A Pilot Study:

Into The Effects of a Single Course of Bérard Auditory Integration Training on the Progress of a Population of Children Diagnosed With Autistic Spectrum Disorder

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Abstract

This study included a group of twenty-four children aged between two-and-a-half and thirteen years with a diagnosis of autistic spectrum disorder. There were eight children in the control group. The sixteen children in the experimental group received the intervention called AIT. Changes in behaviour were monitored after a four-month interval and set against the baseline measurements using the *Autism Treatment Evaluation Checklist (ATEC)* and the *Aberrant Behaviour Checklist (ABC).* The comparison of changes in test scores show the experimental group's pre-post differences were more likely to be positive than the control group's differences. It is also seen that only the control group showed any negative change (i.e. increase of difficulty). The total score difference was significant, with the experimental group showing the greater improvement. The changes in hyperactivity scores and in total scores were highly significant between treatment groups with the experimental group showing the greater improvement. **Key words**: Bérard Auditory Integration Training, autistic spectrum disorder, behaviour, ATEC.

Autistic Spectrum Disorder (Autism)

The Autism Society of America (ASA) describes autism as:

> "…a complex developmental disability that typically appears during the first three years of life. The result of a neurological disorder that affects the functioning of the brain, autism and its associated behaviours have been estimated to occur in as many as 1 in 500 individuals (Centres for Disease Control and Prevention, USA, 1997). Autism impacts the normal development of the brain in the areas of social interaction and communication skills." (ASA 2000).

The Geneva Centre of Toronto, Canada, reports statistics that show an incidence of 1 in 200 children. * The California Health and Services Agency Report to the Legislature (Department of Developmental Services 1999) states that the incidence of autism has increased dramatically relative to other developmental disabilities, and that "the accelerated rate appears to be sustaining an upward trend into future years". Autism is four times more prevalent in boys than girls, and shows no racial, ethnic or social boundaries. (ASA 2000)

The clinical picture of autism can vary greatly among individuals. No single behaviour defines autism, but rather a cluster of behaviours, and the intensity to which they are displayed. This variability of the clinical picture of autism, its tendency to change with age, and its potential co-occurrence with other developmental difficulties present significant difficulties for diagnosis of the condition. In Dr. Lorna Wing (Wing 1988) introduced the concept of a "spectrum of disorders" in autism, to assist in the appreciation of this variability. It is internationally accepted practice to express the diagnosis of Autism with reference to this spectrum of potential behaviours, degrees of handicap, degrees of ability and associated problems.

In the USA Autism is described in the categories outlined in the *Diagnostic Statistics Manual* - IV (1994) of the American Psychiatric Association. The categories are:

- Impairment in the quality of verbal and non-verbal communication (receptive and expressive).
- Impairment in the quality of reciprocal social interaction.
- Markedly restricted repertoire of interests and activities that *may* include obsessions, fixations, and repetitive movements, and usually includes resistance to learning.

The Autism Society of America also emphasises that individuals with autism may experience various problems with sensory feedback or processing of sensory information (ASA 2000)

Most researchers agree that there is no known cure for autism. It is often described as a "severe life-long condition". There are those who support the possibility of recovery from autism, at least for some individuals. Rimland reports incidents of 'spontaneous recovery', classified as follows:- instances of 'significant recovery' (Grandin 1986; Barron, 1992; McDonnell 1993), and of 'partial recovery' (Williams 1994). Reported recovery attributed to known causes include: milk- free diet (Callahan 1987); Bérard AIT (Stehli 1991; Stehli-Thomas 2000); Lovaas ABA (Maurice 1994; Johnson & Crowder 1994) .

For most children with autism, it appears that intensive, structured, multi-faceted intervention offers the best possible outcome (Greenspan 1998; Stehli 1995; Giant Steps Programme, Montreal, Canada).

While the cognitive approach (education) is the most-frequently applied intervention, there is increasing evidence of the need for and value of including intensive sensory interventions (Williams 1998; Bérard 1993; Blackman 1999; Grandin 1986; Stehli 1995; Tomatis 1983)

Auditory Difficulties In Autism

Unusual responses by children and adults to sensations are indicative of problems with sensory processing that underlie various developmental difficulties (Ayres 1979; Fisher, Murray & Bundy 1991). Drs Courchesne (1985) and Delacato (1974) were among the first who investigated the problem of altered sensory processing in autism. Kanner (1943) had noted the children's' unresponsiveness to certain sounds. Case studies illustrate sensory processing or modulation differences in people with autism (Grandin 1986; Stehli 1991 & 1995; Williams 1994 & 1998; Delacato 1974). Dahlgren & Gillberg (1989) point out that the appearance of sensory differences may be the first indication that 'something is wrong' with the child who is later diagnosed with autism.

