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Positive Technology: A Free Mobile Platform for the Self-Management of Psychological Stress

Andrea GAGGIOLI [a,b,1], Pietro CIPRESSO [a], Silvia SERINO [a], Danilo Marco CAMPANARO [a], Federica PALLAVICINI [a], Brenda K. WIEDERHOLD [c,d] and Giuseppe RIVA [a,b]

[a] *Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan, Italy*
[b] *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*
[c] *Virtual Reality Medical Institute, Brussels, Belgium*
[d] *Interactive Media Institute, San Diego, Belgium*

Abstract. We describe the main features and preliminary evaluation of Positive Technology, a free mobile platform for the self-management of psychological stress (http://positiveapp.info/). The mobile platform features three main components: (i) guided relaxation, which provides the user with the opportunity of browsing a gallery of relaxation music and video-narrative resources for reducing stress; (ii) 3D biofeedback, which helps the user learning to control his/her responses, by visualizing variations of heart rate in an engaging 3D environment; (iii) stress tracking, by the recording of heart rate and self-reports. We evaluated the Positive Technology app in an online trial involving 32 participants, out of which 7 used the application in combination with the wrist sensor. Overall, feedback from users was satisfactory and the analysis of data collected online indicated the capability of the app for reducing perceived stress levels. A future goal is to improve the usability of the application and include more advanced stress monitoring features, based on the analysis of heart rate variability indexes.

Keywords. Stress, biofeedback, heart rate, wearable sensors, mobile health, positive technology

Introduction

Psychological stress contributes to many chronic diseases suffered by citizens in today's society: according to the World Health Organization, mental health problems and stress-related disorders are the biggest overall cause of early death in Europe [1]. Exposure to prolonged stress is known to increase the risk of physical and mental health problems, including depression and disabling anxiety conditions. In recent years, several research groups have started investigating the opportunities offered by wearable biosensors and computers to address psychological stress. The combined use of wearable biosensors and smartphones allows collecting, elaborating and transmitting real-time information related to the psychophysiological state of the user and provide appropriate recommendations/exercises. Here, we describe the main features and

[1] Corresponding Author.

preliminary evaluation of Positive Technology, a free mobile platform for the self-management of psychological stress.

1. Positive Technology Platform: Main Features

The Positive Technology application (free download at: http://positiveapp.info/) consists of the following three main components, which are described in more details below:

a) Guided Relaxation;
b) Biofeedback;
c) Stress self-reporting and tracking.

1.1. Guided Relaxation

The guided relaxation component provides the user with the opportunity of browsing a gallery of relaxation music and video-narrative resources for stress therapy designed by professional therapists. The user can choose among four different 3D interactive environments (from beach or forest to campfire or mountain hiking) and six relaxing music traces that are designed to support relaxation. Once a relaxation environment has been chosen the user can also set the duration of the exercise, typically in the time range of 5 to 15 minutes.

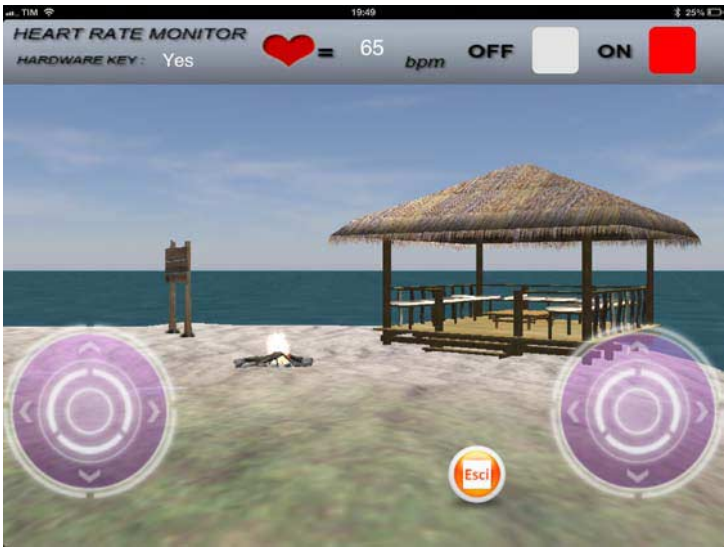

Figure 1. A screenshot of the Positive Technology app

1.2. Mobile biofeedback

The aim of the biofeedback component is to establish a feedback loop between the user and the relaxation environment. It consists of a portable heart rate monitor connected

via Bluetooth interface with the mobile application (the current version of the application supports all commercial cardiac monitoring sensors providing Bluetooth Smart protocol). The heart rate is displayed in form of animated 3D visual feedback to the user: by controlling the respiration rate, variations in the heart rate control the features of the virtual environment, such as the increase or the decrease of the size of a virtual campfire or waterfall. In this way, the user learns to control autonomic responses to stressful situations.

1.3. Stress self-reporting and tracking

The user has two options to track his/her stress levels: (i) manually, by reporting perceived stress level on a 10-point scale, and the arousal-valence levels on a modified version of the Self-Assessment-Manikin (SAM), the non-verbal pictorial assessment scales developed by Lang [2]. The arousal scale includes 5 values (1=relaxed; 5=excited); the valence scale includes 5 values (1=unpleasant; 5=pleasant) (ii) automatically, by having the application capturing instantaneous heart rate values immediately before and immediately after taking a stress management exercise (either biofeedback or relaxation). Values collected by the application are updated on the remote server through Internet connection. The user can also visualize the history of stress levels variations by logging into the service website.

