бральным параличом, задержкой психического и речевого развития. Определены психические и поведенческие реакции родителей на диагноз ребенка, описана специфика клинических и психологических проявлений в течение воспитания, ухода и лечения ребенка. Выделены поведенческие черты состояния тяжелого горя в остром периоде по уходу за ребенком; депрессивные, фобические, тревожные и ипохондрические расстройства в первые годы развития заболевания. На основе полученных данных, отражающих механизмы формирования психопатологических расстройств родителей, предлагается предоставление дифференцированной комплексной психиатрической помощи родителям на этапах лечения неврологических расстройств ребенка с детским церебральным параличом.

Ключевые слова: психическое состояние родителей, поведенческие расстройства, детский церебральный паралич, диагностика.

describes the specific clinical and psychological manifestations of mental disorders during education, care and treatment of the child. Thesis there is determined behavioral features state of severe trouble in the acute period of parental leave; depressive, phobic, anxiety and hypochondriacal disorder in the early years of the disease. Based on the data that reflect the mechanisms of mental illness in response to family derealization in parents are invited to provide differentiated comprehensive mental health care to parents on the stages of the treatment of neurological disorders child with cerebral palsy.

Key words: psychiatric disorders of parents, behavioral disorders, cerebral palsy, diagnosis.

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OPTIMI (ONLINE PREDICATIVE TOOLS FOR INTERVENTION IN MENTAL ILLNESS). BIOFEEDBACK BASED ON HEART RATE VARIABILITY AS A PREVENTIVE TOOL AGAINST STRESS-RELATED DISORDERS


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Summary. Portable health management devices such as mobile phones, based on the biofeedback principle, are becoming increasingly attractive for scientists and individuals who strive to achieve a healthier lifestyle. Portable health management devices such as mobile phones equipped with sensors to provide biofeedback are becoming increasingly attractive to scientists and other individuals who strive to achieve a healthier lifestyle. Under the auspices of the OPTIMI project we have developed and tested a new ECG biofeedback sensor. This sensor monitors heart rate variability as an indication of a participant's level of stress and relaxation. In the study, participants practiced slow, conscious, meditative breathing while observing biofeedback in the form of visual stimulation from the sensor. The training was carried out in healthy volunteers, who as a result of the biofeedback exercises could improve their coping strategies.

Key words: ECG biofeedback sensor, HRV, stress, coping, diaphragmatic breathingy.

Biofeedback involves the recording and monitoring of certain biological signals so that, for example, the sleep quality, the manifestation of various chronic conditions or mood states, and any number of other aspects of oneself can be tracked; this tracking is performed for the purposes of learning and noticing patters and, ultimately, effecting change [1].

Since the inception of the smartphone, and in conjunction with the growth of the «quantified self» movement, the appeal and potential of self-tracking has been increasing. There are several reasons for this. Human beings are innately curious about themselves; at the same time, smartphones have placed the possibility of data capture and representation within the grasp of the masses. The combination of these two factors has great clinical potential.

So-called 'E-therapies' have already been shown to be both clinically and cost-effective [2, 3, 4] when treating any number of psychological problems, including stress among individuals who are otherwise healthy [5, 6]. Recently, interest has been expressed in augmenting such therapies with the potential unleashed by new sensor technologies, which allow objective, automatic monitoring [7].

Biofeedback can be described as self-tracking performed in real time. Biological signals are fed back to the individuals who

originate them in such a way that the signals can be perceived and understood. The individual then tries to influence and control the original signals. The continuous feedback provided by the sensor reinforces those behaviors that lead to the desired effect, allowing the user to develop effective strategies [8, 9]. For example, an increase or decrease in the size of the circle might correspond to each beat of a participant's heart; by observing this pattern the participant can learn to control their heart rate in times of stress.

It is postulated that the effectiveness and appeal of e-therapy programs for stress management could be improved by making such technologies available. In the current study, the biological signal of heart rate variability (HRV) was targeted for the purposes of monitoring and biofeedback.