Of all the sensory modulation problems that beset people with autism, poor auditory modulation seems to be one of the most problematic. It is a difficulty that hampers attention and concentration, as well as sociability and the development of communication (Stehli 1991 & 1995; Williams 1999). First-hand reports by people with autism describe the distress and confusion that result from inadequate auditory modulation (Williams 1994 & 1998; Grandin 1986 ; Stehli 1991). The neurophysiology for auditory modulation was found to be more impaired than the visual modality in people with autism (Courchesne, Lincoln, Kilman & Galambos 1985).

Problems of auditory modulation have been linked to behavioural and attention problems, to speech and language difficulties and to dyslexia (Tomatis 1983; Koegel & Schreibman 1976; Hayes & Gordon 1977). Katz & Kusnierczyk (1993) have described auditory modulation disorders according to their effect on processing speed, speech-in-noise processing, hypersensitivity, poor attention, auditory-visual integration, sequencing and auditory memory problems. They demonstrate that these auditory problems will hamper reading, spelling, and comprehension.

Delacato (1974) documented how a child with autism could be unresponsive to certain sounds (act as-if deaf), but have an exaggerated response to other sounds. Dr Bernard Rimland (1964) indicated that his research found 40% of people with autism to suffer from hyper-processing of the auditory stimuli, or 'hyperacusis'. It is frequently reported that this hyper-hearing leads to social withdrawal, speech problems and overload behaviour in the form of tantrums and aggression (Stehli 1995).

Over-sensitive hearing is not the only auditory symptom of the poor modulation of sound that is common in autism. Wong and Wong (1991), Courchesne (1987), and Condon (1975) have described longer transmission time in the brainstem, resulting in slow processing of sound. It has been found that children with 'language-based learning impairments' had major difficulties with 'temporal processing' at brainstem level. The brainstem cannot adequately process rapidly-changing sounds, as in speech. This would imply that cognitive auditory functions are negatively affected, leading to comprehension problems and learning difficulties (Tallal & Benesich 1996; Merzenich et al. 1996 ; and Kraus et al. 1996).

Structural differences have been found in the medial geniculate nucleus of the brainstem – which is also an area for processing fast-changing sounds (Rosen 1994). Bauman & Kemper (1994) found brainstem and cerebellar differences in people with autism. This indicates a structural base for sensory processing problems.

Cerebral blood-flow studies by Garreau and associates (1992) revealed the autistic auditory response to be atypical (right hemispheral) compared to non-autistic listeners (left hemispheral).

Auditory sensory modulation problems have received little attention in the study of autism, except for the symptom of painful hearing (hyperacusis). The management of hyperacusis has been through wearing of earplugs (Delacato 1974) or metabolic intervention through taking

magnesium supplements with vitamin B_6. These interventions have seemed to be effective in some cases (Rimland 1990; 1991).

It is therefore evident that sensory processing or modulation differences in autism can underlie the well-documented cognitive defects of people with autism, and even may lead to severe challenging behaviours. Of these sensory modulation difficulties, the auditory is often the most severely disrupted, with implications for communication, speech and language, as well as socialisation.

Background to Bérard Auditory Integration Training

A French Ear-Nose- and Throat Specialist, Dr. Guy Bérard, devised an auditory re-training technique that has become known as Auditory Integration Training(AIT). His book describing the process was translated into English entitled "*Hearing Equals Behaviour*"(1993). Dr Bérard devised AIT to treat his own progressive hearing loss. AIT emerged as an effective auditory training method with a much wider application than hearing loss. AIT was found to be beneficial to children with autism, not only assisting them with their academic and speech/language development, but also in improving responsiveness, activity levels, sensory processes, social skills, and their sense of well-being (Bérard 1993).

