

## 6.1. Introduction

Data was collected using several different measuring instruments. In this chapter the information obtained from the data acquisition will be discussed.

- First there will be a comparison of measurements between the experimental group and the control group, before the experimental group experienced the re-training of the auditory system.
- A data comparison between the pre- and three months post- Berard AIT tests for every data acquisition instrument will be made. This was done first for the experimental group of learners. For the learners in the control group the pre-data were compared with the post-data acquired after three months (cf. 1.5), when no intervention was administered.
- The last comparisons of the measurements will be made are pre- and post Berard AIT intervention for the experimental group and pre- and post no-Berard AIT intervention for the control group.
- The data collected from one learner in the experimental group will be discussed in detail. The data from the ten learners, no 1 to 10, of the experimental group, will be presented in Annexure I.
- The same procedure will be followed with the information collected for the control group. The data collected from one learner in the control group will be discussed in detail. The data from the ten learners, no 11 to 19, of the control group, will be presented in Annexure J.

## 6.2. Statistical analysis

A repeated-measures two-way ANOVA (analysis of variance) analysis was done to compare:

1. The differences between the experimental and control groups, before the Berard AIT intervention of all data collection methods.
2. The differences of all data collection methods in the experimental group, before and after the Berard AIT intervention.
3. The differences of all the data collection methods in the control group before Berard AIT and three months later – with no intervention done.

4. The differences between the experimental group after Berard AIT, and the control group after three months since the pre-test, with no intervention done for all data collection methods.

Repeated-measures ANOVA tests the equality of means and is used when all members of a random sample are measured under different conditions. Pietersen and Maree (2008:229) affirm that ANOVA is appropriate if the quantitative variable is normally distributed in each population and the spread (variance) of the variable is the same in all populations. With small numbers as used in this study, it is difficult to prove normal distribution unequivocally. However, normal distribution plots suggested that the data approximated normality for most of the variables tested.

The graphs depicting the data are presented in Annexure M.

### **6.3. Data comparison**

It is important to determine the differences that existed between the experimental and control groups before any intervention was implemented, to ascertain whether either group may have responded to environmental influences, rather than to the AIT.

The first two traits reflect the results of the Listening Profile.

- The Copeland and ABC reflect the data obtained from the checklists.
- The IVA is the Integrated and Visual and Auditory continuous performance test.
- Primitive reflexes are represented as a group of reflexes.
- The QEEG is represented by the F3, F4, C3, Cz, C4, P3 and P4 symbols where the active electrode were palced in a refewrential montage (cf. Annexure F). These symbols represent specific points on the scalp which are internationally recognized as comparable measuring points (Kropotov, 2009:4).

### **6.4. Difference between the two groups prior to the intervention**

Even though the groups were roughly matched according to age, gender and the degree of attention difficulties, it was important to note whether statistical significant differences existed in any of the parameters of interest to this study. The p-values for differences between the control and the experimental group for the various parameters are tabulated in Table 6.1. The highlighted values show significant differences between the experimental group and control groups (p-values between 1 and 0.05 are seen as a 'trend' P-values under 0.05 is significant).

**Table 6.1. Comparison: Experimental and control groups prior to intervention**

<b>Measuring Instrument</b>	<b>Trait</b>	<b>p-value</b>
<b>Listening Profile</b>	125 _ L	ns
Left ear	250 _ L	ns
	500 _ L	0.024
	750 _ L	ns
	1000 _ L	ns
	1500 _ L	ns
	2000 _ L	ns
	3000 _ L	0.031
	4000 _ L	ns
Right ear	6000 _ L	ns
	8000 _ L	ns
	125 _ L	ns
	250 _ L	ns
	500 _ L	ns
	750 _ L	ns
	1000 _ L	ns
	1500 _ L	ns
Copeland	2000 _ L	ns
	3000 _ L	ns
	4000 _ L	ns
	6000 _ L	ns
	8000 _ L	0.034
	Inattention/Distractibility	0.018
	Impulsivity	ns
	Over activity/Hyperactivity	ns
Under activity	ns	
ABC	Non-compliance	ns
	Attention-seeking behaviour	ns
	Immaturity	ns
	Poor achievement	ns
	Emotional difficulties	ns
	Poor peer relations	ns
	Family interaction problems	ns
	Irritability	ns
IVA	Lethargy	ns
	Stereotypy	ns
	Hyperactivity	ns
	Inappropriate speech	ns
IVA	Response Control Quotient	ns
	Auditory	ns
	Visual	ns
	Attention Quotient	ns
	Auditory	ns
	Visual	ns
	Sustained Auditory Attention	ns

**Table 6.1. – continue**

<b>Measuring Instrument</b>	<b>Trait</b>	<b>p-value</b>
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	Palmar – L	ns
<b>Primitive Reflex Testing</b>	Palmar – R	ns
	Babinski – L	ns
	Babinski	ns
	Babinski	ns
	Plantar	ns
	Plantar	ns
	Rooting	ns
	Sucking	ns
	ATNR – lying down	ns
	Tonic Labyrinthine reflex	ns
	ATNR – standing up	ns
	Spinal Galant – L	ns
	Spinal Galant – R	ns
	STNR – lift head	ns
	STNR – look down	ns
	STNR – crawl	ns
	Fear paralysis – walk	ns
	Fear paralysis – child walk	ns
	Fear paralysis – push/wave	ns
	Moro – fixation	ns
	Moro – cover	ns
	Moro - fall	ns
<b>QEEG</b>	Theta – F3	0.048
	Alpha – F3	0.028
	Low beta –F3	0.033
	Beta – F3	0.018
	Beta 3 – F3	0.008
	Theta – F4	ns
	Alpha – F4	ns
	Low beta – F4	ns
	Beta – F4	ns
	Beta 3 – F4	ns
	Theta – C3	0.012
	Alpha – C3	0.037
	Low beta – C3	0.030
	Beta – Ce	0.018
	Beta 3 – C3	ns
	Theta – C4	ns
	Alpha – C4	ns
	Low beta – C4	ns
	Beta – C4	ns
	Beta 3 – C4	ns
	Theta – Cz	0.022
	Alpha – Cz	0.045
	Low beta -Cz	ns
	Beta – Cz	ns
	Beta 3 – Cz	ns
	Theta-beta ratio – Cz	ns
	Theta – P3	ns
	Alpha – P3	0.000
	Low beta – P3	ns
	Beta – P3	0.026
	Beta 3 – P3	ns
	Theta – P4	0.028
	Alpha – P4	0.010
	Low beta – P4	ns
	Beta – P4	ns
	Beta 3 – P4	ns

**ns= not significant**

The measuring instruments which showed greatest variability between the control and experimental groups at the start of the experiment were the Listening profile and

QEEG, while a single trait (Inattention/distractibility) on the Copeland questionnaire also showed statistical significant difference between these two groups (Table 6.1).

**6.5. The differences in the experimental group before and after the Berard AIT intervention.**

**Table 6.2.**

<b>Measuring Instrument</b>	<b>Trait</b>	<b>p-value</b>
<b>Listening Profile</b>	125 _ L	ns
Left ear	250 _ L	ns
	500 _ L	ns
	750 _ L	ns
	1000 _ L	ns
	1500 _ L	ns
	2000 _ L	ns
	3000 _ L	ns
	4000 _ L	ns
	6000 _ L	ns
	8000 _ L	ns
Right ear	125 _ L	ns
	250 _ L	0.043
	500 _ L	ns
	750 _ L	0.019
	1000 _ L	ns
	1500 _ L	ns
	2000 _ L	ns
	3000 _ L	ns
	4000 _ L	ns
	6000 _ L	ns
	8000 _ L	s
<b>Copeland</b>	Inattention/Distractibility	0.025
	Impulsivity	ns
	Over activity/Hyperactivity	0.000
	Under activity	0.030
	Non-compliance	ns
	Attention-seeking behaviour	ns
	Immaturity	ns
	Poor achievement	ns
	Emotional difficulties	ns
	Poor peer relations	ns
	Family interaction problems	ns
<b>ABC</b>	Irritability	0.042
	Lethargy	ns
	Stereotypy	ns
	Hyperactivity	0.001
	Inappropriate speech	0.013

