INVESTIGATING THE EFFECTS OF NEUROFEEDBACK (NFT) ON GENDER DIFFERENCES AMONG INATTENTIVE STUDENTS IN MALAYSIA

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ABSTRACT

The aim of this study was to explore the responses in attention span, behaviour and emotions of inattentive students on gender differences to Neuro feedback Training (NFT).Children who suffer from inattentiveness have difficulties in learning. Six students participated in 22 sessions of NFT for six months. NFT scores were compiled after each training session to assess the attention span of the students. Pre- and post-training interviews with teachers and parents were held to assess the students' attention span, behaviour and emotions. The results indicated NFT could potentially be an efficacious treatment for inattentive students as most of them showed improvement. The changes observed are differed between boys and girls.

Keywords: Neuro feedback Training (NFT), inattentive, students, gender

INTRODUCTION

In 2013, the total enrolment of the students in public schools was 5,233,286 (Ministry of Education Malaysia, 2013). However, to date there are no statistics on Attention Deficit Hyperactivity Disorder (ADHD) in Malaysia. According to child and adolescent psychiatrist, Dr. Aili Hanim, the number of ADHD children in Malaysia is believed to be increasing annually and it could be as high as in the United States (Tan, 2009).

Issues in paying attention in the class are common in school children. Studies in Malaysia have shown that as high as 58.9% of the secondary school teachers say that the most common learning problem of students with learning disorder is inattentiveness behaviour (Teoh et al., 2008). In general, the short attention span and inattentiveness cause these students to underachieve academically.

There are limited studies examining inattentiveness with emotion, behaviour and attention span issue. However, there are studies have shown that inattentiveness is associated with ADHD, emotion and social function (Sroubek et al., 2013; Gjervan et al., 2014).Inattentive behaviour is considered a root and prominent feature of ADHD (Kofler et al., 2010) and ADHD children have the greatest attention problems (Mayes et al., 2000). Hence, inattentiveness is associated with ADHD.

Boys and girls learn differently. Compared to girls, boys generally have a higher level of physical activity because the amygdala in their brain which involves in emotional processing is larger. In other words, boys show more aggression than girls. Besides this display of aggression, aggressive children were found to be less able to learn and participate in learning activities (Margalit, 1989). In contrast, Gurian and his colleagues (2001) points out, "The female cerebellum has stronger connecting pathways, so the girls have superior language and fine motors skills". This suggests that females differ from males on many measures related to ADHD.

ISSN: 2307-3721, e ISSN: 2307-3713
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NFT provides information to individuals on brainwave activity through audio or visual by placing electrodes on the scalp (Hammond, 2011). The information provided on a computer screen will induce individuals to develop mental strategies to control their brain wave activity. Continuous training and feedback from NFT will change the brainwave, consequently enhancing individual performance (Hammond, 2011; Wang &Hsieh, 2013).

Many studies have indicated that NFT is able to improve behaviour, mood and attention span, and to reduce carelessness and impulsiveness (Vernon et al., 2004; Jacobs, 2006; Leins et al., 2007; Gevensleben et al., 2009). NFT leads to a significant improvement in attention, impulsivity and hyperactivity without any side effects. Additionally, there is a persistent amelioration of electroencephalogramme **(**EEG) parameters while drugs do not have the same outcome (Fuchs et al., 2003; Holtmann et al., 2004). However, some researchers have stated that currently NFT is not a well-established treatment for ADHD and do not recommend the use of NFT in a clinical setting based on the current empirical data (Loo & Barkley, 2005; Wills et al., 2011)

Notwithstanding the different results from various researchers, this study was designed to explore if NFT can be an effective alternative treatment for inattentive students and whether it has different effects on boys and girls. This is because there is limited research on the effects of NFT between genders.

METHODOLOGY

The research methodology comprised case study and triangulation approach. Case study is an exploratory form of inquiry that provides in-depth research (Steward, 2014). A triangulation approach uses different sources of information for data collection; multiple sources of evidence are rated higher quality than a single source of information (Yin, 2014). In this study, the data on attention span were gathered from the NFT report, the pre and post NFT interviews as well as researcher's observation. Information from all sources was integrated into the results.