Growing public interest prompted research into the validity of AIT. To-date, there have been approximately twenty-eight published studies, with several of these appearing in peer-reviewed journals for speech therapists and audiologists, and the journals for autism. Although AIT is not a treatment for autism specifically, studies have focused on its effect on autism. Clinical outcome studies have tended to validate anecdotal reports that AIT brings about changes in a wide variety of areas of functioning, with no reported long-term negative effect, nor risk of causing harm (Cimorelli & Highfill 1995; Edelson et al 1999; Geffner et al 1994; Gravel 1994; Monville & Nelson 1994; Rimland & Edelson 1992 & 1994; Rudy et al 1994; Yencer 1998)

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Auditory Integration Training

Bérard Auditory Integration Training consists of having music played through a specially constructed electronic device. This electronic device (the Audiokinetron, the Earducator, or Digital Auditory Aerobics) has filters that alternately remove and enhance the high frequencies and low frequencies in the music while it is playing. This is done to challenge the auditory modulation system to become more effective. To the listener the music sounds a bit distorted, but it remains fairly pleasant. As an additional feature the practitioner may find indications that suggest the setting of some specific filters depending on the client's listening graph (if an accurate one could be obtained). This modified music may be periodically adjusted, and is played to the listener through high-quality headphones at specified levels of loudness for twenty half-hour sessions over a period of ten days. Usually a break for two days, e.g. the weekend, is taken after the first five days have been completed.

Following the ten-day course no further action is recommended specifically to enhance the benefits of AIT. It is recommended to wait for four to five months after the training before finally assessing the results of the intervention. After an interval of 9 months the process may be repeated, often with continuing benefit.

Changes have been reported along a wide spectrum of possibilities, e.g. behavioural, attentional, and communicative (Veale 1994; Bérard 1993; Stehli 1995).

Method

Goal

This investigation is a longitudinal prospective study, comparing the effect of a single ten-day course of Bérard AIT upon a group of children between the ages of 2 and 13 years, who have the diagnosis of autism or autistic-like, alongside the same measures of a like group of children with the same diagnosis, but who have received no AIT. It is intended to explore whether receiving AIT enhanced (or otherwise influenced) the progress of these children .

Research Design

An experimental design was selected wherein a control group was compared to an experimental group to determine whether there would be a more significant change in the measures used after a course of Auditory Integration Training.

Subjects

Participants were identified by accessing a list of all known children with a diagnosis of autism in the Mid-Western Health Board region. The parents were approached and asked if they would be willing to participate in this study project. Those who answered affirmatively, and who met the criteria for inclusion (age range and diagnosis) were so included.

The first sixteen children who consented were assigned to the experimental group, and the next eight to the control group. Three of the children selected had received AIT some years previously, and their parents rated the progress as ‘very much improved’ (N=2), and ‘much improved’ (N=1). Two of these were assigned at random to the control group, and one to the experimental group. Only two of the parents indicated that they did not want AIT at this time, so were assigned to the control group. One of these had received AIT previously and felt it to have been sufficient.

It proved to be impossible to recruit the same number of controls as experimental participants, due to difficulties in the Health-Board region with the diagnosis of autism. Children on the waiting list for diagnosis were not diagnosed in time to be included in this study.

Gender: Five of the control group were male and three female, while fifteen of the experimental group were male and only one female. The ration of male to female in this study is roughly representative of the ratio of male to female reported in epidemiological studies of autism (ASA 2000).

Table 1.1

Gender Treatment Group Crosstabulation

Count		Treatment		Total
		control	experimental	
Gender	male	5	15	20
	female	3	1	4
Total		8	16	24

Ages were between two-and-a-half and thirteen years.

Figure 1:

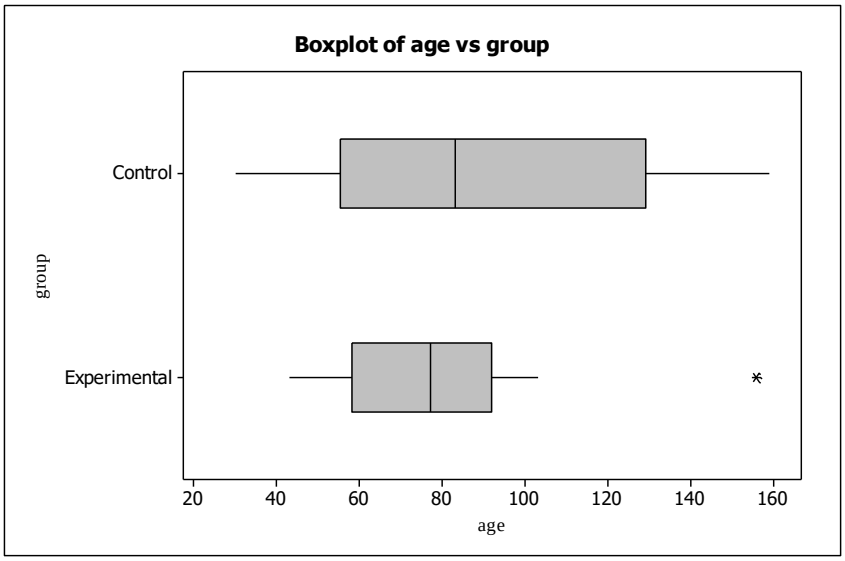

Table 1:2 Age Comparison

Age (months)	Control	Experi-mental		Mean difference	13.4
Sample size	8	15		t-value	0.89
Mean	91.5	78.1		P-value	0.382
Standard deviation	44.0	28.0		Signifi-cant (5%)	No

Diagnosis: All subjects had received a diagnosis of autism or 'with autistic features', or were awaiting a second opinion confirmation of the diagnosis of autism. Due to the diversity of diagnostic procedures involved, it was decided to select participants for inclusion according to their rating on the Rimland Form E2 (1991). Only those whose scores fell between -26 and + 40 were included in the study. Two children of the experimental group also had Downs' Syndrome, and one of these had the additional diagnosis of cerebral palsy.

Figure 2:

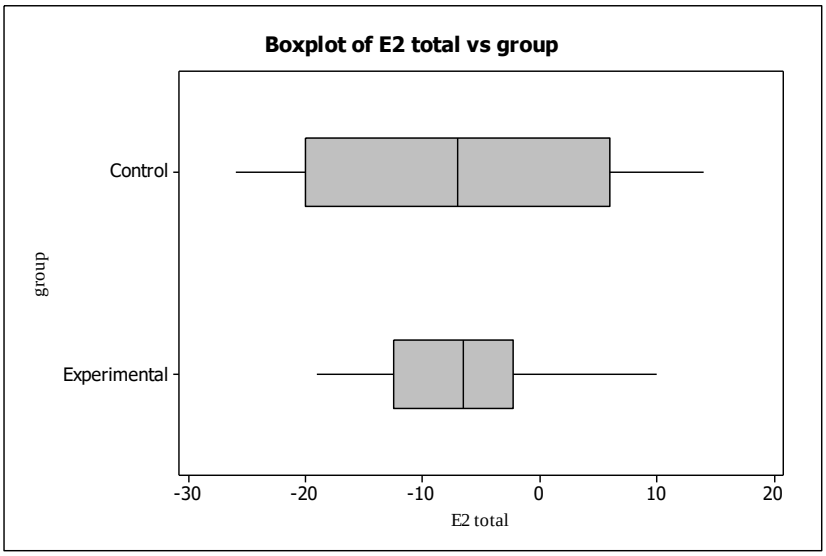

Table 2: Comparison of E2 total scores

E2 total	Control	Experi-mental		Mean difference	-0.5
Sample size	7	14		t-value	-0.1
Mean	-7.3	-6.79		P-value	0.92
Standard deviation	14.8	7.91		Signifi-cant (5%)	No

The twenty-four eligible children were assigned to each of the two groups. Twenty-two of the parents had not sought AIT at this time, but were willing to have their children receive the

intervention. Two of the parents had no interest in receiving AIT, but were willing to participate as controls. One of these controls had received AIT some years ago in London, and the parents deemed it sufficient. Since the number of parents interested in receiving AIT for their children was greater than those not wanting AIT, several were asked to wait until after the completion of the study before having the intervention done. Thus a further six were assigned to the control condition.

