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Brain Training to Improve Sociability and Behavior of Autism Spectrum Disorder (ASD) Children and Young Adults

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Abstract

This article details on the use of brain training device, Neuro feedback Training (NFT) device to improve the sociability and behaviour of ASD children and young adults. A quasi-experimental study using pre-test and post-test within subject design was used. The research involved thirty-four participants, purposively selected from Kuching Autistic Association (KAA). The Autism Treatment Evaluation Checklist (ATEC) was used to measure the effectiveness of NFT on ASD children and young adults in KAA. The observation emphasized on sociability and behavioral changes among the participants. The findings showed an overall improvement in total ATEC score. Sociability and behaviors are among ASD children and young adults. There is a difference between ATEC post-test score in behavior with the age of participants

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1. Introduction

Neurofeedback (NFT) is a non-invasive approach shown to enhance neuroregulation and metabolic function in Autism Spectrum Disorder (ASD) and it is designed to train individuals to enhance poorly regulated brainwave patterns and subsequently implicates on behavioural change through the process of operant conditioning (Coben et. al, 2008, Norsiah &Muhammad Sophian, 2012. According to Thompson & Thompson (2009), NFT training is targeted to reduce autistic symptoms such as mirroring emotions, poor attention to the outside world, poor self-regulation skills, and anxiety. In NFT, the activity of brain can be observed by researcher while the ASD children doing the game task to trigger the brainwave. According to Coben et. al (2009), information on brainwave

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activity were fed to a computer that converts this information into game-like displays that can be auditory, visual, or both. According to Fernandez et. Al (2007), the EEG signal was obtained from a lead situated at the site with the most abnormal theta/alpha ratio, referred to linked earlobes. Individuals learn to inhibit brainwave frequencies that are excessively generated (produce negative symptoms); and augment or enhance specific frequencies that are deficient (produce positive results). In this research, the participants involved the children and young adults diagnosed as having autism spectrum disorders (ASD). The purpose of the study was to use the brain-training device (NFT) to improve sociability and behaviour of ASD children.

2.0 Significance of the Study

It is crucial that this research provides an alternative to get some improvement in autistic sociability and behavior using NFT to reinforce their attention. Moreover, this research can open up people's mind and awareness on the application of NFT on ASD children. It provide more sources for information and alternative solution to enhance ASD sociability and behavior using NFT.

3.0 Research Design

In this research, a case study using pre-test and post-test within subject quasi experimental was carried out with no control over the allocation of the treatments or other factors being studied. A group of 34 participants diagnosed as having symptoms of autism by medical doctor and psychologists were purposely selected from Kuching Autistic Association. The age of participant ranges between 3 to 20 years old (children and young adults). Informed consent were obtained from the parents and the Association to ensure the participants' confidentiality. The researchers and teachers on their social behavior and communication skills carried out a series of observation during their training sessions and interactions with their teachers and peers. This experiment was conducted within the duration of 6 months study. KAA's teacher trained by the expert in NFT gave the treatment. The participants received NFT for 36 training sessions of 30-minute durations in 6 months. Within that period, all the observation were analysed every week. The researcher observed any changes in sociability and behaviour of participants over time. Sociability change observed includes their ability to interact, greet, communicate, cooperate, and ability to control tantrums. Behavioural change refers to the participants' improvement in their ability to engage in a behaviour or cognitive rigidity, ability to pay attention and control emotions. Series of observation and interviews were conducted before and after the NFT to observe the participants' significant change in their behaviour and interactions. ATEC was used to collect data based on observation by parents, teachers and researcher. The changes were observed along with the changes in the EEG pattern of the child obtained as a result of the training. Interview and observations showed better social relationships and improved self-esteem of the participant after neurofeedback treatment.

