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BRAIN WAVES OF THE HEARING IMPAIRED: DANCING IN SILENCE

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Abstract **: The aim of the study is to explore the experiences of the deaf while learning how to dance in silence. It is to identify the type of brainwaves that occurs in the brain when the hearing impaired were learning to dance by watching video model demonstration. Meanwhile the results might revealed the effective technique for teaching the deaf so that they can learn and perform well in dancing. Quantitative method was implemented in this study using quantitative electroencephalogram (QEEG) to record the brain waves. Participants were volunteers from integrated school of the deaf. The learners were studying the steps in Indian classical dance from the video while their brainwave were recorded and were asked to demonstrates and recall the steps. The subjects are visualizing and estimating the steps taken by the video model while trying to imagine and remember the steps for the dance. This shows that delta wave really affects all the candidates during video test.**

***Index Terms*— Deaf, hearing impaired, Brain wave, EEG**

I. INTRODUCTION

Deaf can be defined as the sign language users whom have problems in hearing, yet skilled in lip readings and someone who uses hearing aids [1]. On the other hand, dance is widely known as a patterned, rhythmic, movement in space and time . A normal person with a perfect hearing system can dance without obstacles. However, the study shows that, it is extraordinary to see deaf people having the bodily-kinesthetic intelligence which is related to dance [2]. It is also indicated in Neuropsychological that the frontal lobe of the brain works when the deaf dances [3].

A. Objectives

The purpose of this study was to find out the dominant brainwaves when the deaf are learning to dance while watching video of Indian classical dance.

The second objective is to determine the region of the brain activated while the deaf children were memorizing the dancing?

B. Research Question

1) What were the dominant brainwaves when the deaf are learning to dance by watching video of Indian classical dance.

2) What parts of the brain were activated while the deaf children were memorizing the dancing steps in the video?

II. BACKGROUND OF THE STUDY

A. Reasons to deafness and learn the deaf languages

Deaf individuals, especially, have problems communicating and in social interaction because they have trouble speaking. Writing and signing have been used as another ways of communicating. Lately, communication which is a combination of speech, residual hearing, finger-spelling, and sign language, has become the favorite way of communication among deaf individuals . The utmost used sign language in the United States is American Sign Language (ASL). Like English, American Sign Language (ASL) is used as a language with which one can link and has its own grammar and word structures.: The primary use American Sign Language (ASL) to teach deaf children to dance, with English qualified as a second language, is becoming ever further general in the deaf community.. Based, on the ASL teaching, dance is also taught to the children. It is important to find out the most effective method of teaching the deaf to dance in silence without the music. Based on the past research, some deaf children learns to dance according to the vibration and beats of the music. As deaf dancers, observing and focus to the demonstration of dancing movement, they sometimes earn some sense of rhythm or movement. By visual instruction, dancers effectively learned dance by physical demonstration, finger-count, mirrors, and videos. Deaf and hearing impaired dancers perceived information by observing their teacher's physical demonstrations, from which they could comprehend the dance routines and dance rhythm, simultaneously [4]. The deaf holds or touches the devices to feel the vibrations and beats [5]. In this research, the main focus is find out the brain response of the deaf and their memory while learning to dance by watching the video recorded Indian classical dance demonstration.

B. Short term memory does effects a deaf

According to Gathercole & Baddeley(1993) Short-term memory (STM) is related to a range of cognitive tasks such as learning to read, reading complex text and arithmetic skills). One of the sources of evidence for this relationship comes from research with special populations. Numerous studies have shown that developmental dyslexics have poor memory spans (e.g., Jorm, 1983; Snowling, 1991). The same relationship has also been observed in deaf. For example Hanson, Liberman and Shankweiler (1984) showed that letter recall by poor deaf readers was poorer than that of good deaf readers matched on non-verbal IQ. Deaf dancers are usually person who has a short term memory lost; they could only remember things not for longer time. The fact that both reading ability and STM ability of the average deaf child is poorer than that of their hearing peers makes the relationship between STM skill and other cognitive skills in deaf an important area of research. To improvise the dance skills the deaf will practice foot tapping method. This method of foot tapping basically is an action of continuous tapping of each foot alternately, left then right.