Heart Rate Variability (HRV)

Normal physiological functioning can cause some heart rate oscillations which are normal and healthy. In numerous studies, low HRV (prevalence of sympathetic regulation) is considered as being a sign of anxiety disorders and stress [10] and even rather severe heart conditions. At the same time, high HRV (prevalence of parasympathetic regulation) could be an indicator of balanced emotional regulation and good cooping [11].

Showing the balance between sympathetic and parasympathetic systems, HRV is a clear indicator of their regulatory activity, and is commonly used in biofeedback [12]. The HRV biofeedback training is aimed at producing increases in heart rate during inhalation and decreases in heart rate during exhalation, thus maximising the overall heart rate variability [13]. Participant's visual stimulation could be a great asset, providing him information on his inner state, with the goal of trainees increasing their HRV (in the case it is low). Breathing techniques are an essential part of the training. Because the relationship between HRV and stress is well-known [14], HRV was identified as an appropriate biological signal to allow participants to do self-tracking during the stress management program, and also to use self-tracking in a real-time biofeedback exercise.

The method used for increasing of trainees' HRV in our study is diaphragmatic breathing.

Methodology: Diaphragmatic breathing.

Diaphragmatic breathing, abdominal breathing, belly breathing or deep breathing is breathing done by contracting the diaphragm, a muscle located horizontally between the chest cavity and stomach cavity. Air enters the lungs and the belly expands during this type of breathing (**fig 1**).

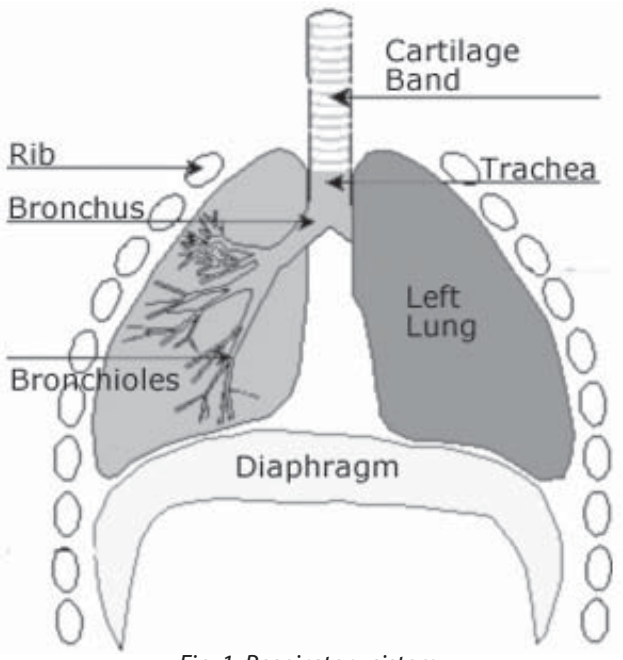


Fig. 1. Respiratory sistem

This deep breathing is marked by expansion of the abdomen rather than the chest. It is considered to be a healthier and more effective way to ingest oxygen.

To breathe with the diaphragm one must draw air into the lungs in a way which will expand the stomach and not the chest. It is best to perform these breaths as long, slow intakes of air – allowing the body to absorb all of the inhaled oxygen while simultaneously relaxing the breather.

To do this comfortably, it is often best to loosen tight-fitting pants/belts/skirts, as these can interfere with the body's ability to intake air. While at first one may not feel comfortable expanding the stomach during breathing, diaphragmatic breathing actually fills up the majority of the lungs with oxygen – much more than chest-breathing or shallow breathing.

Abdominal breathing helps to build heat in the body, regulates the parasympathetic nervous system. Deep breathing exercises are a form of relaxation, and therefore, when practiced regularly, lead to the relief or prevention of symptoms commonly associated with stress including high blood pressure, headaches, stomach conditions, depression, anxiety, and others.