Table 6.2. continue

<b>Measuring Instrument</b>	<b>Trait</b>	<b>p-value</b>
<b>IVA</b>	Response Control Quotient	0.009

	Auditory	0.024
	Visual	ns
	Attention Quotient	0.029
	Auditory	ns
	Visual	0.003
	Sustained Auditory Attention	ns
	Palmar – L	0.002
<b>Primitive Reflex Testing</b>	Palmar – R	ns
	Babinski – L	ns
	Babinski	ns
	Babinski	ns
	Plantar	ns
	Plantar	ns
	Rooting	ns
	Sucking	ns
	ATNR – lying down	ns
	Tonic Labyrinthine reflex	ns
	ATNR – standing up	ns
	Spinal Galant – L	ns
	Spinal Galant – R	ns
	STNR – lift head	0.013
	STNR – look down	ns
	STNR – crawl	ns
	Fear paralysis – walk	ns
	Fear paralysis – child walk	ns
	Fear paralysis – push/wave	ns
	Moro – fixation	ns
	Moro – cover	ns
	Moro - fall	ns
<b>QEEG</b>	Theta – F3	ns
	Alpha – F3	ns
	Low beta –F3	ns
	Beta – F3	ns
	Beta 3 – F3	ns
	Theta – F4	ns
	Alpha – F4	ns
	Low beta – F4	ns
	Beta – F4	ns
	Beta 3 – F4	ns
	Theta – C3	ns
	Alpha – C3	ns
	Low beta – C3	ns
	Beta – C3	0.049
	Beta 3 – C3	ns
	Theta – C4	ns
	Alpha – C4	ns
	Low beta – C4	ns
	Beta – C4	ns
	Beta 3 – C4	ns
	Theta – Cz	ns
	Alpha – Cz	ns
	Low beta -Cz	ns
	Beta – Cz	ns
	Beta 3 – Cz	ns
	Theta-beta ratio – Cz	ns
	Theta – P3	ns
	Alpha – P3	ns
	Low beta – P3	ns
	Beta – P3	ns
	Beta 3 – P3	ns
	Theta – P4	ns
	Alpha – P4	ns
	Low beta – P4	ns
	Beta – P4	ns
	Beta 3 – P4	ns

**ns – non-significant**

The measuring instruments which showed the greatest percentage of traits that differed significantly by 3 months after AIT were the Copeland as well as the ABC

questionnaires, as well as the IVA (Table 6.2). Only the right ear's Listening profile changed statistical significantly at two frequencies in the experimental group, while only single traits in the QEEG and Primitive Reflexes changed statistical significantly. Again, these measuring instruments reflect traits that are highly variable between individuals, regardless of their attentional abilities, and thus 1 analysis of these traits for each individual should be more informative. It is of interest, though, that the right ear receives more stimulation, as the sound is increased for the right ear, but decreased for the left ear, during the second week of AIT, in order to improve stimulation of the language centres in the left hemisphere of the brain.

**6.6. The differences between the control group before Berard AIT and three months later where no intervention was done.**

**Table 6.3.**

<u>Measuring Instrument</u>	<u>Trait</u>	<u>p-value</u>
<b>Listening Profile</b>	125 _ L	ns
Left ear	250 _ L	0.031
	500 _ L	ns
	750 _ L	ns
	1000 _ L	0.031
	1500 _ L	ns
	2000 _ L	ns
	3000 _ L	ns
	4000 _ L	ns
	6000 _ L	ns
	8000 _ L	ns
Right ear	125 _ L	ns
	250 _ L	ns
	500 _ L	ns
	750 _ L	ns
	1000 _ L	ns
	1500 _ L	ns
	2000 _ L	ns
	3000 _ L	ns
	4000 _ L	ns
	6000 _ L	ns
8000 _ L	ns	
<b>Copeland</b>	Inattention/Distractibility	ns
	Impulsivity	ns
	Over activity/Hyperactivity	ns

**Table 6.3. continue**

	Under activity	ns
	Non-compliance	ns
	Attention-seeking behaviour	ns

	Immaturity	ns
	Poor achievement	ns
	Emotional difficulties	ns
	Poor peer relations	ns
	Family interaction problems	ns
<b>ABC</b>	Irritability	ns
	Lethargy	ns
	Stereotypy	ns
	Hyperactivity	ns
	Inappropriate speech	ns
<b>IVA</b>	Response Control Quotient	ns
	Auditory	ns
	Visual	ns
	Attention Quotient	ns
	Auditory	ns
	Visual	ns
	Sustained Auditory Attention	ns
	Palmar – L	0.002
<b>Primitive Reflex Testing</b>	Palmar – R	0.010
	Babinski – L	0.019
	Babinski	0.006
	Babinski	ns
	Plantar	0.048
	Plantar	ns
	Rooting	ns
	Sucking	0.008
	ATNR – lying down	ns
	Tonic Labyrinthine reflex	ns
	ATNR – standing up	ns
	Spinal Galant – L	ns
	Spinal Galant – R	ns
	STNR – lift head	ns
	STNR – look down	ns
	STNR – crawl	ns
	Fear paralysis – walk	ns
	Fear paralysis – child walk	ns
	Fear paralysis – push/wave	ns
	Moro – fixation	ns
	Moro – cover	ns
	Moro - fall	ns
<b>QEEG</b>	Theta – F3	0.025
	Alpha – F3	ns
	Low beta –F3	ns
	Beta – F3	ns
	Beta 3 – F3	0.049
	Theta – F4	ns
	Alpha – F4	ns
	Low beta – F4	ns
	Beta – F4	ns
	Beta 3 – F4	ns
	Theta – C3	ns
	Alpha – C3	0.032
	Low beta – C3	ns
	Beta – C3	ns
	Beta 3 – C3	ns
	Theta – C4	ns
	Alpha – C4	0.045
	Low beta – C4	ns
	Beta – C4	ns
	Beta 3 – C4	ns
	Theta – Cz	ns
	Alpha – Cz	ns
	Low beta -Cz	ns
	Beta – Cz	ns
	Beta 3 – Cz	ns
	Theta-beta ratio – Cz	ns
	Theta – P3	ns
	Alpha – P3	0.030
	Low beta – P3	ns
	Beta – P3	ns
	Beta 3 – P3	ns

	Theta – P4	ns
	Alpha – P4	ns
	Low beta – P4	ns
	Beta – P4	ns
	Beta 3 – P4	ns

**ns – non-significant**

In the control group, after three months, none of the questionnaires, nor the IVA, showed any significant change, but significant positive changes (cf. 6.7) were noted in a number of parameters of the Primitive Reflex status and the QEEG measuring instruments. This group also showed statistical significant changes in two frequencies of the Listening Profile of the left ear. After Berard AIT there are a marked improvement in listening ability.

### **6.7. Nature of the change in the control and experimental groups.**

In order to better understand the nature of the changes tabulated above, as well as to further understand how the control and experimental groups differed from each other with respect to changes in the measuring instrument parameters (i.e. did both groups show improvement after the 3 month period, or not, or did one group improve while the other did not?), the mean values of the different traits in the various measurements are shown in graph format per-AIT as well as 3 months later (post-AIT for the experimental group). This is relevant to interpreting whether change over time is due to the AIT intervention, or may be ascribed to other, possibly environmental, influences.

The data is presented in Annexure N. Throughout, circles denote the mean, while error bars indicate the 95% confidence intervals. Experimental group data are shown in blue and control group data are shown in red. P-values indicate the significance of a statistical “time\*group interaction”: in other words, whether changes in the control group and changes in the experimental group were significantly different.

**Figure 6.1. Changes over three months in the parameters of the Listening Profile of the left ear of both groups (Annexure N, p.2).**

The changes indicate that the mean lowest level at which individuals in the control group could perceive sounds at all but one of the elevated frequencies (6000Hz), increased (i.e. hearing “worsened”). In contrast, the lowest level at which individuals in the experimental group could perceive sound in the left ear decreased, i.e. hearing improved, at all but 6000Hz and 8000Hz. At 6000Hz, the mean listening threshold for the experimental group remained static, while at 8000Hz the mean increased slightly. As the latter frequency was the only frequency where some individuals demonstrated auditory sensitivity (a listening threshold <0dB), this increase indicates a decrease in auditory sensitivity and is therefore in fact a positive sign of improvement in listening skill. The behaviour of the two groups reached significant difference for 250 and 1000Hz.

