

Optimizing water fountain as community based therapy for better health continuance – Preliminary Study.

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Abstract- Background: The healing aspects of natural sounds therapy including water sound are beginning to get a lot of interest in the medical fields. Numerous studies conducted on the value of natural sounds as a therapy for various psychological treatments. Objective: to observe the influence of water fountain melodies on anxiety level among the experimental groups before undergoing dental checkup and to compare the effect of different water fountain melodies in reducing anxiety level by measuring the changes of brainwave signals. Methods: 4 types of water fountain melodies have been selected from 100 created melodies for the purpose of lab test. In this preliminary study we analyzed Electroencephalograph (EEG) data of 12 subjects. Volunteers divided into 4 experimental groups each group listen to one type of melody and one control group with no melody. Results: statistical analysis showed that Melody 2 has the first ranking which means that Melody 2 give the most effectiveness to brain in reducing anxiety. Conclusion: Melody intervention may has noticeable effectiveness on the brain in reducing anxiety than no melody and different melodies may have different effectiveness.

Keywords: Natural sounds, Water fountain, Melodies, Electroencephalograph, Teenagers,

1Background

Music has a countless of health-related benefits, both psychologically and physiologically. However, because the healthful effects of music have not been fully explored scientifically, many questions about the efficiency of music have not been answered yet. Scientific attention begin to recognize this concept for alternative treatments especially for pain relief management, stress reduction, improvement of sleep patterns, development of general physical and mental wellbeing (Mullooly et. al, 1988). With the advancing

technologies such as EEG (Electroencephalogram) and ECG (Electrocardiogram), physiological effects of sound on human mind and body can be investigated and quantified (Abdul Kadir et. al, 2009). Many authors reported that more researches are needed to study the effects of music on patients' stress and anxiety reduction (Bradt J and Dileo C 2009).

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A clinical trial had done on the effects of music therapy on female breast cancer patients' anxiety following radical mastectomy and concluded that music therapy has positive effects on decreasing their anxiety (Xiao-Mei Li et al 2011). The healing aspects of natural sounds therapy including water sound are beginning to get a lot of interest in the medical fields. Numerous studies conducted on the value of natural

Hypothesis:

It is predicted that water fountain rhythms could affect teenager's emotions in managing their uneasiness before undergoing dental checkup.

2 Objectives:

We aim to observe the influence of water fountain melodies on anxiety level among the experimental groups before undergoing dental checkup.

3 Methods:

Nearly 100 types of water fountain melodies have been created. 4 types of melodies have been selected from the collection for the purpose of lab test. 4 types dynamic white noise have been created one for each type of melody. The sound has been modified based on lab test results. Hands on training for EEG recording using Enobio.

Inclusion criteria

- a. No previous anxious dental experience
- b. Not having serious disease that can influence in EEG examination (e.g., brain disease)

Exclusion criteria

- a. If in a serious debilitating oral disease (acute periodontal pain, pulpitis, abscess, or other acute infections, attachment loss or gingival recession, root hypersensitivity that might cause tooth hypersensitivity)
- b. Patients with severe anxiety and non-cooperative

Once volunteer arrived, divided into groups by sequence of:

Volunteer 1 will listen to Melody 1

Volunteer 2 will listen to Melody 2

Volunteer 5 will not listen to any Melody.

sounds as a therapy for various psychological treatments (Coensel BD et al 2011).

Does water fountain melody reduce anxiety induced by dental checkup? Are there any significance changes between experimental groups with melody intervention and control group?

We expected that there are differences in reducing anxiety among teenagers after melody intervention in term of brainwave signals.

To compare the effect of different water fountain melodies in reducing anxiety level by measuring the changes of brainwave signals.

