

## SUMMARISING CAPD RESEARCH AND AIT RESEARCH

### The Efficacy of Auditory Integration Training: Summaries and Critiques: 28 Clinical Studies PRE-2000

Number Of AIT Studies 1993 to 2000				
Disorders	Positive Findings	Ambiguous, Controversial, &/or Contradictory	Results Unclear/ Questionable	No Effects
Autism	13	1 (Bettison) 1 (Gillberg)	1 (Mudford et al.)	0
ADHD	4	0	0	0
CAPD	2	0	1 (Yencer)	0
Several Populations	2	0	1 (Zollweg et al.)	0
Animals (chicks)	2	0	0	0

All of the studies show discernible benefits.

The authors of 23 (i.e. 82%) studies concluded that their data supported the efficacy of AIT, 3 (i.e. 11%) claimed to have found no evidence of efficacy, 2 (i.e. 7%) report ambiguous, 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 clearly favours AIT as a useful intervention, especially in autism

KEY TO ABBREVIATIONS USED IN THE TABLE:

- Aberrant Behaviour Checklist (ABC-1),
- Autism Behaviour Checklist (ABC-2),
- Behaviour Summarized Evaluation (BSE),
- Childhood Autism Rating Scale (CARS),
- Clinical Evaluation of Language Fundamentals--Revised (CELF-R),
- Conner's Parent Rating Scales (CPRS),
- Fisher's Auditory Problems Checklist (FAPC),
- Screening Test for Auditory Processing Disorders (SCAN),
- Self-Injurious Behaviour Questionnaire (SIBQ),
- Staggered Spondaic Word (SSW), and the
- Test of Nonverbal Intelligence (TONI).

TOPIC	YEAR	AUTHORS	SUBJECTS	DESIGN	COMMENTS/ RESULTS
Ocular Movements Among Individuals with Autism Pre- and Post-Auditory Integration Training	1993	Margaret P. Creedon in collaboration with Stephen M. Edelson and Janice E. Scharre	22 ASD subjects  No control group	open-clinical study, visual tracking movements and optokinetic nystagmus (a visual reflex) were assessed.  Parents completed the FAPC and the ABC-1.	Significant improvements were seen in horizontal tracking immediately following <b>AIT</b> and in both horizontal and vertical tracking three months post-AIT . No changes were seen in optokinetic nystagmus.  The FAPC indicated significant improvement at 3 months post-AIT, and the ABC-1 indicated significant improvement both immediately following and 3 months post-AIT.
Study of the Effects of Auditory Integration Training in Autism	1993	Dawn Cortez-McKee and Jaak Panksepp	33 ASD  No control group	open-trial clinical study.  Participants were assessed using multiple measures prior to, at 1-week, 1-month, and 3 months following <b>AIT</b> . The measures included: ABC-1, BSE, CARS, CPRS, FAPC, and SIBQ.	Significant improvement was seen on all of the measures, except the FAPC, at the one- and three-month follow-up assessment periods.  Critique:- FAPC is a survey tool, not a suitable instrument to measure change after AIT.
Study 1 of the Effects of AIT in Autism	1993	Tina K. Veale	5 ASD  5 controls, matched according to checklists right	In a double-blind placebo pilot study. Parents completed the ABC-1, the CPRC, and the FAPC. These instruments were completed prior to, one month following, and three months following <b>AIT</b> .	Positive trends indicating improvement in the experimental group were seen at three months following <b>AIT</b> for all three evaluation forms.
Study 2 of the Effects of AIT in Autism	1993	Tina K. Veale	46 ASD  No controls	This was an open clinical study	Parents completed the ABC-1, CPRS, FAPC as well as the <b>Autistic</b> Behaviour Composite Checklist and Profile.  Significant improvements were observed at one month and six months following <b>AIT</b> .. Some of the behavioural changes included: reductions in hyperactivity, social withdrawal, auditory problems, restlessness, and anxiety.