**Figure 6.2. Changes over three months in the parameters of the Listening Profile, of the right ear of both two groups (Annexure N, p.3).**

The changes indicate that the mean lowest level at which individuals in the control group could perceive sounds remained static (125, 250, 750Hz), or increased, i.e. hearing “worsened” (500, 1000, 15000, 2000, 3000, 4000Hz) or decreased (6000, 8000Hz). In contrast, the lowest level at which individuals in the experimental group could perceive sound in the right ear decreased, i.e. hearing improved, at all but 3000Hz and 8000Hz (where it increased), and remained static at 4000Hz. At 6000Hz, the mean listening threshold for the experimental group remained static, while at 8000Hz the mean increased slightly. However, there was no indication of a time\*group interaction, i.e. the change of the two groups over time did not reach statistical significance.

**Figure 6.3. Changes over three months in the parameters of the Copeland questionnaire, between the experimental and control groups (Annexure N, p.4).**

The parameters measured by the Copeland questionnaire shows that the control group remained essentially unchanged over 3 months. However, the mean of the experimental group for the different parameters decreased (i.e. the child improved) to a greater or lesser extent on all the scales. The difference in the way that the two groups changed over time was statistical significant ( $p=0.06$ ) for the

overactivity/hyperactivity scale, while a trend towards significance ( $p=0.067$ ) was noted for the inattention/distractibility scale.

**Figure 6.4. Changes over three months in the parameters of the ABC questionnaire between experimental and control groups (Annexure N, p. 5).**

With regard to the parameters of the ABC questionnaire, the control group either changed very little, or the mean increased, i.e. behaviour worsened (see Stereotypy). In contrast, the experimental group showed decreases in the mean value for all the parameters of this instrument; viz. the experimental group's behaviour improved in all aspects. The way that the two groups changed over time reached statistical significance for Hyperactivity ( $p=0.016$ ) and Stereotypy ( $p=0.015$ ), while a trend was noted for Irritability ( $p=0.084$ ).

**Figure 6.5. Changes over three months in the parameters of the IVA questionnaire between experimental and control groups (Annexure N, p.5).**

On the IVA parameters, both groups showed some measure of improvement (i.e. increase in scores), but, as indicated by the steeper slope of all of the experimental group curves in the graphs of Figure 6.5, the experimental group showed greater gains 3 months post-AIT than did the control group. However, the manner of change over time was not significantly different for the two groups, although a trend towards statistical significance was noted for the Response Control Quotient ( $p=0.076$ ), the visual aspect of the Auditory Quotient ( $p=0.082$ ), and the Sustained Visual Attention Quotient ( $p=0.053$ ).

**Figure 6.6 Changes over 3 months in primitive reflex integration status between the experimental and control groups (Annexure N, p.6).**

With the Primitive Reflexes (Figure 6.6), the control group showed a higher mean score (thus indicating poorer integration of the reflexes) for all but the STNR-look down test (which remained essentially unchanged). In contrast, the experimental group showed a decrease (thus improved reflex integration) in scores for all but the Plantar-Left and -Right, Babinski-Left, Spinal Galant-left and -Right and Moro-cover

tests, which mostly showed minimal change. The manner of change over time was statistical significantly for the Palmar-left ( $p=0.006$ ), Palmar-Right ( $p=0.005$ ), Sucking ( $p=0.007$ ) tests, statistical significantly for the Babinski-Right ( $p=0.0113$ ) and ATNR-Lying down ( $p=0.028$ ) tests, and showed a trend towards statistical significance between the two groups for the Tonic Labyrinthine Reflex ( $p=0.063$ ) and the STNR – lift head ( $p=0.066$ ) tests.

**Figure 6.7 Changes over 3 months in QEEG parameters between the experimental and control groups (Annexure N, p.8).**

With the QEEG traits, both the control and the experimental groups showed both increases and decreases in the various frequency bands, and the mean of only few brainwaves remained essentially unchanged (Figure 6.7). However, the way in which the control and experimental groups changed reached statistical significance for Beta 3 in F3 ( $p=0.015$ ) and F4 ( $p=0.014$ ) as well as Alpha at P3 ( $p=0.031$ ). Trends towards statistical significance was also seen for Alpha at C3 ( $p=0,081$ ) and Beta 3 at P3 ( $p=0,086$ ). The changes in Beta 3 and F3 and F4 as well as Alpha and Beta 3 at P3 entailed a mean decrease in these brainwaves in the control group, but a mean increase in these waves in the experimental group; conversely, mean Alpha levels increased in the control group at C3, but decreased slightly for the experimental group.

## **6.8. Comparison between pre- and post intervention data for individuals**

Below, the tests that were used will be introduced by using one learner out of each group as an example. The results varied quite extensively between the individuals, and therefore the results for each individual will be tabuled.

### **Data comparison amongst the learners of the experimental group:**

#### **6.8.1 Listening profile (Graph 6.1a; 6.1b; Table 4)**

### 6.8.1.1. Changes in listening acuity.

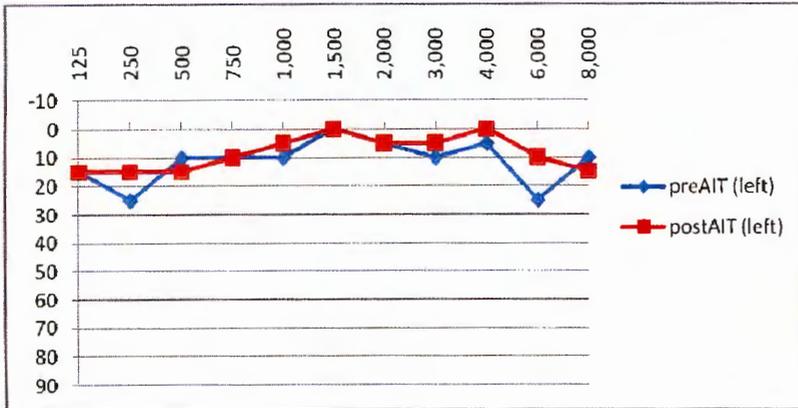
#### Learner no 1 – JG

Learner 1 was an eleven year old boy with quite severe attention difficulties. As a result he got into trouble quite often and developed a poor self-image. He was quite depressed and experienced school as a daunting place.

#### Left ear – pre- and post AIT.

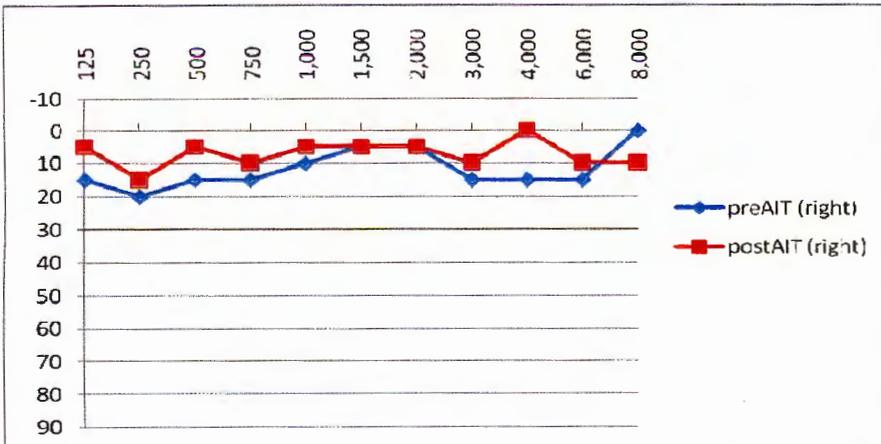
In the graphs below, the horizontal axis represents the different frequencies – Hz and the vertical axis represents the sound volume –dB. Zero dB represents perfect listening skills. Hypersensitive hearing is present when hearing acuity is in the <0dB thresholds. Normal hearing is considered to be between 10 and 20dB. The blue line indicates hearing acuity before the intervention and the blue line after Berard AIT.

