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Reducing the Student's Stress from Studying by Personalized Brain Music Training

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Abstract

In this research we implement an EEG based music therapy. Music therapy can help the student deal with the stress, anxiety and depression problems. To do so we will develop EEG-based human emotion recognition algorithm. Proposed training program works as a therapist. The music choice and duration of the music is adjusted based on the student's current emotion recognized automatically from EEG. If the happy emotion is not induced by the current music, the system would automatically switch to another one until he or she feel happy. Proposed system is personalized brain music treatment that is making a brain training application running on smart phone or pad. That overcomes the critical problems of time and space constraints of existing brain training program. By using this brain training program, student can manage the stress easily without the help of expert.

Keywords: *Personalized Music Training, Electroencephlagraphy*

1. Introduction

According to a recent survey, most elementary and secondary school students nationwide are stressed out by their academic records. Furthermore most of high school students in Korea have to study under the great duress [1]. Some of them who can't overcome the academic stress finalize their life by committing suicide. A study has found that it is one of the leading causes of stimulating the thought of committing suicide in Korean high school students. It is a serious social problem in Korea. So it is necessary to reduce the high school student's suicide rate.

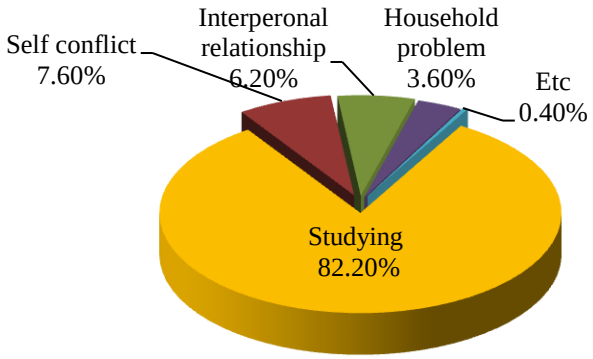

Figure 1. Stress Type of High School Student in Korea

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There have been many studies to handle stress. Among them a new groundbreaking method about stress management called biofeedbak training [2-3]. Brain training with biofeedback changes the brain's neurophysiological and biochemical set up and eventually changes the brain's response to stress effectively [4-5]. But most of the biofeedback training is conducted by expert instructor in professional organization. According to brain training research paper, prolonged training is more effective method than intensive training doing in professional organization. But the existing brain training program is not proper for students for their stress management because they must spend most of the time in school. So it is necessary to develop another brain training program for Korean students to reduce the stress. Recently portable EEG (Electroencephlagraphy) is developed and it gives us an easy and portable way to monitor brain status and manage it through biofeedback training.

Figure 2. EEG Device

The motivation of this research is that through this it will made a large contribution toward solving a high school student's suicide problem in Korea.

2. Theoretical background

Existing biofeedback brain training programs can be summarized as follows. First most of the brain training treatment is done by in professional organization. In reality it is not easy for Korean high school students to find free time for themselves. Furthermore according to experimental results show that everyday biofeedback training is more effective. Second, most of the brain training programs are provided as game based form. They have defect that users play compulsively, isolating themselves from family and friends or from other forms of social contact, and focus almost entirely on in-game achievements.

2.1. Originality of this research

To sum up the prior research we come to the following conclusion. Brain training must be universally available and it must not be a game based but a more useful form. To overcome the time and space constraints, we will combine a cutting edge technology (smart phone or pad) with the brain music treatment which has never tried yet. Through this research we will make a brain training program as smartphone application. Because most of the students in Korea use smartphone or pad, they can use the program at any place and every single day. It overcomes the problem of place and time constraints which existing brain training programs

have. Another originality of this research is that we will implement a personalized music therapy system. Because individual's music preference is different, we will develop training program which automatically switch to another music when the user can't feel relaxed. In short we will develop a personalized brain music treatment system which is running on smartphone or pad.

The EEG is typically described in terms of rhythmic activity. It is divided into 5 categories depending on the frequency [6]. In this research we focus on Alpha and Beta wave among 5 categories. Beta wave is associated with stress, anxiety and restlessness whereas Alpha wave indicates in deep relaxation. The brain's natural response to stress is a decrease of Alpha wave and an increase in Beta one [7]. Studies have shown that listening to Alpha wave music is the most efficient way to reach states of deep relaxation within a short time [1].