Recruiting volunteers were selected. Brochure and consent forms have been prepared and distributed for the volunteers to participate in this study. In this preliminary study we analyzed EEG' data of 12 subjects. The subjects aged 12-16 years old, will be selected according to the inclusive and exclusive criteria:

- c. Have no dentin sensitivity to air stimulation.
- d. No hearing problem

- c. Not interested in music
- d. Having medical or psychology disorder that might affect pain thresholds
- e. Using pain or anxiety medication

Volunteer 3 will listen to Melody 3

Volunteer 4 will listen to Melody 4

Volunteer's behaviors were not controlled by the experimenter as we would like to study volunteer's behaviors in the actual state before undergo dental checkup.

Discussion session to prepare the subject to be more serious during the experiment' steps.

In order to determine the effectiveness of water fountain melody in reducing anxiety, Melody Intervention introduced

right before dental checkup. EEG recordings were not implemented during dental checkup session to avoid confounding variables, e.g. facial muscle movement will affect clean data collection. We decided that EEG analysis focus on Melody Intervention section to examine the effectiveness of water fountain melodies in boosting volunteer's relaxation and reducing their anxiety level before undergoing dental checkup.

Steps of Composing Raw EEG Data

Since EEG signals consist of robust data, permutation method has been selected for the analysis. Thus, exact significance levels will be obtained rather than approximations. EEG data was analyzed and the sampling frequency was set. Next, the intelligent signal processing techniques were developed in *MATLAB* to calculate EEG raw data. The artifacts were filtered

by applying threshold value into the signal analysis program. Afterward, the computed data was separated into 2 minutes data for each condition. Lastly, SPSS was utilized for further statistical analysis.

4 Results

Distribution Assumptions

Descriptive Statistics								
	N	Minimum	Maximum	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Ch1Mel	12	.81163	7.12011	2.4948779	2.030	.637	5.061	1.232
Ch3Mel	12	.99691	10.14306	3.0099535	2.297	.637	5.669	1.232
Ch4Mel	12	.91076	2.93909	1.7237240	.832	.637	-.031	1.232
Ch1Sil1	12	1.02284	5.47180	2.1807161	1.787	.637	3.487	1.232
Ch3Sil1	12	.78484	3.14936	2.0593842	-.400	.637	1.203	1.232
Ch4Sil1	12	.82166	3.19443	1.5003539	1.686	.637	1.682	1.232
Ch1Sil2	12	.70590	9.93326	2.4637347	2.426	.637	6.353	1.232
Ch3Sil2	12	.66646	3.00778	1.3134512	2.321	.637	6.653	1.232
Ch4Sil2	12	.68590	4.84021	1.6052200	2.043	.637	3.986	1.232
Ch1Sil3	12	.81660	2.70721	1.3177538	2.162	.637	5.300	1.232
Ch3Sil3	12	.55638	3.42722	1.4613246	1.449	.637	1.530	1.232
Ch4Sil3	12	.61847	9.91000	2.4178642	2.411	.637	6.166	1.232
Ch1WVN	12	.54934	2.65079	1.2728990	1.054	.637	1.532	1.232
Ch3WVN	12	.51279	4.93533	1.6131000	1.736	.637	2.748	1.232
Ch4WVN	12	.63837	2.78854	1.2966301	1.418	.637	2.850	1.232
Valid N (listwise)	12							

Table 1: shows the descriptive statistics about the EEG data. In the present study, researchers have collected 12 subjects. Each subject was analysed by conditions/channels example melody/channel 1. From here, some of the data follows the normal distribution and some are not follows the normal

distribution since the value of minimum and maximum is not beyond -1.0 and 1.0 and it is permutation method, so we assume that this data will freely follow any distribution.