Neurofeedback. "Play Attention" (PA) is a Neurofeedback device. In the NFT session, each student had to wear a headset or helmet before focusing on the object on a computer screen. The helmet would capture and record the brainwave activity when the student pay attention on the computer screen.

Semi-structure interview. Pre- and post-training interviews with teachers and parents were conducted to assess the students' attention span, behaviour and emotion. Semi-structured interviews were used for the study. Table 1 shows the semi-structured interview questions used in the study.

Table 1. Semi-structure questions used in the interview

Attention Span	*Behaviour*	*Emotion*
Does your student/child have attention span issue in class/at home?	Does your student/child have a behavioural issue in class/at home?	Does your student/child have an emotional issue in class/at home?
Is easily distracted.	Fidgets.	Is easily frustrated.
Does not follow verbal instructions.	Talks excessively.	Cries easily.

ISSN: 2307-3721, e ISSN: 2307-3713
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Forgetful/ Needs repeated instructions .	Attempts inappropriate behaviour.
Fails to remember short instructions.	Cannot interact positively with peers.
Is unable to work independently on seat work.	Did not returns homework assignments when due.
Unable to copy from blackboard/book with less error.	Impulsive and aggressive.

Have you noticed any other changes in this child which is not indicated above?

Participants. The class teacher had nominated a total of 13 inattentive students based on their attention span, behaviour and performance in class. Informed consent from the students' parents was obtained before the NFT started. For all nominated students, a trial session was conducted to determine their commitment level and basic verbal ability. Only six students were selected: three boys and three girls. All age 11 years old.

RESULTS

One of the boys withdrew after completing 22 sessions of NFT. As a result, the calculation of the average attention span was based on 22 completed sessions of six students.

For the first sessions, the attention span of the boys and girls were 85.5% and 86.3% respectively, which was only a difference of 0.8%. This means that at the beginning of the NFT, there was not much difference between their attention span. It indicated that the concentration of the boys and girls was about the same at the beginning of the NFT.

A significant difference of boys and girls could be observed in session 13. The boys achieved their highest attention during session 13whereas the girls scored their lowest attention percentage at the same session. The result indicated that the boys achieved their highest concentration percentage earlier (Session 13) but scored their lowest percentage at session 18. In contrast, the girls scored their lowest concentration at session 13 but achieved their highest attention span at Session 20. It shows that the girls need to achieve their highest attention span 7 more sessions than boys. At session 18, boys achieved their lowest attention span at 81.4 % whereas girls achieved their highest attention span of 88.3% at session 20.

It is important to be aware of the effects of gender differences on ADHD and how psychosocial treatments can be optimized to achieve effectiveness for both genders (Rucklidge, 2010). The findings show the attention spans of different genders differ at different stages. It was observed that the boys had greater attention span at the earlier sessions, the lack of motivation and decreasing attention span was unexpected at the later sessions.

The results of this NFT study indicated a small gender difference among children with inattentive issues. Most of the respondents became unmotivated after18 sessions of NFT but the girls were more determined to complete the sessions. The boys were more impatient and less persistent than the girls. The findings are consistent with the results of the study by Norsiah Fauzan and Muhammad Sophian Nazaruddin(2012) in which the respondent showed improvement in the ninth session of NFT, because "she looked happier, and more interactive

and sociable". However, in the 19 and 20 sessions, she looked tired and was less enthusiastic during training.

Before the NFT: Interview with school teachers and parents

The respondents were three boys, Ahmad, Kelvin and Leo and three girls, Cherry, Vivian and Basirah. All participants' names have been changed to protect the identities of the students.

All participants exhibited symptoms of poor attention span. However, some have additional issues which affected their daily life such as being easily distracted, needing instructions to be repeated, fidgeting, talking excessively and emotional problems.

Attention span

In the interviews, the six class teachers of the respondents perceived that the respondents were unable to focus in class. Each student had poor attention span and was easily distracted.

Ahmad's teacher:

> I know he can perform better. He is smart but lazy. He is unable to improve. He always loses attention when doing his homework….

Leo's teacher:

> Sometimes I doubt if he has a listening problem. Whenever I say something, he misses it. He always asks questions on things which I have just mentioned.

Leo's inattentiveness at school irritates his mother. Leo's mother:

> He is an inattentive boy (and is) easily frustrated. He is unable to pay attention at school and comes home with a lot of unfinished homework.

