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ANALYSIS OF MUSIC EFFECT ON N-BACK TASK PERFORMANCE

Ms Nithya.S

Assistant professor, Department of BME,GKM College of Engineering and Technology, Anna University,Chennai-63,Tamilnadu,India

Abstract: Listening to music causes either positive or negative effect while performing any task. To identify the effect in this paper EEG signal was acquired from different subjects while performing N-back task & listening to music. The N-back task has four levels of cognitive load which is designed & presented to subject using Paradigm stimulus presentation software (PSPS).N-back task is performed for 4 trials. During first trial without music, second trial with Country music, third trial with Rock music & Fourth trial with Jazz music. During the performance of N-back task the Reaction time (RT) is also measured. It is observed that the subjects can perform n-back task well without music. A total of seven parameters were extracted. From these it is seen that Rock music has negative effects which as less performance. While comparing Country and Jazz music the performance and effect are similar to no music condition. For no music, the subject performed well in all the cognitive loads. The variations are seen in the Frontal and temporal electrodes in each band. From this it can be noted that the Frontal and temporal lobes are more active compared to the other lobes, so while performing any tasks along with music, greater importance can be given for Frontal & temporal lobe electrodes and pleasant music like Country and Jazz music has been preferred. So it is better to do any task without listening music.

Keywords: Cognitive load, N-Back task, Parameters, Reaction time, Stimulus

1. Introduction

The Cognition is a group of mental process which also includes the attention of working memory. Now-a-days humans are used to hear the music while performing tasks such as Driving, Reading, Walking, Studying, etc. Listening to music causes changes in the activity of the brain signal which may result in either positive or negative effect which has to be identified. Since if it decreases the performance, then the music will not be listened else appreciate them to listen continuously to increase the efficiency of task.

The objective of this paper is to acquire EEG signal while performing N-back task with four different cognitive loads along with/without music in order to identify the effect of music. Cognitive load is defined as mental activity which involves in working memory (WM) process, and an increase in WM increases the cognitive load [1]. WM is defined as a system which acts as a short-time storage and process the information, which is essential for cognitive activities [1].The N - back task is designed and presented through Paradigm stimulus presentation software to the subject. Music is given through headphones. Based upon cognitive load of N-back task, the reaction time varies [2]. The EEG signal will be analyzed l using Matlab software.

2. Task and Music selection

The N-back task is defined as the current stimulus matches with n steps back stimulus. The level of n increases, the difficulty level to maintain the information in the brain also increases. The N-back task captures the active part of the WM and also includes the updating of WM. To complete this task, the subject needs to both maintain and manipulate the information in working memory. In this work, we used four different cognitive loads to determine the performance of subjects for each load.

Music is chosen based upon the previous studies. Hence, three different music such as Country, Rock, and Jazz are used in this paper [3]. RT was measured while performing N-back task. Reaction time (RT) or response time refers to the time which takes the subject to react/ respond to the stimulus. Reaction time is used to measure how the different individuals react to the same stimulus, or how the same individuals react to a different stimulus. Because reaction time gives how the subject react quickly. Reaction time measurement is needed to measure the effect of different music when the subject performs N-back task [4].

3. Methods and Materials

3.1. Subjects

Twenty healthy subjects were participated in the task. All subjects were right handed, with a mean age of 23 years. All the subjects are normal with common educational background, without any psychiatric disorders.

3.2. Experimental Protocol

EEG signal was acquired from the subject using scalp electrodes placed on the head while they were performing N-back task and listening music. N-back task design uses Paradigm stimulus presentation software (PSPS) and it is given as per previous studies [1]. The stimuli consist of 20 Letters which may be targeted or non-target. They are presented individually in a sequence manner on a laptop monitor using Paradigm stimulus presentation software. Each stimulus displays for the period of 500ms with a 2500ms inter-stimulus interval. There are four different conditions were used to increase the cognitive load of working memory the load starts from zero to three [4-7].