Behavior of Conditions

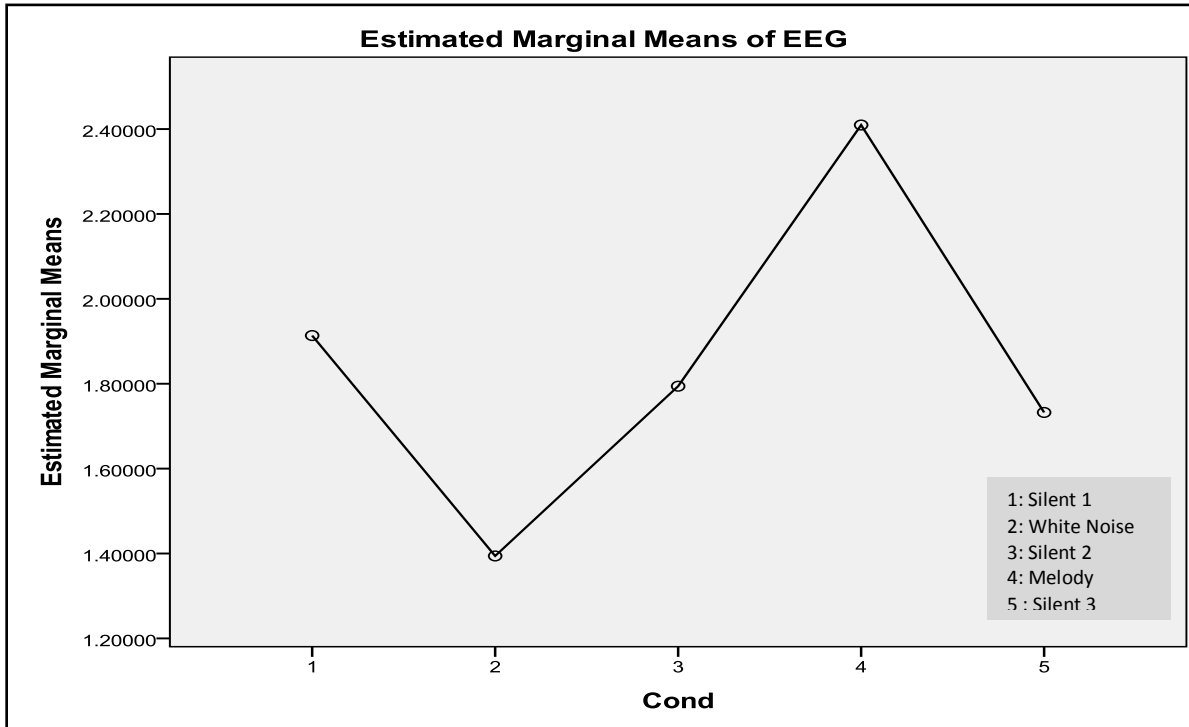


Figure 1: Estimated Marginal Means of EEG signal between Conditions.

Figure 1: shows the estimated marginal means of EEG data of all group of melody for each condition. Here, the purpose of this analysis is to see roughly the behaviour of EEG brainwave signals for each condition. From Figure 1.0, there is decrement of marginal mean from condition 1 (Silent1) to condition 2

(White Noise). Then, there are upward trend of marginal mean from condition 2 (White Noise) until condition 4(Melody). The trend starts to decrease from condition 4 (Melody) to condition 5 (Silent 5).

