IJITKM Volume 7 • Number 2 • Jan– June 2014 pp. 129-132 (ISSN 0973-4414)

A Pilot Study on Cognitive Enhancement using Odor as Intervention

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Abstract: This article reports the outcomes of a pilot study made on 5 young healthy engineering students after being exposed to the of odor of lemon. The study observed the effect of this odoron emotions- happy and sad by computation of asymmetry indices for each subject. This concept is quantified by calculation and comparison of asymmetry indices pre and post the odor intervention. It could be concluded that on being exposed to olfactory stimulus of lemon frequently on regular basis the subjects tend to become emotionally more sensitive.

Introduction

The abilities of brain get affected by different emotions. Human beings emote through various gestures like laughing, smiling, giving a poker face, having grumpy looks, sobbing and crying. They express their emotions of being happy, neutral and sad. Some people acquire the art of mimicking these emotions like, for example, showing the world they are happy when they are actually sad within or vice versa. Cognitive science as effectively broad about the means to know these emotions by studying physiological signals like EEG. This pilot study shows that one parameter, asymmetry index, can reveal a lot about the inner emotional state of a subject being happy or sad.

Olfaction plays a very important role in extending or amplifying the core capacities of the mind [1]. For instance, Ai Yoto et al. studied the effect of odor of green tea on EEG activity and memory task performance [2]. Inspired from such researchers, this research studies the effect of odor of lemon on happy and sad emotions by computation and comparison of asymmetry indices.

Hypothesis

It is assumed that asymmetry index is positive when the person is happy and is negative when the person is sad.

Proposed Method

Any cognitive enhancement technique involves application of suitable intervention. Pre and post-intervention cognitive assessment is made to confirm the cognitive enhancement achieved, if any. The protocol proposed for this research involves the following:

(a) Selection of Participants

10 healthy engineering students contributed in the study. All the participants shall be engineering students from undergraduate or postgraduate level**.** Before the experiment, all participants shall be given a detailed, written summary of the experimental procedures. None of the participants shall have any neurological or psychiatric disorders or previous head injury that might affect the experiment. It shall be confirmed that all subjects had normal or corrected normal vision and normal hearing. All experiments shall be conducted in the Laboratory of Thapar University.

(b) Preparation of participant for EEG

Participants shall sit on a comfortable armchair in the front of monitor. They shall be explained about complete procedure, that is, hardware (EEG system), data acquisition, and all the tests to be carried out, as a result of which subject shall become familiar with the experiment. The scalp of subject shall be prepared by light abrasion to remove dead cells [3].

(c) Baseline data acquisition

The EEG data as the baseline shall be taken by making the subject seated calmly for 2 minutes with eyes opened and no movements in the body. EEG data is recorded using BIOPAC MP150 system having 10 channels. The electrodes are placed according to international 10-20 system. EEG data is acquired while the person watches the videos during pre and post-intervention procedures. The sampling rate at which data is acquired is 500 Hz.

d) Tests for pre-intervention cognitive assessment

As a part of pre-intervention cognitive assessment, the subject shall be made to watch videos of two different emotions of his/her choice- one of happy and another of sad emotion. The videos shall be picked up from the internet. EEG data shall be acquired while the subject watches the videos.

(e) Intervention

The odor of lemon is used as a part of intervention. The subject shall be provided with an aroma lamp and aroma oil of lemon. The aroma shall be inhaled by the subjects for 15 days for one hour daily.

(f) Tests for post-intervention cognitive assessment

As a part of pre-intervention cognitive assessment, the subject shall be made to watch videos of two different emotions of his/her choice- one of happy and another of sad emotion. The videos shall be picked up from the internet. EEG data shall be acquired while the subject watches the videos.

(g) Statistical analysis of data

Statistical analysis of data shall be done using one tail paired type t-test. The t-Test shall be used to test the null hypothesis that the means of two populations are equal. For testing statistical significance of data either one tailed or two-tail test shall be computed. Depending on whether one trend is considered in extreme or both trends are considered equally likely one tail or two tail test shall be considered respectively. Type of t-Test, that is, whether it is type one, type two or type three shall depend on whether data is paired, homoscedastic or unequal respectively. It shall return the value of "p" i.e. probability associated with the t-Test.

(h) Signal Processing and feature extraction

For computing physiological results, the parameters like asymmetry index shall be computed and then compared. Alpha asymmetry indices can be computed by subtracting the natural logarithm of left-sided alpha power from the natural logarithm of right-sided alpha power (Asymmetry Index = ln[right alpha] - ln[left alpha]). A more positive asymmetry index reflects a greater relative left hemispheric activity. Details are provided in the paper discussing changes in asymmetry of brain wave rhythms during different emotions [4].

(i) Comparison of EEG data acquired during pre and post-intervention procedures

The EEG data acquired during both procedures is compared to know how much the cognitive abilities have been enhanced. Values asymmetry indices are compared.

Results and Discussion

This section shows the values of asymmetry indices while the subject watches videos of different emotions during pre and post procedures.Hye-Ryeon Yang et al. and Nazre bin Abdul Rashid et al. also studied the values of asymmetry indices for their reseaeches [-].