In the 0-back condition, the subjects respond to a single pre-specified target letter (‘‘X’’) with their dominant hand (pressing a button to identify the stimulus). In the 1-back condition, the target is given as any letter which is identical to the one immediately preceding it (i.e.one step back). Similar to 1-back the 2-back and 3-back conditions include the targets were defined as any letter that was identical to the one presented two or three letters back, respectively as per previous studies [6].

Previous studies stated that the Subject used to press one button (Left mouse button) for targets and none is pressed for no targets, similar is followed here [7]. Each n-block lasted for 60s with 15s of rest periods between N-back blocks. Total test included 4 trials and each consists of 4 N-back conditions (hence a total of 16 N-back blocks).The order is same for each trial. The music is given using Windows media player through headphones. Music and N-back presentation is synchronized. Fig 1 shows the work flow.

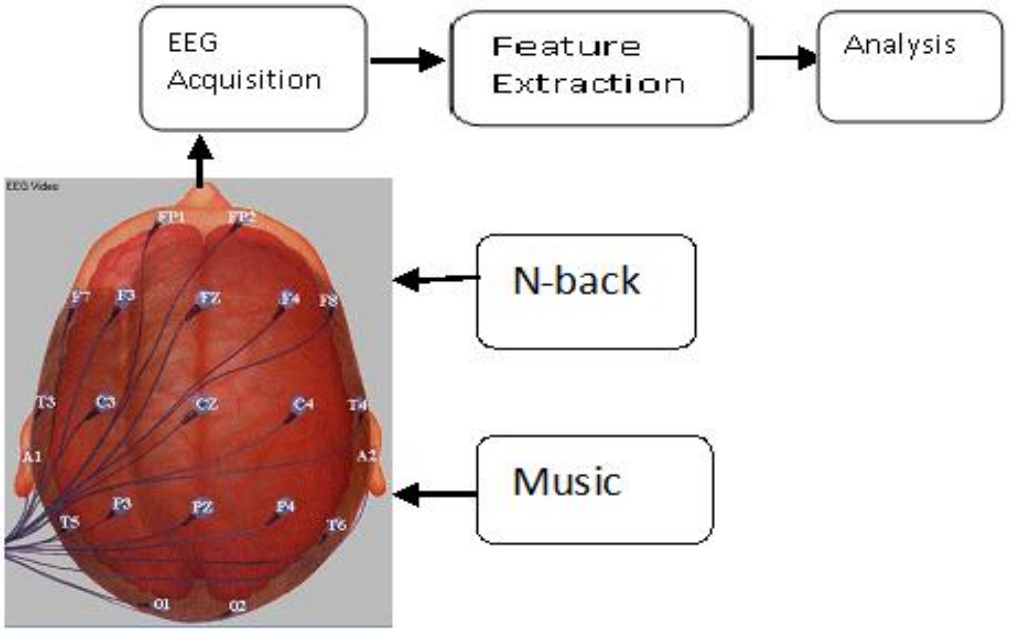

figure 1: Work Flow

3.3. Design and Procedure

3.3.1 N-back task Design:

Using Paradigm stimulus presentation software N-back task design is done. From the Events menu using the tab Text input, instructions were given and in the Block, stimuli as well as inter-stimulus interval were given with the duration of 500ms (single stimulus) and 2500ms respectively. Pause event was used to provide the intermediate relaxation with duration between n-back conditions. Response device such as Keyboard (for

instructions) and Mouse (for n-back response) were used. Using the properties tab we can change the text display, type, color, alignment, size and duration which is shown below in the Fig 2.

