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1. Background to problem and problem statement

Attention is a pre-requisite for the obtainment of knowledge. According to John Ratey (2002:114), attention is much more than simply taking note of incoming stimuli. It involves a number of distinct processes, from filtering out perceptions, to balancing multiple perceptions and attaching emotional significance to them. The brain continually decides when to stop paying attention and shift to a more important or more appropriate matter. The brain is multitasked and has to attend to internal stimuli, such as memories, thoughts and body cues (Ratey, 2002:114; Amen, 1998:3).

Ratey (2002:111) declares that the ultimate purpose of the attention system is to help the brain tune in to the world, including tuning in to the personal mind. This results in consciousness. As attention, memory and consciousness build upon one another to give a higher-order cognition, an impaired attention span can make life seem incomprehensible for learners with a deficit in attention control.

1.1. Attention difficulties

According to Green (in Serfontein, 1995:5), each learner has a 1:10 chance of a significant specific weakness in learning. This is mostly due to a lack of sustained and appropriate attention. This may affect areas such as spelling, reading, writing, memory, organization, mathematics, concentration and language. Often these difficulties are co-morbid with behavioural problems. Where a school should be an area of exploration, learning and success, it is not for the majority of learners with attention difficulties. Rather, these learners experience school as a place of isolation, frustration and failure and they eventually lose their self-confidence and self-esteem (Serfontein, 1995:5).

Amen (2001:13) found that learners with attention difficulties have trouble sustaining effort over prolonged periods of time. Their minds wander and they frequently get distracted, thinking about or doing things other than the task at hand.

Taylor (2001:4) recognized the collection of traits of attention problems as so vast, that one child can appear to function entirely different from the next child who also has
attention difficulties. Learners with attention problems often have to work twice as hard even to experience half the degree of success of their peers, even then their only reward may be to be branded as lazy, unmotivated, under-achieving, anti-social or having a behaviour problem (Taylor, 2001:4).

Serfontein (1995:9), the father of a child with learning problems, sees this as a “hidden handicap” compared to visible handicaps such as blindness, deafness, cerebral palsy or intellectual handicaps. He feels that if a handicap is seen as a restriction of a child’s abilities to develop appropriately, a child with learning disabilities or with developmental behavioural disorders is just as handicapped (Serfontein, 1995:9).

According to Levine (2002:52), dysfunctions of the attention controls often lead to chaos in the learning process. When the attention controls operate effectively, they help a learner to concentrate, to be productive, to learn and to behave appropriately. It is commonly believed that the earlier a learner’s dysfunction can be detected and dealt with, the more likely the prevention of disastrous behavioural complications will be (Levine, 2002:52).

Levine (2002:246) further declares that adults with attention deficit survive socially by hiding their vulnerabilities and promoting their talents, but learners at school do not have the same freedom. Typically, at school, all learners are taught as a group in the same way, without considering the individual’s learning style. This can increase performance problems and strongly increase anxiety and stress levels, as well as decrease self-worth and self-esteem. Serfontein (1995:11) feels that from a humane perspective society is obliged to help learners who suffer because of weak attention controls.

Serfontein (1995:52) asserts that from a learning point of view, the diminished short-term memory, present in learners with attention problems, appears to be their biggest disadvantage. All new learning has to be held for a period of time so that when the learner is exposed to the same information again, the earlier information can be recognized, reinforced and eventually consigned to long-term memory. Learners with attention problems have particular difficulty with retention of auditory (or verbal) information. Consequently, when they learn something new or are re-exposed to it a
week or two later, they are unable to reinforce the previous learning or to recall it. If there is no short-term memory, there can be no learning (Serfontein, 1995:52). In this respect, learners with attention problems often display problems with auditory reception and verbal comprehension, auditory discrimination, auditory memory as well as gross and fine motor co-ordination, spatial problems and distractibility (Serfontein, 1995:52).

Similarly, Taylor (2001:8) also describes how learners with attention difficulties have particular challenges around the sense of audition. Specifically, Taylor found that learners who are very distractible have little ability to block out noises in order to concentrate. A noise outside the window, a cough, or a dropped pencil is treated as equally important as to what the teacher is saying by the brain of a learner with attention difficulties. According to Taylor (2001:8) this may indicate that an Auditory Processing Disorder is present in learners with attention difficulties. McArthur, Ellis, Atkinson and Coltheart (2008:946) found that auditory processing deficits are also present in learners with other diagnosed learners difficulties.