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Non-Pharmaco-logical Techniques in the Treatment of Brain Dysfunction	1994	Jeffrey M. Gerth, Steve A. Barton, Harold F. Engler, Alyne C. Heller, David Freides, and Jane Blalock	10 children with auditory-based learning deficits Eight of the ten had also been diagnosed as having Attention Deficit Disorder.	Subjects were given a series of diagnostic tests, and parents were requested to complete several questionnaires. Two subscales from the Woodcock-Johnson Psycho-Educational Battery test were used to evaluate changes in auditory processing.	The Sound Blending scale and the Incomplete Words scale, indicated an improvement of one standard deviation or more in 4 of the 10 subjects, and moderate improvement in two other subjects.
Auditory Processing Skills and Auditory Integration Training in Children with ADD	1994	Donna Geffner, Jay R. Lucker, Ann Gordon and Dolores A. DiStasio	16 children with ADD/H.	This study investigated changes in audition and language. A large number of tests were employed to evaluate possible changes as a result of <b>AIT</b> . The measures included: standard audiometric threshold testing, tolerance for tones and speech, speech recognition in quiet and noise conditions, and the Goldman-Fristoe-Woodcock (GFW) Test of Auditory Selective Attention. Post-assessments were conducted within 3 months following <b>AIT</b> .	Significant improvement was observed in the subjects' tolerance to tones and speech, speech recognition in the noise condition, and in listening skills as measured by the GFW Auditory Selective Attention Test and several subscales from the Detroit Test of Learning Aptitude (oral commissions, attention span for unrelated words, and attention span for related words.)
Positron Emission Tomography Measure of Modified Auditory Integration Therapy: A Case Study	1994	Jacqueline M. Cimorelli and Melanie K. Highfill	A single-subject The research subject was an 8-year old male with mental retardation and <u>autism</u>	investigated changes in brain functioning following <b>AIT</b> using <b>Positron Emissions Test (PET) Scan technology</b> .  <b>PET</b> scans were conducted prior to a second set of <b>AIT</b> listening sessions (baseline), one day after and again six months after <b>AIT</b> .	The results at both the one-day and six-month follow-up evaluations indicated a normalization of brain wave activity, including a decrease in hyper-metabolism in the frontal lobe and an increase in activity in the occipital lobe.
Changes in Unilateral and Bilateral Sound Sensitivity as a Result of Auditory Integration Training	1994	Deborah Woodward	60 ASD  No controls	Uncomfortable loudness level (UCL) measurements were performed prior to and immediately following <b>AIT</b> .	Following <b>AIT</b> , the monaural tolerance level to each ear increased 13 to 15 dBHTL, This increased tolerance to speech noise was statistically significant. In addition, the binaural tolerance level indicated a more normal response.

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Parental Perceptions of Change Following Auditory Integration Training for Autism	1994	Dana Monville and Nickola Nelson	40 surveyed parents	Parent Survey	25 (63%) reported an increase in attention span; 25 (63%) reported a decrease in sound sensitivity; 12 (30%) reported an increase in language. 4 parents (10%) reported an increase in tantrums and aggression.
Auditory Integration Training	1994	Dr. Jane R. Madell and Darrell E. Rose	4 children, ASD/ PDD/ Learning Disabilities	Audiological and behavioural assessments were used.	<u>Audiograms</u> of all four children showed improvement following <b>AIT</b> (i.e., a decrease in variability).  Behavioural improvement was observed in three of the four children: <ul style="list-style-type: none"> <li>• increased calmness,</li> <li>• decreased sound sensitivity,</li> <li>• improvements in speech/language</li> <li>• improved word recognition in noise.</li> </ul>
The Effects of Auditory Integration Therapy on Central Auditory Processing	1994	Brenda Huskey, Kathryn Barnett, and Jacqueline M. Cimorelli	6 exp  6 controls	An experimental study of 2 auditory processing tasks, . the SSW test and the Phonemic Synthesis Test (PST).	Pre- and post-tests were given prior to, and at 4 to 6 weeks, and at 8 to 12 weeks following <b>AIT</b> .  For the SSW test, there were no improvements in the subjects 4 to 6 weeks following <b>AIT</b> , but there were improvements on the total score and on the left competing condition at 8 to 12 weeks following <b>AIT</b> .  There were no changes in the results from the PST.