Behavior between Conditions & Channels

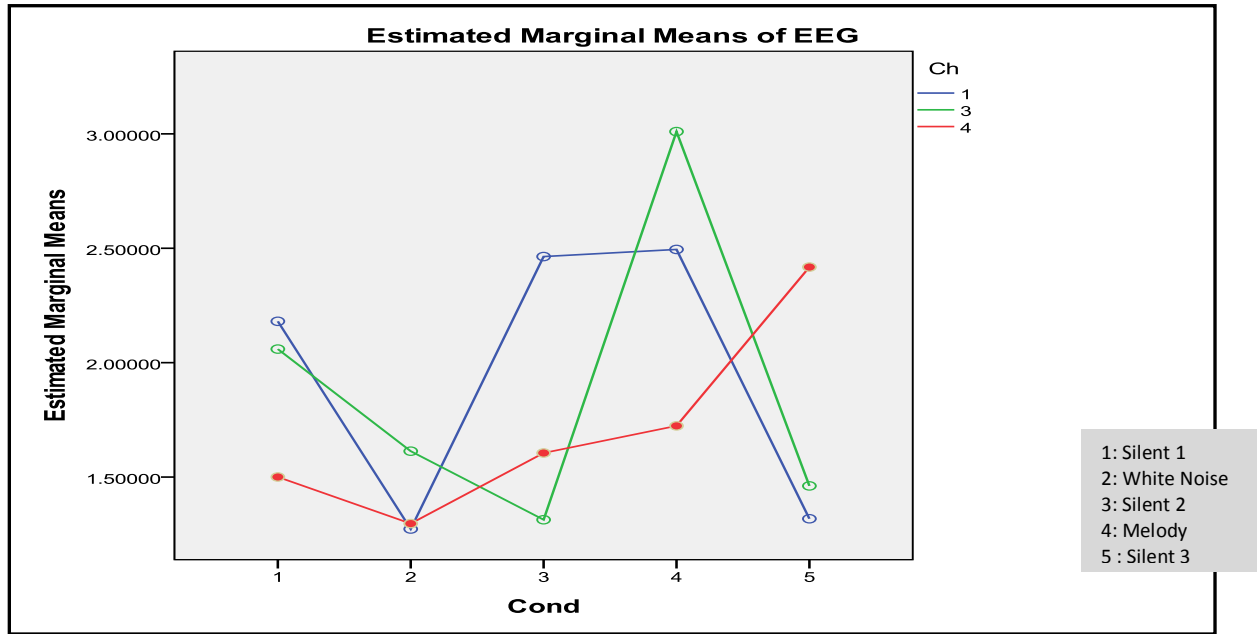


Figure 2: Estimated Marginal Means of EEG signal between Conditions and Channels.

Figure 2: shows the estimated marginal means of EEG signal between conditions and channels. The purpose of this analysis is to see which channel exhibits higher brainwave signal for each condition. From Figure 1.1, it shows that for condition 1(Silent1), the means of Channel 1 has the highest values followed by Channel 3, and Channel 4. For condition 2 which is White Noise, it seems that the mean of Channel 1 and 4 are same. While for condition 3 (Silent 2), the mean of Channel 1 has the highest values followed by Channel 4 and Channel 3.

For condition 4 (Melody), it seems that Channel 3 has the highest mean compare to Channel 1 and 4. Channel 4 for condition 5 (Silent3) has the highest mean, followed by Channel 3 and 1.

Choosing the Most Effective Melody Using ERP

Table 2 Means and Ranking of each Type of Melody Based on Channel

Type Melody		Ch1 Melody	Ranking Channel- 1	Ch3 Melody	Ranking Channel- 3	Ch4 Melody	Ranking Channel- 4	Total Ranking	Ranking of Total Ranking
Melody 1	Mean	1.11329	5	5.56998	1	1.37666	4	10	3
Melody 2	Mean	2.31556	3	3.35199	2	2.31255	1	6	1
Melody 3	Mean	2.19476	4	1.93915	5	1.80915	2	11	4.5
Melody 4	Mean	3.62669	1	3.13635	3	1.80330	3	7	2
No Melody	Mean	2.80825	2	1.52450	4	1.23446	5	11	4.5

Table 2: shows the means and ranking of type of melody based on channels. The purpose of this analysis is to illustrate which melody is effective in reducing anxiety level among participant during dental check-up. The researchers rank the mean for each channel based on the highest mean value. In order to evaluate which melody gives more positive effect, the researcher sum up the ranking of each channels. From column Ranking of Total

Ranking, it shows that Melody 2 has the first ranking which means that Melody 2 is most effective among four melodies in reducing anxiety level. Followed by second ranking; Melody 4 and Melody 1 as the third melody that shows positive effects toward brainwaves signals. However, it seems that Melody 3 and No Melody have given the less effect on reducing the anxiety to subject before going to dental treatment.