During the training, sensors were placed on the scalp and connected to sensitive electronic device and computer software that detect and record specific neuronal activity. EEG responses to stimuli displayed on a computer screen were analysed in real time for frequency, amplitude and artifact characteristics. The computer provides feedback information in the form of visual displays showing how well the subject is performing. The resulting information was fed back to the trainee to indicate the trainee's brain activity is within the designated range. The sensorimotor rhythm (SMR) training protocol were used employed and placed on the frontal lobes to increase the EEG rhythm and training to inhibit (decrease) slow activity in the range from 4-8 Hz over the same area. Training focusing on attention was performed, aiming at increasing higher frequency beta activity in the range between 15 and 20 Hz. Training were performed twice a week (30 minutes per session) beginning september, 2010. The subjects in our case study took about 36 sessions (30-40 minutes each) for NFT to produce clinical changes in the brain wave patterns and behaviour.

4.0 Data Analysis

Autism treatment evaluation checklist (ATEC) was used to evaluate the improvement on sociability and behaviour of ASD individuals after undergoing NFT. It is a one-page form designed completed by parents, teachers,

or caretakers. It consists of 4 subtests: I. Speech/Language Communication (14 items); II. Sociability (20 items); III. Sensory/CognitiveAwareness (18 items); and IV. Health/Physical/Behavior (25 items).

ATEC scoring from the sociability and behavior checklist were then coded and entered into the Statistical Package for Social Sciences (SPSS) version 17.0 for analysis. All the data from ATEC were analyzed through the ATEC Internet Scoring. The score of total and every subscale weightage score were computed and displayed for the researchers and parents.. Information regarding the identity of each participant were kept confidential. ATEC scores range from zero to 180. The lower the score means the better. If a child scores zero or close to zero, that child can no longer be distinguished an autistic child in this aspect. Independent T-test was used to determine the differences of the post-test weightage score in sociability and behaviour among ASD children and young adults by demographical characteristics such as age and gender. The paired samples t-test was undertaken determine the differences between total score, weightage score in sociability and behaviour in pre-test and post-test. , ANOVA was used to measure differences between age and post-test weightage score in sociability and behaviour after NFT among ASD children and young adults.

5.0 Results

Treatment efficacy was analysed by calculating the difference between pre-test and post-test in total ATEC score, and score in sociability and behaviour. These differences in scores were tested for significance with Paired Sample T-test measures comparing changes in the experimental group in KAA. The findings suggested therapeutic changes from little to no changes in those participants.

5.1 Total Score for Pre-Test and Post-Test

Figure 1 shows the ATEC scores of pre- and post-test in KAA. This is a total score from both pre and post-test of the 4 subtests on ATEC form; speech/Language Communication (14 items), Sociability (20 items), Sensory/Cognitive Awareness (18 items) and Health/Physical/Behaviour (25 items). 2.94% (1) of participants did not show the differences of ATEC pre-test and post-test. 97.06% (33) showed the differences of ATEC pre-test and post-test. The percentage of improvement of all participants in KAA is shown in Figure 2. Five of them improved in overall score as much as more than 20%. 14 participants improved within the range of 10-20%. 14 of them improved in less than 10% and there was one participant who did not improve but no worsening behavioural problem was reported.

Figure 1: The differences of ATEC score in pre- and post-test graph

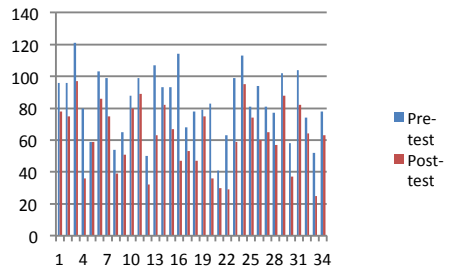
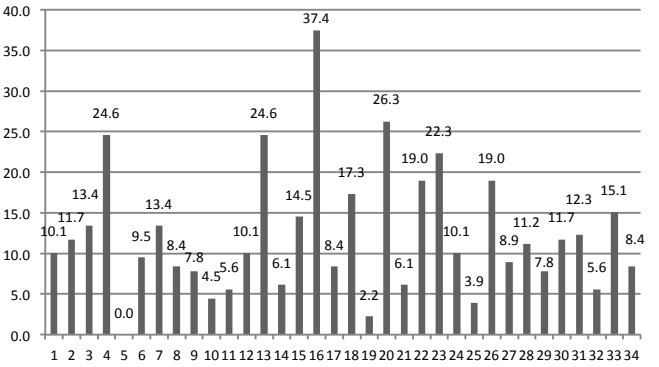