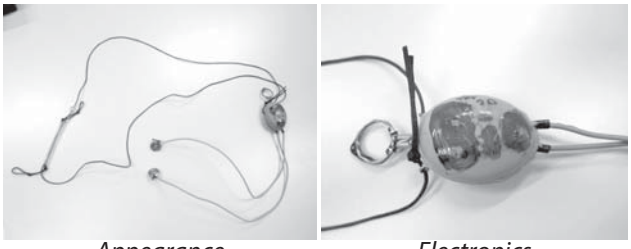
Performing diaphragmatic breathing can be therapeutic, and with enough practice, can become a standard way of breathing.

According to different yoga schools, breath directly affects the mind, to the point that breath-mastery leads to self-mastery. The abdominal breathing technique is one of the first that all yoga students learn. Previous studies have suggested that therapies that improve modulation of

sympathovagal balance, such as biofeedback and slow abdominal breathing, are effective in patients with stress-related disorders [15].

ECG sensor for biofeedback (HRV biofeedback exercise).

The ECG sensor monitoring heart rate variability can be used for biofeedback training (**fig 2**).



Appearance (electronics with a necklace and electrodes) *Electronics with charging loop*

Fig. 2. ECG Biofeedback sensor

In order to attach the ECG Biofeedback sensor to the body we use electrode pads which are readily available on the market and used in routine medical practices. They contain a special gel to prevent skin irritation (**fig 3**).

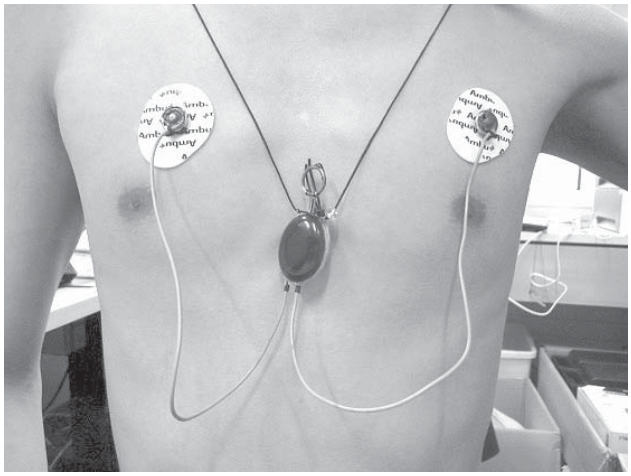


Fig. 3. Application

In biofeedback mode, the ECG sensor transmits a stream of raw data (the differences between heartbeats) to a software application on a netbook. The netbook software calculates the heart rate variability and displays the Fast Fourier Transform (FFT) which results to the user as a frequency power spectrum. The software calculates the energy in the spectrum around a specific range of frequencies, which matches the optimum respiration rate for that person (based on pre-defined values according to age and gender). The software displays an animated cue for in-breaths and out-breaths, which encourages the user to breathe at their optimal rate. When optimal breathing is achieved, the power spectrum rises. Rises in the power spectrum produces an additional graphical cue to the user – a black-and-white butterfly becomes increasingly colorful (**fig 4**).

Fig. 4. Colorful butterfly

Biofeedback procedure.

Our study involved 38 university students who were moderately stressed (scoring >13 on the Perceived Stress Scales [16] but not depressed (scoring <19 on the Beck Depression Inventory [17] aged (25 – 46) without major physiological and mental diseases. The recruitment was carried out among students and employees at ETH, Zurich (Switzerland). Advertisements offered the opportunity for learning stress management techniques and provided monetary compensation for time spent during the study. The study was carried out according to the principles of the Declaration of Helsinki and was approved by the ETH Ethics Committee. All participants signed Informed Consent Forms.

Results of the study were assessed on the individual basis.

Participants had to follow the instructions:

1. Sit comfortably and relax.
2. Slowly inhale through your nose or through pursed lips (to slow down the intake of breath). As you inhale, push your belly/ stomach out and feel your stomach expand. Follow the breathing pattern in the program (slowly inhale while the circle is increasing) (**fig 5**).