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Clinical Outcome Evaluation: Auditory Integration Training	1994	Jane H. Rudy, Sharon S. Morgan, and Marianne Shepard	13  No controls	An open-clinical study, 13 subjects diagnosed with attention deficit/hyperactivity disorder (ADHD) and/or central auditory processing dysfunction (CAPD) were given a variety of assessments prior to, immediately following, and three months post-AIT. These tests examined hearing acuity, central auditory processing (SSW, SCAN), auditory evoked potentials (i.e., brain waveforms--P200 and P300), language function (CELF-R), and intelligence (TONI) immediately following <b>AIT</b> ,	There were significant improvements in the SSW, SCAN, and CELF-R, and no change in the TONI.  Three-months post-AIT, there was additional improvements in the SSW and CELF-R, but no further change in the SCAN. There was also a significant improvement in the TONI.  An analysis of the P200 waveform indicated a significant change in amplitude but no change in the P300 waveform latency.
Long-Term Effects of Auditory Integration Training Comparing Treated and Non-Treated Children	1996	Donna Geffner, Jay R. Lucker, and Ann Gordon	10 with AIT  10 controls	The study involved a one-year follow-up evaluation of children with Attention Deficit Disorder. A tolerance testing procedure for 'uncomfortable' listening levels was used.	Improvement was observed for the <b>AIT</b> group, but no change in the control group. Additionally, tests evaluating speech recognition in noise and auditory-language processing showed improvement for those in the <b>AIT</b> group but not for those in the control group.
ANIMAL STUDIES	1995  1996	M. Waldhoer, J. Panksepp, D. Pruitt, M. Vaningan, D. McKee, J. Rossi III, and J. Lindsey  Jaak Panksepp, John Ross III, and T.K. Narayanan	Newborn chicks and AIT		The data suggests that <b>AIT</b> may modify serotonergic tone in the brain  Panksepp suggests such music arouses and activates attentional circuits in the brain  <i>These findings indicate that listening to music produced neurochemical changes.</i>

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The Effects of Auditory Integration Training for Children with Central Auditory Processing Disorder (CAPD)	1996	Karen A. Yencer	36 exp and controls	36 children diagnosed with central auditory processing disorder. Children with <b>autism</b> , pervasive developmental disorder (PDD), and multiple-handicaps were excluded from the study.	Testing prior and 1 month after AIT. Standard audiometric testing, the SSW test, the Phonemic Synthesis test, the Standard Progressive Matrices test, FAPC, auditory brainstem response (ABR), event-related potential (P300), and a speech-in-noise test. The P300 analyses indicated some improvement in the <b>AIT</b> condition (mean latency from 366.2 msec. to 348.5 msec.) versus a slight worsening in the placebo condition (mean latency from 400.8 msec. to 402.2 msec.).  <b>Critique – post-AIT testing at 4 weeks instead of the required 3 to 6 months!</b>
The Long-Term Effects of Auditory Training on Children with Autism	1996	Sue Bettison	80 in 2 groups, exp / control, 3-17 years of age, with <b>autism</b> or Asperger syndrome and mild to severe distress in the presence of some sounds.	Measures used were the Hearing Sensitivity questionnaire (HSQ) – an informal survey devised by Bernard Rimland but not validated nor scorable. Also used the Developmental Behavior Checklist.	No difference between AIT and normal music. Improvement in both conditions, Improvements in sensitivity as well as IQ.  <i>Critique: severe shortcomings, The HSQ was designea <u>only</u> as a survey of sound sensitivity in the <b>autism</b> population ana <u>not</u> an instrument to evaluate treatment effectiveness. Is unstandardized , lacking even face validity</i>
Epileptic Activity in Autism and Acquired Aphasia: A Study Using Magneto-Encephalography	1997	Jeffrey D. Lewine, Sherri L. Provencal, John T. Davis, and William W. Orrison,	2 subjects	Magnetoencephalography and EEG recordings were used to measure electrical activity in the brain in one child with dyslexia and one high-functioning <b>autistic</b> adult.	Baseline recordings demonstrated larger than normal responses in the areas associated with <b>hyperacusis</b> .  <b>Following AIT, a more normalized balance or symmetry in electrical activity was observed</b>
The Efficacy of Auditory Integration Training: A Double Blind Study	1997	William Zollweg, Vere Vance, and David Palm	30 participants assigned at random to either an experimental <b>AIT</b> group or a placebo-control group. Mild to profound Mental handicap , some with ASD.	A double-blind research design, Evaluations were conducted using audiometric tests, a Loudness Discomfort Level test, and the ABC-1 at 3, 6, and 9 months following <b>AIT</b> .	No differences were found between the <b>AIT</b> and control groups.  <b>Critique:- AIT not recommended for MD Loudness incorrectly set as high as 122 dB SPL 27% were given wrong narrow-band filters.</b>