1.2 The Berard AIT

The literature shows that auditory processing difficulties can be addressed successfully by psychoacoustic methods. One other method claimed to be useful in addressing difficulties with auditory processing, is auditory integration training. Auditory integration training (AIT) was developed by French otolaryngologist Guy Berard, based on the work of his predecessor, Alfred Tomatis. The training consists of 20 half-hour sessions of listening to randomly, modulated music over a ten day period (cf. 4.5). AIT is said to be beneficial for several conditions, including Attention Deficit/ Hyperactivity Disorder (ADHD), autism, dyslexia and hypersensitive hearing (Brockett, 2003:5). Moreover, sound based therapies such as Berard AIT, might adjust a natural deficit in the functioning of a learner with attention difficulties and for some parents may be a preferred solution to attention difficulties, rather than reverting to chemical control (Stehli, 1996:23).
The largest research study on Berard AIT that has been conducted, involved people with autism, and was done by Rimland and Edelson of the Autistic Research Institute in San Diego (Rimland & Edelson, 1994:16). This research was done on request of Annabel Stehli, whose daughter Georgiana, 12 years at the time, underwent AIT with Dr. Berard in France in 1976. Georgina was thought to be retarded, diagnosed autistic, dyslexic and psychotic. The result of the training was considered highly successful and Georgie’s extreme auditory sensitivity underwent such a profound change during AIT that she was allegedly rehabilitated from autism (personal communication with Dr. Edelson, 2006). She eventually obtained a degree *cum laude*, and is married and the mother of a little girl. Although there are still autistic tendencies present, she is able to hold down a job and live a happy life (SAIT, 2001:4).

After the progress Georgie made, Annabel was prompted to write a book about Georgie’s experience. However, Annabel was not sure if this training would help other children on the autistic spectrum, or whether her daughter’s case was an anomaly, and she did not want to give parents false hope. She agreed to write the book on condition that a large study was done with children on the autistic spectrum (Brockett, 2003:5).

The outcome of the study suggested that Berard AIT is beneficial to many autistic children, but was met with criticism from the academic and medical community (Dawson & Watling, 2000:415; Goldstein, 2000:423). Although the topic remains controversial, several studies have been conducted to verify anecdotal changes that practitioners, parents and teachers noticed after re-training of the auditory system of children, adults and spectrum with Berard AIT (Edelson, Rimland, Grandin, 2003:8; SAIT, 2001:3; Stehli, 1995a, Stehli (ed) 1995b & 2004; Rimland & Edelson, 1994:18). Consequently it is essential to have a discussion on the efficacy of Berard Auditory Integration training (AIT).
1.2.1. The Efficacy of Berard Auditory Integration Training

From January 1993 to May 2001 Edelson and Rimland conducted several studies to determine the effectiveness of the Berard AIT intervention (Brockett, 2003:56). From these studies a total of 28 reports emerged (Edelson & Rimland, 1994:2). Twenty-three reports concluded that AIT benefits various population subgroups, three studies claimed to show no more benefit than the benefits seen in a control group, and two studies reported rather ambiguous or contradictory results. Considering the great difficulties in both providing a credible placebo treatment and assessing improvement in the subject populations, these results are quite encouraging. The balance of the evidence appears to favour AIT as a useful intervention, especially in autism (Brockett, 2003:56).

Considering that Berard Auditory Integration Training may be effective as a therapeutic modality, the question remains as to what physiological system is being influenced to the benefit of the learner’s behaviour. Consequently, the technique has been investigated by different researchers through the years to assess its influence on the following structures:

1.2.2. Vestibular – Cerebellum System

Ayers (1972:23) found that sensory integration dysfunction prevents the child from correctly processing the sensations of his own play in such a way that it reorganizes the brain. Goddard (1996:44) supports this theory in her discussion of how vestibular stimulation and rotation seem to open the door for further remediation when there is an impairment in the sensory channels in general.

