

ELECTROPHYSIOLOGICAL CORRELATES OF AUTOGENIC TRAINING

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Abstract

Electrophysiological correlates of Autogenic training (AT) are examined, as an attempt for better understanding of the effects of AT, as medically widely applied auto-suggestive method for body relaxation, on contextual information processing. The AT study was carried out on 30 adult volunteers (3 males and 27 females, whose ages varied from 24 to 69 years with a mean age of 46 years) who had been practicing the AT technique from 2 to 60 months, with a mean of 45 months - with EEG analyzed before, in the middle, and at the end of AT. The observed significant EEG δ and θ activities may be a consequence of the increased *restfulness*, while significant β , γ , and ω activities may be a consequence of the increased *alertness* during AT - which may be compared with corresponding classical results in transcendental meditation, which have been interpreted as a support for the fourth major state of consciousness, the *restful alertness state*, being a combination of restfulness and alertness. In the case of the subject 16 with most significant AT changes, we also noticed very increased mean coherence during AT in α band for all channels.

1. Introduction

Autogenic training (AT) is a medically widely applied *auto-suggestive technique of relaxation* of muscles and blood vessels, recognition of the body feeling of breath and heart, and exercise for concentration, based on Schultz's idea of the *equivalence of muscular and mental strain*. By auto-suggestive short relaxing messages one's undesired psychosomatic reactions in daily stressful situations are softened: it can help in all functional psychosomatic disorders, where mistakes produced by habits should be corrected, or where severe emotional reactions should be smothered [1]. Technique of autogenic training is not only recommended for everyday anti-stress self-aid, but its short morning and evening exercising at home is a necessary condition for its success.

First experiences in AT originate since 1911 from early Schultz's works in his ambulance for hypnosis in Wroclaw, followed by his neurological practices in

Jena, Dresden, and Berlin, and finally published in his big monograph in 1932, being until 1970's reprinted almost without changes in Germany and world wide; in the further affirmation of AT a significant role was played by Lindemann, who has pointed to its great importance in anti-stress prophylaxis [1]. The related techniques have been also developed in USA ("progressive relaxation", Jacobson) and France ("relaxation", Ajuriaguerra, Lemair, et al.) [2].

So, AT has passed through the whole 20th century, and "in the following one it will enter as a method which outlived many psychotherapeutic trends, which have appeared and disappeared with the waves of fashion" [3]. Although AT, in the context of psychotherapy, might be classified into relatively "shallow or pragmatic methods, which are not concerned with the background of mental, neurotic, and psychosomatic disorders, but directly attack and remove the symptoms of these disorders" [4] - nevertheless Poro in his renowned *Encyclopedia of Psychiatry* points out its great practical significance: "*Autogenic training is the most contemporary method of medical relaxation*" [5].

In the near future it might be expected that AT will emerge outside the medical framework, with a wider spectrum of applications, as excesses of psychophysiological and social tensions are becoming more and more a problem of civilization at the beginning of third millennium, which will be less and less resistible by unconscious self-defending automatism [6]. One of the ways of self-defense is AT and related methods, based on the millennial tradition of Eastern meditative techniques.

Classical AT is acting primarily from the state of alertness, but with careful sinking to deeper levels of consciousness, as auto-suggestive short relaxing messages are *softening* one's undesired psychosomatic reactions in daily stressful situations. Experience has shown that this is more efficient if emotional flows are more freely engaged, this being the reason that auto-suggestive messages include the words: perfect, relaxing, calm, pleasant, easy, good, free, happy, friendly, bravely, strong, far, quickly, highly ... [1].

Although classical AT might be classified into relatively shallow psychotherapeutic techniques, in order

to strengthen integration and communication among different levels of consciousness, higher courses of AT were developed, like *Autogenic Training - New Generation* (AT-NG) [7]. In developing AT-NG especially inspiring was Jung's warning, that rationalism of the modern age is keeping back to unconscious everything considered irrational, religious [8], this being the reason that AT-NG is directly oriented towards these speculative Jung's focuses of archetype tensions, with intention to weaken and cleanse them, and to recover old, forgotten, principles of morality [7].

At the end, let us try to put AT in the theoretical-practical context of psychotherapeutic techniques.