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Auditory Integration Training in Children with Autism: Brief Report of an Open Pilot Study	1997	Christopher Gillberg, Maria Johansson, Suzanne Steffenberg, and Orjan Berlin	9 pupils with ASD  No controls	9-month follow-up period, using ABC and the ABC Sensory Subscale.	8 of the 9 children showed improvement on the Autism Behaviour Checklist (ABC) total score, And 7 of 9 children showed improvement on the ABC sensory subscale.
Auditory Integration Training: A Double-Blind Study of Behavioral, Electro-Physiological, and Audiometric Effects in Autistic Subjects	1999	Stephen M. Edelson, Deborah Arin, Margaret Bauman, Scott E. Lukas, Jane H. Rudy, Michelle Sholar, and Bernard Rimland	19 ASD assigned at random to exp/control	All evaluations were 'blind' to group assignment. Behavioral, electro-physiological, and audiometric measures were assessed prior to and following <b>AIT</b> (  Used the ABC-1) in the experimental group at the 3-month follow-up assessment.	A significant improvement was observed in behavioral problems . Electrophysiological: Of the 19 subjects, three experimental group and two placebo group subjects were able to cooperate with the auditory P300 Event Related Potential (ERP) task. <b>All five subjects showed abnormal P300 ERPs prior to the <a href="#">AIT listening sessions</a>. Three months following AIT, all three subjects showed a dramatic improvement in their auditory P300 ERP.</b>  No improvement was seen in the placebo group.
Auditory Integration Training and Autism: Two Case Studies	1999	Mark Morgan Brown	2 subjects ASD	Report of Observations made at three and six months	following <b>AIT</b> . Improvements were reported in attention, arousal and sensory modulation, balance and movement perception, praxis and sequencing, speech and language, social and emotional maturity, and eye control.
The Effects of Auditory Integration Training on Children Diagnosed with Attention Deficit /Hyperactivity Disorder: A Pilot Study	2000	Wayne J. Kirby	5 experimental,  5 controls	A placebo-control design, Subjects were assessed using the Auditory Continuous Performance Test (ACPT) prior to and three months following AIT.	Comparison of the two groups at three months post-AIT indicated a statistically significant reduction in the total number of errors for those in the <b>AIT</b> group.  Improvement on the impulsivity and inattention scores were not significantly different from the placebo group.

COMMENTS REGARDING TWO PARTICULAR CRITICISMS OF AIT AND POSITIVE RESEARCH RESULTS:



Patricia Howlin's criticisms were based on her misunderstanding the interpretation of the statistics. E.g. She stated "Thus, the mean fall in the ABC score was less than 0.4 points; hardly a dramatic change in a scale of 58 items" (page 348). Howlin assumed that the maximum possible score on the ABC-1 was 58; however, the maximum possible score was only 3. Thus, the difference of almost 0.4 points is a meaningful proportion of the 0 to 3 range and is clinically significant.

Regarding another measure, Howlin stated that a 12-point difference on the 93-item FAPC was also not clinically important. Howlin was wrong again. The FAPC contains 25 items, not 93 items; thus, an average change on 12 of 25 items is quite dramatic and clinically significant. Again, the results were positive, not negative

In another report, Rankovic, Rabinowitz, and Lof (1996) measured the sound output levels of a single AudioKinetron, set at its loudest output possible – 118dB. They conclude it can be harmful to hearing. However, they ignored the protocol for AIT which recommends maintaining client comfort and safety in setting loudness. They also conjecture harm, where none has ever been found. The opposite is more likely to occur, where in fact some improvement in graphs is the change found.