Auditory integration training may be one method of providing stimulation to the vestibular – cerebellum system to help re-organize a dysfunctional system (SAIT, 2001:1). Individuals with known vestibular processing dysfunctions appear to receive the greatest gains from AIT. These improvements may occur in the areas of overall arousal, organization and social-emotional response (Frick & Lawton-Shirley, 1994:2).
1.2.3. Sensory reorganization

Dr. Melvin Kaplan (SAIT, 2001:3) suggests that the auditory system is organized in a dysfunctional and unstructured way in people with developmental disorders. He believes that the auditory system develops abnormally in these individuals, due to problems in genetics, in utero, and/or to early childhood experiences. However, the auditory system is very adaptable and can change with the appropriate stimuli and structure. It has therefore been suggested that during and after the AIT listening sessions, the auditory system reorganizes itself, in a more natural, structured and functional manner (SAIT, 2001:2).

1.2.4. Middle ear mechanics

Tomatis and Berard (SAIT, 2001:2) have stressed the importance of the structure and movement within the middle ear. After repeated ear infections the muscle tension in the middle ear may not be adequate for proper functioning. It may also be possible that the tensor tympani and stapedius muscles are not working together appropriately to allow the proper functioning of the acoustic reflex. Berard AIT listening sessions is thought to exercise and strengthen these muscles, which leads to the correct amount of muscle tension and efficient sound transmission (SAIT, 2001:1)

1.2.5. Biochemical changes

Jaak Panksepp (in SAIT, 2001:3) found growing evidence that some individuals with attention problems have elevated levels of brain opioid activity as well as variants of beta-endorphins. The beta-endorphin hypothesis of AIT suggests that the modulated music stimulates, and possibly normalizes, certain areas of the brain which release endogenous opioids (SAIT, 2001:2).

Berard (in SAIT, 2001:3) noted an improvement in allergic disorders such as eczema, hay fever, and asthma after AIT. According to Lisa Boswell (in SAIT, 2001:3), melatonin regulates a host of neuroendocrine functions including sleep patterns and autoimmunity, and stimulates the pituitary gland to produce melanocyte
stimulating hormone; melanocytes, in turn, produce melanin. She speculated that in addition to reduction in sound sensitivity, AIT improves production of melanin in the stria vascularis in the inner ear. In particular, melatonin production may be increased through impulse noise like that experienced during AIT, which might help both to normalize listening profiles (reduce sound sensitivity) and mitigate the effects of hyperacusis on the pineal gland. AIT could then improve pineal function, normalize circadian rhythms and decrease autoimmune symptoms (SAIT, 2001:3).

1.3. Theories related to attention

Bill Clark (SAIT, 2001:2) suggested that the random modulation of the AIT music, viz. the reduction of predictability, may train the listener to ‘tune in’ to his/her environment. By conditioning the person to attend to the music, the person is then able to generalize the process of paying attention and ‘tune in’ to their surroundings (SAIT, 2001:3).

Edelson (SAIT, 2001:2) maintains that AIT trains or conditions the listener to shift his/her attention more rapidly and more efficiently. The modulation during the AIT listening sessions changes the music at random intervals. The listener is trained or taught to shift attention during the listening sessions, since the AIT music is constantly changing from low to high frequencies and from soft to loud music in an unpredictable manner (SAIT, 2001:3).

There is no evidence of research conducted with the Berard AIT in relation to attention.

1.3.1. Calming effect of music

Berard found that if certain frequencies of sounds bother an individual, exposure to stimulating sounds, such as through AIT, may allow a person’s auditory system to adapt to intense sounds. As a result they may consciously or unconsciously adapt and learn to ignore excessive sounds. There will be a reduction in activation to incoming sounds (SAIT, 2001:2).
1.3.2. Reduction of internal noise

One of the most frequently reported changes after AIT that Edelson (SAIT, 2001:6) documented, was an overall calmness in the listener. This description was reported by parents as well as by people who participated in AIT listening sessions. The calming effect included better sleeping patterns, an increased attention span, a decrease in anxiety and a decrease in hyperactivity.

In addition to challenges around the sense of audition, various other influences may affect the ability of a learner to pay attention. Thus, some of the primitive reflexes that might also have an influence on attention control will be discussed next.

1.4. Reflexes and their impact on education

Primitive reflexes are automatic, stereotypical movements directed from the brainstem and executed without cortical involvement (Goddard, 1996:1). Goddard (1996:1) states that before a child is born, he is equipped with a set of primitive reflexes to help him survive in utero and post-natal, by ensuring an immediate response to the surroundings.