**Graph 6.1a.**



#### Learner no 1 – right ear

**Graph 6.1b.**



Post AIT, the graph of the listening profile of both ears evened out and showed less variability. There is less difference between hearing different frequencies at different decibels.

### 6.8.1.3. Experimental group: Learners 1 – 10

**Table 6.4.**The results of all the Listening Profiles with their means and standard deviation are depicted below.

Learner		Left ear		Right ear		Hypersensitive		points
		Pre	Post	Pre	Post	Pre	Post	
1	Mean	11.4	8.6	11.8	7.3	0	0	
	Std dev	7.8	6.0	4.8	4.2			
2	Mean	11.8	10.5	13.2	12.7	0	0	
	Std dev	6.4	6.9	8.3	4.7			
3	Mean	10.9	11.8	15.0	14.5	1	0	
	Std dev	6.6	6.4	4.6	5.0			
4	Mean	5.5	10.9	13.6	10.0	2	0	
	Std dev	8.5	5.8	10.3	4.4			
5	Mean	17.3	6.8	20.5	7.3	0	0	
	Std dev	7.9	4.0	9.1	7.1			
6	Mean	14.1	7.3	8.2	9.1	2	0	
	Std dev	10.4	4.7	8.8	4.7			
7	Mean	7.3	10.5	9.5	9.5	2	0	
	Std dev	9.8	3.5	6.4	4.7			
8	Mean	16.8	8.6	14.1	15.9	0	0	
	Std dev	5.1	7.4	8.5	8.2			
9	Mean	17.3	11.8	14.1	12.7	1	0	
	Std dev	10.8	5.1	7.7	6.7			
10	Mean	-2.3	6.4	4.5	8.6	4	0	
	Std dev	4.1	2.3	9.6	3.4			

For learners 1,2,3,5,6,8,9&10 the standard deviation dropped after the AIT intervention. For learners 4 & 7 the standard deviation dropped in one ear. The listening graph of the listening profile evened out for all the learners. This means that they will be able to process sounds with greater ease.

Learners 3,4,6,7,9,&10 in the experimental group had hypersensitive hearing when tested before they did Berard AIT. Three months after the intervention no hypersensitivity was measured.

Overall, these findings are consistent with Berard's assertions that hearing acuity will improve slightly and auditory peaks will decrease as a result of AIT. Basically, a decrease in variability from the first to the last listening profile was compared to

improvement as assessed by the ABC and the Copeland checklists, as shown in the following sections. A reduction in variability in the listening profile tended to be associated with improvement on behaviour measures. This is consistent with the idea that Berard AIT “smooths out” listening and improves attention and behaviour (Berard, 1993:18). Edelson also found that learners were able to shift attention with ease after Berard AIT (SAIT, 2001:1).

## 6.8.2. Behavioural changes

### 6.8.2.1. Behavioural changes reported by parents.

Parents were asked to complete checklists verifying their children’s behaviour. For both checklists a comparison between the pre- and post checklists revealed statistically significant decreases in problem behaviour and an increase in controlled attention.

### 6.8.2.2. Aberrant Behaviour Checklist (ABC) (Table 6.5a, 6.5b and Bar chart 6.1)

A dramatic reduction in behavioural problems was observed at 3 months post-AIT, as indicated by decreased scores on the Aberrant Behaviour Checklist, a well-validated questionnaire covering 58 behavioural problems, grouped under 5 main headings. (Aman, Singh, Stewart & Field, 1985b). These findings supported Berard’s statement that improvement as a result of AIT may take up to 3 months to mature (Berard, 1993:91). Edelson found that Berard AIT produced a calming effect which will improve behaviour (SAIT 2000:6).

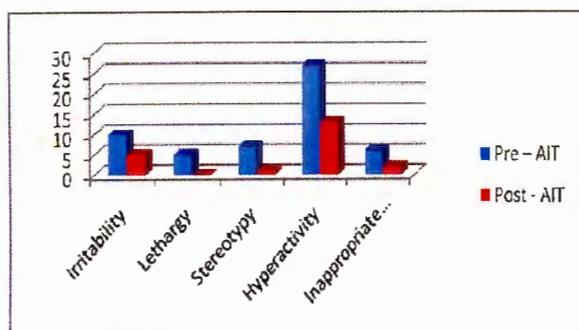
An example of the behavioural and attention traits on the checklist is shown below.

#### Learner no.1

**Table 6.5a. Results of checklist ABC**

ABC	Pre-AIT	Post-AIT	Pos. changes
Irritability	10	5	+
Lethargy	5	0	+
Stereopathy	7	1	+
Hyperactivity	27	13	+
Inappropriate speech	6	2	+

**Bar chart 6.1. ABC Learner no.1**



There was a statistical significant reduction in all the measured traits, with the greatest reduction in points in the hyperactivity scale. Of note, Learner 1 was experienced as calmer and happier by his mother.

The graphic representation of the data of the ten learners in the experimental group are included in Annexure I.

### 6.8.2.2.1 Learners 1 – 10

In the table below, the number of learners with positive improvements in traits measured by the ABC are shown as “+”, while those who did not improve are left unmarked. Negative changes are indicated with“-“.

**Table 6.5b. ABC improvements seen in experimental group 3 months after intervention**

Traits	Learners										Change
	1	2	3	4	5	6	7	8	9	10	
Irritability	+		+	-	-		+	+	-	+	5
Lethargy	+	-	+	+	+	+		+	-	+	7
Stereotypy	+		+	+				+		+	5
Hyperactivity	+	+	+	+	+	+	-	+	+	+	9
Inappropriate speech	+	+		+		+	+	+		+	7

Total positive changes: 33    Negative changes: 6

Nine out of the 10 learners in the experimental group showed improvement in the hyperactivity parameter. Three learners (1, 8 and 10), showed a reduction in all the measured traits, while two learners (3 and 4) experienced a decrease in acting out behaviour in four of the five measured traits. None of the learners failed to show at least some improvement in this measuring parameter.

### 6.8.2.3. Copeland Symptom Checklist for Attention Deficit Disorders

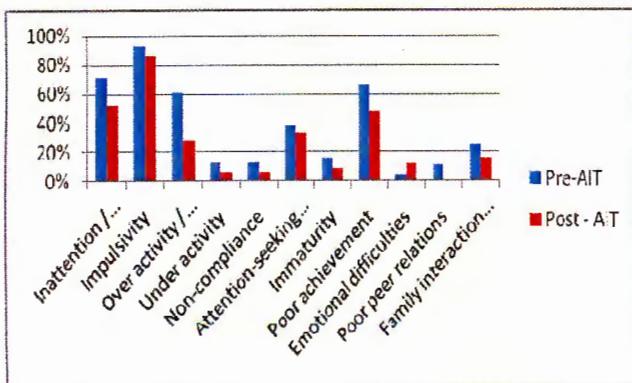
(Table 6.6a, 6.6b, and Bar chart 6.2).

**Table 6.6a. Changes recorded for Learner no. 1 – JG, pre-and post AIT**

Copeland	Pre-AIT	Post - AIT	Pos. changes
Inattention / Distractibility	71%	52%	+
Impulsivity	93%	86%	+
Over activity / Hyperactivity	61%	27%	+
Under activity	13%	6%	+
Non-compliance	13%	6%	+
Attention-seeking behaviour	38%	33%	+
Immaturity	16%	8%	+
Poor achievement	66%	48%	+
Emotional difficulties	4%	12%	-
Poor peer relations	11%	0%	+
Family interaction problems	25%	16%	+

As can be seen in Table 6.7a and Graph 6.2, there was a reduction in all the behaviour traits of the Copeland in Learner 1, except for the emotional difficulties. This might have been because the learner could now open up and show his emotions, as he felt more in control of himself. As he is calmer he will be able to pay sustained attention.

**Bar chart 6.2. Copeland learner no.1**



This bar chart displays the results in a more visual way. Although there had been a reduction in symptoms, the symptoms were still present and definitely interfering with the learner's optimal performance. He will thus still have problems with paying attention and this will have to be addressed by maybe repeating AIT after 6 months.

The data of the ten learners in the experimental group are included in Annexure I.

