2 weeks. For the Fixed-EA, 2 Hz EA was applied to the left ST36 and ST37 acupoints with a fixed intensity between sensory detection threshold and pain threshold. In the Varied-EA, stimulus intensity was adjusted every 5 min by change of a parasympathetic measure, HF power in HRV; If the HF increased, the stimulation intensity was reduced. Galvanic skin response, thermal quantitative sensory testing, Pain score of Headache (VAS), and the Brief pain inventory (BPI) were measured. Even though Varied-EA induced the increase of HF power in stimulation session significantly, no stronger change of HF power than Fixed-EA and MA was found. Consequently, the Varied-EA didn't show the pain releasing effect, while only Fixed-EA decreased both of headache VAS score and BPI over the six visits. And GSR change indicates all the three groups induced significant sympathetic activation. While the conventional form of EA showed pain relieving effect, our approach failed to show the therapeutic effect as well as stronger autonomic modulation effect than others. Also the opposite stimulation strategy, decreasing intensity when the parasympathetic drops, is worth trying for the next study. And frequency change of EA should be considered.
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Keywords

- Electro-acupuncture
- Real-time biofeedback
- Chronic tension-type headache

Smart Phone/Tablet Apps for Biofeedback Clinical and Personal Use

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Abstract: For more than a decade, researchers have been working on designing hardware and software biofeedback applications ('apps') for use on smartphones and other portable computing devices. The purpose of the study is to compile and evaluate useful health care and biofeedback applications currently available for the Apple and Android platforms that can be used for clinical and personal use on smartphones and tablets and encourage clinicians to share useful apps as they come to the market place. Available apps were searched through the buying marketplaces for each platform using keywords including "biofeedback," "self-regulation," "observational data," and "behavioral change" and interviewed biofeedback vendors. The results identified 80 apps which were organized into 3 groups, "logging/reminders/pacing," "physiological monitoring (via the phone/tablet)," and apps requiring "adjunctive biofeedback sensors." 24 apps gave feedback without the use of adjunctive sensors and utilized the camera or movement detector, 46 apps were used for behavioral and monitoring that required input from the user, and 10 apps used adjunctive biofeedback sensors. The top 15 apps are listed and assessed in utility for clinicians to use in their practice and clients for personal use. In conclusion, Apps requiring adjunctive sensors were more focused on clinical biofeedback methods, while behavioral monitoring apps were general "wellness" types that included themes like weight loss and stress reduction. Using readily available technology enables both clinical and non-clinical biofeedback users to

access equipment and forms of feedback previously only available in biofeedback labs or by other types of specialized equipment. This systematic review of biofeedback apps for the Android and Apple platform smartphones and tablets serves as a baseline measure for what will surely emerge as a growing field of biofeedback technology. We invite clinicians and educators to contribute by submitting descriptions and links of apps so that the database will be more complete.
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Keywords

- Smart phones
- Applications
- Healthcare
- Biofeedback

Integrating Biofeedback in the Treatment of Migraine and Tension Type Headaches: Preliminary Observations

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Abstract: Chronic pain has been associated with the interplay between physiological, psychological, physical, and social factors. In Europe, the 1-year prevalence of chronic headaches seem to be 4.0 %. Prevalence of Migraines are approximately 14 %, while prevalence of Tension Type Headaches (TTH) are 62 %. Biofeedback is a technique that addresses health issues in a biopsychosocial perspective. An extensive body of literature indicates that it can be considered efficacious in treating migraines and TTHs . The purpose of the study was to present preliminary observations resulting from a series of 6 cases diagnosed with Tension Type Headache (TTH) or Migraine treated integrating pharmacological, psychophysiological (biofeedback), and psychological interventions.
Method. Pre and post treatment, we measured pain duration, intensity, and frequency, as well as emotional symptoms and quality of life. After a neurological, psychological, and psychophysiological assessment, patients received an average of 15 biofeedback sessions integrated with cognitive intervention and, in some cases, with medications. The results showed that after treatment, patients reported a 50 % reduction in pain duration and a 62 % reduction in pain frequency. In most cases, symptoms of anxiety and depression appeared improved. Finally, the negative impact of headaches on daily life was also reduced. Our experience suggests that integrated treatments for headaches could be feasible and efficacious. Consistent with scientific literature, biofeedback training seems to decrease pain, to reduce emotional symptoms, and improve quality of life.
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Keywords

- Migraine
- Tension-type headache
- Biofeedback
- Interdisciplinary teams

Quantification of Co-contraction Index During Walking Using a Low-tech Ambulatory System: A Preliminary Reliability Study

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Abstract: Muscle co-contraction index (CoI) has been shown to be important for walking stability. It can be reliably quantified using two

different methods. However, this has been mainly explored in laboratory settings using high-tech equipment (H-Tech). The aim of the study was to explore the reliability of existing methods to quantify muscle CoI using a low-tech ambulatory equipment (L-Tech) in a clinical setting.