5 Discussions:

- EEG is a study of charging electrical potential of the brain. Each electrode was placed on specific site of the scalp (T3, T4, T1) and measured brainwaves of different frequencies within the brain region (Abdul Kadir et. al, 2010). In our study, each melody has special characterization and accordingly different effect on brain activity (Fig. 3, 4, 5, 6). Changes of
- Figures 3, 4, 5 and 6 are the power spectrum of the part of each data Where Average dB is the loudness of each data. If it is 0, it means loudness is maximum and lower value means lower loudness relatively.

several rhythmic frequencies especially Alpha and Beta bands were examined to observe brain responses toward water fountain melodies. By analyzing brain signal activities, it is assumed that increasing alpha band power during listening water fountain melody will reflect relaxation in volunteer's conscious conditions.

Surround dB is the stereo width of the data. If it is 0, it means the data is narrow perspective and higher value means wider perspective

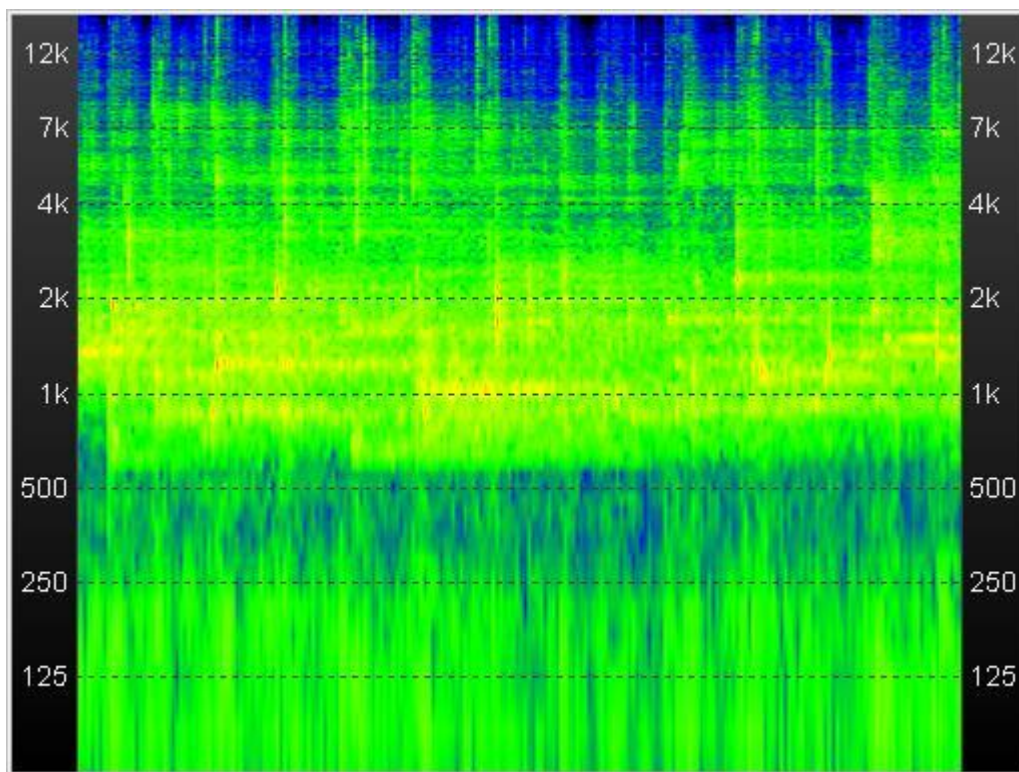


Figure 3: For Melody 1 Average dB -23.40 and Surround dB 1.97

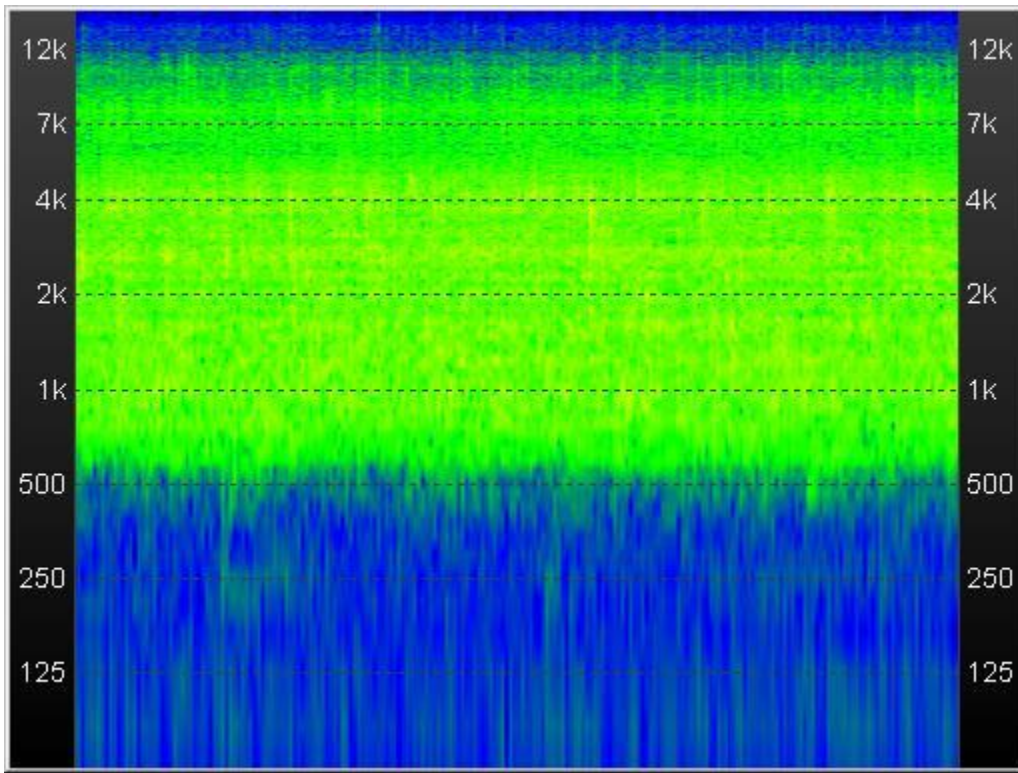


Figure 4: For Melody 2 Average dB -25.58 Surround dB 0.20, for Melody 3 Average dB -34.60