### 6.8.2.3.1 Summary of the experimental group’s results in the Copeland questionnaire.

In table 6.6b, the number of learners with positive improvements in traits measured by the Copeland are shown as “+”, while those who did not improve are left unmarked. Negative changes are indicated with”-“.

**Table 6.6b. Improvements seen in Copeland questionnaire**

Traits	Learners										Pos. Changes
	1	2	3	4	5	6	7	8	9	10	
Inattention/ distractibility	+	+		+	+	+	-		-	+	6
Impulsivity	+	+	+	+	+	+	-	+	-	+	8
Overactivity/Hyperactivity	+	+	+	+	+	+	+	+	+	+	10
Underactivity	+	+	-	+	+	+	-	+	-	+	7
Non-compliance	+	-	+	+				+		+	5
Attention-seeking behaviour	+		+		+	+	-		+	+	6
Immaturity	+	+	+	+				+	-	+	6
Poor achievement	+	-		+	+	+	-	+	-	+	6
Emotional difficulties	-	-	+	+	+		-	+	-	+	5
Poor peer relations	+	+		+	-	+	-	+	-	+	6
Family interaction problems	+	+	+	+	+			+		-	6

Total positive changes: 71 Negative changes: 21

The Copeland checklist measured 11 behavioural and attention problems. As can be seen from the table above, there was an overall reduction in problems listed. Again, no learners failed to show at least some improvement in the parameters measured by this checklist. As with the ABC, all learners showed improvements in the hyperactivity parameter, while 8 of the 10 learners showed improvement in impulsivity.

Thus three months after the intervention, the data on the checklist indicated a marked decrease in behavioural problems, a lessening of signs of hyperactive behaviour and a reduction in attention difficulties in learners. This correlates with the tune in/tune out theory of Bill Clark (SAIT, 2000:3). After the intervention the learners has more control over staying “tune in” when they want to pay attention.

### 6.8.3. Physiological symptoms

#### Primitive Reflexes (Table 6.7a, 6.7b, and Bar chart 6.3)

Twenty three different primitive reflexes were tested before and three months after the Berard AIT intervention.

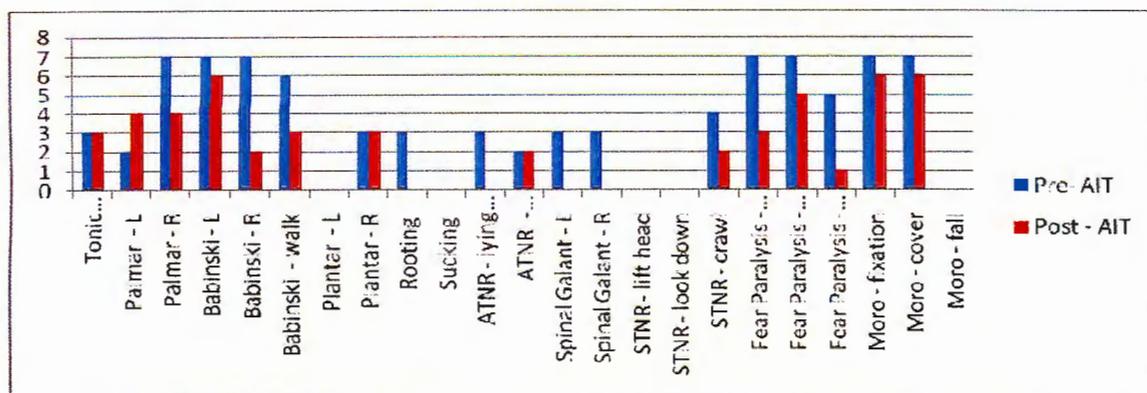
The inhibition of the primitive reflexes was quite impressive for learner no. 1 - JG.

#### 6.8.3.1. Learner 1 - JG

Table 6.7a.

Primitive reflexes	Pre- AIT	Post - AIT	Pos. changes
Tonic Labyrinthine Reflex	3	3	
Palmar - L	2	4	
Palmar - R	7	4	+
Babinski - L	7	6	+
Babinski - R	7	2	+
Babinski - walk	6	3	+
Plantar - L	0	0	
Plantar - R	3	3	
Rooting	3	0	+
Sucking	0	0	
ATNR - lying down	3	0	+
ATNR - standing up	2	2	
Spinal Galant - L	3	0	+
Spinal Galant - R	3	0	+
STNR - lift head	0	0	
STNR - look down	0	0	
STNR - crawl	4	2	+
Fear Paralysis - walk	7	3	+
Fear Paralysis - child walk	7	5	+
Fear Paralysis - push/wave	5	1	+
Moro - fixation	7	6	+
Moro - cover	7	6	+
Moro - fall	0	0	

Bar chart 6.3. Primitive reflexes - learner no.1



### 6.8.3.2. Experimental group

The results of the other learners in the experimental group varied significantly, as can be seen in the following data.

In the table below, the number of learners with positive improvements in Primitive Reflexes are shown as “+”, while those who did not improve are left unmarked. Negative changes are indicated with “-“.

Table 6.7b. Improvements seen in Primitive Reflexes

Traits	Learners										Pos. changes
	2	3	4	5	6	7	8	9	10		
Tonic Labyrinthine Reflex		✓		✓		✓			✓	✓	5
Palmar - L		✓			✓	✓				✓	4
Palmar - R	✓	✓			✓	✓				✓	5
Babinski - L	✓	✓		✓		✓			✓		5
Babinski - R	✓	✓		✓		✓			✓		5
Babinski - walk	✓	✓		✓		✓	✓		✓	✓	7
Plantar - L						✓	✓				2
Plantar - R		✓				✓					2
Rooting	✓	✓		✓							3
Sucking					✓	✓		✓		✓	4
ATNR - lying down	✓			✓	✓	✓			✓		5
ATNR - standing up				✓	✓	✓			✓		4
Spinal Galant - L	✓	✓	✓		✓	✓				✓	6
Spinal Galant - R	✓	✓	✓		✓	✓				✓	6
STNR - lift head					✓	✓			✓	✓	4
STNR - look down		✓			✓	✓				✓	4
STNR - crawl	✓			✓	✓	✓		✓		✓	6
Fear Paralysis - walk	✓	✓		✓		✓		✓			5
Fear Paralysis - child walk	✓	✓		✓		✓					4
Fear Paralysis - push/wave	✓			✓		✓					3
Moro - fixation	✓			✓	✓	✓			✓	✓	6
Moro - cover	✓				✓					✓	3
Moro - fall				✓		✓				✓	3

Total number of positive changes: 101 Number of negative changes: 43

Although the results were very individualized, there was a clear inhibition of reflexes for the experimental group, and again no child failed to show at least some improvement in this measuring instrument.

Before a primitive reflex can be inhibited, it must first be present. If it has never been present it is possible that an intervention can elicit the reflex, which can then with further interventions be inhibited. This might have been the case with learner 8, as there was a overall improvement of his attention control as reported by his mother and the class teacher.



had improved (as shown by the checklists – 6.8.2.2 and 6.8.2.3.) possibly after the left brain had been activated apparently by the Berard AIT intervention.

### 6.8.4.2. Summary of changes in the experimental group’s QEEG data.

Table 6.8b.

Experimental group – positive changes seen in brainwave activity											Pos. changes
Learners											
Brainwave ratios	1	2	3	4	5	6	7	8	9	10	
Excessive theta 3-7Hz				+				+	+		3
Too little 12-15Hz				+							1
Excessive high beta 20Hz				+							1
Theta – beta ratio		+	+	+						+	4
Balance x cortical areas											
Left versus right frontal	+			+		+	+	+		+	5
Left versus right hemisphere	+			+	+		+			+	4
Theta –central versus parietal	+				+		+		+	+	4

Total positive changes: 22

The changes in the brainwave patterns are not statistical significant enough to see this as the cause of the changes in attention and positive behaviour that were seen in the other data, except possibly for Learner 4.

- Learner 4: A statistical significant change in frequency band ratios, as 6 of the 8 measured ratios showed a positive improvement as well as the balance between different cortical areas resulted in a dramatic change in mood and disposition for this learner.
- Learners 2, 3, 4 and 10 had a decrease in theta-beta ratio measured in the central part of the brain – Cz. This is an indication of better attention control.
- An improved balance between the different cortical areas was seen in the data of learners 4 to 10.