Charles Sherrington (in Shepherd, 1994:417) emphasized the importance of the reflex as an elementary unit of behaviour. He stated: “A simple reflex is probably a purely abstract conception, because all parts of the nervous system are connected together and no part of it is probably ever capable of reaction without affecting and being affected by various other parts, and it is a system certainly never absolutely at rest.” (Goddard, 1996, xii.) According to Sherrington reflexes do not take place in isolation (Shepherd, 1994:433).

Primitive reflexes should only have a limited life-span and most should be inhibited by about 6 months of age. This allows the postural reflexes to develop which will help the infant to control voluntary responses. If the reflexes are not inhibited immature patterns of behaviour may be the result. Gross- and fine-motor as well as sensory perception and cognition can be affected (Goddard, 1996:1).
Hocking (2007:14) found that if the primitive reflexes are inappropriately retained they remain active and may cause extra stress on the central nervous system, leaving less energy and function for other development and learning. This will result in an inability to pay sustained attention for long periods (Hocking, 2007:14). Moreover, these reflexes are retained in a number of disorders associated with learning problems (McPhillips & Jordan-Black, 2007:748; Teitelbaum, Benton, Shah, Prince, Kelly & Teitelbaum, 2004:11909).

Each reflex has a vital role to play in setting the stage for later functioning. Detection of uninhibited reflexes can help to isolate the causes of a learner’s problem so that remedial training can be targeted more effectively (Goddard, 2004:3). Moreover, directed inhibition of these reflexes appears to be beneficial to the educational improvement of these children (Dennison, 2006:40; Hannaford, 2002:59; McPhillips, Hepper & Mulbern, 2000:537; Freeman, 1998:96, Hannaford, 1995:31;)

1.4.1. Tonic Labyrinthine Reflex (TLR)

The Moro and Tonic Labyrinthine Reflexes (TLR) are closely linked. Both are vestibular in origin and both are activated by any alteration of position in space. Any movement of the head in a vertical direction beyond the midline will affect muscle tone from the head downwards (Goddard, 2004:ix;1996:16). As AIT affects the vestibular system, it can be expected to have an important modulatory influence on these reflexes (Brockett, 2003:35).

1.4.2. Palmar reflex

A light touch or pressure in the hand will result in the fingers closing. Continued reflex activity can have a lasting adverse effect on small muscle coordination, which will affect a child’s handwriting skills (Goddard, 1996:8). Anecdotal reports have mentioned a sudden improvement of the learner’s handwriting after Berard AIT training (personal communication with Sally Brockett, 2006a).
1.4.3. Asymmetrical Tonic Neck Reflex (ATNR)

This reflex will be elicited when the baby’s head moves to one side; the extension of the arm and leg to the side which the head is turned will follow automatically. Goddard (1996:10) states: “The ATNR not only assists the birth process but is reinforced by it. This may be one reason why children born by Caesarean section are at higher risk for developmental delay.” (Goddard, 1996:10).

Goddard (1996:11) as well as Stiller and Wennikes (1998:16) declare that this reflex represents the first eye-hand coordination that takes place and most probably helps in development of eye fixation on nearby objects. Continued presence of this reflex will interfere with numerous functions, e.g: It will be difficult to cross the mid-line and hand dominance will not be fixed. In the classroom, hand writing will be the most obvious casualty. Each time the learner turns his head to look at the book, his arm will want to extend and the fingers will want to open. The physical act of writing will always require intense concentration at the expense of paying attention and cognitive processing (Goddard, 1996:11; Stiller & Wennikes, 1998:16).

1.4.4. Spinal Galant Reflex

Stimulation down one side of the spine will cause the hip to flex towards the side which is stimulated. In 1991, Dickson (in Goddard, 1996:15), has suggested that this spinal galant reflex could act as a primitive conductor of sound. Sound vibration will travel through the baby's body in utero, enabling the fetus to 'feel' the vibrations travelling up the spinal column (Goddard, 1996:15).

According to Goddard (1996:15) the child with a retained spinal gallant reflex will have difficulty sitting still and giving attention to the work. This is the typical ‘ants in the pants’ child who wriggles, squirms and changes position as the waistband of the pants or leaning against the chair back elicits the reflex. This may affect attention, concentration and short-term memory as the child’s attention is continually diverted (Goddard, 1996:15).
1.4.5. The Moro Reflex

This reflex is the earliest to arrive and forms the foundation for life; it is fully present at birth (Goddard, 1996:5). The Moro reflex, which is an involuntary reaction to a threat, emerges at 9 weeks in utero and should be inhibited at 2 - 4 months after birth. When the baby is startled, the brain triggers an immediate Moro reflex to try and escape danger. Its role in the first months of life is to alert and to arouse (Goddard, 1996:5).