Materials and Equipment

1. Questionnaires

- The Diagnostic Checklist for Behaviour Disturbed Children, Form E2. (Autism Research Institute 1964). This is a widely used checklist for assisting in the diagnosis of Autism and related conditions. The data upon which the norms are based, come from 40 countries, and over 34,000 cases. The average score on Form E2 for a child diagnosed 'autistic' is -2, and scores for children classified as 'autistic' range between -15 and + 45. A score of - 16 or lower denotes children who are classified as 'autistic-like' or 'with autistic features.' Thus, the higher the score, the more likely the child is to be classified as 'autistic' by experienced professionals. The score on form E2 is not a measure of severity, or of level of functioning.
- In 1999 Dr Bernard Rimland of the Autism Research Institute, San Diego, published the *Autism Treatment Evaluation Checklist* (ATEC), an instrument specifically designed to measure improvements due to intervention. This form will be the chief measure of change, both for the experimental condition (AIT), and the control condition (no AIT)
- The Aberrant Behaviour Checklist (Aman and Singh 1985). This is a checklist of problem behaviours, with measures for irritability, lethargy, stereotypy , hyperactivity, and inappropriate speech. There are 58 question to be completed, rating whether the behaviour under question is 'not a problem', through 'mild' and 'moderate' to 'a severe problem'. In

this study, the scores were expressed as a percent rating, with 100% being the most severe rating on each behaviour sub-scale.

2. Instruments

Bérard AIT was delivered by means of the Audiokinetron, EERS system, using Beyerdynamik DT100 headphones. Standard AIT was provided, to the specifications of Dr Bérard. No additional special filters were set, since accurate audiograms for the participants could not be achieved.

Music was delivered to the Audiokinetron from a JVC Multi-shuttle CD player, model XL-F254BK. Music was selected from the recommended list supplied during practitioner training. A fresh selection of suitable CDs was provided daily, as is required.

3. Procedure

Participants were identified through the above-mentioned process. The checklists were completed by their parents, and the date was noted as the baseline measuring date.

The experimental group received AIT according to specifications, i.e. either in a continuous ten-day sequence, or with a two-day weekend break. Only one client (E5) did not follow this timetable. She developed an ear infection after 5 days, and accordingly AIT was discontinued until the infection had cleared. Hereafter AIT was completed according to the guidelines of Dr Bérard for the completion of interrupted AIT (Training Manual 1993).

The parents of the control group were asked to complete the same forms as the experimental participants, and the date of completion of the forms was recorded as the baseline measure date.

Each of the groups continued with their usual respective (educational) interventions during the four-month waiting period.

For both groups, the four-month follow-up date was calculated, and the same forms were again completed.

4. Statistical Analysis of Data

The data was collected and group means were calculated. The statistical significance was calculated by Maoilíosa Ó Rathaille, B.A., M.Sc., C.Stat., , Lecturer in Mathematics and Statistics, Waterford Institute of Technology

Results

Two groups of clients were studied; a control group (n = 8) and an experimental group (n = 15). Mean age was not significantly different between the two groups (ref. Table 1.2 and fig. 1)

The Diagnostic Checklist, Form E2

The E2 rating means were not significantly different between groups (ref. fig. 2 and table 2). The range for the control group was –26 to +14 and the range for the experimental group was –20 to +10.

Baseline scores:

The Autism Treatment Evaluation Checklist (ATEC)

The two groups were comparable in their baseline ATEC scores (see fig 5 and table 5).

In addition, both groups started from the same baseline in terms of ATEC and ABC scores. As can be seen in figure 5 and in table 5, there is no statistical evidence of any differences between the groups for the initial ATEC total scores.

Figure 5:

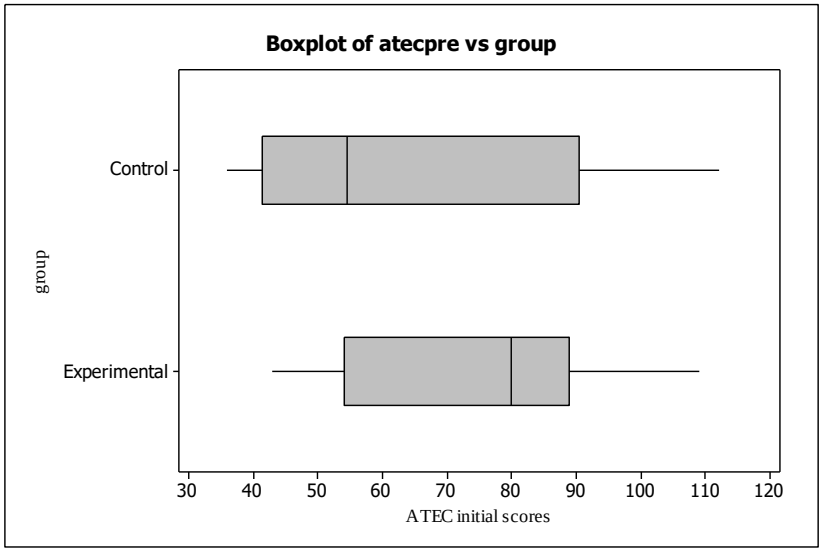

Table 5: Comparison of ATEC initial scores

ATEC initial	Contr ol	Experi-mental		
Sample size	8	15	W-value	79.5
Median	54.5	80.0	P-value	0.3017
Difference between medians	-12.5		Signifi-cant (5%)	No

The Aberrant Behaviour Checklist

The two groups were comparable in their baseline ABC scores (see fig 6 and table 6).