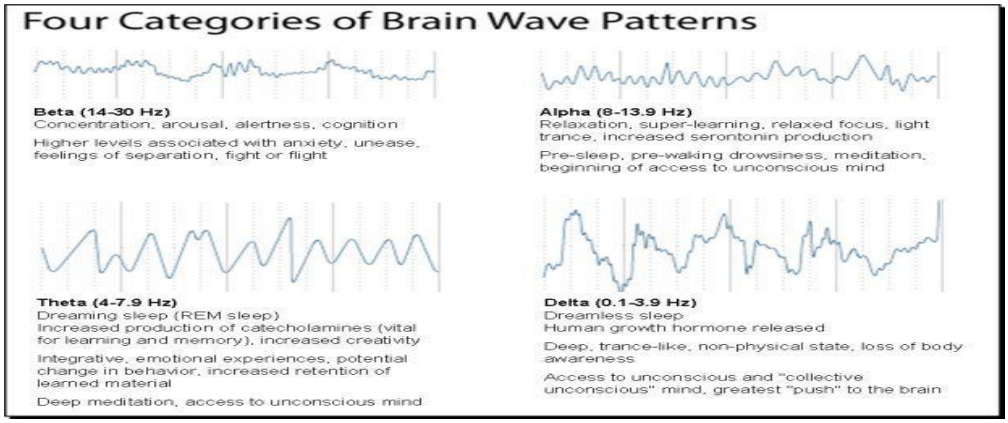

Figure 3. Type of Brain Wave

Main content of this research is to implement an EEG based music therapy. Music therapy can help the student deal with the stress, anxiety and depression problems. To do so we will develop EEG-based human emotion recognition algorithm. Proposed training program works as a therapist. The music choice and duration of the music is adjusted based on the student's current emotion recognized automatically from EEG. If the happy emotion is not induced by the current music, the system would automatically switch to another one until he or she feel happy. Proposed system is personalized brain music treatment that is making a brain training application running on smart phone or pad. That overcomes the critical problems of time and space constraints of existing brain training program. By using this brain training program, student can manage the stress easily without the help of expert.

3. Experiment

Experiment will be progressed as following steps. We recruit 30 students who are under the stress from academic record and want to join the experiment. Participants will be divided into 2groups namely experimental group and control one. We interview about their stress and they fill out a stress-questionnaire. Next we will construct EEG with student's brain map. This gives us an overview of the brain's functional state and indicates the level of stress.

Table 1. Design of Experimental Group

	Pre-test	Training	Post-test
Experimental group	E_1	Yes	E_2
Control group	C_1	No	C_2

We will survey what kind of music enhances Alpha wave. To do so literature review and taking professional advice will be conducted. After selecting the proper music, we will provide experimental group with music as smartphone application. We will request the experimental group to listen the music at least 30 minutes everyday during 4 weeks. Because individual's music preference is different, we will develop training program which automatically switch to another music when the user can't feel relaxed.

EEG recording was done for 90 seconds with a sampling rate of 128 Hz using 2 channels. EEG was recorded simultaneously and the each frequency bands (delta, theta, alpha, and beta) was calculated. The EEG data was collected in a relaxed position with eyes closed. At first students of control group listen to classic music for ten minutes. If Alpha wave is increased then he or she listens to the classic music continuously. But in inverse case the application switches the music to another one. The application repeats this process until the increasing of experimenter's Alpha wave.

Students who are joined this research desire accessing their preferred music while they listening to music such as popular music, new age music, or etc. To provide such request to the students, proposed application must provide the function of adding the playing list. Proposed application operates as follows. First The bicycle computer can receive sensor information and display metrics related to the sensor information on a display for the user. The displayed information can be updated at any suitable interval, for example determined based on power considerations, sensor refresh rates, user requests for particular information, or any other suitable interval. The overall system configuration of smart bicycle is as follows.

In our experiment we take Alpha wave enhances music. Among various genre we select Baroque music that is composed by Bach, Handel or Telemann, that is 50 to 80 beats per minute creates an atmosphere of focus that leads students into deep concentration in the alpha brain wave state.(Cited from Music and Learning: Integrating Music in the Classroom by Chris Boyd Brewer, Johns Hopkins school of Education). Basically all students in experimental group must listen in the following music that is Bach, Suite No.1 in G major BWV 1007 and Variation on the Kanon by Pachelbel. If the student whose alpha wave is not increased, then switch the music by one's preference until alpha wave increases.

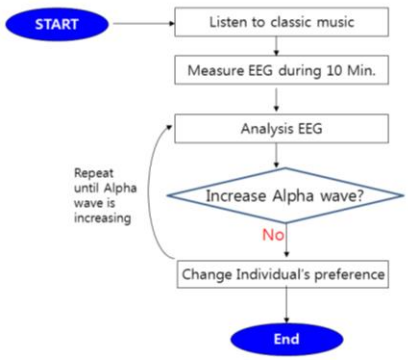

Figure 4. System Diagram

4. Research Result

After 4 week's training we evaluate EEG before and after training using statistical method (*i.e.*, chi-square test of homogeneity) whether proposed training program is efficient. Table 1 shows the change of Alpha wave according to music stimulation. In Table 1 stimulation 1 is listening to classic music and stimulation 2 is listening to his or her favorite music.