Figure 2: *The overall improvement for each participant*



5.3 Weightage Score Sociability Before and After

The graph (Figure 3) demonstrates the differences in ATEC weightage score in sociability for pre-test and post-test. Most participant (91.18%) showed the improvement in sociability scoring. Few participants did not improve, but no major problems or worsening case were reported from this data. Figure 4 shows 15 participants

(44.12%) improved more than 20 % in terms of social behaviour. Hence, 9 of them (26.47%) improved 10-20% and only 10 participants (29.41%) shows less than 10% improvement in social behavior. 3 participants did not show any improvement in social behaviour.

Figure 3: The differences in ATEC weightage score in

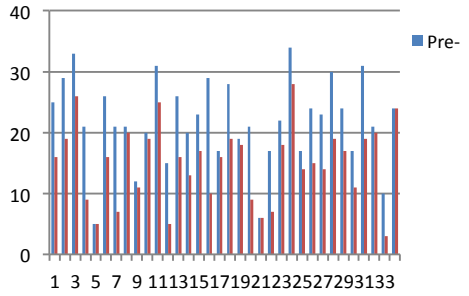
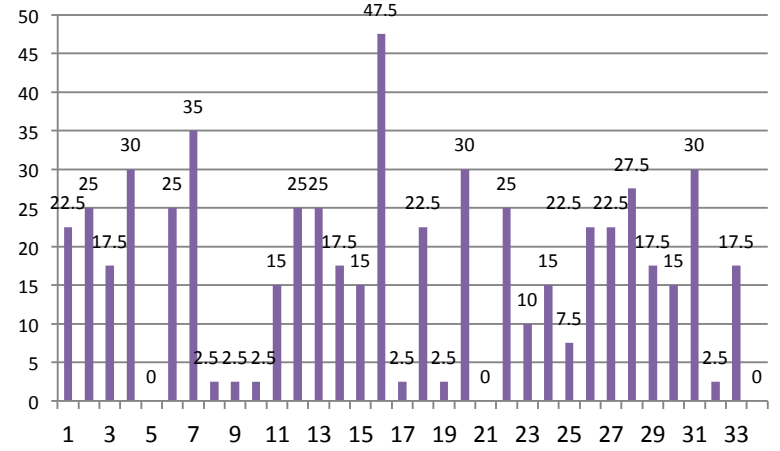


Figure.4: *participant's improvement in sociability* (%) sociability for pre and post-test graph



5.5 Weightage Score Behaviour Before And After

Figure 5 shows the weightage score in behaviour on pre- and post-test from ATEC.. Most participant (88.23%) showed the improvement in sociability scoring and few of them did not show any improvement as observed by the researcher. The graph in Figure 6 shows 2 participants (5.88%) improved 20% in their behavior. Hence, 9 of them (26.47%) improved 10-20% and 23 participants (67.65%) show less than 10% improvement in behavior. 4 of them (11.76%) did not show any improvement in behaviour

Figure 5: The differences in ATEC weightage
score in behaviour for pre- and post-test