The brainwaves did not normalise at every point, but it might be that this intervention caused a shift that could then easily be enhanced by other interventions.

Although there were changes in the QEEG assessment of the ten learners in the experimental group, the changes in the measured brainwaves at each point of assessment were not really indicative of major improvements in the ability to control

attention. The researcher is of the opinion that the influence of the intervention should also have been measured at six months post-AIT. Structural neurological changes most probably take longer than three months to be reflected in a change of brainwave intensities (Private communication – Gary Schumann, neuro-psychologist, California, in 2010).

**6.8.5. IVA** (Table 6.9a, 6.9b and Bar chart 4)

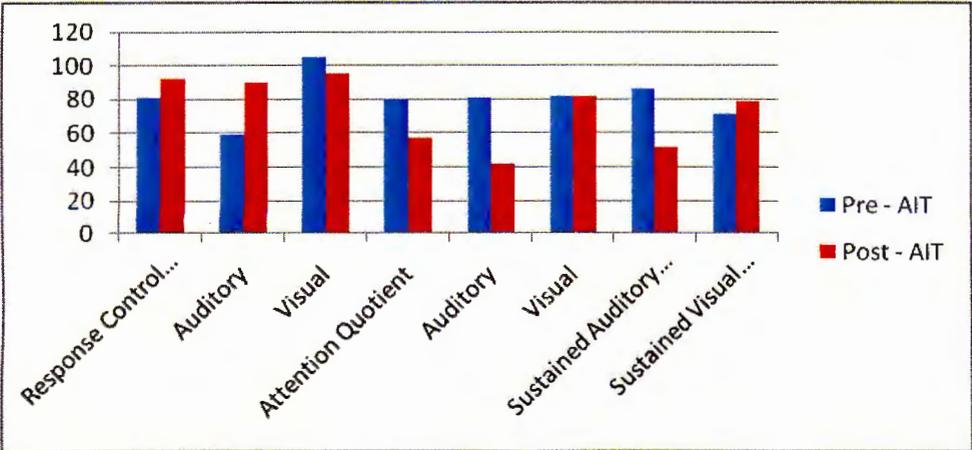
The Integrated Visual & Auditory Continuous Performance Test evaluated the learner’s ability to sustain attention in less stimulating environments. The test measured how the learner responded to visual and auditory cues and determined the learner’s ability to give attention to and respond correctly to the various stimuli. The experimental group made significant improvements compared to the control group. There were, however, great individual differences between the group members.

**6.7.5.1. Learner no 1 - JG**

Table 6.9a

Positive changes seen in IVA	Pre - AIT	Post - AIT	Pos changes
Response Control Quotient	81	92	+
Auditory	59	90	+
Visual	105	95	
Attention Quotient	80	57	
Auditory	81	42	
Visual	82	82	
Sustained Auditory Attention Quotient	86	52	
Sustained Visual Attention Quotient	71	79	+

**Bar chart 6.4. IVA results of learner no.1**



These are the results of the pre- and post tests of Learner no. 1. It shows a slight increase in sustained visual attention, but a significant drop in the auditory sustained

attention. This might be an indication of the internal slow wave activity measured by the QEEG, which means that the learner will have difficulty in attending to external stimuli.

**6.8.5.2. Summary of changes seen in the experimental group**

In the table below, the number of learners with positive improvements in attention tested with the IVA are shown as “+”, while those who did not improve are left unmarked. Negative changes are indicated with”-“.

**Table 6.9b. Experimental group—changes seen in IVA data changes 3 months after intervention**

Learners											
	1	2	3	4	5	6	7	8	9	10	Pos. changes
Response Control Quotient	+	+	+	+	+	+	-	+	+	+	9
Auditory	+	+	+	-		+	+	+	+	+	8
Visual	-	+	+	+	+	+	-	-	-	+	6
Attention Quotient	-	+	+	+	+	+	+	-	+	+	8
Auditory	-	+	+	+		+		-	+	+	6
Visual	-	+	+	+	+	+	+		+	+	8
Sustained Auditory Attention Quotient	-	+		+		+	+	-	+	+	6
Sustained Visual Attention Quotient	+	+	+	+	+	+	+	+	+	+	10

Total positive changes: 61                      Negative changes: 13

The table above shows that there had been dramatic positive changes in the ability of this group to complete the integrated continuous test. None of the learners failed to show at least some improvement, while all learners showed improvement in the Response Control quotient as well as the Sustained Visual Attention quotient. To be able to give visual and auditory attention is vital for learning. To be able to shift the attention from the visual to the auditory stimulus and respond appropriately is necessary for effective intake and output of information (Levine, 2002:65).

## 6.9. Data comparison in the control group of changes in the listening profile

### 6.9.1. Listening profile (Table 6.10)

Table 6.10.

learner		left ear		right ear		hypersensitive points	
		Pre	3m	Pre	3 m	Pre	3 m
11	Mean	11.8	18.6	13.2	15.9	0	0
	Std dev	8.7	8.7	8.8	9.4		
12	Mean	31.4	18.6	14.5	21.8	0	0
	Std dev	9.5	6.7	9.4	10.6		
13	Mean	22.3	23.6	17.3	18.6	0	0
	Std dev	11.0	10.0	6.3	5.2		
14	Mean	13.6	10.9	16.8	14.1	0	1
	Std dev	7.4	9.4	6.8	8.8		
15	Mean	10.0	14.5	8.6	16.4	0	0
	Std dev	6.7	6.9	4.1	6.3		
16	Mean	18.2	31.4	17.3	17.7	1	1
	Std dev	9.6	8.1	8.9	5.2		
17	Mean	17.7	32.3	31.8	33.6	1	1
	Std dev	11.0	12.3	8.5	8.8		
18	Mean	6.4	15.5	15.5	13.3	2	2
	Std dev	8.4	11.3	6.8	6.4		
19	Mean	5.0	12.3	6.8	4.5	1	1
	Std dev	7.7	6.5	8.2	5.0		
20	Mean	19.1	13.2	27.7	15.0	0	0
	Std dev	8.6	4.6	7.1	3.7		

The control group's Listening Profiles show a variation in measurement after three months. There was not a noticeable change in the morphology of the Listening Profile, in contrast to the flattening of the listening profiles noted for the experimental group. Standard deviations diminished in both ears for learners 13, 16, 19 & 20, while two learners, no. 12 & 18 had one ear where the standard deviation dropped.

Four of the learners in the control group had hypersensitive hearing. After three months the sounds at selected frequencies were still detected in the hypersensitive range by these learners. Learner 14 developed hypersensitive hearing by the end of the three months. Normal maturation did not diminish hypersensitivity to sounds.

### 6.9.2. Behavioural changes

Two checklists were used to determine if there were any behavioural changes during the three months from the initial tests to the post three months tests.

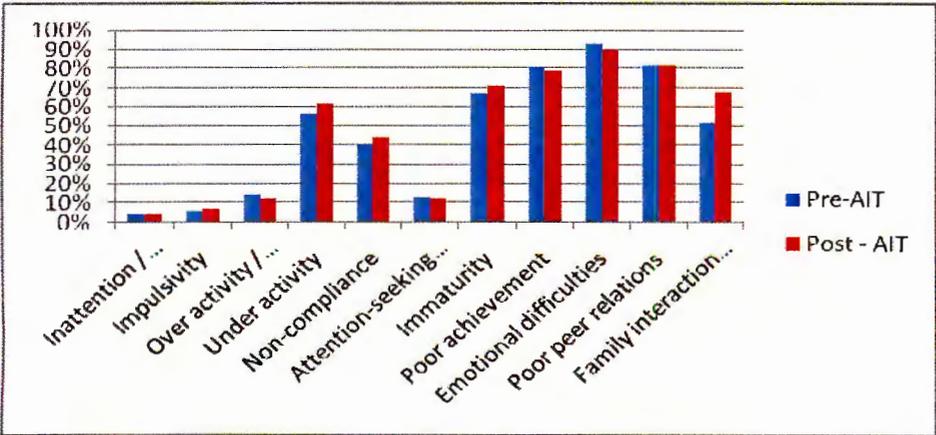
The **Copeland Symptom Checklist for Attention Deficit Disorders**, depicted below, shows the different behavioural qualities that were rated by the parents of the learners. (Table 6.11a, 6.11b and Bar chart 6.5)

#### Results of Copeland checklist for Learner 19 - CB in control group.

Table 6.11a.