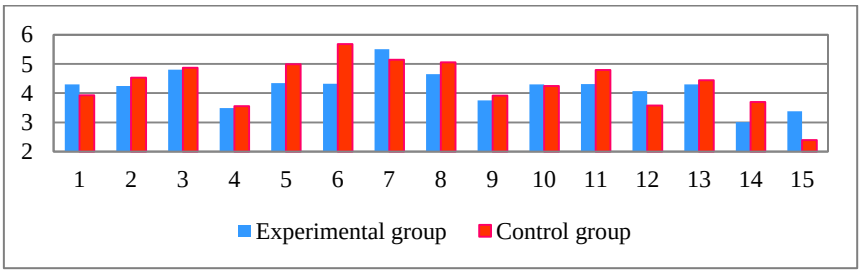

Figure 5. Alpha Wave of before Training

Table 2. Mean and Standard Deviation of each Group before Training

	Mean	St.dev.	t-value	p-value
Experimental group	4.18484	0.606782	-0.506827	0.308303
Control group	4.319353	0.829694		

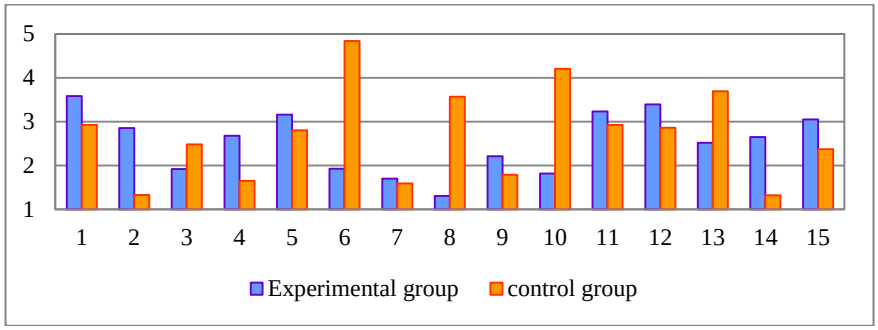

Figure 6. Beta Wave of before Training

Table 3. Mean and Standard Deviation of each Group before Training

	Mean	St.dev.	t-value	p-value
Experimental group	2.533333	0.689437	-0.478860	0.318182
Control group	2.689933	1.06246		

Because P value 0.308303 > 0.05, two groups are homogenous. There is no difference between experimental group and control group

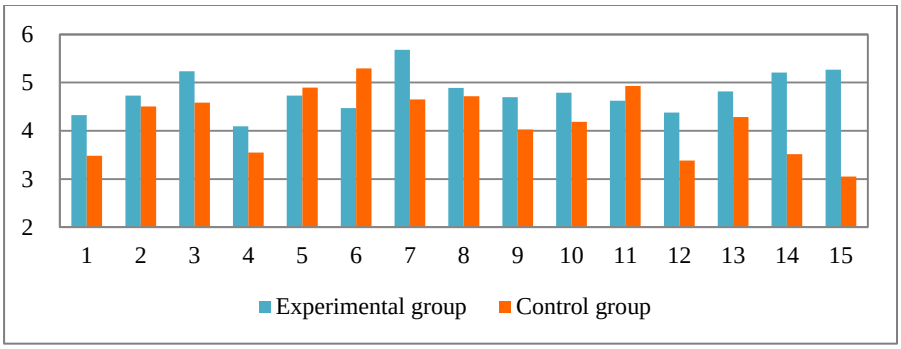

Figure 7. Alpha Wave of After Training

Table 4. Mean and Standard Deviation of each Group after Training

	Mean	St.dev.
Experimental group	4.7958	0.415609
Control group	4.319353	0.829694

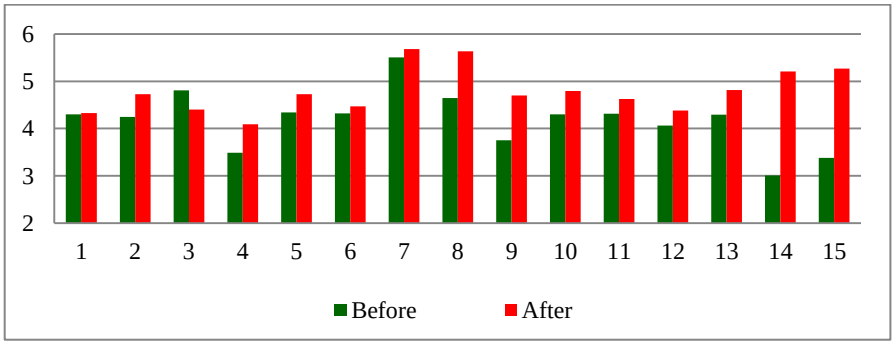

Figure 8. Change of Alpha Wave

Table 5. Mean and Standard Deviation of Alpha Wave Changing

	Mean	St.dev.
Experimental group(pre)	4.018484	0.606781
Experimental group(post)	4.789753	0.468494