The visual teaching and visual learning affects the deaf dancers

The deaf have their own techniques for learning dance. Their limited availability to auditory symbols during pre-linguistic years produces an information processing system that seems to be analytically different from that of normal people hearings . Some research shows that those who process most information in a visual mode have a different information processing system from those who don't [6]. The findings regarding different learning procedures for the deaf highlight the consideration of different methods for teaching deaf students which maximize their ability for the deaf.

All the senses are engaged when people dance. People stimulate kinesthetic senses as they diagnose the body placement and motions they are making. The visual sense reacts to the image they see, while the auditory is stimulated as they respond to the sounds they make or hear, as well as to music. The tactile sense is stimulated in touching one another. Such multi-sensory experiences are necessary in leading people to act in natural way. The development of actual multi-sensory instruction for deaf dancers decreases the gap between hearing and hearing impaired (deaf) dancers. It also increases where it makes easier for hearing impaired dancers to learn and makes it possible for them to obtain professional skills[7].

Dance is an effort in rhythm and time. First, dancers observe the physical demonstrations of the instructor. In this awareness of physical demonstration, dancers recognize the flow of dance movement by witnessing steps and physical rhythms. As dancers move, they identify and develop precise skills and movement techniques. Meanwhile, as in [8} described six stages of physical appearance through dance movements for the deaf are: the development of body movement; the conversion of language into body movement; the coordination of movement with music; the translation of language into visual images; the use of facial expression to deliver emotional reactions to words; and the presentation of words to an audience.

Dance movements involve general movements, such as walking, jumping, running, and specific movements, such as twisting the arms, rotating the hips, and flexing the ankles. The development of both common and exact movement increases control above the whole body as well as special skills for each specific body part that each dance form requires. In this stage, deaf dancers obtain dance patterns through visual observation. The second stage of physical expression through dance is the translation of language into body movement. In this stage, dancers put meanings into each dance movement. Dancers decide to jump, glide, or twist to demonstrate the meaning and emotion of each movement. For example, when dancers exhibit the meaning of "I want to dance with you", they will choose an appropriate dance movement to express "eagerness to dance". In this stage, dancers build the ability to translate meaning and emotion of language into dance movement.

The third stage is the coordination of movement with music. In this stage, deaf dancers use inner rhythm. Generally, rhythms are divided into two categories: external rhythms which are produced from outside the individual's body; and internal rhythms which are generated from inside the individual's body. External rhythms are produced by various musical instruments or equipment, such as gongs, a bass, drums, an audio system, flash lights, or ringing bells, all of which aid the persistence of inspiring dancers to identify rhythmic patterns of movements.

However, deaf dancers have no sound memory to review them of the rhythm of dance because deaf dancers cannot hear music and have no knowledge of pulse or rhythm in a dance phrase. Instead of processing sound memory, deaf dancers conquer rhythmic information through visual modes and are aware of the rhythm of steps and movements by using inner rhythm stimulated through all major senses. Inner rhythm is created from the speed of breathing and heartbeat. Deep breathing helps deaf dancers know the slow tempo of dance movement. Deep inhalations and exhalations enable satisfying slow movements. In silence, deaf dancers feel rhythmical inhalation and exhalation, shallow breathing, and pulse. The calm mood of deep breathing makes the way for dancers to move their own slow sequences. An accurate senses of pace also helps them become aware of the movement itself [9]. Inhalation can help tolerate balance and makes sure that a jump is high and stops in the air at its peak, while exhalation renovates energy and prepares for the next inhalation. Thus, inhalation and exhalation can help achieve dance movement easily. However, the speed of breathing tends to accelerate the nervous system, so that dancers tend to breathe rapidly and more shallowly when dancers get nervous. Nervousness often causes dancers to breathe more rapidly, making their movements smaller and less well-defined.

Therefore, an awareness of the pace of breathing is important in controlling body movement as well as increasing the quality of dance movement. Deaf dancers can dance by

following their rhythm of breathing and their own sense of time [10]. The human body possesses its own sense of time, where it is generated by physical and muscular memory that is attained by the repetition of dynamic physical exercise [11]. As in [12] that introduced an example of this in his book Rhythm, Music, and Education to show the power of muscular memory in dance activities. According to his experience, a profoundly deaf girl had a dance experience which she tried to repeat three months later. She remembered all the dance movements and steps in a slightly faster tempo. She remembered all the dance movements with her own sense of time generated by her rhythm of breathing and physical memory.