According to Goddard (1996:6), if the Moro reflex fails to be inhibited, the learner will have difficulty in paying sustained attention. He will be hypersensitive to incoming sensory impulses e.g. sudden noise, light, movement or a change in balance which can all elicit the reflex. The learner would be constantly hyper-vigilant and pay attention to all incoming sensory stimulation, while having an inability to inhibit sensory stimulation (Goddard, 1996:6).

When the stress hormones, adrenaline and cortisol are secreted, sensitivity and reactivity increase, and the possibility of triggering the Moro reflex is enhanced. This results in a vicious self destructive loop (Goddard, 1996:6). Adrenaline and cortisol are also the body's chief defences against allergy and infection. As the Moro reflex is said to be inhibited during AIT, the stress hormones can be put to work defending the body against invading organisms instead of maintaining the hyper alert state (Goddard, 1996:6). This could be the reason why individuals have reported a general calming of the system after AIT, but also a lessening of allergic reactions. A lack of inhibition of the Moro reflex will have a devastating influence on the attention control of the learner. If the learner cannot sit still, experiences anxiety or experiences visual and auditory problems, sustained attention is simply not possible.

Annexure D includes a copy of the primitive reflexes that were tested in this study.

1.5. Berard AIT as an intervention

All management programmes for learners with attention problems aim to ensure appropriate development in learning and behaviour. The various people working with
the learner with attention problems find that the synergistic effect of the various interventions obtains a composite improvement in the learner's development (Levine, 2002:88).

An analogy sees AIT as the lifting of a boom in front of a parking garage. Before AIT training, information cannot enter the brain. AIT training lifts the boom and the child's attention can be focused on obtaining information and assimilating it into short- and eventually long-term memory (Brockett, 2006a:12). Similar to other psychoacoustic methods for addressing auditory processing difficulties, AIT may not increase the learner's ability to do certain scholastic activities (such as reading and spelling), but it may improve the child's ability to learn such activities with appropriate tuition (McArthur et al., 2008:946).

1.6. Hypothesis

Many anecdotal cases have shown that Berard AIT intervention has given learners the ability to improve their attention control (Stehli, 1995:xi). The alternative hypothesis is therefore that Berard AIT will change the intrinsic locus of attention control to enable the learner to pay appropriate attention without effort. Electroencephalographs will become flexible so that attention will shift from intense concentration, to scanning incoming information, to discerning which stimuli are important enough to give attention to.

The null hypothesis is that Berard AIT will not change the intrinsic locus of attention control to enable the learner to pay appropriate attention without effort. Electroencephalographs will not become more flexible and attention will not easily shift from intense concentration, to scanning incoming information, to discerning which stimuli are important enough to give attention to.

1.7. Objectives of the study

The main aim of the study is to explore Berard Auditory Integration Training as a possible intervention for learners between the ages of six and twelve years, who
experience problems with sustained attention and who have difficulty in shifting their attention from task to task.

As Berard AIT re-trains the listening system, this intervention should result in a normalization of hyper-sensitivity to sound, a normal arousal of attention, sustained attention, and a flexible attention system (Stehli, 1995:xi). Paying sustained attention can be seen as a learner who stays calm, relaxed yet alert, with focused attention and thus concentration with appropriate reflection before action.

The sub aims of the intervention is to help a learner with attention problems to reach:

a) A state of Physiological Readiness.
   This will be a relaxed state which will enable the learner to broaden associative capabilities and perspective, increase reaction time and decrease fatigue, tension and stress. The physiological readiness state will keep the learner alert to respond efficiently to new information (Thompson & Thompson, 2003:242).

b) A state of Mental Readiness.
   The learner will be calm, aware, reflective and optimistic in attitude (Thompson & Thompson, 2003:242).

c) A state of Active Mental Work.
   This will keep the learner focused, concentrating and creative, as well as goal orientated (Thompson & Thompson 2003:242).

1.8. Method of Research

1.8.1. Literature search

Appropriate databases were used e.g. Ebsco Host, Sabinet and Eric in the literature search.

