The EEG S-transform of F3, C3 P3 vs F4, C4, P4 during 7 second epochs showed typical frontal area left-right asymmetry (1) as well as centro-parietal cortex left-right asymmetry.

DISCUSSION

The psychometric results showed that extroversion and stability of the studied Facebook users are correlated positively with the intensity of social networks usage. The re-

"Other" items, suggesting that the obtained differences could be generators of hidden threats, which was not initially expected.

The pilot results of the polyphysiographic monitoring have demonstrated promising initial base for evaluation of the experts' models threats' foresees and psychometric measurements using bioelectrical signals like: EEG, EMG and ECG dynamic changes monitoring.

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