The fourth stage of performing dance is the translation of language into hand and body images and lip movements. In this stage, deaf dancers reproduce movements as meaningful movements in an eye-catching and graceful manner. Hand movements are particularly important instrument in translating words into dance. In addition to hands movements are movements of other parts of the body: head, arms, legs, and upper body help to convey words into physical pictures. Putting emotions into dance movement is the fifth stage of producing dance movements, completing the artistic and meaningful dance movements. In this stage, dancers express inner feelings for language through facial expressions. For the final stage, dance performance for the deaf dancer's grants posters or slides in order to deliver a clear picture of all the words the dancers symbolize.

III. METHOD

This research was carried out by using quantitative electroencephalogram (QEEG) to record the brain response among the deaf children who watch the physical demonstration of Indian classical dance in the video.

An electroencephalogram is known as a report on electrical activity within the brain that provides full information about the brain activation and frequencies of different parts of the brain in different sub-bands such as delta, theta, alpha and beta.

A. Sampling

Participants were volunteers from an integrated school of the deaf in Kuching, Sarawak who came to the Neuro-Lab in the faculty for a half day educational tour.

Inform consent form were given to the teachers and students to inform the purpose, duration, confidentiality, and prospective benefits of this study. They were guaranteed of the right to withdraw from the study without any penalty and the data of the research remain confidential for the sole purpose of this study only. Below are the stages carried out for each participant. The instructions and tasks at each stage were explained by using sign language by their teacher. :

i. Participants are required to read and sign the consent form.

ii. Participants sat comfortably and relaxed on a chair with headrest.

iii. His/her skin on the forehead and the ear lobes was cleaned with a dirt remover gel to enhance the connectivity.

iv. The electrodes with conductive gel were connected on the electrode scalp which is worn by the participant. The impedance of each electrode is checked.

v. Four tasks were given to the participants ;

The first task – eyes open, participants were asked to relax and to remain focus on a black dot displayed in front of them. This is to ensure that the brain is in the focus state.

Second task – eyes close, participants were asked to close their eyes and remain relaxed. Hence, the brain would be prepared for the next task and to avoid from distractions such as unwanted artifacts (eye blinking or muscle movements). Constant Alpha wave indicates that the individual is in a relaxed state.

Third task- Arithmetic task

Fourth task -watching the physical demonstration by the video model (Indian classical dance)

vi. The raw EEG signals and brainwave were recorded and stored in the computer for analysis.

B. Electroencephalography (EEG) Data Acquisitions

This research was performed at the Counseling Laboratory, Ground floor, Faculty of Cognitive Sciences and Human Development, Universiti Malaysia Sarawak (UNIMAS). The electroencephalography (EEG) consists of 19 electrode channels with conductive gel connected to the electrode scalp that is attached to the EEG machine, which transmits the brain signals to a computer as shown in Figure 1.0. The electrode channels are placed on the respondents scalp using the '10/20 International System' guideline. The impedance checker ensures proper connections exist between the electrodes and the scalp with the impedance of all electrodes maintained below 5 kΩ before the procedure begins.

C. Physical Demonstration by Video Model

In order to teach a new Indian semi- classical dance, the candidates were provided with a dance video which was pre-recorded using an experienced dancer. Her video demonstration was repeated seven to eight times according to the difficulties of the movement techniques. There was also a whole perfect dance video shown. In this process, there are readings taken before video shown and during video viewing to indicate the brain response while watching the dance demonstration in the video.