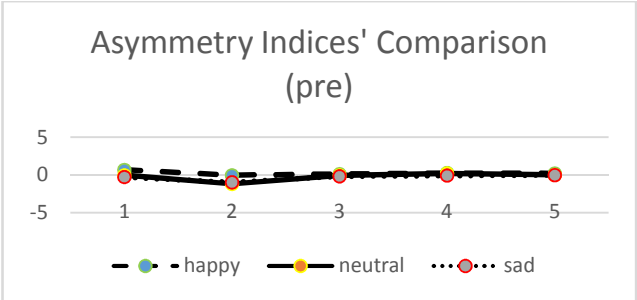

Figure 1: Comparison of Asymmetry Indices obtained during pre-intervention

From figure 1 it is inferred that for happy emotion the value of asymmetry index is more than that of baseline and sad emotion. Also, the value of sad emotion is less than that of baseline. Hence, the result is as expected. It is also computed statistically using single tailed paired t-test. Result of t-test for happy emotion is p=0.045541472 and for that of sad is p=0.17380686.

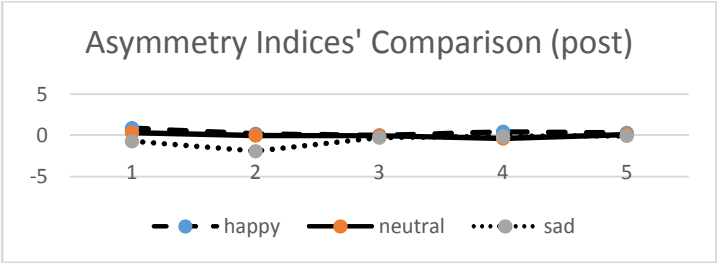

Figure 2: Comparison of Asymmetry Indices obtained during post-intervention

From figure 2 it is inferred that for happy emotion the value of asymmetry index is more than that of baseline and sad emotion. Also, the value of sad emotion is less than that of baseline. Hence, the result is as expected. It is also computed statistically using single tailed paired t-test. Result of t-test for happy emotion is p=0.036397and for that of sad is p=0.0902.

Also, comparison has been made between happy emotions of both pre and post procedures. Similarly, the same has been carried out with sad video.

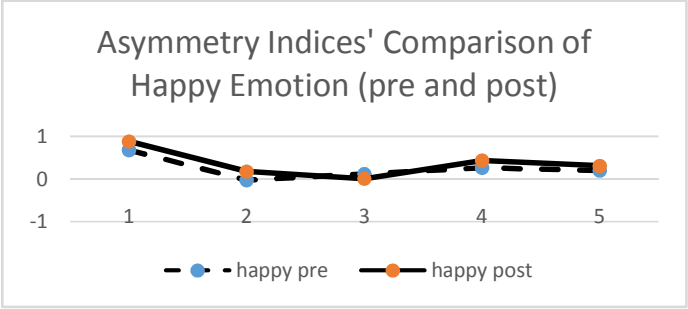

Figure 3: Comparison of Asymmetry indices of happy emotion during pre and post-intervention

From figure 3 it is inferred that for happy emotion during post-intervention the value of asymmetry index is more than that of during pre-intervention. Hence, the result is as expected. It is also computed statistically using single tailed paired t-test. Result of t-test is p=0.066017925.

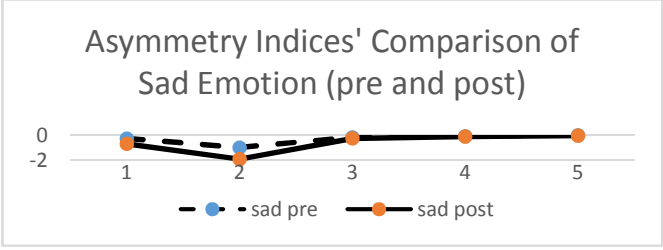

Figure 3: Comparison of Asymmetry indices of sad emotion during pre and post-intervention

From figure 4 it is inferred that for happy emotion during post-intervention the value of asymmetry index is more than that of during pre-intervention. Hence, the result is as expected. It is also computed statistically using single tailed paired t-test. Result of t-test is p=0.079923695.

Conclusion

Emotions can be described as strong agitation of feelings like experiencing happiness, love, fear, anger and so on. Cognitive science as effectively broad about the means to know these emotions by studying physiological signals like EEG. This research shows that one parameter, asymmetry index, can reveal a lot about the inner emotional state of a subject being happy or sad. The pilot study indicated that this asymmetry index is positive when the person is happy and is negative when the person is sad.The subjects were exposed to the odor of lemon for fifteen days for one hour daily and post intervention analysis of asymmetry index on being provided with similar stimulus indicates that subjects show more positive asymmetry index for happy emotion and more negative for sad emotion. It can therefore be concluded that on being exposed to olfactory stimulus of lemon frequently on regular basis the subjects tend to become emotionally more sensitive.

Future Scope

We plan to increase the number of subjects in near future to carry out this research. Also, there should be one control group which does not involve in any sort of intervention so that the results can be compared easily. Also, the study can involve the effect on other cognitive abilities like motor speed, reaction time, fatigue, etc.

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