The following key words were employed:
Sound based therapies; Attention control; Brainwaves; Auditory system; Primitive reflexes; Postural control; Berard AIT; Cerebellum; Recticular activating system; Temporal lobes; Brainstem; Focused attention; Impulsivity; Attention Disorders; Sensory-Motor Strip.
1.8.2. Research design

A quantitative experimental study with a pre-test and post-test control group design, was conducted to investigate the effect that Berard Auditory Integration Training has on learners with attention problems (Leedy & Ormrod, 2005:217; Sherman, 2003:92). According to Leedy and Ormrod (2005:94) quantitative research is used to answer questions about relationships among measured variables with the purpose of explaining, predicting and controlling phenomena.

A positivistic research paradigm has been followed since this is quantitative research which is objective and facts are observable (Jansen, 2008:21). In a pre-test post-test control group design the experimental group is observed/tested and subjected to the experimental treatment and then observed/tested again. The control group does not undergo any experimental treatment and is simply observed/tested at the beginning and end of the research (Leedy & Ormrod, 2005:225). Leedy and Ormrod assert that this design can determine if a change took place after the treatment and eliminate other possible explanations as to why change has taken place.

1.8.3. Population and Sample

According to McMillan and Schumacher (2006:119) a population is a group of elements or cases, whether individuals, objects or events, that conform to specific criteria and to which we intend to generalize the results of the research. In this study the population, chosen from primary schools, will all be learners who experience attention problems. Two primary schools are purposefully chosen for the sample, since the researcher has a good relationship with them and will therefore have positive cooperation which will enhance the possibility that the research can be implemented thoroughly.

Sampling is the procedure according to which participants are chosen to participate in a study (Sherman, 2003:114). A random sample is an unbiased way of choosing participants for a research study. For this study systematic sampling was chosen. In
systematic sampling every \( nth \) element is selected from a list of all elements in the population (Sherman, 2003:114).

Twenty learners between the ages of six and twelve years with attention problems were chosen to participate in the study. Parents, an educational psychologist as well as teachers submitted names of children that they felt would benefit from the Berard Auditory Integration Training programme. The only requirements were that the learners had to have attention problems and that the learners had to be between the ages of 6 and 12 years of age.

After 100 names had been submitted from two schools no further names were accepted. Systematic sampling was done (Sherman, 2003:114), where every 10\(^{th}\) learner on the Knysna Primary School list were selected for the experimental group. Every 10\(^{th}\) learner on the Stepping Stones Primary School list was chosen for the control group. If those learners were unavailable the next name on the list was selected. This was done so that there could be no influence from educators on the control group who had to wait until after the study to receive the Berard AIT intervention.

The learners in both groups came from the same educational and socio-economic background. The ages and gender of the learners in the experimental group were matched as close as possible with the learners in the control group. These measures were put in place to keep the control variables as similar as possible.

The learners in the control group did the same pre- and post-tests, but did not receive the Berard AIT intervention during the three month period which elapsed between the pre- and post tests. After the study the ten learners in the control group also received Berard AIT training.

1.8.4. Variables
The following variables that impact on attention were tested:

1.8.4.1. **Frequencies** - measurable levels at which sound is produced (Brockett, 2006a:10). It has been found that the intensity at which a person hears a sound at a certain frequency, could change after the Berard AIT intervention (Berard, 1993:106).

1.8.4.2. **Auditory system problems** or also called Auditory Processing Disorder. This is the ability of a person to block out unimportant sounds and concentrate on relevant incoming sounds. This disorder frequently disappears after Berard AIT intervention (Seymour, 1998:12).

1.8.4.3. **Behaviour problems.** This often accompanies attention difficulties. If the attention problems ameliorate, so may the behaviour problems (Picton, 2002:5).

1.8.4.4. **Attention problems.** The learner will gain control of attention and be able to shift his/her attention to be effective in various situations (Demos 2005:232).

1.8.4.5. **Reflexes.** Primitive reflexes emerge *in utero* to assist the baby with the birth process and with survival shortly after birth. Primitive reflexes should be inhibited during the first year of life, but sometimes they are not inhibited and this can cause learning problems (Hocking, 2007:3).

The literature search did not show any evidence that Berard AIT would have any effect on uninhibited primitive reflexes, but as this is a relatively extensive study the reflexes test were included to investigate the extent of the influence of this intervention.