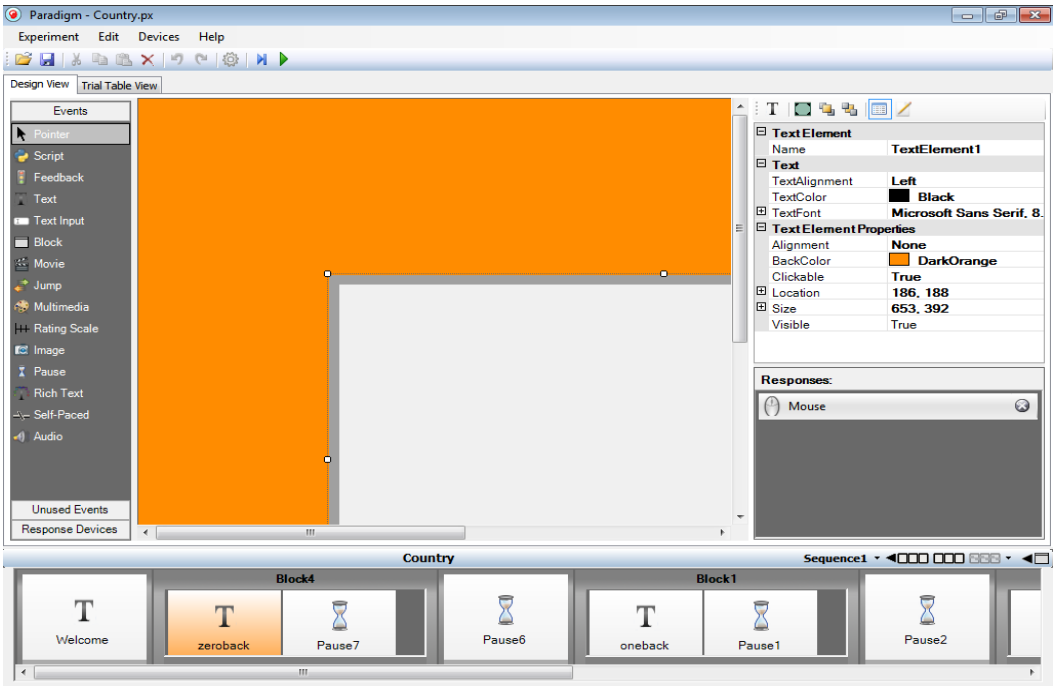

Figure 2: Snapshot of N-back task

The N - back task is performed for four trials such as no music, Country music, Rock music and Jazz music which is shown in TABLE 1.The cognitive load levels are: 0-Back, 1-Back, 2-Back and 3-Back. The music is played through windows media player with the volume of 60-80dB.

Table 1: Arrangement of tasks

Task/Music	**0-back**	**1-back**	**2-back**	**3-back**
Trial 1	No music	No music	No music	No music
Trial 2	Music A	Music A	Music A	Music A
Trial 3	Music B	Music B	Music B	Music B
Trial 4	Music C	Music C	Music C	Music C

3.4. Signal Acquisition

EEG signals are recorded using Ag/AgCl electrodes which are placed on the scalp. The electrical impedance is kept under 20KΩ for all electrodes. Electrodes are placed according to the international 10–20 system and put on the following areas: Fp1, F7, F3, T3, C3, T5, P3, O1 and Fp2, F8, F4, T4, C4, T6, P4, Fz, Cz, Pz against ipsilateral ear lobe electrode (A1 or A2). EEG signals are amplified and filtered by a digital EEG machine (RMS-BVEC) with the sampling frequency of 200Hz, a low-frequency cutoff of 0.5Hz, and a high-frequency cutoff of 70Hz.

The subject is seated at 70 cm distance from the laptop which displays verbal stimuli at the center of the monitor. The mouse is used to get a response from the subject by pressing the left button.

4. Results and discussions

In this paper, EEG signals were acquired during the N-back task with four different cognitive loads (0, 1, 2& 3) along with music. Hence corresponding Reaction time (RT) had been measured for each N-back condition. The RT gives the response time for each response in milliseconds. Simultaneously, the raw EEG signal also acquired from the subject using Mono-polar configuration. Hence Reaction time & EEG signal has been analyzed .For 0-back condition target is six similarly for 1-back, 2-back, 3-back the target is five, four and three respectively. According to subject response in each n- back condition the reaction time is measured and the data's are saved as an excel sheet using Paradigm stimulus presentation software. .