Because P value 0.318182 > 0.05, two groups are homogenous. There is no difference between experimental group and control group

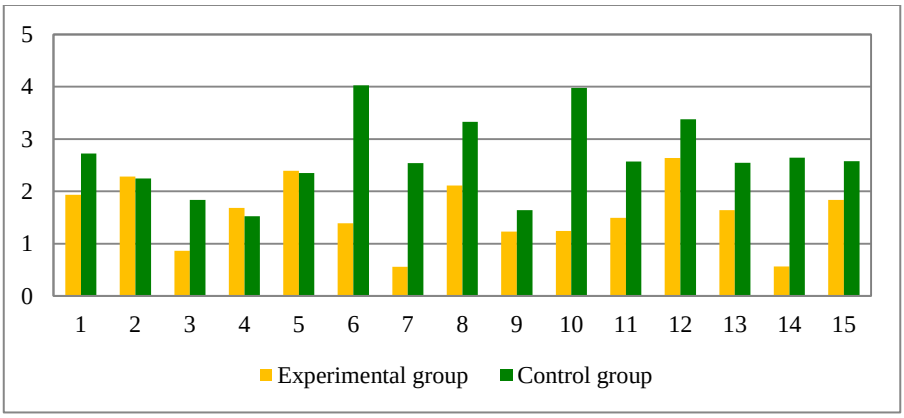

Figure 9. Beta Wave of After Training

Table 6. Mean and Standard Deviation of each Group After Training

	Mean	St. dev.
Experimental group	1.59114	0.634275
Control group	2.65979	0.750539

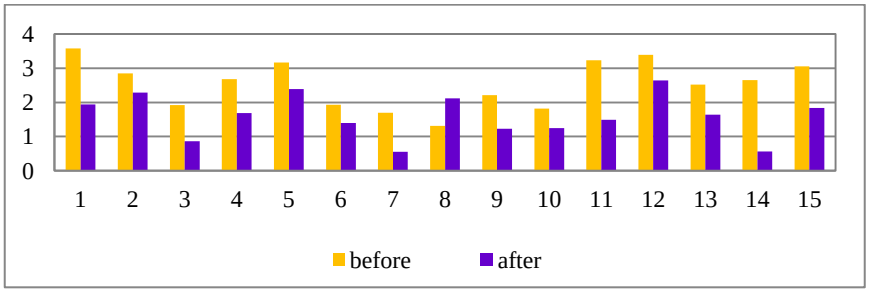

Figure 10. Change of Beta Wave

Table 7. Mean and Standard Deviation of Beta Wave Changing

	Mean	St.dev.
Experimental group(pre)	2.53333	0.689437
Experimental group(post)	1.59114	0.634276

We can interpreter this result that preferred music is more effective than classic music.After that we will interview the participants in experimental group about the proposed training. From them we will receive valuable feedback whether it is helpful or not. On the basis of feedback we will modify the training program until students will satisfy comparatively.

5. Summary and Discussion

Our proposed personalized music treatment system has following advantages.

① According to research paper, 82 percent of the entire stress is caused by studying and this kind of situation will not change easily. Our proposed application will be very useful to the students who are under the stress of studying.

② Through this research we will develop a brain training program for students. Because it is designed for stress management, it can be applied to anyone who is suffering from any kind of stress.

③ Students medical spending on relieving stress of studying will be increased as an competitive society progress. This situation also leads to a budget deficit of national health insurance. Our proposed system causes not only decreasing of individual medical spending but also helpful to government to overcome the current financial difficulty.

④ Finalize their life by Committing suicide is one of the most serious problem in Korea. Because proposed application reduces their stress, it will be very helpful to prevent suicide.

Future work is as follows.

① Current system initially plays classic. Because each person's music preference is difficult we will survey more deeply what kind of music is friendlier to each person.

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Authors

Ga-Hyung Kim, she is a sophomore in Hankuk Academy of Foreign Studies. She is interested in brain science and tries to find the cause of brain related disease especially Stroke and Alzheimer disease.

Byung-Joo Kim, he got a Ph.D. from Kyungpook national university and M.S and B.A from Pusan National University respectively. His research area is Machine learning, exploring big data and Human Brain Interface. He is now a professor at Department of Computer Engineering in Youngsan University.