Learner – 19 - Copeland	Pre-AIT	Post - AIT	Pos. changes
Inattention / Distractibility	4%	4%	
Impulsivity	6%	7%	
Over activity / Hyperactivity	14%	12%	+
Under activity	56%	62%	
Non-compliance	40%	44%	
Attention-seeking behaviour	13%	12%	+
Immaturity	67%	71%	
Poor achievement	81%	79%	+
Emotional difficulties	93%	90%	+
Poor peer relations	82%	82%	
Family interaction problems	52%	68%	

Bar chart 6.5. Copeland - Learner 19 - CB



Some of the traits e.g. impulsivity, under-activity, non-compliance and family interaction problems worsened, while hyperactivity, attention-seeking behaviour and emotional difficulties improved minimally. As the control group did not receive any intervention during the three months between testing, this might be a natural fluctuation in all learners.

### 6.9.2.1. Summary of data of control group

In the table below, the number of learners with positive improvements in Copeland checklist is shown as “+”, while those who did not improve are left unmarked. Negative changes are indicated with”-“.

**Table 6.11b. Improvements seen in Copeland checklist in the control group**

Traits	Learners										Pos. changes
	11	12	13	14	15	16	17	18	19	20	
Inattention / Distractibility		-	-	+	-	+	-	-		-	1
Impulsivity	-	+	-	+	+	+	+		-	+	6
Over activity / Hyperactivity	+	+	+	-	+	+	-	+	+	+	8
Under activity	-			-	-	+	+		-	+	3
Non-compliance	-			-	-	+	+	+	-	-	3
Attention-seeking behaviour	+	+	+	+	-	+	+	+	+	+	9
Immaturity	-	-	+	+		+			-		3
Poor achievement	+		+	-	-	+	+		+	-	5
Emotional difficulties	-			-	+	+	-		+	-	3
Poor peer relations		+	+	+	+	+	-			-	5
Family interaction problems	+	-		-	+	+	-	+	+		5

Total positive changes: 51      Negative changes: 36

All the traits that have been indicated by a + mark, showed a positive reduction in appearance. There are quite a few positive changes that took place during the three months even though there were no interventions. This could be due to natural maturation and/or a realisation of the parents that their child is really struggling at school, which could have led to more attention being given to the child. Although there was a slight overall improvement in behaviour as assessed by the total number of positive changes (51), it is still less than those achieved by the experimental group (71) (cf. Table 6.6b).

### 6.9.2.2. Aberrant Behaviour Checklist (Table 6.12a, 6.12b, and Bar chart 6.6)

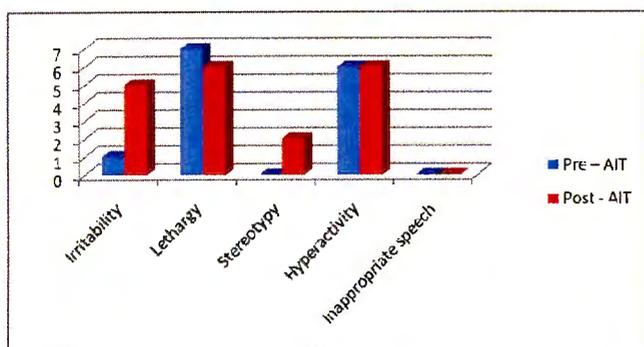
#### Results of ABC checklist for Learner 19 – CB in control group.

Table 6.12a.

Learner 19 - ABC	Pre – AIT	Post - AIT	Positive changes
Irritability	1	5	
Lethargy	7	6	+
Stereotypy	0	2	
Hyperactivity	6	6	
Inappropriate speech	0	0	

Learner 19's irritability and stereotypic behaviour increased during the three months, while the lethargy diminished slightly.

Bar chart 6.6.



### 6.9.2.3. Comparison between the learners in the control group

Table 6.12b. Changes in the control group after 3 months as seen in the ABC

Traits	Learners										Pos changes
	1	2	3	4	5	6	7	8	9	20	
Irritability	-	-	-	-	-	-	-	-	-	-	1
Lethargy	-	-	-	-	-	-	-	-	-	-	5
Stereotype	-	-	-	-	-	-	-	-	-	-	0
Hyperactivity	-	-	-	-	+	-	-	-	-	-	5
Inappropriate speech	-	-	-	-	-	-	-	-	-	-	3

Total positive changes: 18      Negative changes: 18

There was a slight improvement in some of the traits, by learners 11,13 & 16 and the total number of positive changes (18) was almost half of that attained by the experimental group (33) (cf. Table 6.5b). At least 2 learners, no. 17 & 20 failed to show improvement in any parameter.

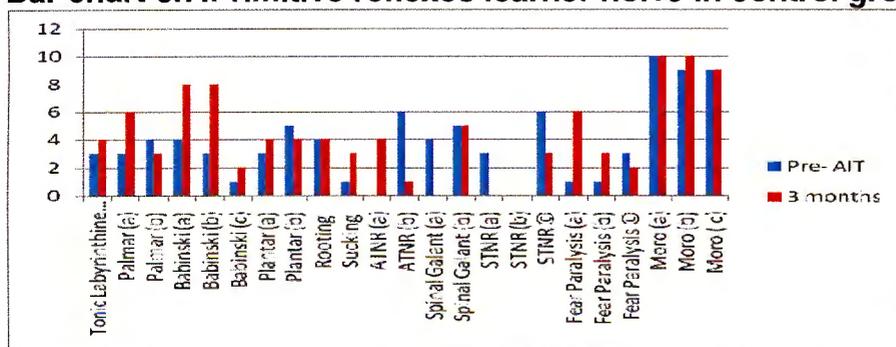
### 6.9.3. Physiological symptoms (Table 6.13a, 6.13b and Bar chart 6.7)

#### Inhibition of primitive reflexes in Learner 19 - CB of control group.

Table 6.13a.

Control group - Primitive reflexes	Pre- AIT	3 months later	Positive changes
Tonic Labyrinthine Reflex	3	4	
Palmar (a)	3	6	
Palmar (b)	4	3	+
Babinski (a)	4	8	
Babinski (b)	3	8	
Babinski (c)	1	2	
Plantar (a)	3	4	
Plantar (b)	5	4	+
Rooting	4	4	
Sucking	1	3	
ATNR (a)	0	4	
ATNR (b)	6	1	+
Spinal Galant (a)	4	0	+
Spinal Galant (b)	5	5	
STNR (a)	3	0	
STNR (b)	0	0	
STNR ©	6	3	+
Fear Paralysis (a)	1	6	
Fear Paralysis (b)	1	3	
Fear Paralysis ©	3	2	+
Moro (a)	10	10	
Moro (b)	9	10	
Moro (c)	9	9	

Bar chart 6.7. Primitive reflexes learner no.19 in control group



As indicated by Table 6.13a & Bar chart 6.7, learner 19 again showed a varied, highly individualized response when the primitive reflex data was compared after three months. There was a worsening of the following traits: Tonic labyrinthine reflex; left Palmar reflex; Babinski reflexes; left Plantar reflex; Sucking reflex, ATNR left; two of the Fear paralysis reflexes and a Moro reflex.

Positive changes were found in the right palmar; right plantar and the ATNR right. As the control group did not do the training at this stage, this variation in primitive reflexes might be a natural occurrence, which could be influenced by the child's maturation and activities.