As can be seen , there is no statistical evidence of any differences between the groups for the initial ABC total scores.

Figure 6:

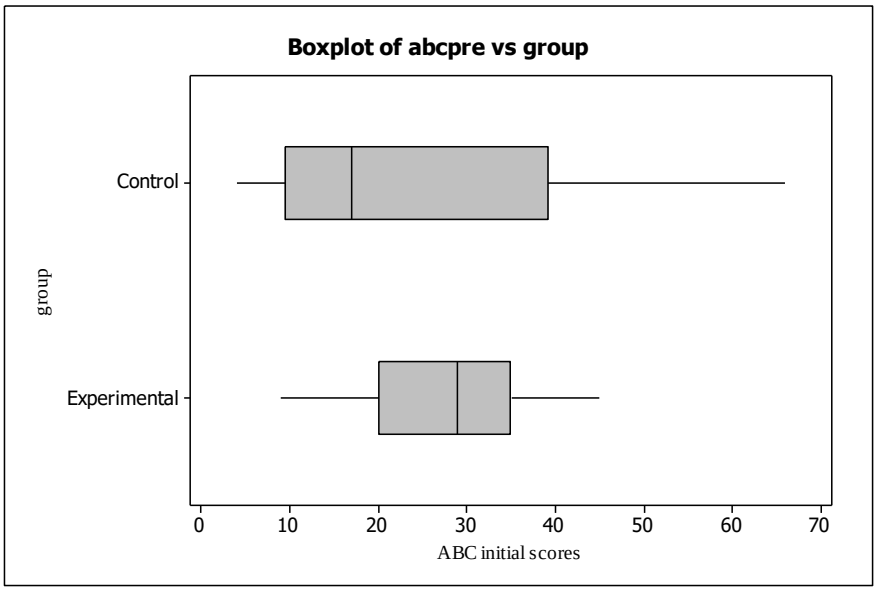

Table 6: Comparison of ABC initial scores

ABC initial	Control	Experi-mental			
Sample size	8	15		W-value	78.0
Median	17.0	29.0		P-value	0.2583
Difference between medians	-8.0			Significant (5%)	No

Thus the baseline ATEC and ABC scores for the two groups were comparable.

Pre-post score analyses:

The scores for the three measurement tools used , the ATEC, and the ABC were calculated, and compared with the baseline scores. The pre- and post scores were compared for the control group and for the experimental group. The pre-post score group means were calculated, and statistically manipulated to derive their significance. The results are displayed below.

The Autism Treatment Evaluation Checklist (ATEC)

The ATEC post-treatment scores were calculated for each group and compared for each group with the baseline scores. The score differences (pre- and post-) were compared for the two groups for each subcategory, and in total.

Looking at the differences of the ATEC scores and the ABC scores for the two groups, the statistical evidence suggests that the there is a significant difference for the ATEC scores (see Figure 7 and Table 7) and almost a significant difference for the ABC scores (see Figure 8 and Table 8), with the experimental group doing better in both cases.

Figure 7.1:

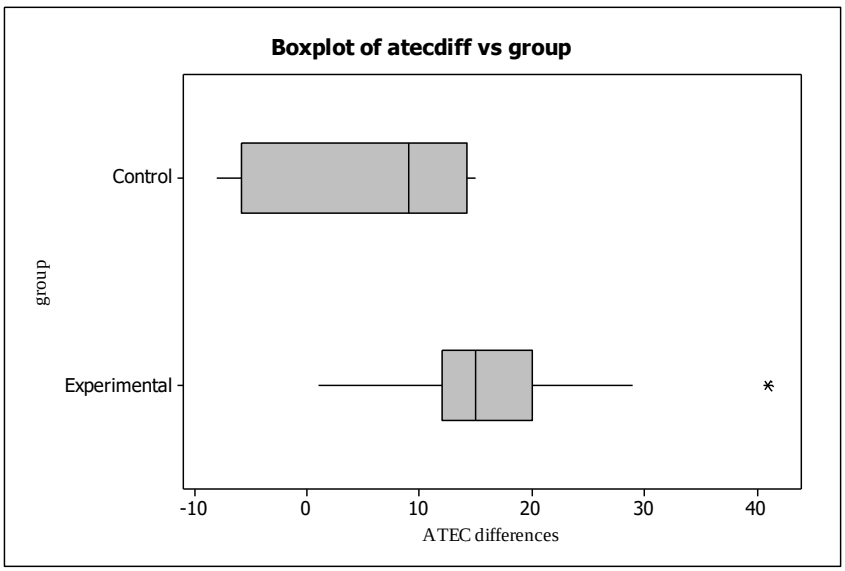

Table 7: Comparison of ATEC differences

ATEC differences	Control	Experi-mental		Mean difference	-10.3
Sample size	6	15		t-value	-2.16
Mean	5.7	16.0		P-value	0.044
Standard deviation	10.3	9.79		Significant (5%)	Yes

To further clarify the importance of these changes or differences, the shifts in percentile rankings are shown (fig 7.2). *(a decrease in the ranking denotes a reduction of severity).*

FIGURE 7.2 ATEC Changes in Percentile Scores

%ile	Speech		Sociability		Sensory cognitive		Health behaviour	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
0-9								
10-19								
20-29								
30-39							✸	✸
40-49		✸		✸				
50-59	✸		✸			✸		
60-69					✸			
70-79								
80-89								
90-99								

ATEC Control group

%ile	Speech		Sociability		Sensory cognitive		Health behaviour	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
0-9								
10-19								
20-29								
30-39				✸				✸
40-49						✸		
50-59		✸					✸	
60-69	✸		✸		✸			
70-79								
80-89								
90-99								

ATEC Experimental group

The Aberrant Behaviour Checklist total score changes were compared (see fig. 8 and table 8).

The tendency for the changes to be more positive for the experimental group than for the controls is seen.

Figure 8:

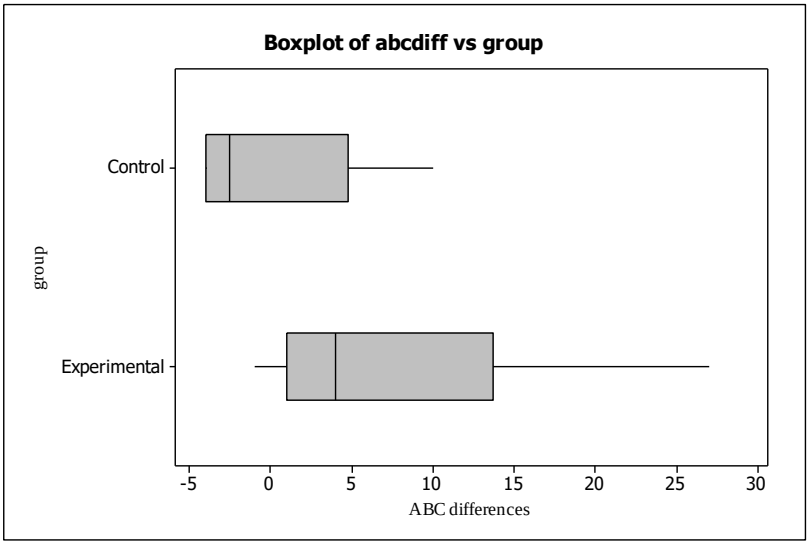

Table 8: Comparison of ABC differences

ABC differences	Control	Experi-mental		Mean difference	-8.07
Sample size	6	14		t-value	-2.03
Mean	0.0	8.07		P-value	0.058
Standard deviation	5.62	8.94		Significant (5%)	No

Discussion of Results

The results of this study seem to confirm the reports that Bérard Auditory Integration Training has beneficial effects that range over many categories. Previous studies have listed these in more detail than is done in this study (Veale, 1993).

It had been the intention to comment upon the effect of AIT upon the outcomes of a range of treatments for children with autism – to compare improvement in speech therapy, occupational and visual therapy, if AIT was added to the intervention protocol. Unfortunately, at the time of study, access to these therapies by the children in this study was too erratic or infrequent to allow this to be explored. It might form a topic for future study.