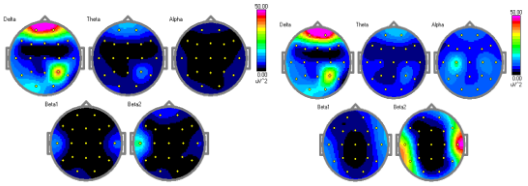
Fig 1. Brain waves recording Fig 2. Subject & translator

IV. RESULTS

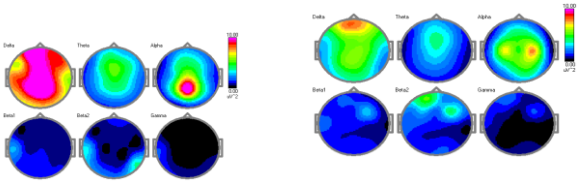
A. Summary of the data collected for different kind of test

1. Open eyes test 1

Candidate 1 Candidate 2



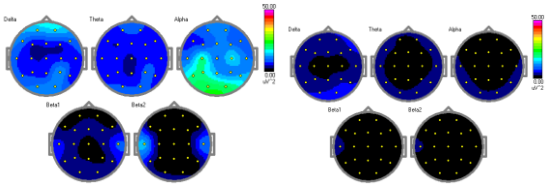
Candidate 3 Candidate 4



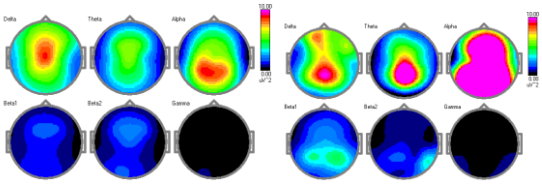
Based on the open eyes test 1, the alpha wave C3-Av has the highest frequency. The average frequency (uV^2) is 7.51. For all the candidates we have obtained it has proven that their sensor motor has the highest average frequency. Meanwhile, beta1 wave shows the highest average at T3-Av with a frequency (uV^2) of 5.97. Same goes for beta2 wave it has the average point at T3-Av, with a frequency of 13.66625. At this point it shows that candidates have verbal memories, and their usage is higher. At the delta wave, the average point is at Fp2-Av with average (uV^2) of 27.1. Same goes to the theta wave, where its average frequency is high at Fp2-Av, with (uV^2) of 7.44. This is because the candidate's judgmental values part of brain is working. But there is only two candidates detected who has gamma wave. It showed a highest average at the T3-Av, with (uV^2) of 0.60. From this we could detect that these two candidates has higher verbal memory.

2. Close eyes test 1

Candidate 1 *Candidate 2*



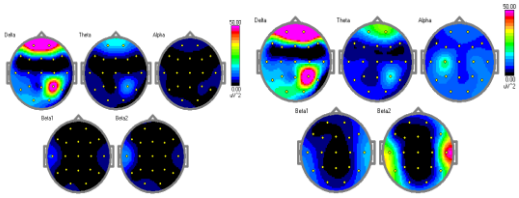
Candidate 3 *Candidate4*



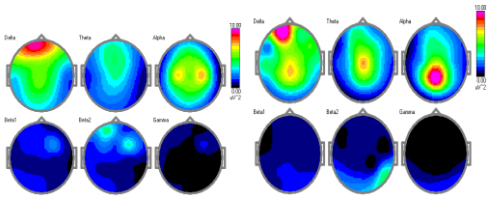
Based on the close eyes test 1, the alpha wave Pz-Av has the highest frequency. The average frequency (uV^2) is 17.20. The main brain part of the brain that was working is the cognitive reasoning. Meanwhile, beta1 wave shows the highest average at T3-Av with a frequency (uV^2) of 2.60. Same goes for beta2 wave it has the average point at T3-Av, with a frequency of 4.2417. At this point it shows that candidates have verbal memories, and their usage is higher. The delta value Fp2-Av, (uV^2) of 7.35 shows that the judgmental value of the candidates is high. The theta wave shows that the average point falls on the Pz-Av with a frequency of 6.20. The candidates were actually using more of their cognitive reasoning. But there is only two candidates detected who has gamma wave. It show a highest average at the O1-Av, with (uV^2) of 0.44. From this we could detect that these two candidates has higher visual processing part of the brain that is working.