1.8.4.6. **Electroencephalographs.** The brain continually produces a variety of brainwaves to assist the body in responding appropriately to various situations. Slow theta brainwaves, as well as high beta waves, can cause attention to be uncontrollable (Demos, 2005:95).
1.8.4.7. **Emotional functioning.** People with attention problems often have a low self-esteem. If the attention control is going to be improved with AIT training, the emotional functioning of the learner should also improve (Miller & Blum, 2000:5).

1.8.5. **Measuring Instruments.** The following measuring instruments were used by the researcher to ensure that variables that could influence the attention of a learner were tested.

1.8.5.1. A **Listening Profile** was obtained from every participant before the training started and after ten sessions of training had been completed. This was repeated after the twenty sessions had been completed and again two to three months after the training. The purpose of the Listening Test was to determine which frequencies might have caused the learner discomfort and therefore had to be cut on the Earducator. During the test the listening levels where the learner perceived the softest sound at the different frequencies, were plotted on a graph.

1.8.5.2. Two **checklists** were completed by parents of the learners who took part in the study.

* **Aberrant Behaviour Checklist**
This checklist gave an indication of possible listening problems.

* **Copeland Symptom Checklist for Attention Deficit Disorders**
This checklist gave an indication of possible behaviour problems.

1.8.5.3. **Primitive Reflexes** were tested by the researcher before the intervention began and three months after the training had been completed. Retained primitive reflexes that were not inhibited several months after birth, could be a cause of inappropriate behaviour and a lack of attention control.

1.8.5.4. A **Quantitative EEG** was conducted by the researcher before and three months after the Berard AIT intervention to see if the functioning pattern of the learner's electroencephalographs had changed. It is suspected that Berard AIT stimulates the growth of new neurons in the brain and that existing connections between neurons might be strengthened. This will take a few months to show on a quantitative EEG.
1.8.5.5. The Integrated Visual & Auditory (IVA) Continuous Performance Test was completed by each child on a computer. This test measured the learner's response to visual and auditory cues and determined the learner's ability to give attention, and response, to the various stimuli. The test took about 20 minutes to complete. The test evaluated the learner's ability to sustain attention in less stimulating environments.

To ensure internal validity of this research study, precautions were taken to eliminate uncontrolled influences on the outcome of the study, such as food intake, which might have influenced the learner's control of attention. The only way to monitor this was to educate the parents and to ask their help in controlling the intake of undesirable food, such as dairy, colourants, flavours, preservatives, sweeteners and sugars which have different effects on individuals. This had to be managed per individual. The same advice was provided to the parents of both the experimental as well as the control group.

To enhance the validity and reliability, the pre- and post tests were conducted by the researcher. The auditory training was also carried out by the researcher who is a qualified Berard AIT practitioner and the checklists were completed by the same parent and the same teacher. The quantitative EEG, primitive reflexes and IVA were tested at the same time of day.

1.8.6. Statistical technique

A repeated measures ANOVA, using the mixed model approach, was performed. Although this presupposes the assumption that the data was normally distributed, proof of normal distribution of data derived from a small sample number is not faultless. However, normal distribution plots of the data indicated that most of the data approximated normality (Private communication – Prof. Moolman-Smook, Univ of Stellenbosch).

The following comparisons were made:

1. The pre- and post-tests (1.8.5.) of the ten learners in the experimental group were individually compared with the ten learners in the control group.
2. The pre- and post tests (1.8.5.) of the experimental group were compared with the pre- and post tests of the control group.

1.8.7. Ethical aspects

The participants as well as the parents of the participants were informed of every aspect regarding the research method. Participants had the right to withdraw from the study at any time. Participation in the study was strictly voluntary.

Informed consent was also obtained from the two school principals. Informed consent was obtained from the parent or guardian of the participants.

Participants’ names were withheld from the study.

Findings were reported in a complete and honest fashion, without misrepresentation. The Ethical Committee of the North West University approved the study.

1.8.8. Data collection procedure

The research procedure that was followed included the following:

- Phase 1: a literature study was conducted;

- Phase 2: interviews were held with teachers and parents to identify learners with attention problems.

- Phase 3: checklists and different measurements (cf. 5.3) were conducted on the learners in both the experimental and control groups;

- Phase 4: the Berard AIT intervention was supplied to the learners in the experimental group. The learners listened to music twice a day for ten days. Each session lasted thirty minutes. Three hours had to elapse between the two training sessions to give the auditory system a chance to rest. Twenty half-hour sessions were completed in 10 days.
Phase 5: as the effects of Berard AIT is considered to be completed only after two to three months (Berard, 1993:46), the checklists and different measurements were repeated three months after the training had been completed, to monitor if there had been any change in the way that the learners payed attention. The checklists also indicated if there had been a change in the learners' problematic behaviour, if present initially.