AT as an auto-suggestive (auto-hypnotic) technique of relaxation, helps auto-suggestive positive contextual messages to be memorized on subconscious level, in order to *soften from this level one's undesired psychosomatic reactions* in daily stressful situations, which is suggested from theoretical modeling of cognitive processes. Namely, according to the oscillator model of a neuron [9], the electroencephalographic (EEG) rhythmicity is qualitatively predicted in such a way that an increase in the input causes an increase in the frequency of oscillations - which might basically be the mechanism of information ascending upon the (frontolimbic) selection and amplification from the lower-frequency (δ , θ) unconscious form of primordial subliminal thought to the higher-frequency (α , β , γ) conscious thought [10] - while other contextual non-amplified information is memorized on subconscious level. As this whole automatic process of perception, selection, and amplification of information begins below the threshold of consciousness, this stresses the significance of *contextual reprogramming* of sub-consciousness in autogenic training, in order to put under control that part of undesired instinctive associative reactions which jeopardizes one's psychosomatic health. However, the practice reveals that this mechanism is not sufficiently efficient for persons with strong psychological conflicts, which give rise to neurotic and even psychotic disorders, and for such persons the main priority is to *resolve their psychological conflicts* by some deep psychotherapeutic technique.

These extraordinary characteristics of AT (as well as related interest in better understanding of contextual language learning and cognitive processes in general [10]) were our motivation to study its electrophysiological correlates, on the similar grounds as has been done previously in examination of transcendental meditation, musicogenic states, microwave resonance relaxation, healer/heelee interaction, and alertness/drowsiness (as some of easily reproducible altered states of consciousness) [11] - with contemporary EEG equipment and corresponding software described below.

2. Method

Electroencephalograms were recorded in electromagnetically shielded room by a MEDELEC Profile EEG Reader with full polygraphic properties, with

lower and upper band-pass filter limits set at 0 Hz and 128 Hz, respectively. Ag/AgCl electrodes with impedance less than 5 k Ω were placed at 22 locations (*Electroencephalogram* EEG Fp2-F4 F4-C4 C4-P4 P4-O2 Fp2-F8 F8-T4 T4-T6 T6-O2 Fp1-F3 F3-C3 C3-P3 P3-O1 Fp1-F7 F7-T3 T3-T5 T5-O1 Fz-O1 Cz-A2 Pz-O2; *Electrocardiogram* ECG2-ECG1; *Respiration* RESP2-Ref; *Electromyogram* EMG A1-A2), cf. Fig. 1.

So apart from EEG channels (mounted according to International 10/20 system, available as the commercial 'Electrocap®' product), three additional polygraphic channels were used (ECG, RESP, EMG) in order to follow the level of vegetative state.

The EEG outputs were digitized with 12-bit precision at a sampling rate of 256 Hz per channel using A/D converter Data Translation 2801.

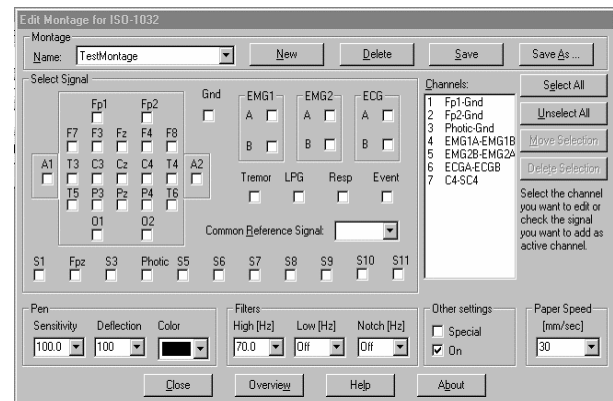


Figure 1. The applied EEG, ECG, RESP, and EMG Edit Montage Graphic User Interface.

The length of each three EEG-traces was 60 s (15360 points). Time-varying EEG spectra (spectrograms) with 0.5 Hz resolution were calculated by the MATLAB program using a 256-point FFT algorithm performed on 2 s Hamming-windowed, half-overlapped epochs. An array of EEG partial power spectra for each subject and each derivation was computed by the trapezoidal integration rule of the spectrogram over the five frequency bands: δ (0.5-3.5 Hz), θ (3.5-7.5 Hz), α (7.5-13 Hz), β (13-30 Hz), γ (30-64 Hz), and ω (64-128 Hz).