2. Open eyes test 2

Candidate 1 *Candidate 2*



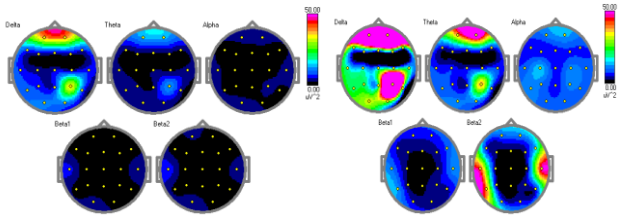
Candidate 3 *candidate 4*



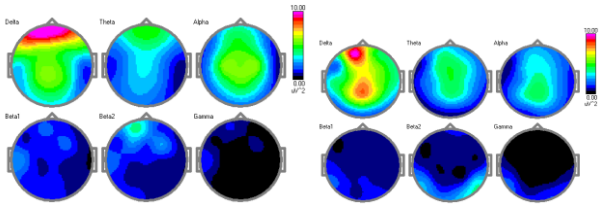
Based on the close eyes test 2, the alpha wave C4-Av has the frequency (uV^2) which is 7.67.The main brain part of the brain that was working is the sensory motor. Meanwhile, beta1 wave shows frequency at T3-Av with a frequency (uV^2) of 4.36. From this we know that the candidates have used more of their verbal memory part of their brain. At beta2, high average could be seen at the point of T4-Av with frequency of 12.70. The candidates here had used a strong emotional memory of their brain. The delta value Fp2-Av, (uV^2) of 48.0 shows that the judgmental value of the candidates is high. Theta wave also undergoes the same judgmental value with an amplitude point of Fp2-Av where the (uV^2) is 11.85. But there is only two candidates detected who has gamma wave. It show a highest average at the O1-Av, with (uV^2) of 0.75. From this we could detect that these two candidates has higher visual processing part of the brain that is working.

3. Arithmetic test

Candidate 1 Candidate 2



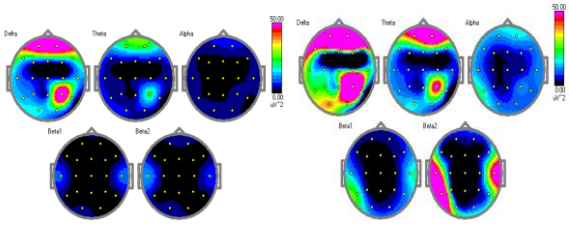
Candidate 3 Candidate 4



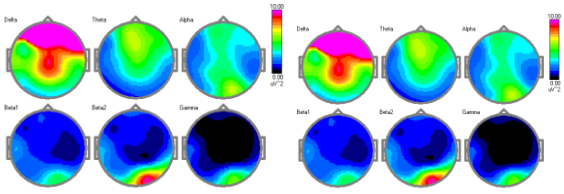
Based on the arithmetic, the alpha wave C3-Av has average frequency (uV^2) is 6.00 .The main brain part of the brain that was working is the sensory motor. Meanwhile, beta1 wave shows the frequency at average T3-Av with a frequency (uV^2) of 4.81. From this we know that the candidates have used more of their verbal memory part of their brain. For beta2 wave it has the average point at T3-Av, with a frequency of 12.5.At this point it shows that candidates have verbal memories, and their usage is higher. At the delta wave Fp1-Av has (Uv^2) point of 53.1 which is the highest of all. Here all the candidates have given a full part of the brain to work on the attentions. The theta wave also undergoes the judgmental value with an amplitude point of Fp2-Av where the (uV^2) is 19.3.But there is only two candidates detected who has gamma wave the T5-Av, with (uV^2) of 0.95. From this we could detect that these two candidates has been using their verbal understanding in focus. It is very unique when the deaf and the dumb could understand the verbal movement of their teacher. This shows how talented and focus they are in detecting the movement of the teachers mouth.