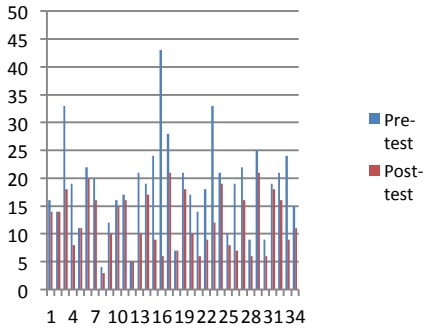
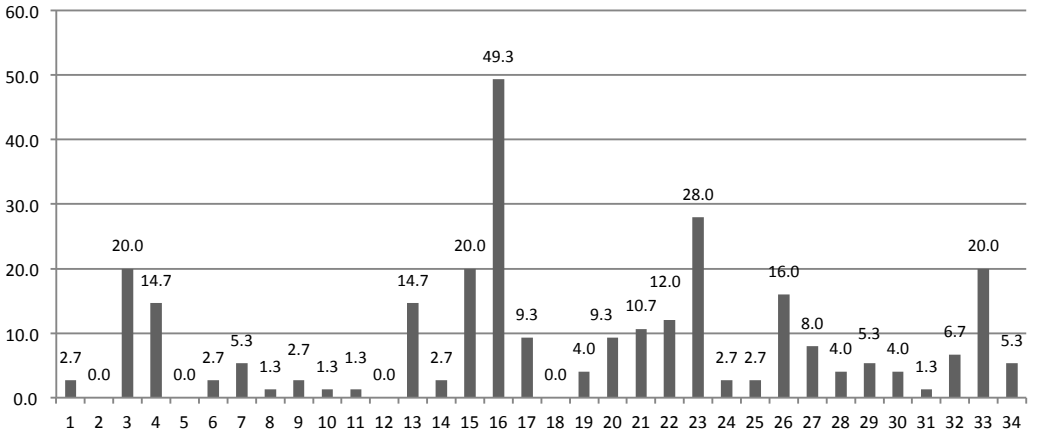


Figure 6: Participant's improvement in behaviour (%)



5.7 Paired Sample t-test (Sociability, Behavior and Total ATEC Score)

5.7.1 Sociability : Initial examination of the data indicated a difference in the weightage score of sociability of all 34 subjects before and after undergoing NFT. The mean score of pre-test and post-test was 21.82 and 15.029 respectively. One of the hypotheses in this study was whether there is no significant difference on ASD sociability after using NFT. The findings revealed a significant difference on ASD sociability after using NFT (t= 8.391; df= 33; p= .00; p< 0.05).

5.7.2 Behaviour : Initial examination of the data indicated a difference in the weightage score of behaviour of all 34 subjects before and after undergoing NFT. The data in Table 3 showed that the mean score pre-test and post-test was 18.47 and 12.15 respectively. This test show there is a significant difference on ASD behaviour after using NFT (t= 4.875; df= 33; p= .00; p< 0.05).

5.8 Total ATEC score

Initial examination of the data indicated a difference in the weightage score of behaviour of all 34 subjects before and after undergoing NFT. The data in Table 1 showed that the mean number of score pre-test and post-test was 83.58 and 61.62 respectively. There is significant difference on ASD behaviour after using NFT (t= 9.12; df= 33; p= .00; p< 0.05). ANOVA test shows no difference in sociability by age among participants at KAA (p= .287; p> 0.05). Thus, sociability does not have a relationship with the range of age of participants in KAA. In behaviour aspect, ANOVA test shows a difference by age among participants at KAA (p= .021; p< 0.05). There is a relationship between behaviour with the range of age of participants in KAA. There was a good progress of participants with ASD (n=34; 10 aged below 6 yrs; 12 aged 7-12 yrs; 6 aged 13-15 yrs; and 6 aged above 16 yrs after treated with NFT for 6 months. There was an improvement of more than 20% in social interaction in 30% of