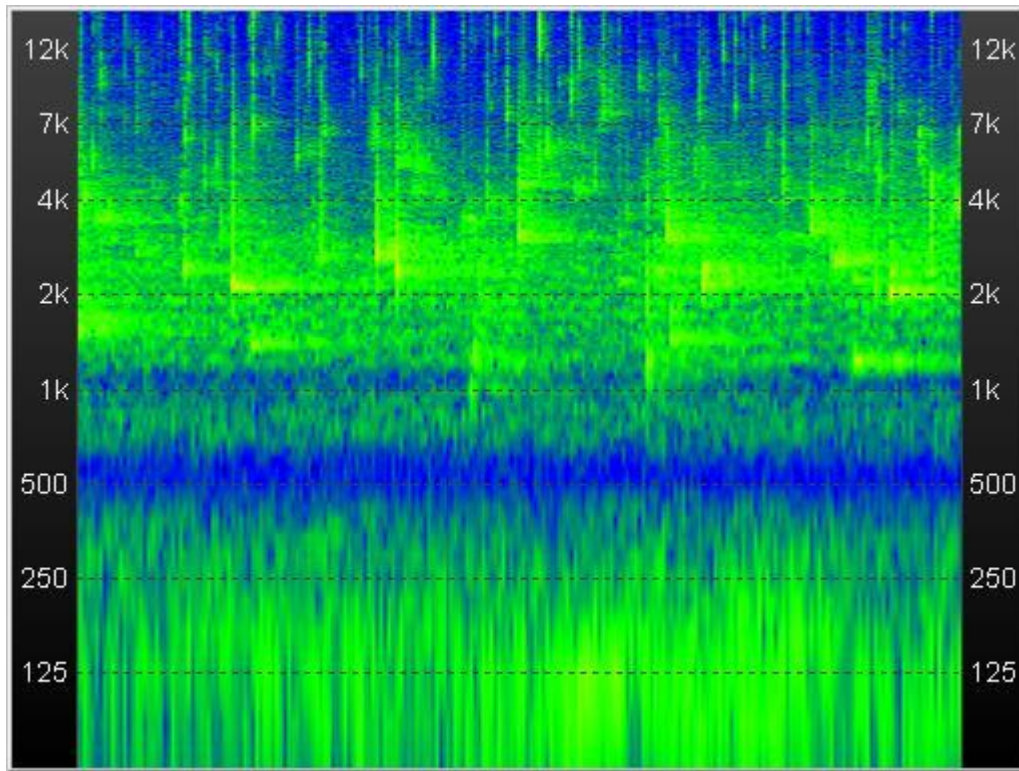
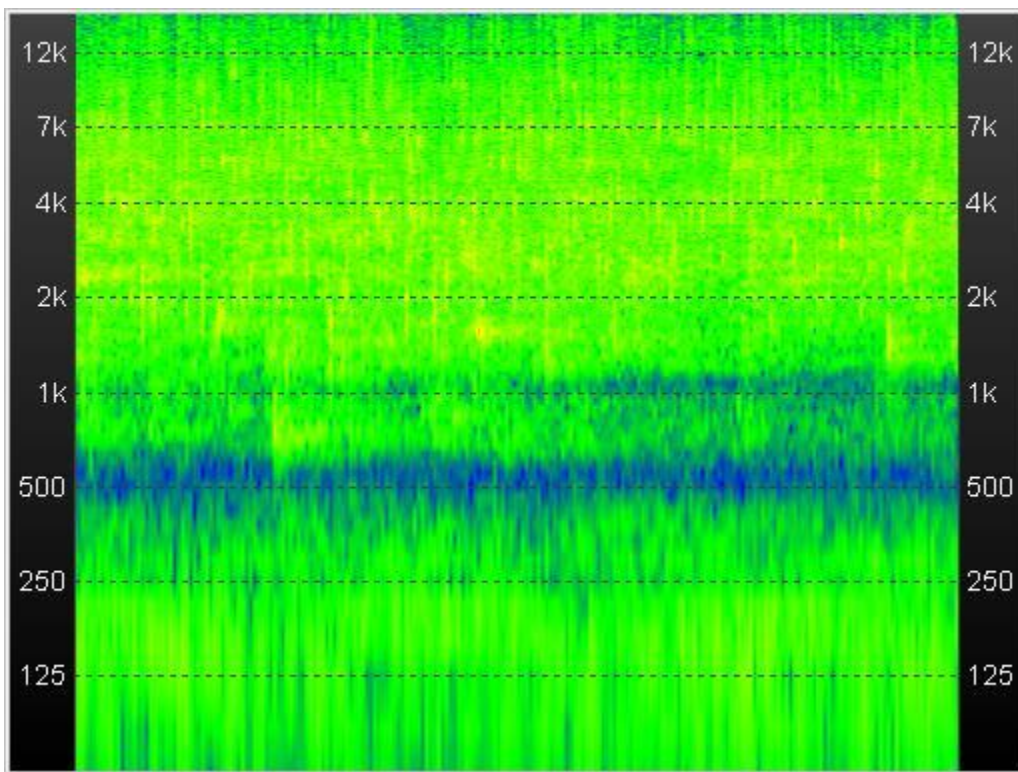


Figure 5: For Melody 3 Average dB -34.60 Surround dB 6.13



• Figure 6: For Melody 4 Average dB -21.82 Surround dB

5 Conclusions

Analysis of EEG collected data indicated different changes of the brain wave signals after melody intervention. They showed that melody intervention has noticeable effectiveness on the brain in reducing anxiety than no melody and different melodies have different effectiveness. Within the study limitations, our findings do not support that there are

significant differences between different melodies or between melody and no melody. Future analysis of data of large sample size should help to have more investigations of the changes in brainwave signals, facial actions and emotional regulations after melody intervention and provide more powerful statistical implementation.

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