Exploring the Efficacy of Biofeedback Training in Smoking Addiction: A SFB Pilot Study

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Background Skin temperature could be considered as a reliable indicator of stress (Karthikeyan et al., 2012). Based on the existing evidence, smokers seem to be more anxious than non-smokers (Hughes et al., 1986; McCabe et al., 2004). Moreover, people with high anxiety levels have been found more vulnerable to adopt a smoking habit (Patton et al., 1993). Since biofeedback seems to be an effective intervention to anxiety or stress-related conditions or diseases, skin temperature training could be beneficial for smokers dealing with stress, especially during the initial phase of smoking cessation.

Objectives The pilot study primarily aims at investigating the role of skin temperature training in smoking cessation. The secondary goal is to explore the effect of biofeedback training in increasing quality of life, general health, and self-esteem and reducing depression, anxiety and stress levels. Moreover, the exploratory objective is to investigate the neuroplastic effects of the skin temperature training.

Methods A 22-years old young and unemployed man participated in this pilot study. He used to smoke at least 10 cigarettes per day for more than 8 years. The pilot study consisted of three phases. In the pre training phase, an experienced psychologist completed the behavioral assessment of the participant using a battery of psychometric tests. The battery was compiled by the Greek version of the following tests: Fagerström Test for Nicotine Dependence (Heatherton et al., 1991), Motivation (Curry et al., 1997), Minnesota Nicotine Withdrawal Scale (Hughes, 1986), Beck Depression Inventory (Beck et al., 1961), State-Trait Anxiety Inventory (Spielberger et al., 1983), General Health Test (Goldberg and Hillier, 2009), Rosenberg Self-Esteem Scale (Rosenberg, 1965), EuroQol – 5D (EuroQol Group, 1990), Stroop Test (Stroop, 1935), Trail A and B (Tombaugh, 2004) and Digit Span Test (Wechsler, 1981). At the same day, EEG recordings in two conditions were held an electrically and acoustically shielded chamber with dimmed light in the EEG lab located in the Laboratory of Medical Physics (AUTH, Medical School) using a Nihon Kohden EEG device with 128 scalp electrodes and a sampling rate of 500Hz. The EEG recordings included a resting-state recording with eyes open (5 minutes) and a resting-state recording with eyes closed (5 minutes). An active electrode cap (actiCAP 128Ch, Standard-2, BrainProducts) was used. Electrode impedances of brain signals, ground electrode, and references were kept lower than 2 kΩ via the application of an

electroconductive gel. The electrodes were placed according to the 10–20 system. The second phase consisted of five 30-min skin temperature training sessions. Each training session was targeted at temperature enhancement receiving an audiovisual feedback. Every time the temperature exceeded the auto-adjusted threshold a puzzle was being formed accompanied with a pleasant music. In the post training phase, a psychological assessment and EEG recordings were held following the same procedures as those of the pre training phase.

Results The preliminary results from the psychometric assessment have shown improvement in the degree of nicotine dependence classifying the participant as a low-dependent smoker. Moreover, the short-memory has been improved as shown by the forward task of Digit Span test. Additionally, the participant scored lower in the Beck depression scale and in the Minnesota nicotine withdrawal scale as well as significantly higher in the Motivation task after the completion of the biofeedback training. Since the analysis of resting-state EEG recordings is in progress, the results regarding the differences in brain networks' characteristics in post-treatment phase compared to the baseline recordings will be announced in the conference.

References

Beck, A., Ward, C., and Mendelson, M. (1961). An inventory for measuring depression. *Arch. Gen. Psychiatry* 4, 561.

Curry, S. J., Grothaus, L., and McBride, C. (1997). Reasons for quitting: Intrinsic and extrinsic motivation for smoking cessation in a population-based sample of smokers. *Addict. Behav.* 22, 727–739. doi:10.1016/S0306-4603(97)00059-2.

EuroQol Group (1990). EuroQol—a new facility for the measurement of health related quality of life. *Health Policy (New. York).*, 199–208. doi:10.1016/0168-8510(90)90421-9.

Goldberg, D. P., and Hillier, V. F. (2009). A scaled version of the General Health Questionnaire. *Psychol. Med.* 9, 139. doi:10.1017/S0033291700021644.

Heatherton, T. F., Koslowski, L. T., Frecker, R. C., and Fagerstrom, K.-O. (1991). The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. *Addiction* 86, 1119–1127. doi:10.1111/j.1360-0443.1991.tb01879.x.

Hughes, J. R. (1986). Signs and Symptoms of Tobacco Withdrawal. *Arch. Gen. Psychiatry* 43, 289. doi:10.1001/archpsyc.1986.01800030107013.

Hughes, J. R., Hatsukami, K., Mitchell, J. E., and Dahlgren, L. A. (1986). Prevalence of Smoking Among the Psychiatric Patients. 993–997.

Karthikeyan, P., Murugappan, M., and Yaacob, S. (2012). Descriptive Analysis of Skin Temperature Variability of Sympathetic Nervous System Activity in Stress. *J. Phys. Ther. Sci.* 24, 1341–1344. doi:10.1589/jpts.24.1341.

McCabe, R. E., Chudzik, S. M., Antony, M. M., Young, L., Swinson, R. P., and Zolvensky, M. J. (2004). Smoking behaviors across anxiety disorders. *J. Anxiety Disord.* 18, 7–18. doi:10.1016/j.janxdis.2003.07.003.

Patton, D., Barnes, G. E., and Murray, R. P. (1993). Personality Characteristics of Smokers

and Ex-Smokers. 15, 653–664.

Rosenberg, M. (1965). Rosenberg Self-Esteem Scale. *New York*. doi:/S0034-98872009000600009.

Spielberger, C., Gorsuch, R., Lushene, R., and Vagg, P. (1983). State-Trait Anxiety Inventory (STAI). *BiB 2010*.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions.

Tombaugh, T. N. (2004). Trail Making Test A and B: Normative data stratified by age and education. *Arch. Clin. Neuropsychol.* 19, 203–214. doi:10.1016/S0887-6177(03)00039-8.

Wechsler, D. (1981). WAIS-R manual: Wechsler adult intelligence scale-revised.