Thirty-five gait cycles were recorded whilst 5 healthy participants walked along 5 meter corridor at their comfortable speed. Complete gait cycles (first double support-DS1; single stance-SS; second double support-DS2; swing phase-SW) were identified using a L-Tech (USB-webcam; 15fps, sagittal plane) and a H-Tech (12-camera,Vicon system; 200fps.), both synchronized with electromyography (Procomp Infiniti Encoder, 2000 fps.). Electromyographic muscle activity of rectus femoris (RF) and biceps femoris (BF) was recorded for one randomly assigned lower limb. CoI was quantified for each walking phase, using two formulas: (i) Unithan—the common area of linear envelopes between two muscles/the number of data points ($_U$CoI); (ii) Falconer—the common area of the linear envelopes of antagonist muscles/the sum of the areas of those muscles ($_F$CoI). Paired t-test, intraclass correlation coefficient ($ICC_{3,1}$) and limits of agreement (Bland-Altman analysis) were calculated between $_U$CoI obtained in L-Tech and in H-Tech and repeated for $_F$CoI.

The results demonstrated that both $_U$CoI and $_F$CoI for all walking phases, fair to good reliability ($_U$CoI ICC: 0.4–0.75; $_F$CoI ICC = 0.52–0.79). No systematic bias was found in $_U$CoI versus $_F$CoI: DS1: 0.25 (−0.56 to 1.25) versus 0.008 (−0.33 to 0.36); SS: −0.18 (−0.78 to 0.41) versus −0.07 (−0.27 to 0.13); DS2: 0.34 (−0.60 to 1.29) versus 0.08 (−0.26 to 0.42); SW: − 0.10 (−0.80 to 0.60) versus 0.028 (−0.23 to 0.17).Contrary to $_F$CoI ($p < 0.05$), the $_U$CoI demonstrated significant differences between L-Tech and H-Tech in DS1 and SW ($p > 0.05$). In conclusion, measurement of muscle co-contraction can be undertaken with acceptable reliability using L-tech equipment and the $_F$CoI, allowing for low-cost data collection in clinical environments.
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Keywords

- Electromyography
- Co-contraction
- Walking
- Reliability

Relaxation Effects of a Biofeedback Assisted Respiratory Training on Japanese Adult Diabetic Patients

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Abstract: Mental stress is known to be a risk factor of deteriorating glycemic control of diabetic patients. This study aimed at clarifying how a biofeedback-based respiratory training for relaxation affects such patients. Subjects were 15 diabetic patients with the average age of 63.4 yo (SD = 10.8). They underwent a biofeedback-based respiratory training using such biosignals as surface EMG, skin conductance, respiration and heart rate (BioGraph Infiniti, Thought Technology Ltd., Canada). The training session lasted for 5 min and was done 8 times individually in a period 3 months. Before and after the 5-min training, the biosignals and salivary amylase were recorded at rest. In the first and last sessions, a sensory test on the training and relaxation was done. Additionally hemoglobin A1c (HbA1c) was measured once a month. Results were analyzed using paired t-test, repeated measures analysis of variance (rANOVA) and two-way rANOVA. The results showed a significant 33 decrease was observed in HbA1c levels after 3 months, compared with those prior to training ($p < 0.05$). The average level of every biosignal and the level of salivary amylase were assessed at rest before and after the 5-minuite training. Consequently a rate of decrease in skin conductance before and after the training increased significantly after 3 months ($p < 0.05$), while no significant change was observed in other parameters. Initially most of the patients complained about the difficulty of consciously practicing abdominal breathing, while finally 10 out of 15 patients gave favorable answers on mental and/or physical effects of the training. In conclusion, analysis of HbA1c verified that all patients remained under a good glycemic control. Biosignal analysis revealed that skin conductance sensitive to emotional change could be usable as an index of relaxation. Results of sensory tests suggested that the biofeedback-assisted respiratory training would be effective for prompting patient's awareness and behavior modification required to acquire relaxation.
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Keywords

- Diabetes
- Biofeedback based respiratory-training
- Relaxation

From Learning Disabilities to Learning Differences Over to Learning Abilities and Learning Gifts

Edna Tune & Dan Tune, Israel

At our respective learning centers in Israel we have worked with thousands of adults and children who present with the whole range of learning difficulties. Our programs are in most cases intensive, ranging from 9 to 30 h a week, followed by many months of support work and continued follow up.

Depending upon the person, the problem, the need, we rely on a "mix" of peripheral biofeedback, neurofeedback, and other innovative brain technologies to regulate and balance the LD brain. As educators and performance coaches, we weave these throughout the day into the framework of our content-oriented tutoring or coaching programs. The poster defines the following topics:

- What is a learning disability (LD) and what isn't one?
- A brief history of treatment methods for learning disabilities (LD)—both comic and tragic
- A new and promising key to unlocking the mystery of LD—Sensory Processing Disorder (SPD)
- Stress as a major factor in dealing with LDers (theirs, their families, their teacher's/employer's)
- The Intake Interview Tools for LD—psychophysiological instruments and more
- The Confusion Cycle, how you can identify it and what you can do about it.
- Perceptual distortions and how they affect learning, their triggers, their effects throughout the school day and at home.
- A micro look at Thinking Styles—what teachers and parents may not know.
- Lateral Training: a breakthrough approach to balancing the processing speeds of the brain to visual and auditory stimuli at the basal level of the central nervous system for more consistent attentional skills.
- "THE MIX": some variations on how we combine the various systems (sequentially and parallel) peripheral multimodal biofeedback, neurofeedback, Brain Boy /Lateral Trainer, HEG (nIR HEG and pIR HEG), HRV (Heart Math), pROSHI

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