The RT time for all twenty subjects for no-music, Country music, Rock music and Jazz music are observed by varying the load. The Grand average of ten subjects had been taken and the corresponding bar graph is shown in Fig 3. It is observed the reaction time increases along with load increases for all trials.

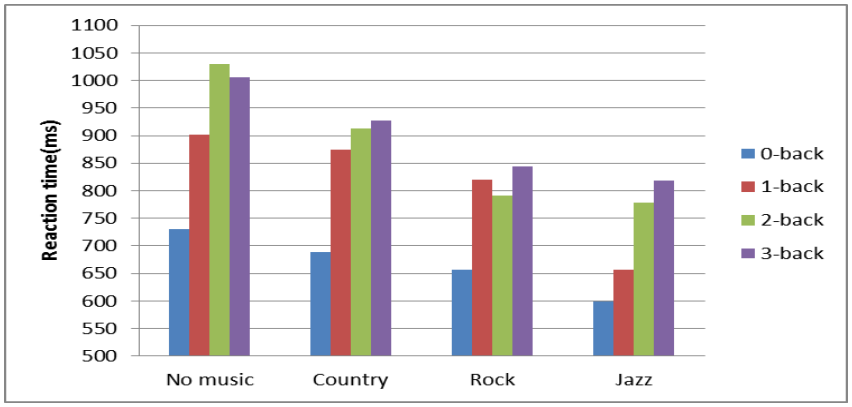

Figure 3: Reaction time measurement

In a previous study [4] it is stated that when the cognitive load increases the reaction time also increases. In this work, four different levels of cognitive load are used to test the performance of the working memory. It is observed that no music up to 3rd cognitive load the reaction time linearly increases. In 4th difficulty level, there is a slight decrease in reaction time. During Country music trial reaction time increases linearly with respect to cognitive load, and similar results were also observed in jazz music. During Rock music there is a dip in the 3-back task. Since it has significant diversion while doing N-back task it is also seen in percentage of accuracy which is shown in Fig 4.

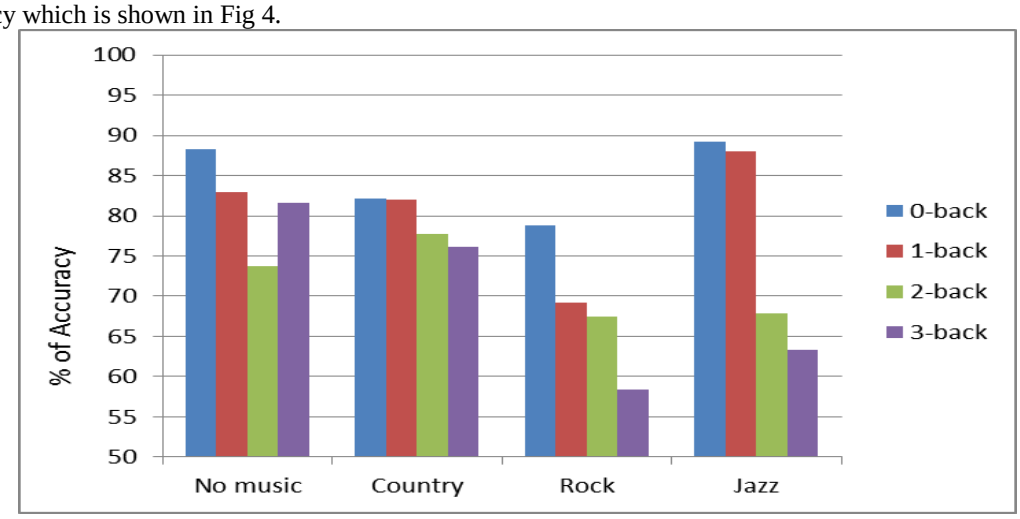

Figure 4: Percentage of Accuracy

5. Conclusion

The N-back task performance in each subject is observed for four different trials such as no-music, Country music, Rock music and jazz music. It is found that the Reaction time increases with cognitive load increases for no-music.A total of seven parameters such as spectral analysis of four bands (alpha, beta, theta and delta) were extracted. From these seven parameters it is seen that the Rock music has negative effect which as