5. Test during the dance video

Candidate 1 **Candidate 2**

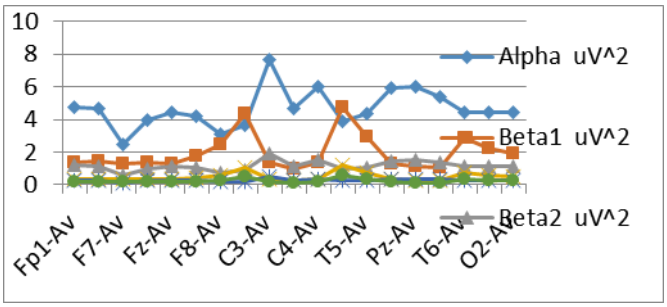


Candidate 3 **Candidate 4**

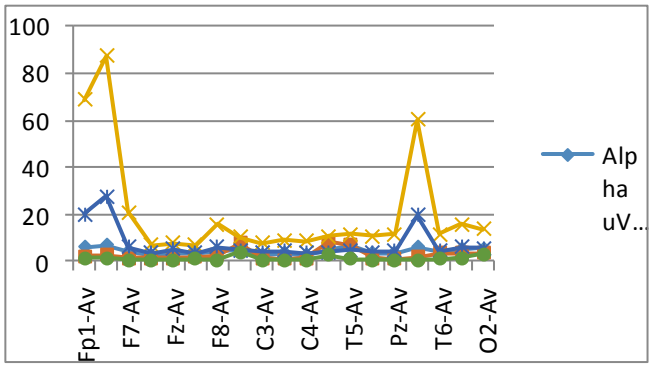


Based on the test from the dance video, the alpha wave Fp2 has average frequency (uV^2) of 7.00.The main brain part of the brain that was working is the judgement memory. Meanwhile, beta1 wave shows the highest average at T4-Av with a frequency (uV^2) of 7.97. From this we know that the candidates have used more of their emotional memory part of their brain. For the beta2 wave, T5-Av has shown a frequency (uV^2) of 22.23. This is where it is proven that the verbal understanding of the candidates was working. The delta wave has the highest frequency at Fp2-Av, with (uV^2) of 87.54. In addition, the theta is also the same but with different (uV^2) of 27.59. The main part of the brain that was working for both waves is the judgement memory. But there is only two candidates detected who has gamma wave. It showed an average at the T5-Av, with (uV^2) of 3.90. From this we could detect that these two candidates has been using their verbal understanding in focus. It is very unique when the deaf and the dumb could understand the verbal movement of their teacher. This shows how talented and in focus they are in identifying and recalling the movement of the teachers mouth.

The comparison graph between the wave activity before video and during video is shown



Graph 1: Open eyes test



Graph 2: During video

From Graph 1, the dominant wave is alpha which is highest at the frontal (Fp1-Fp2) and Prefrontal cortex (F3-F4) at central region (C3-C4) and the parietal area at P3-P4 during the open eyes test. The sensory motor area and spatial functions at the parietal area are activated. The subjects are anxious and are

expecting the cognitive tasks given . Before the qEEG session, the subjects were informed earlier that there will be memory test on the dance steps based from the visual. Meanwhile, from Graph 2, we can see that delta wave is highest at the Frontal region (Fp1-Fp2, Fp7-Fp8) and P4 during watching the video. The subjects are visualizing and estimating the steps taken by the video model while trying to imagine and remember the steps for the dance. This shows that delta wave really affects all the candidates during video test. Next the beta 1 wave, it has high influence on candidates during open eyes test 1, but the beta1 does not influence much on the subjects during the video. Meanwhile beta 2 did have slighter effect before the video shown compared to the effect during video shown. Delta wave was passive before the video was shown (Graph 1) compared to a high activation in the part of the brain which can be seen in Graph 2 this is because they are focusing more with some emotional feelings on. The theta wave doesn't show any changes before the video viewed (Graph1), but it has been drastically changing in Graph 2 during the video viewed. Gamma waves were detected from the two candidates, whom are actively showing progress and interest in this research.

V. CONCLUSION

The overriding purpose of this study was to explore the experiences of the deaf in learning how to dance, to identify the type of brainwaves pattern that occurs in the brain when the deaf were learning the Indian classical dance from the video demonstrations. The deaf students were actually exposed to classical Indian dance. They were actually very excited as it was their first time learning dance. The deaf students were shown video of a model dancing and trying to memorize the basic steps in indian classic dance.

Overall, the dominant wave in the four candidates during the video demonstration was Delta. This is because the brain of the participants is actually focusing on what is shown on the screen where, there was video of a model teaching dancing. Their sensory motor region and parietal area shows a very high activation point. The hearing impaired subjects could not hear a single noise or sound from the surroundings. They were more focused on their visual. As the video is one of the visual teaching devices, the candidates were only viewing the dance without any distractions. From the evaluation done, it was indicated that their memory ability is quite good but relating to previous literature studies, it was revealed that deaf has short term memory. With the aid of various techniques of visual teaching and learning, the hearing impaired could be taught how to dance in silence without the music. the text edit has

Acknowledgment

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