In effect, the children included in this study were all in an educational system of some kind – whether at home, or special class or school. Thus, the effect of AIT upon their progress in

these educational settings was studied. The children remained in these settings during the study period, without dramatic change of programme occurring. The most common programme being followed was an adaptation of the TEACCH approach with an adapted curriculum.

The two groups were not assigned randomly, but rather in order of presentation. Those who were identified for inclusion were first assigned to the experimental condition, with the later arrivals being assigned to the control condition. This method of selection was unavoidable, given the difficulties in the region with the identification of Autism, and problems with access to the database of children so diagnosed. Since there may have been some bias due to this selection method, it might be that the experimental group represents a different attitude towards AIT, and the results may be affected by this possible bias.

Even so, it does suggest that in general conduct, attention and responsiveness, there are positive changes after a course of AIT. It might further suggest that there is indeed an auditory basis for behaviour, as stated by Dr Bérard (1993) and Tomatis (1983).

For ATEC total scores, the changes were more positive for the experimental group than for the controls.

It would suggest that children with autism in a teaching environment will make some progress, but that the use of AIT enhances their rate of progress.

For changes in the ABC the changes in total scores were significant between treatment groups, with the experimental group showing the greater improvement. The control group differences in mean score change were not only smaller than those for the experimental group, but the controls showed some negative change during the period of the study, in the subcategories of irritability and hyperactivity. The experimental group showed no negative change, or worsening, on any subcategory. This would confirm observations that AIT does no harm (Madell 1994), (Berard 1993), (Stehli 1995). Once again these results would suggest that AIT can enhance the progress of children with autism.

Conclusions

The results of the ATEC suggest that there is some improvement in each of the areas of difficulty of autism:- speech, socialisation, sensory - cognitive, health – physical behaviour. When the total profile is evaluated, the improvements after AIT were significant and not negative (worsening) as they were for the control group in some subscores.

These results demonstrate that AIT could be a useful asset to enhancing the progress of children with autism. They further demonstrate that AIT is likely to be without risk of harm to the recipient.

The results of this study, and of similar studies of the behavioural effects of Bérard Auditory Integration Training, tend to support the general belief that AIT may be 'a risk worth taking' (Veale 1994). In the years since the first studies were done until the present, AIT has never been shown to cause any harm – despite warnings of the potential damage to hearing (in conversations with some audiologists). To the contrary, the only effect on hearing has been positive change (personal experience of over 1000 cases, reports by AIT practitioners).

A high level of parental satisfaction was expressed regarding the use of the Diagnostic form E2 of the Autism Research Institute, whereby a score is achieved of the child's placement on the autistic spectrum. This could suggest the Form E2 could be a useful part of the diagnostic process for the over-36-month-olds.

The ATEC was found to be a valuable instrument to measure progress. Parents found some difficulty with one item of this questionnaire, in section 4 number 1. If a child is in diapers, he won't wet the bed, so parents of children in diapers tended to place a low severity score for this item, although this should have elicited a high severity rating.

This scoring confusion was most marked in the ABC in the section for 'inappropriate speech': A child who *doesn't speak* would have a lower score on this subsection (indicating less

difficulty) than a child who might *speak, but be inappropriate or repetitive*. Thus, this section contains questions that are framed in such a way that improvement can appear to be a regression when a non-verbal child begins to speak. Caution should be exercised when dealing with the data of this particular subsection of the ABC

Suggestions for further study

This study has yet again validated the usefulness of Bérard AIT as an intervention in autism. The author would suggest that there have been a sufficient number of behavioural studies of validation. Future studies might more profitably focus upon the criteria that determine the setting of the additional filters during AIT. The setting of the additional filters is done only upon the completion of a reliable 'Bérard listening test'. This is a specific style of test, using an audiometer, in the manner devised by Dr Bérard. The results of this 'listening test' are scrutinised according to criteria set by Dr Bérard, and latterly by the Society for Auditory Intervention Techniques. These criteria have been set according to 'experience', but have not been subjected to formal study.

Dr Bérard has declared that it is improper to test the hearing of children with autism merely for the AIT. It is frequently impossible to obtain a reliable, repeatable, exact result from these candidates. The attempt to do so leads to unnecessary stress, and to confusions about whether AIT can be done in the absence of a listening test. Thus it is proposed that it would be of benefit to practitioners and parents, to subject this issue to closer study.

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