less performance. While comparing Country and Jazz music the performance and effect are similar to no music condition. For no music, the subject performed well in all the cognitive loads. The variations are seen in the Frontal and temporal electrodes in each band. From this work it can be noted that the Frontal and temporal lobes are more active compared to the other lobes, so while performing any tasks along with music, greater importance can be given for Frontal and temporal lobe electrodes and pleasant music like Country and Jazz music has been preferred. So it is better to do any task without listening music.

REFERENCES

[1] Xuebing Li , Zhengzheng Ouyang, Yue-Jia Luo, "The Effect of cognitive load on interaction pattern of Emotion and Working memory:an ERP study" *Proc.9th IEEE International Conference on Cognitive Informatics (ICCI)*,2010,61-67(10).

[2] Erika Molteni, Michele Butti, Anna M. Bianchi, Gianluigi ReniPhil, "Activation of the prefrontal cortex during a visual N-back working memory task with varying memory load: a Near Infrared Spectroscopy Study," *30th Annual International IEEE EMBS Conference*, Vancouver, 2008, 4024-4027.

[3] Xuemin Zhang, Li Chuchu, Zhang Jing, Ma Xiyu ," A Study of Different Background Language Songs on Memory Task Performance" *International Symposium on Intelligent Ubiquitous Computing and Education*,2009,May 15-16,291-294.

[4] Roberto A.I soardi,David W. Townsend,Cameron *S* . Carter,Amy Herbster,"Optimum Activity Levels of 150-Water to Map Human Brain Function with the ECAT HR+",*Nuclear science symposiumIEEE Transactions*,1997,1494-1498(2)

[5] Susanne,M.Jaeggi,Martin,Buschkuehl,Walter J.Perrig, Beat Meier,"The concurrent validity of the N-back task as a working memory measure", *Psychology press memory*,2010,Apr19,394-412.

[6] Hasan Ayaz , Meltem Izzetoglu,Scott bunce,Terry Heiman-Patterson and Banu Onaral, "Detecting cognitive activity related hemodynamic signal for brain computer interface using functional near infrared spectroscopy,"*IEEE Proceedings of the 3rd International IEEE/EMBS.Conf on Neural Engg* , Kohala Coast, Hawaii, USA, 2007,May 2-5, 342-345(10)

[7] Yoshiaki Nakao, Atsushi Kodabashi, Masaru Yarita,Toshiro Fujimoto, and Toshiyo Tamura , "Temporal activities during P3 components on the working Memory-related brain regions: N-back ERP study" *Proceedings of the IEEE-EMBS International Conference on Biomedical and Health Informatics* (BHI2012) Hong Kong , China,2012,Jan 2-7,424-427(10).

[8] Yang Jing,Shi Jing, Cai Huajian, Shen Chuangang, Lin Yan, "The gender difference in distraction of background music and noise on the cognitive task performance", *8th International Conference on Natural Computation(ICNC2012)*,2012,584-587(10).

[9] Kane,M.J.Conway,A.R.A.miura,T.K.& Colflesh,"Working memory,attention control and the N-back task:A question of construct validity,*Journal of Experimental Psychology,Learning,Memory and Cognition*,2007,33(3),615-622.

[10] Steinberg,Reinhard(Ed),"Music and the machine,The psychopathology of the sense of music",*Convergent research methods in music cognition,Biomedical sciences*,Springer publications,1995,3-18(26).