Fig. 5. Breathing pattern in the program

3. Hold your breath for a short while.
4. Slowly exhale through pursed lips to regulate the release of air while squeezing your stomach. Follow the breathing pattern in the program (slowly exhale while the circle is decreasing).
5. Hold your breath for a short while.
6. If you do it properly and your heart works the optimal way, you will be rewarded.

The black-and-white butterfly on the screen will become colorful (**fig 6**).

Fig. 6. There is the black and white butterfly on the screen

If participants could not make the butterfly colorful, or if they could not keep it colorful long enough, it did not mean that they were sick. The biofeedback sensor is not a diagnostic tool and cannot reveal heart problems, although striking abnormalities could be a reason to seek medical advice. In case of an inability to reach the goal of the training (colorful butterfly), the participants were instructed to relax, repeat the exercise and after which they were usually able to succeed.

Results (examples).

1. Background (stressed) (**fig 7**).

2. Successful biofeedback training (deep breathing for 10 min) (**fig 8**).

3. The exercise is finished (normal breathing, much more relaxed subjective feeling) (**fig 9**).

Biofeedback training helps (subjects?) to lean the diaphragmatic breathing technique, which is well-known as being beneficial for

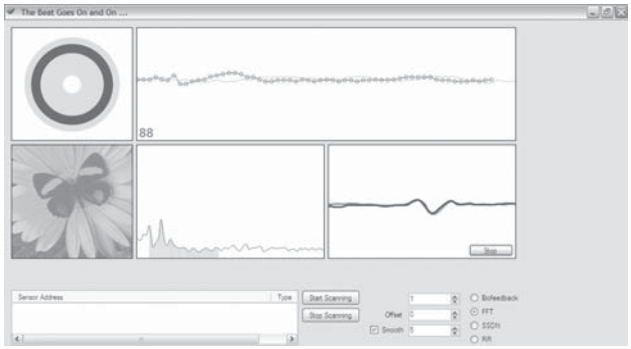


Fig. 7. Background (stressed)

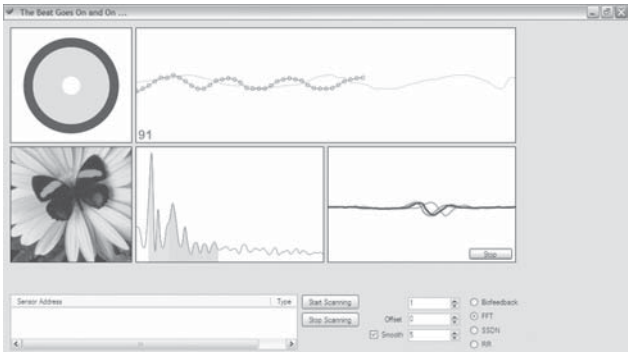


Fig. 8. Successful biofeedback training (deep breathing for 10 min)

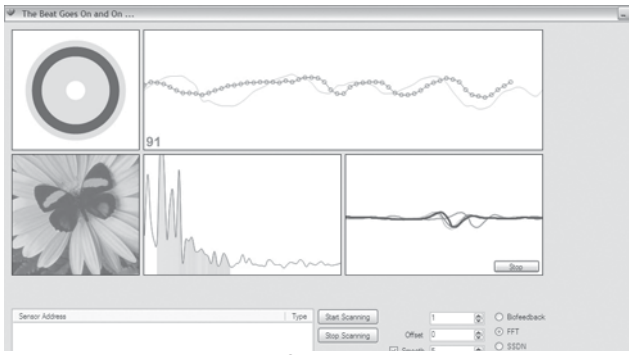


Fig. 9. The exercise is finished (normal breathing, much more relaxed subjective feeling)

both physical and mental states. Participants could profit in a variety of ways. First, after the training, the heart continues working in an optimal way for some time. (The subjects?) remain calm and relaxed. Second, they learn how to relax and make their heart work more effectively. Students could use this method (without the program) in different stressful situations or as a part of their usual physical training.

Discussion and conclusions: the findings of our study supported the assumption that there is significant value in biofeedback exercises. Most of the study participants found the experience enjoyable and profited from being in the study.