Kelvin is well behaved but has problems copying notes and passing his examinations. His teacher:

> He is playful in the class….He can't finish copying (from the blackboard)…. His handwriting is terrible and always fails in his exam.

According to Cherry's class teacher, she is timid, withdraws from group activity and is always in her own world. She seldom talks and does not participate in any class activities. In contrast to the feedback from the teacher, Cherry's mother has few complaints but she is aware that Cherry has attention problem, especially relating to school work.

Cherry's mother:

> Cherry is a good girl. She is willing to help with house chores. But she is lazy to do her homework and slow in doing her work. She daydreams a lot.

Another participant, Vivian, faces a different situation at home.

Vivian's mother:

> Vivian is a clever girl but she does not perform well in school. She says that she has no homework but later [I] receive complaints from her teachers that she has not done her homework….

The feedback from Vivian's mother on her daughter's underachievement in school shows that she believes Vivian did not finish her homework unintentionally due to her inattentiveness.

In contrast, Basirah's mother blamed her daughter for not putting enough effort in her homework. Basirah's mother:

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> Basirah is a lazy girl. She always needs to be reminded to do her homework. If I do not remind her, she will not do.

Vivian's teacher has commented that Vivian forgets to bring her books and homework to school. She has to be reminded often. She is the last to hand in whatever work that the teacher requires.

Leo has a similar problem. Besides forgetting to bring his homework and books to school, Leo also misplaces his belongings. Leo's mother is upset with him.

Leo's mother:

> In the two months after school began, he has lost three tumblers and two food containers.

Behaviour

According to Margalit (1989) aggressive students were found to be less able to learn because of the interpersonal difficulties. However, in another study found that children with inattentiveness were related uniquely to behavioural issues (Counts et al., 2005).

Basirah talks incessantly in the class. The class teacher:

> She loves to interrupt while I am teaching. She will ask questions which are not related to the topic.

It could be perceived from his expression and the tone of his voice that he was annoyed by Basirah's behaviour.

Basirah's mother agrees:

> Basirah is the most talkative child in the family.

Like Basirah, Leo loves to talk to his classmates. He will blurt out the answer before the teacher has finished her questions. At home, Leo behave the same.

Leo's mother:

> He loves to tell what happened in school every day after school and he is the last to finish his meals most of the time because he is too busy talking….

The behaviour of some of the children changes in different settings. The participants revealed various behavioural issues.

Kelvin exhibits a playful behaviour in class but at home he is aggressive. It is a great concern to his father.

Kelvin's father:

> Kelvin is a very active boy. He loves to play football… but I am worried about his aggression towards small animals….

At school, Ahmad's teacher punishing him for disturbing others in class. At home, his mother is stressed by his behaviour.

Ahmad's mother:

> He is lazy to do his homework. He is either playing or watching TV at home. When I ask him to study or do his homework, he says that he is too tired after a long day.

According to Leo's teacher, he has a problem admitting his mistakes when he is scolded for misbehaving in class.

His class teacher:

ISSN: 2307-3721, e ISSN: 2307-3713

> Whenever I find that he is misbehaving in class, I will scold him and hope that he learns from his mistake. But he is angry by my comments.

It is the same at home. Leo's mother is annoyed with his behaviour when he argues with her if she asks him to stop watching television or playing computer games.

Emotion

Students with attention problems may experience negative effects in more salient ways compared to others. Cognitive affects emotion is prominent in students with attention problems. Hence, students with attention problems likely to have emotional issues in school (Sideridis et al., 2009).

In contrast to the boys' behavioural problems, the girls show more emotional issues. Cherry's teacher comments that she does not participate in class activities. She ignores her teacher's instructions and does not get involved in any activity.

At school, the teacher complains that Basirah interrupts class lessons and bursts into tears easily. If things are not working out according to her wishes, she cannot hold back her tears. This happens frequently not only in school but also at home. Basirah's mother says she is a sensitive child who becomes emotional if her siblings annoy her. This is consistent with the perceptions of other researchers (Gershon, 2002; Sciutto et.al., 2004) that there are differences in gender with ADHD whereby boys typically exhibit higher levels of hyperactivity, behaviour problems and aggressiveness while girls tend to exhibit lower levels of disruptive behaviour but higher levels of inattentiveness and other social impairment.