The study was carried out on 30 adult volunteers who had been practicing the AT technique from 2 to 60 months, with a mean of 45 months. There were 3 males and 27 females, whose ages varied from 24 to 69 years with a mean age of 46 years. Prior to the experiment, subjects were verbally informed about all aspects of the experimental procedure. We intended to take the test with wide range of health conditions of volunteers. So 22 of them have been completely healthy and 8 of them have some medical problems taking medical drugs permanently (for whom AT has appeared significantly helpful, as they were taking less drugs).

The experiment was conducted in a soundproof room, dimly lit for observation. Subjects were laying at the bed comfortably. Each recording session was done without any physical contact, moving the volunteer or opening his eyes. A session lasted about 10 minutes each. In first 2 minutes the apparatus was set up and

volunteer was suggested to keep his/her eyes closed performing no exercise. Later on the suggestion was given that the AT exercise should start. After approximately 8 minutes volunteer finished his exercise, opened his eyes and told that he completed the task.

We selected three sequences of 60 s each: the first 60 s before AT suggestion, the second 60 s in the middle of the AT record, and the third as the last 60 s of the AT record. Our analysis has been performed on these three sequences for every volunteer. In the case of large amount of artifacts (e.g. slow-waves due to eyeball, eyelids, or other movements) recognized after carefully visual inspection, these epochs were rejected from analysis [12]. The applied methodology corresponded closely to the demands of psychophysiological experiments [13].

3. Results

Overall power changes during the experiment (with lower 25% cutoff adopted) are presented in Fig. 2. It is obvious that experiment shows significant changes in power spectral density (PSD) with time, especially in lower (δ , θ) and higher (β , γ , ω) bands.

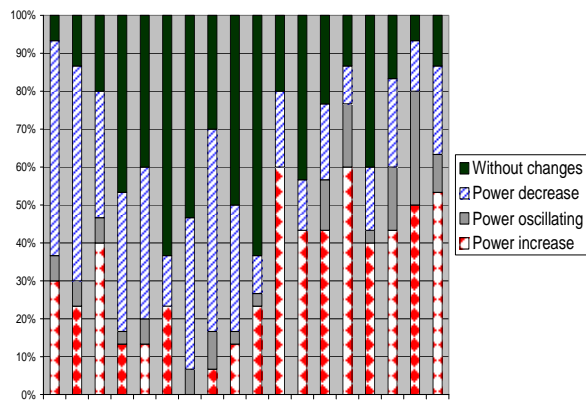


Figure 2. Overall power changes during the experiment with lower 25% cutoff adopted. It is obvious that experiment shows significant changes in PSD during AT, especially in lower (δ , θ) and higher (β , γ , ω) bands.

The representative examples of spectral arrays for subject 16 are shown in Fig. 3 (with decrease in α band activity, and special increase in lower δ and θ bands and less increase in higher β band) and Fig. 4 (with less increase in highest ω band).

As an illustrative example, changes in topographic mapping of PSD for subject 16 in δ , θ , α , and β bands are presented in Fig. 5 - in all three stages of the AT experiment.

Finally, Fig. 6 shows the mean coherence during AT in α band for all channels, for subject 16. In spite of the PDS decrease in α band (Fig. 3), the level of coherence in α band is really significant.

Our preliminary U-test calculations have also been performed to check out statistical significance of the mean coherence between the paired channels, showing most significant results for the F7-F8, T5-T6 paired channels in δ band.

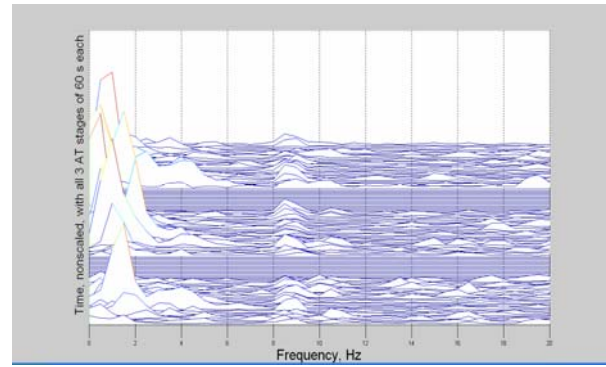


Figure 3. Compressed power spectral arrays of the EEG, in the frequency region 0-20 Hz - for subject 16 obtained from the electrode Fz before, in the middle, and at the end of AT. The rise in δ and θ bands is obvious.