2. Pilot Evaluation

The pilot evaluation took the form of an online trial, having participants using the application and self-reporting arousal-valence levels before and after a biofeedback or relaxation training. In addition, heart rate of participants wearing the wrist sensor was recorded. All users provided online an informed consent to the collection of their self-reported data.

3. Results and Discussion

Overall, 288 users downloaded the Positive Technology app. However, only the data collected from those users who performed at least one stress management exercise (either relaxation training or biofeedback), for at least 120 seconds, were considered in the analysis. Out of the 32 users who met these criteria, only 7 used the software in combination with the wrist sensor. From the selected sample, a total of 182 relaxation sessions were analyzed. A one-way repeated measure ANOVA was performed on perceived stress, arousal, valence and the heart rate to determine the effects of mobile stress management exercises. Results indicated a significant decrease of perceived stress level ($F=15.2$; $p<.01$); a significant decrease of arousal ($F=13.7$; $p<.01$) and a significant increase of valence ($F=13.1$; $p<.01$). There was a pre-post decrease in mean heart rate values, albeit not statistically significant.

These findings show that the relaxation exercises performed with the application were effective in reducing users' stress, as indicated by the significant decrease in self-reported levels of anxiety/arousal and by the increase of positive values of hedonic valence after the relaxation session. In addition, a pre-post decrease of mean heart rate

values was observed, although the difference was not statistically significant. However, it should be noted that heart rate was monitored only in 7 participants and the relative small number of sessions in which cardiac activity was recorded (46) might have decreased the statistical power of the analysis. Despite preliminary, these data suggest that even a short-duration relaxation exercise performed on a mobile application might be useful to reducing psychological stress and supporting positive emotional states.

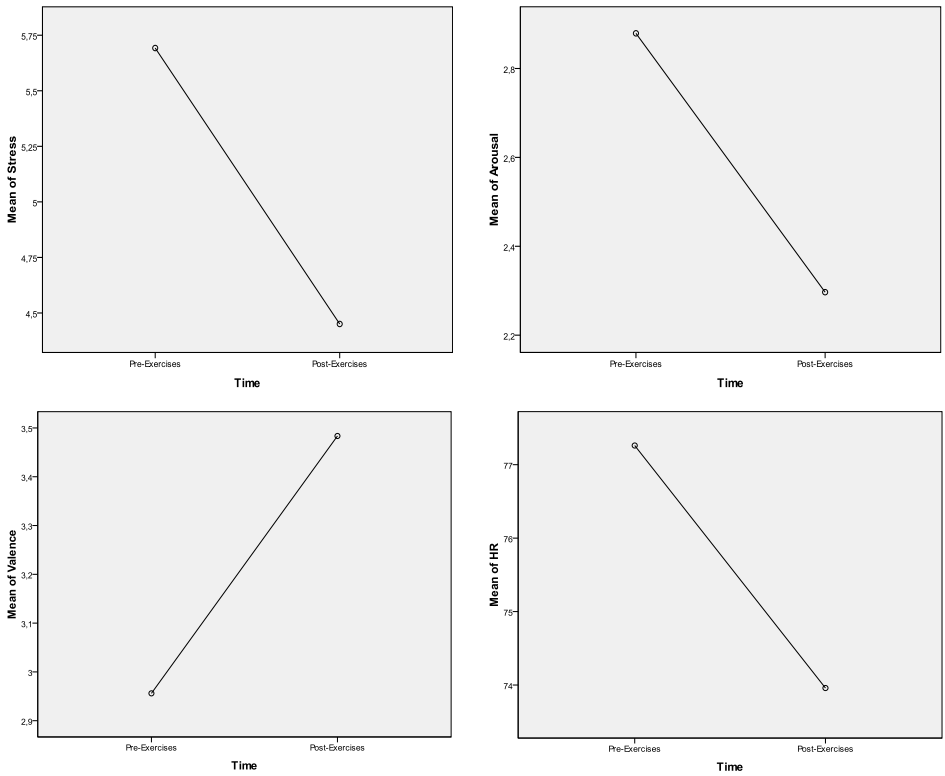

Figure 2. Results of pre-post ANOVA

Conclusion

Chronic stress has become an increasingly important public health concern. Stress-related disorders have been shown to cause and exacerbate physiological and behavioural disturbances ranging from immune system dysfunction to psychiatric disorders. Financial costs of work-related stress in the EU-15 were estimated to be 20 billion Euro in 2002, while in the U.S. alone cost estimates are as high as $200 billion per year including accidents, absenteeism, employee turnover, diminished productivity, and direct medical, legal, and insurance costs. Mobile meantal wellness tools may provide a potential effective approach to integrate prevention strategies into the everyday lives of citizens [3-4]. Here, we described the key features and preliminary evaluation of Positive Technology, a mobile platform for self-management of psychological stress. To our best knowledge, Positive Technology is the first free

mobile stress management platform available on the market which combines relaxation training, biofeedback and interactive 3D contents. In fact, most existing applications use mainly text instructions for relaxation training and breathing exercises, while others are "monitoring" and recording emotional status by simple and easy text questions that appear on the screen of the mobile device. There are applications that include a biofeedback feature, however this is usually achieved by tapping on the screen during each breath or using the camera as a less reliable heart rate monitor.
Findings of the pilot evaluation showed that the Positive Technology app was effective in reducing users' perceived stress levels. However, due to the limited number of users wearing the wrist cardiac monitor it was not possible to support these subjective findings with objective stress correlates. A future goal is to improve the usability of the application and include more advanced stress monitoring features, based on the analysis of heart rate variability indexes.

Acknowledgments

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