Table 2. Summary of feedback from teachers and parents for participants before NFT

No	*Problem*	*Cherry*	*Vivian*	*Basirah*	*Ahmad*	*Kelvin*	*Leo*
1	Poor attention span in class/inattentiveness	√	√	√	√	√	√
2	Behavioural Issue (Talking excessively, disturbing others , disobedience, ignoring teacher's instruction, impulsive behaviour)	√	√	√	√	√	√
3	Emotional problems (Cries easily, sensitive)	√		√			

After the NFT: Interview with school teachers and parents

Attention span

The teacher notices that Kelvin's attention span in the class has improved and he completes the tasks given to him.

His teacher:

> He is more focused compared to last year, especially during the first half an hour of class. In the second half hour, [I] can see that he has lost his focus. Still, it is a great improvement compared to last year.

Kelvin's father has noticed that there is some improvement in his study and his writing. He is more confident now as he was selected to be a librarian recently.

ISSN: 2307-3721, e ISSN: 2307-3713

Before the NFT, Leo was easily distracted. After the NFT, the teacher found that he is more focused on his task. Leo's mother feels that his attention span has improved. Now, he is able to complete his homework by himself despite having the distraction of a television nearby. His mother is very impressed with this change.

His mother:

> Previously, if I forgot to switch off the TV, he can't complete his homework. Now, he can do his homework at the dinner table without peeping at the TV in the living hall.

Cherry's attentiveness has improved. Now, she is aware of what is happening in class and has more eye contact with the teacher. At home,her mother is happy with her progress as her homework has improved.

Vivian's mother is satisfied with the change in her.

Vivian's mother:

> The good thing here is that I have not received complaints from her teachers that she has forgotten to bring her books. I treat it as a good sign.

Similar results had been observed by Rossiter and La Vaque (1995) in their research on the participants of an electroencephalography (EEG) group who show significant improvements in attention, speed of information processing and consistency of attention after completing 20 treatment sessions.

It is important to point out that teachers also commented that three students (Leo, Cherry and Vivian) showed significant improvement in their copying skill. One possible explanation is that their speed of information processing has improved, helping them to copy at a faster speed.

In contrast, the teachers have not noticed any improvement in the attention span of Ahmad and Basirah.

Basirah's teacher:

> I can't see changes …I would say that she manages to focus for 15 minutes out of a 30-minute class.

Basirah's mother feels the same.

> She still needs close supervision. If I do not monitor her, she will stop doing her homework and live in a world of her own. Her attention span is short.

Ahmad's teacher is unhappy with his performance in class.

Ahmad's teacher:

> Ahmad is still not paying attention in class. He does not submit his homework on time.

Ahmad's mother says the same:

> …..the games (NFT) didn't help Ahmad at all. I can't see any improvement in him.

Leo has shown a slight improvement. He is aware of his impulsive talking. Leo teacher:

ISSN: 2307-3721, e ISSN: 2307-3713

> Sometimes, I see him talking to himself and reminding himself to think first before he talks.

Vivian has experienced a significant change. She remember to bring her books to school.

Vivian's teacher:

> I notice that she has managed to complete her homework, compared with [what had been] before the NFT.

Leo has shown improvement in doing his homework. His mother mentions that the frequency of losing things has gone down.

Leo's mother:

> At least during these few months, I have noticed that he remembers to bring his stuff home.

Behaviour

Kelvin is less playful and has become more matured after the NFT. Kelvin's father said his aggression has reduced: he no longer abuse animals. Leo has improved slightly in his behaviour. After NFT he is able to control his talkativeness. This finding is similar to the findings of Gevensleben et al. (2009) which indicate that respondents improved 25-30% in inattention and hyperactivity/impulsivity after the NFT.

The behavioural changes of Cherry were observed by her teacher. She has become more active in group work, communicative in class and shown more interest in her studies. She has become confident because she is able to voice her opinions and approach the teachers when she needs help.

Cherry's teacher:

> Her communication skills have improved, [and she has]more confidence now. [I] can see that she has made some progress. Overall, I am happy to see the progress in her within these six months.

After 20 sessions of NFT, her self-esteem rose and her newfound confidence helped her to succeed in school (Swingle, 2008).

Vivian's mother responded that she [Vivian] is more willing to do her homework now. This is also due to the improvement in her attentiveness, she remembers to bring her homework back.