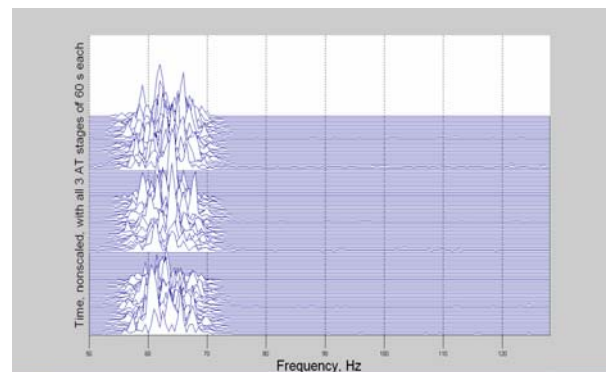


Figure 4. Compressed power spectral arrays of the EEG, in the frequency region 50-128 Hz - for subject 16 obtained from the electrode Fz before, in the middle, and at the end of AT. There is obvious increase between 58-68 Hz (however, note that amplitudes in ω band are an order of magnitude lower than those (δ , θ , α , β) presented in Fig. 3).

Volunteer with characteristic spectra in all AT stages

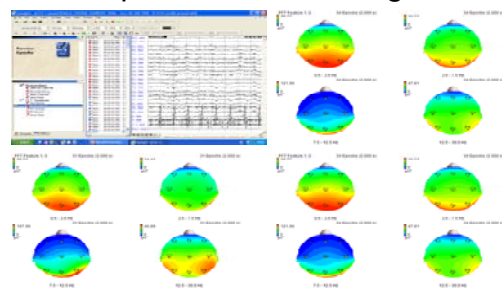


Figure 5. The topographic mapping of PSD for subject 16 in δ (0.5-3.5 Hz), θ (3.5-7.5 Hz), α (7.5-12.5 Hz), and β (12.5-30 Hz) bands - in all three stages of the AT experiment: before (above right), in the middle (bellow left), and at the end (bellow right) of AT. In the above left inlet, the corresponding EEG record is presented (2-D spectra obtained with eemagine Medical Imaging Solutions GmbH software® [14]).

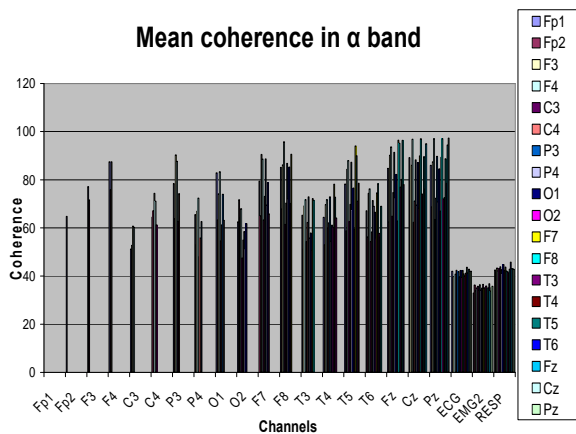


Figure 6. The mean coherence in α band between all channels. Excluding ECG, EMG, and RESP channels, the mean coherence exceeds 60% for all pairs. Notice that mean coherence exceeds 85% for F4, P3, F7, F8, Fz, Cz, Pz channels compared to all other EEG channels.

4. Conclusions

Even at this stage of preliminary analysis, it is obvious that our study appears significant.

Our results of the increased activity in both lower bands (δ , θ) and higher bands (β , γ , ω) may be compared with corresponding classical ones in transcendental meditation (TM), which have been interpreted as a support for the fourth major state of consciousness, the *restful alertness state*, being a combination of restfulness (increase in θ and α activities) and alertness (increase in β activity) [11]. In the case of autogenic training (AT), appearance of significant δ and θ activities may be similarly the result of the increased *restfulness*, while significant β , γ , and ω activities may be a consequence of the increased *alertness*.

In the case of the subject 16 with most significant AT changes, we also noticed very increased mean coherence during AT in α band for all channels.

5. References

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