### 6.9.3.1. Summary of improvements made by the control group

Table 6.13b. Control group - Improvements seen in Primitive Reflexes

Learners											
Traits	11	12	13	14	15	16	17	18	19	20	Pos. changes
Tonic Labyrinthine Reflex	+	-	-	-		-		-	-	-	1
Palmar - L	-	-	-	-	-	-		-	-	+	1
Palmar - R	-	-	-	-	-	+	-	-	+	-	2
Babinski - L	-	+	-	-		+	-	-	-		2
Babinski - R	-	+	-	-			-	-	-	-	1
Babinski - walk		+	-	+	-	+	+		-	+	5
Plantar - L	-		-	-	-	+	+	-	-	-	2
Plantar - R	-		-	-	-		+	-	+	+	3
Rooting	-		-	+			+	-		-	2
Sucking		+	-	-	-	-	-	-	-		1
ATNR - lying down	-		-	-		-		+	-	+	2
ATNR - standing up	-	-	-	-	-		-		+		1
Spinal Galant - L	-	-			-	-	+	-	+	+	3
Spinal Galant - R	-	-	+	-	+		-	-		-	2
STNR - lift head			-			-		+	+	-	2
STNR - look down		-	-		-	+		+			2
STNR - crawl	+	-	-	-				+	+	+	4
Fear Paralysis - walk	-	+	-		+	-	+	+	-	+	5
Fear Paralysis - child walk	-	+	-	-	-		+		-	-	2
Fear Paralysis - push/wave			-	-	-	+		-	+	-	2
Moro - fixation	-	-	-	+	+			+			3
Moro - cover	-		-		-	-	+	-	-	-	1
Moro - fall	-	-	+			+	-	-			2

Total positive changes: 51 Negative changes: 122

Quite a few of the primitive reflexes were inhibited during the three months in the control group; however, the total number of positive changes were again less (51) than that seen in the experimental group (101). It is also quite interesting to note that a primitive reflex was seldom inhibited in totality, and thus the chance that it was permanently inhibited was slim. The negative changes in the experimental group was (43) (cf. Table 6.7b.) compared to the (122) of the control group. This might be because the control group did not receive the Berard AIT intervention.

## 6.9.4 Cognitive assessment – QEEG (Table 6.14a, 6.14b)

### Results of Learner 19 - Control group

Table 6.14a. Before AIT 3 months later

	L. Hemi		R. Hemi		L.Hemi		R.Hemi
	<b>F 3</b>		<b>F 4</b>		<b>F 3</b>		<b>F 4</b>
Theta	16.95		17.12		19.21		20.44
Alpha	11.59		9.47		11.69		11.23
Low beta	6.43		6.03		5.89		5.47
Beta	6.48		5.87		5.69		5.13
Beta 3	9.63		7.92		5.61		4.68
	<b>C 3</b>	<b>C z</b>	<b>C 4</b>		<b>C 3</b>	<b>C z</b>	<b>C 4</b>
Theta	19.58	21.94	19.73		18.96	19.69	19.13
Alpha	16.50	14.05	20.51		14.27	10.75	13.8
Low Beta	5.81	4.52	5.81		5.94	4.53	5.67
Beta	4.59	5.28	4.65		5.09	4.96	4.85
Beta 3	4.11	5.80	3.91		4.12	5.61	4
T/B ratio		4.15				3.97	
	<b>P 3</b>		<b>P 4</b>		<b>P 3</b>		<b>P 4</b>
Theta	20.45		19.48		20.15		19.79
Alpha	17.48		15.26		13.47		16.36
Low Beta	7.04		6.42		6.46		6.45
Beta	5.33		5.01		4.92		4.85
Beta 3	4.35		3.85		3.46		3.54

The shift in brain waves in this learner during the three months was not statistical significant (Table 6.14b). What was gained at one spot was lost at another, e.g. the slow Theta waves, indicative of attention problems, became less at C3, Cz, C4, and P3, but increased at F3, F4 and P4.

The following table shows the results of the changes in encephalogram frequency changes.

Table 6.14b. Control group – improvements seen in brainwave activity

Learners	11	12	13	14	15	16	17	18	19	20	Pos. changes
Brainwave ratios											0
Excessive theta 3-7Hz											0
Too little 12-15Hz	+										1
Excessive high beta 20Hz +		+									1
Theta – beta ratio				+		+		+	+	+	5
Balance x cortical areas											0
Left versus right frontal											0
Left versus right hemisphere											0
Theta –frontal versus parietal											0

Total positive changes: 7

For learners 11,12,14,16,18,19, & 20 there was a positive change of brainwaves at one spot on the scalp; this overall total number of positive changes is less than a third of that noted for the experimental group (22). For three learners there were no positive changes during the three month period. The Theta-Beta ratio became less for five of the seven learners, which shows a slight improvement in the ability to pay attention.

Results of the IVA measurements.

**6.9.5 IVA (Table 6.15a, 6.15b, and Bar chart 6.8.)**

**Results of IVA for learner 19**

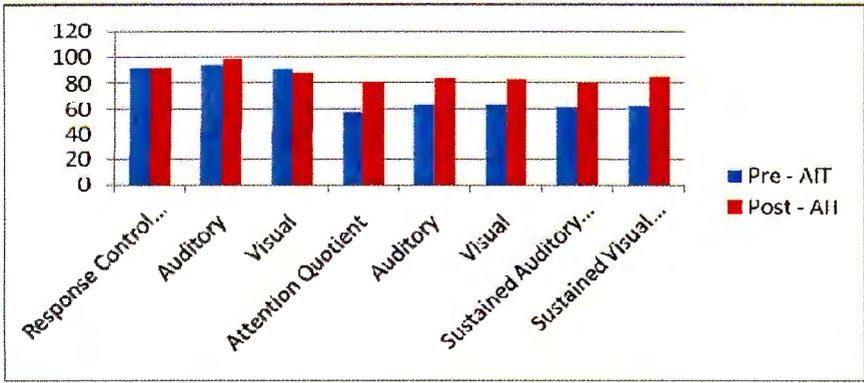
Table 6.15a.

IVA	Pre-AIT	Post-AIT	Positive changes
Response Control Quotient	92	92	
Auditory	94	98	1
Visual	90	88	
Attention Quotient	58	81	1
Auditory	63	84	1
Visual	63	83	1
Sustained Auditory Attention Quotient	61	80	1
Sustained Visual Attention Quotient	62	85	1

(Positive change is indicated when the post AIT measurement is higher).

As can be seen in Table 6.15a, learner 19 did much better when the IVA was performed for a second time after three months. This test was done on a computer and the learner had to respond to a software prompted voice. This improvement can be indicative of maturation, or a memory of the type of task that the learner had to do. As the task was not unfamiliar, the learner could have relaxed and thus performed better.

**Bar chart 6.8. IVA – learner 19**



### 6.9.5.1 Group analysis of the IVA data of the control group.

Table 6.15b. Control group - IVA –data

		Learners										
		11	12	13	14	15	16	17	18	19	20	Pos. Changes
Response Quotient	Control	+		-	+	+	-	-	-		+	4
	Auditory	+	-	+	+	+	-	+	+	+	+	8
	Visual	+		-	+		+	-	+	-	-	4
Attention Quotient		-		-	+	-	-	+	-	+	+	4
	Auditory	-	+	+	+	-	-	+	+	+	+	7
	Visual	-		-	+	-	+	+	-	+	+	5
Sustained Attention Quotient	Auditory	-	+	+	+	+	-	+	-	+	+	7
Sustained Attention Quotient	Visual	-		-	+	-	+	+	+	+	+	6

Total positive changes: 43    Negative changes: 27

Most of the learners in the control group performed better when the IVA was repeated at the end of three months. The reasons why this happened could be the same as stated for learner 19. This improvement can be indicative of maturation, or a memory of the type of task that the learner had to do. As the task was not unfamiliar, the learner could have relaxed and thus performed better. Both the experimental and control group showed positive changes after three months, but the total number was again higher for the experimental group (63) (cf. Table 6.9b) than for the control group (43). Negative changes for the experimental group was (13) and for the control group (27).

### 6.1. Conclusion

The ten learners in the experimental group showed varied changes as reported in the data acquired from the different checklists and measuring instruments. As a group they showed an overall improvement in their ability to maintain attention to a task and their behaviour was rated as more positive with less oppositional behaviour.

The control group went through the same assessment procedures, but no intervention was done. The only change that these ten learners appeared to have experienced was:

- Natural maturation,
- The fact that the learners in the control group have been identified as having difficulties could have played a role in how the learners were treated by their teachers and parents,
- Instruction in the different classes. Teachers have a difficult role to play in the education of learners who experience attention difficulties. Despite the problems the teachers still achieve success.