## **NOTE:**

**Scientific, evidence-based opinion about AIT should be based on evidence and observable facts rather than prejudice or supposition.**

## RESEARCH OUTCOMES : AUDITORY INTEGRATION TRAINING, POST- 2000

TOPIC	YEAR	AUTHORS	SUBJECTS	DESIGN	COMMENTS/ RESULTS
Study on the Correlation between Hearing Quality and Learning Ability	2001	Maria Vega, Spain	158 pupils	Apd - the actual learning performance of each subject as testified by the school records and staff.	The study conclusion is that hearing quality is so important for classroom activity that learning success and failure depend on its integrity.
<b>A Pilot Study:</b> 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	2002	Rosalie Seymour	16 ASD exp  8 ASD controls	Baseline to matched exp and controls using form E2, ATEC, ABC, Parents Questionnaire	the AIT group's pre-post differences were more likely to be positive than the control group.. It is also seen that only the control group showed any negative change (i.e. worsening). The AIT group total score improvement was significant, The improvement in hyperactivity scores was <i>highly significant</i> in the AIT group. And the difference between the control and AIT was highly significant.
Autism Research 2005: Report on the Changes in Scores for a Group of 13 Children with Autism After Berard Auditory Integration Training	2005	Rosalie E Seymour, Maoilíosa Ó Rathaille	12 pupils with ASD	This study to answer two questions: 1. To determine whether AIT made any difference for those children with autism who participated . 2. The next question to answer was, is this difference bigger than one can expect from ordinary chance? Used ATEC and ABC and PQ.	Results showed significant changes to the ATEC subscales for Sociability, and for Sensory/Cognitive, and the total scores. These results show that there were improvements for the group in all the areas covered by this checklist. There were significant changes in the areas of <u>irritability, lethargy, hyperactivity, and the Total</u> scores. That is, we can confidently say they were not as a result of chance but are likely to have been due to AIT.

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The Hearing Ear and the Listening Brain – an Evaluation of Auditory Integration Training in Children/Students with Concentration Problems and Learning Difficulties	2006	Britta Alin Åkerman, Lars Borazanci Persson	56 subjects, 21 students with ASD  28 AIT 28 controls	Listening tests, parents and teacher questionnaires rating attention, and household behaviours.	Show a difference between the intervention and control groups ranging from slight difference to considerable difference. Additional observed improvements included:- Improved eye contact, improved communication, longer sentences, improved interaction. Reduced sound sensitivity. Attention and calmness.
Research	2006	Alaa El-Din Abou-Setta, MD; Iman Sadek, MD; Amani Shalaby, MD; Nagwa Hazzaa, MD, <i>Ain Shams University</i>	15 children with ASD. Included 8 with hyperacusis.	To explore the value of AIT as a complementary measure in rehabilitation of autistic children. Autism Performance Observation Sheet (APOS) was developed for parents to report on behaviour and communication..	Reduction in hyperactivity, in social withdrawal, in auditory problems, in restlessness and in anxiety following AIT. Found an increase in attention span, a decrease in sound sensitivity, and an increase in language.  <b>Commented: ‘AIT can be viewed as a reasonably effective complementary tool in the rehabilitation of autistic children. It seems that it paves the road for more benefit from the classical ways of rehabilitation’.</b>
Berard AIT Supports Memory Training Program The Mediterranean Project	2013	Dr Selvi Borazanci Persson	68 subjects, ages 6-65 yrs AIT before memory training only. 33 controls - memory training	A study was to determine if memorizing can be enhanced by AIT. Task = 1. memorizing image cards (auditory & visual) 2. peg words (auditory), 3. face recognition with names (auditory & visual)	In each task, and for all age groups, the improvement in the AIT condition was highly significant, and continued to improve over a 9-month period post-AIT.

