Auditory Integration Training for Autistic Children

Abou-setta A [*], Sadek I [**], Shalaby A [**], Hazzaa N [**]

Introduction:

Auditory Integration Training (AIT) is essentially a form of music therapy developed by Dr Guy Berard in Annecy, France in 1963. His technique gained world-wide recognition with the publication of the book titled "The sound of a miracle" in 1986 about Georgia, diagnosed with severe autism who greatly benefited from a course of 20 AIT sessions. AIT was successfully used to help patients with attention deficit hyperactive disorders (ADHD), learning disabilities, pervasive developmental disorders, central processing disorders, sound sensitivity, vestibular processing dysfunction and speech comprehension problems [1].

AIT, as developed by Berard and based on the work of his predecessor Alfred Tomatis, consists of two sessions per day, 30 minutes each, for ten days [2]. Therapeutic listening implies that the listening programs are individualized to each patient. Different studies were conducted to investigate the efficacy of AIT. While the majority supported its beneficial effect [3-9], few studies either reported no benefit or controversial findings after AIT [10-12].

The aim of this work was to explore the value of AIT as a complementary measure in rehabilitation of autistic children.

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[*] Audiology Dept., Suez Canal University

[**] Audiology Dept., Ain Shams University

***Methodology*:**

Sixteen children, previously diagnosed as having classic autism, or some autistic traits**,** by a child psychiatrist, underwent AIT, during the period from July-September 2005, as part of their rehabilitative program. They were submitted to audiological evaluation, which was performed to ensure that all children have normal peripheral hearing, normal middle ears function and to detect hypersensitivity to sounds if present.

Immittancemetry using acoustic immittancemeter, Madsen model Zodiac 901, was done prior to hearing threshold assessment. Children with middle ear effusion or Eustachian dysfunction were given medical treatment and retested after resolution of middle ear disturbances. Based on the behavior of the child; either free-field or play audiometry was applied using two-channel audiometer Madsen model Orbiter 922.

Hearing thresholds were determined using traditional methods or audioscan at all frequencies from 125 Hz up to 8 KHz, including half-octaves. Peaks and/or plateaus in audiogram were identified, denoting auditory hypersensitivity. Uncomfortable loudness thresholds were also determined for each child using pure tones, narrow band noise, live speech sounds and speech noise.

The previous evaluation was routinely performed by two examiners at a time, and then repeated at least twice to ensure consistency of the results. In addition, auditory brainstem response was recorded, whenever hearing loss was suspected, for confirmation of results using Evoked potential system Biologic Navigator EP317.

An important step prior to application of AIT was to train the child to wear the headphones. This training was held partly in the clinic and partly at home by the help of the parents and/or the shadow teacher.

AIT listening sessions was conducted using the Kirby Auditory Modulation System "KAMS". Based on the audiological evaluation, notch-filtering applications

were made for AIT candidates consistent with Kirby's protocol. Every patient was submitted to 20 listening sessions of 30 minutes each, at least three hours apart. Re-evaluation was done after the first ten sessions to readjust filters; (if necessary). Starting from the 6th day of listening, lateral emphasis was applied to stimulate left auditory cortex. A final evaluation was done after completion of the 20 listening sessions.

Before admission to AIT program, parents were allowed to fill pre-admission questionnaire in order to explore their main concerns and to ensure realistic expectations.

Autism Performance Observation Sheet (APOS) was developed to allow parents to report on changes in behavior and communication abilities of their children. Parents were allowed to fill APOS three months after the last AIT session.

Results:

Out of the sixteen children who received AIT, the outcome could be evaluated in 15 of them. One child traveled abroad immediately after the sessions and his data were not available. The age of the children ranged from 3 years 7 months up to 12 years 2 months. The mean age was 5 years 5 months. They were distributed as follows: eight children were less than 5 years of age, while three were from 5 up to 9 years and five children lied between 9 and 12 years.

Audiological evaluation for all children proved absence of any peripheral hearing loss. Auditory hypersensitivity was encountered in 8 children. Hypersensitive peaks in the audiogram could be identified in 6 children at either 2, 3, 4 or 6 KHz. One child had multiple bilateral symmetrical peaks . Another one showed single bilateral symmetrical peaks. The other four had asymmetrical peaks, whether

unilateral or bilateral, single or multiple (table 1). Two children showed reduced loudness discomfort level. The final evaluation revealed disappearance of all previously detected peaks. This was true except for one child (aged 12 years and 2 months). His peaks at 2&3 KHz did disappear from the audiogram. Yet, there was evident emergence of new peak at 750 Hz in right ear only.

Table (1): Hypersensitive peaks detected in audiogram of six autistic children

Case no.	Age-years	Right ear	Left ear
1	11	2 & 4 KHz	2 & 4 KHz
2	7	None	2 &3 KHz
3	3	3 KHz	None
4*	12	2 &3 KHz	None
5	12	4&6 KHz	6 KHz
6	5	4 KHz	4KHz
* new peaks	12	750 Hz	None

The results of APOS showed different degrees of improvement, reported by the parents, in many of the behavioral and communicative abilities of the children (table 2). Self-esteem, expressing feelings, and self-help skills were the most common behavioral aspects improved. In addition, response to orders, eye contact, attention and verbal language were the most common communicative abilities reported to improve (table 3).