Emotion

A few of Cherry's teachers have noticed Cherry has become more cheerful compared with her disposition the year before. She has more eye contact with her teachers and is more expressive now. The same finding was noted by Norsiah Fauzan and Muhammad Sophian Nazaruddin (2012) who reported their respondent looked happier and was more interactive after her ninth session of NFT.

Basirah's teacher did not see any emotional changes in her, and finds that she is still easily bursts into tears. However, her mother says that Basirah gets along well with her siblings.

ISSN: 2307-3721, e ISSN: 2307-3713

Table 3: Summary of feedback from teachers and parents on participants after NFT

Areas of Observation	*Female*			*Male*		
	Cherry	*Vivian*	*Basirah*	*Ahmad*	*Kelvin*	*Leo*
Attention span in class/attentiveness	Attentiveness improved, able to follow verbal instructions	More aware of what homework to do, remembers to bring books	More willing to follow instructions at home (does chores) but not much improvement in school	No improvement	Completes homework on time	More focused on doing homework, fewer missing belongings
Behavioural(Talking excessively, aggression, disturbing others , disobedience, ignoring teacher's instructions)	Improved eye-contact, follows teacher's instructions, participates in class activities	More willing to do her homework	More responsible at home, but still talks a lot in class.	No improvement	Playfulness & aggression reduced at home and in class	Less disobedient behaviour& controlled talkative behaviour
Emotional (Cries easily, sensitive)	More cheerful	No emotional issue	No emotional issue at home but sensitive in school.	No emotional issue	No emotional issue	No emotional issue

ISSN: 2307-3721, e ISSN: 2307-3713

Researchers' observation

NFT not only uses as a tool to train the participants but it also involves the researcher who has to communicate and motivate the participants during the training.

Besides the participants' willingness to improve, the support from teachers and parents is important. If anyone of these groups have little faith in the NFT, it is difficult for the participants to complete all the sessions or show any improvement. The parents' positive attitude toward NFT helped to improve some of the behavioural concomitants of inattentive children (Fuchet al., 2003). Motivation, expectations and parental support are important factors that can contribute to positive outcome of the NFT on children (Linchet al., 2010)

Beside parents' support, teachers' belief in NFT can influence the participants' response in NFT. Teacher's doubt about the efficacy of the NFT could be one limitation in the research (Williams, 2010).

From this research, it is noted that the boys showed interest during the initial sessions but became bored after the beginner's level. Compared to the girls, the boys were difficult to manage during the NFT sessions as they found that the games were not challenging enough. More and different games are needed to motivate the boys to continue. However, the girls were more persevering.

Although the boys might have attained the highest scores in attention span during the initial sessions, they were soon discouraged by the repetitive games and the girls managed to catch up in the later sessions.

This research is consistent with other research (Fuchs et al., 2003; Fox et al., 2005; Gevensleben et al., 2009; Sherlin et al., 2010; Williams, 2010), NFT is an efficacious treatment for ADHD and some of the researchers found that NFT has significant improvements on behavioural conduct too. The five participants showed some improvement in different areas and different degrees of changes although there were no positive effects on one participant. It can be concluded that improvements were observed in the majority of the participants and some differences in the attention span between the boys and the girls.

Boys were found to be significantly more impulsive than girls but there was no difference in inattention (Hasson and Fine, 2012). In this research, data showed that the boys were not only more impulsive but also more inpatient during the NFT sessions. The report on students' attention span showed that the girls have 1.7% higher of attention span than the boys.

CONCLUSIONS

The NFT is not a panacea for ADHD or any other disorder. It is a training procedure that requires cooperation on the part of the participants. A good rapport between the researcher and the participants is an important motivator to help the participants complete the sessions to obtain the desired changes.

However, the improvement shown by five participants suggests that NFT can be an alternative and complementary treatment for inattentive students. NFT also can help the inattentive child in academic improvement, social integration and overall life adjustment (Rossiter, 1995). In sum, girls shown higher attention span compare with boys after NFT.

ACKNOWLEDGEMENTS

This research was funded by the Sunway University Internal Research Grant Scheme, Malaysia.

ISSN: 2307-3721, e ISSN: 2307-3713

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ISSN: 2307-3721, e ISSN: 2307-3713