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Effectiveness of Auditory Integration Therapy in Autism Spectrum Disorders —Prospective Study	2013	Prof. Laila Y. Al-Ayadhi, Abdul Majeed Al-Drees and Ahmed M. Al-Arfaj, <i>Saudi Arabia</i>	72 with ASD (CARS: 21 moderate, 51 severe)	To determine the effectiveness of auditory integration training (AIT) in people with ASD. Pre-intervention and post-intervention (3 and 6 months) scores were calculated using CARS, Social Responsiveness Scale (SRS), and the Autism Treatment Evaluation Checklist (ATEC).	All subjects demonstrated improvement 3 and 6 months following the AIT. ASD subject showed 22% and 26% percentage improvement in SRS scoring. Statistically significant changes in social awareness, social cognition, and social communication. Similar results were achieved with the ATEC <i>'The results of this study support the therapeutic effects of auditory integration training on social awareness, social cognition, and social communication, as well as speech and communication.'</i>
Berard Auditory Integration Training: Behavior Changes Related to Sensory Modulation.	2014	Sally S. Brockett, Nancy K. Lawton-Shirley and Judith Giencke Kimball	Cases of 54 children with disabilities (34 with autism), ages 3–10 years, who received Berard AIT, were reviewed.	A study to determine if behaviours specifically related to sensory modulation showed positive changes following 10 days of Berard auditory integration training (AIT).	Behavioural problems reduced on all five factors of the Aberrant Behaviour Checklist (P < 0.01), maintained at three and six months. The Short Sensory Profile scores improved.
The Effects of Auditory Integration Training (AIT) on Mismatch Negativity in Children with Autism	2015	E. M. Sokhadze , S. M. Edelson , L. L. Sears , M. F. Casanova, A. Tasman and S. Brockett	11 ASD 11 control	The aims of the study was application of Berard's Auditory Integration Training (AIT) techniques in children in autism and assessment of AIT course outcomes using MMN, frontal P2a and P3a evoked potentials, and behavioral questionnaires (ABC,CPI).	Berard AIT resulted in significant decrease of Irritability, Hyperactivity and Lethargy scores on the Aberrant Behavior Checklist (ABC), and improved Emotion, Behavior and Receptive Language Scores on the Comprehensive Performance Index (CPI) scales. <b>The study demonstrates that Berard AIT positively affects auditory stimulus processing, reflected both in early (MMN) and late (P2,P3a) evoked potentials.</b>

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Before-and-After Central Auditory Processing Test Results For AIT – a Clinical Retrospective Study	2015	Judith Paton	210 subjects:- with learning disability (LD), dyslexia, speech/language disorders, and/or central auditory processing disorders (CAPD or APD).	<p>Changes in central auditory processing test scores between pre- and post-AIT evaluation. Used 11 CAP tests.</p> <p>The four tests showing the most improvement (70-90%) were:</p> <ol style="list-style-type: none"> <li>Speech Discrimination in Ipsilateral Noise at 0dB S/N (signal-to-noise ratio) (90%)</li> <li>Filtered (low-pass) Speech at (81%)</li> <li>Time Compressed Sentences (at 60% compression) (73%)</li> <li>Pitch Pattern Sequencing (70%)</li> </ol> <p>Second-most improved by AIT (50-69%) were:</p> <ol style="list-style-type: none"> <li>Sound Blending (68%)</li> <li>Duration Pattern Sequencing (56%)</li> <li>Dichotic Competing Sentences (56%)</li> <li>Binaural Fusion (55%)</li> <li>SSW (Staggered Spondaic Word) test (54%).</li> <li>Competing Words (47%).</li> </ol>	<p>The average improvement for LD and ASD groups together across tests was 67%. (<i>The small number of ASD patients showed 61% improvement, with the even smaller number of adults at 78%.</i>)</p> <p>The total amount of improvement after AIT for all subjects on all repeated tests was:</p> <ol style="list-style-type: none"> <li>80 to 100% improved -- 49%</li> <li>50 to 79% improved -- 50%</li> <li>12 to 49% improved -- 1%</li> </ol> <p><b><i>'Results of this study show that AIT can be reasonably quick and effective way of improving functioning of the central auditory nervous system'.</i></b></p>
Impact of Auditory Integrative Training on Transforming Growth Factor- $\beta_1$ and Its Effect on Behavioural and Social Emotions in Children with Autism Spectrum Disorder	2018	Prof. <u>Laila Al-Ayadhi,</u> <u>Abdulrahman Mohammed</u> <u>Alhowikan, Dost Muhammad</u> <u>Halepoto Saudi Arabia.</u>	15 children with ASD	This study investigated the impact of Auditory Integration Training (AIT) on transforming growth factor (TGF)- $\beta_1$ and its effect on behavioral and social emotions in children with autism spectrum disorder (ASD).	The increased plasma levels of TGF- $\beta_1$ after AIT support the therapeutic effect of AIT on TGF- $\beta_1$ followed by improvement in social awareness, social cognition, and social communication in ASD children.