Phase 6: after all the data was collected, the learners in the control group also received the Berard AIT intervention.

Data was collected from the different measuring instruments that were used. The tests and checklists were completed at the private consulting rooms of the researcher, before the Berard AIT intervention was applied to the research group. The data for the control group was collected at the same time.

The learners in the experimental group underwent the Berard AIT re-training intervention during school hours. The first 30 minutes was done before school and into the first half hour of school before the academic teaching started and the second half hour was done at least three hours later during recess.

Three months after the intervention the same checklists were completed and other measuring devices repeated for the research group, as well as for the control group. Data from these collections are compared in chapter six.

1.8.9. Data analysis

The data analyses were quantitative experimental. Appropriate statistical analyses were performed to compare information obtained in the pre- and post-tests (Leedy & Ormrod, 2005:150) (cf. 1.8.6.).

Two means were calculated to do:

i. the comparison between the pre- and post tests (1.8.5.) of the ten learners in group 1,

ii. the comparison between the pre- and post tests (1.8.5.) between group 1 and group 2. Group 2 initially received no intervention.
1.9. Role of the researcher

The researcher is an experienced Neurofeedback practitioner and personally conducted the QEEG assessment. She obtained her Bio- and Neurofeedback education under different clinicians at various clinics in Los Angeles; Seattle; Denver; Hartsford and New York in the United States of America. She holds certificates from the Biofeedback Certification Board of America, as an Associate Fellow in Bio- as well as Neurofeedback.

1.10. Definition of terms used in this study

For the purposes of this study, the researcher wishes to clarify the following terms:

- **Attention difficulties:**
  This refers to the inability to be able to pay sustained attention to a task and/or to shift attention from one activity to another (Demos, 2005:93).

- **Berard AIT:**
  Berard Auditory Integration Training is a two week intervention where the client listens to music twice a day (Berard, 1993:82).

- **Listening Profile:**
  The listening profile is a reflection of the softest sounds that the learner can hear at different frequencies (Brockett, 2006a:12).

- **Frequencies:**
  Measurable levels at which sound is produced. For this study it ranges from 125dB to 8000 dB (Berard, 1993:61).

- **Auditory pathway system:**
  The connections between the outer ear and the auditory system in the brain and various other parts in the brain that are affected by, and play a role, in the perception of sound (Stach, 1998:68).
• **Behaviour problems:**
For the purpose of this study behaviour problems refer to unruly, disorganised behaviour that do not fit the situation (Picton, 2002:5).

• **Primitive reflexes:**
Primitive reflexes emerge in utero to assist with the birthing process and to aid with initial survival. All the reflexes should be inhibited several months after birth (Hocking, 2007:6).

• **Brainwaves:**
The brain continually produces a variety of brainwaves to assist the body and mind in responding appropriately to various situations. It is measured on the scalp with sensors (Thompson & Thompson, 2003:35).

• **QEEG:** Quantitative electroencephalograph.
A QEEG is the measurement, using digital technology, of electrical patterns at the surface of the scalp. It reflects cortical electrical activity or 'brain waves'. These waves occur at different frequencies and range from slow to very fast waves (Demos, 2005:147).

• **IVA – Integrated Visual & Auditory continuous performance test:**
This is a test that measures how the learner responds to visual and auditory stimulation (Sandford, 2000:4).

2.1. **Preview of the chapters**

A preview of the chapters are shown as follows:

• **Chapter 2:**
In chapter 2 the problems which learners with attention difficulties experience, are discussed.

• **Chapter 3:**
in this chapter the functioning of the auditory system are examined. The route of sound entering the ear is followed to try and determine the neurobiological mechanism underlying individual differences in attention control.
• Chapter 4:
Listening skills and the Berard AIT as an intervention are discussed.

• Chapter 5:
Chapter 5 contains the research methodology to be used in the experimental study. This includes the problem, the aims and the research design which was followed.

• Chapter 6:
A data analysis of the various pre-and post tests outcomes of the study are discussed.

• Chapter 7:
Conclusion of the study and recommendations for further studies are discussed.

Chapter 2. Attention Problems