participant aged below 6, 50% of participant aged 7-12, 50% of participant aged 13-15 and 50% of participant aged above 16. However, moderate improvements (within range of 10%-20%) were found in 70% of participant aged below 6, 16.67% of participant aged 7-12 and 33.33% of participant aged 13-15. Slight improvements (less than 10%) were found in 25% of participant aged 7-12, 16.67% of participant aged 13-15 and 16.67% of participant aged above 16. The remaining participants reported no improvement in social behavior, as indicated in 8.33% of participant aged 7-12 and 33.33% of participant aged above 16. Marked improvements (more than 20%) in behaviour were noted in 16.67% of participant aged below 6. However, moderate improvement (in range of 10%-20% improved) were found in 50% of participant aged below 6, 16.67% of participant aged 7-12 and 16.67% of participant aged above 16. Slight improvement in behaviour (less than 10%) were found in 50% of participant aged below 6, 50% of participant aged 7-12, 100% of participant aged 13-15 and 50% of participant aged above 16. The remaining reported as no improvement in behaviour in 16.67% of participant aged 7-12 and 33.33% of participant aged above 16. The results of this study indicates that NFT was effective in improving social and behaviour of ASD participants within the age of 7-12 while majority of the participant above 16 years old showed slower progress.

5.9 Independent t-test (sociability and behaviour)

Table 1: Independent t-test for sociability and behaviour by gender

	Gender	N	Mean	F	sig	Sig.(2 tailed)	df	t
Sociability	Male	30	14.6000	.55	.46	.28	32	-1.08
	Female	4	18.2500					
Behaviour	Male	30	11.5667	.26	.610	.0.9	32	-1.75
	Female	4	16.2500					

T-Test shows no differences in the score of sociability between the gender among ASD in KAA (F= .559; df= 32; p= .285; $p > 0.05$; t=-1.088) and no differences in the score of behaviour between the gender among ASD in KAA (F= .266; df= 32; p= .090; $p > 0.05$; t=-1.751). Thus, it was concluded that the sociability and behaviour of the participants does not have relationship with the type of gender of participants in KAA.

6.0 Discussion , Recommendations and Conclusion

Statistical analyses revealed significant improvement in ASD participants who received neurofeedback training in KAA. 97.06% of participants showed improvement in overall symptoms of ASD. Highly significant improvement were noted for the experimental group on sociability ($p < 0.05$), behaviour ($p < 0.05$) and total ATEC score pre- and post-test ($p < 0.05$). In the sociability category, 14.70 % of participants showed improvement in social behaviour. The changes are shown by those participants who are able to recognize the friend's name, faces, interest in their peers, smiles, happier and showed appropriate emotion toward teacher and the surroundings, more speeches and tend to imitate peers.

From the behaviour/health/physical aspect, teachers, parents and researchers reported improvement in sleeping pattern, reduced in aggressiveness and tantrum.. Factors that might contribute to the effectiveness of NFT include Bipolar training, number of training session, training at the pre-frontal regions and SMR training. Findings revealed that a group of participants who received bipolar training at the frontal, pre-frontal and parietal sites (e.g C3-Fz and C4-Fz) helps to train the functional connectivity between these sites. This training encourages the interhemispheric interaction of the brainwave and would reduce the hyper-connectivity and increase the connectivity.. Most participants trained between more than 20 sessions to 37 sessions improved in terms of social behaviour. All participants in KAA received training on the frontal lobes (FP1-FP2, F3.F4) to implicate on their emotions such as depression, motivation, and mood. Prefrontal training at FP1-FP2 has a very different effect – calming and organizing. SMR training can elicit a slightly downward shift in arousal, which affect the subjective feeling on ASD participants such as relaxation, emotional calm and centeredness (Othmer et. al,). The results are consistent with the previous research done by Coben and Padolsky (2007) which. Indicated that the major findings

included an 89% success rate with a 40% reduction in core ASD symptoms. To improve the efficacy of the NFT on social and behaviour of ASD children, consistency and the number of training sessions attended by each of the child is crucial. The duration of training depends on the severity and needs of each child as suggested by the brain trainer who designed the appropriate training protocol for each of the child.

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