The study results demonstrate the good real-time performance of the system and the positive effects of biofeedback training sessions, as documented by an increased HRV and reduced heart rate. HRV biofeedback significantly reduced sympathetic activity, as was reflected in the ratio of low-frequency power to high-frequency power (the LF/HF ratio, $P<0.001$); it also increased parasympathetic activity, as was shown by the normalized high-frequency power (HFnm) ($P<0.001$). Thus, biofeedback training contributed to the beneficial effect of reducing stress-related cardiovascular responses by improving autonomic sympathovagal modulation. The respiration control method, which relaxes the body and mind, may efficiently prevent stress-related disorders.

Future research is of great importance to examine the usefulness of stress management programs on a larger scale. That said, our study results suggest that such a future program will be successful.

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OPTIMI (ПРЕДИКАТИВНЫЕ ИНСТРУМЕНТЫ В РЕЖИМЕ ONLINE ДЛЯ ВОЗДЕЙСТВИЯ НА ПСИХИЧЕСКОЕ ЗДОРОВЬЕ). БИОЛОГИЧЕСКАЯ ОБРАТНАЯ СВЯЗЬ, ОСНОВАННАЯ НА ВАРИАБЕЛЬНОСТИ СЕРДЕЧНОГО РИТМА, В КАЧЕСТВЕ ПРОФИЛАКТИЧЕСКОЙ МЕРЫ ЗАБОЛЕВАНИЙ, ВЫЗВАННЫХ СТРЕССОМ

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Аннотация. Портативные устройства для контроля состояния здоровья, такие как мобильные телефоны, основанные на принципе биологической обратной связи, вызывают повышенное внимание у ученых и лиц, стремящихся к более здоровому образу жизни. В рамках проекта OPTIMI мы разработали и протестировали новый ЭКГ-сенсор для биологической обратной связи. Этот сенсор мониторирует вариабельность сердечного ритма в качестве показателя уровня стресса и расслабления у участников. В этом исследовании участники использовали медленное, осознанное, медитативное дыхание, наблюдая биологическую обратную связь в виде визуальной стимуляции, получаемую от сенсора. Тренинги проводились для здоровых добровольцев, которые в результате упражнений по биологической обратной связи могли улучшить свои копинговые стратегии.

Ключевые слова: ЭКГ сенсор обратной связи, стресс, копинговые стратегии, диафрагмальное дыхание.

OPTIMI (ПРЕДИКАТИВНІ ІНСТРУМЕНТИ В РЕЖИМІ ONLINE ДЛЯ ВПЛИВУ НА ПСИХІЧНЕ ЗДОРОВ'Я). БІОЛОГІЧНИЙ ЗВОРОТНІЙ ЗВ'ЯЗОК, ЗАСНОВАНИЙ НА ВАРІАБЕЛЬНОСТІ СЕРЦЕВОГО РИТМУ, ЯК ПРОФІЛАКТИЧНИЙ ЗАХІД ЗАХВОРЮВАНЬ, ВИКЛИКАНИХ СТРЕСОМ

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Анотація. Портативні пристрої для контролю стану здоров'я, такі як мобільні телефони, засновані на принципі біологічного зворотного зв'язку, викликають підвищену увагу у вчених і осіб, що прагнуть до більш здорового способу життя. В рамках проекту OPTIMI ми розробили і протестували новий ЕКГ-сенсор для біологічного зворотного зв'язку. Цей сенсор моніторірує варіабельність серцевого ритму як показник рівня стресу і розслаблення в учасників. У цьому дослідженні учасники використовували повільний, усвідомлений, медитативний подих, спостерігаючи біологічний зворотний зв'язок у вигляді візуальної стимуляції, що отримували від сенсора. Тренінги проводилися для здорових добровольців, які в результаті вправ по біологічному зворотному зв'язку могли поліпшити свої копінговий стратегії.

Ключові слова: ЕКГ-сенсор зворотного зв'язку, стрес, копінгові стратегії, діафрагмальне дихання.