Table (2): (APOS) Behavioral changes 3 months post AIT as reported by the parents.

Behavior	Better %	Same %	Worse %	N/A %
Self esteem	66.7	33.3	-----	-----
Aggressiveness	13.3	20	13.3	63.2
Defending him/her self	26.6	20	-----	53.3
Expressing feelings	46.6	40	-----	13.3
appropriate emotions	13.3	73.3	-----	13.3
Anger spills / hyperactivity	26.6	6.6	13.3	53.3
Self help skills	46.6	33.3	-----	20

N/A: Not applicable .i.e. there was no compliant in such aspect before AIT.

Table (3): (APOS) Communication abilities changes 3 months post AIT as reported by the parents.

Communication	Better %	Same %	Worse %	N/A %
Eye contact- attention	80	13.3	-----	6.6
Response to his/her name	26.7	60	-----	13.3
Response to orders: - auditory/ non-auditory	86.7	13.3	-----	-----
Express him/herself needs	73.3	26.7	-----	-----
Playing with family members	66.7	26.7	-----	6.6
Playing with other children	60	40	-----	-----
Receptive verbal language	80	20	-----	-----
Sensory hypersensitivity: -auditory / touch / appetite	66.7	20	-----	13.3
Sleep rhythm	26.7	33.3	-----	40
Toilet training	20	26.7	-----	53.3

N/A: Not applicable .i.e. there was no compliant in such aspect before AIT.

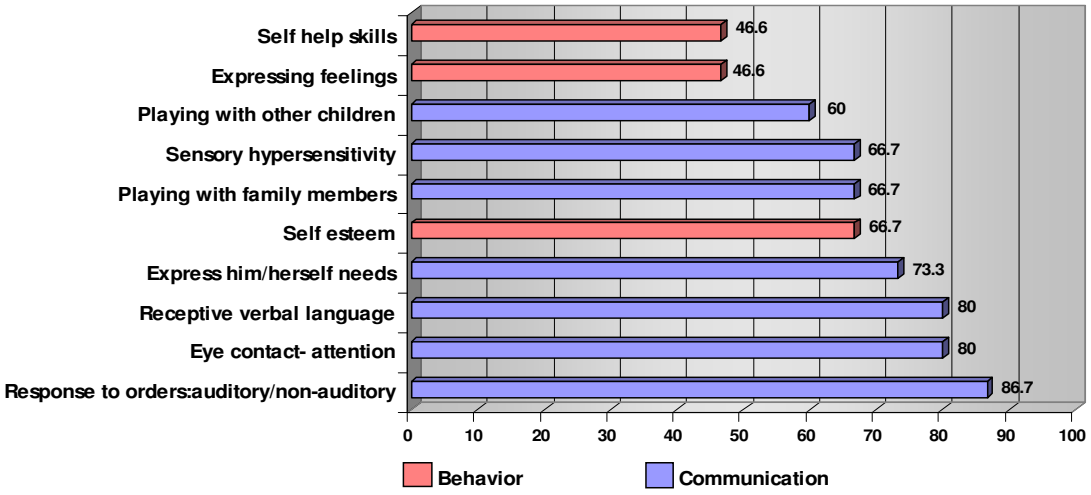

Figure 1 - Percent of children showing improvement
in different aspects following AIT

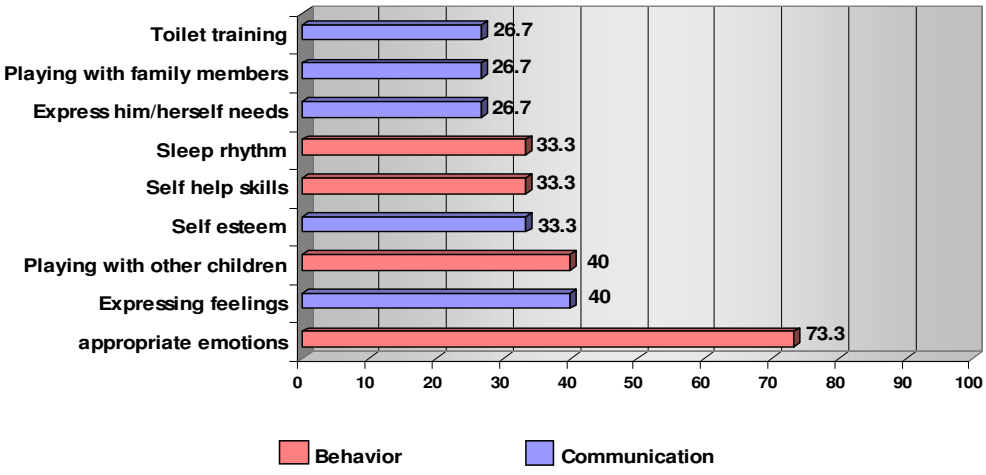

Figure 2 - Percent of children showing no change
in different aspects following AIT

Discussion:

The ultimate goal of the present work was to record the changes –whether in behavior or in communicative abilities– in a group of 16 autistic children, three months following AIT sessions..

There was a general improvement in different aspects studied as shown in tables (2,3) and figure (1). Similar improvement was reported by Veale [4] who mentioned behavioral changes including: reductions in hyperactivity, social withdrawal, auditory problems, restlessness and anxiety in a group of 46 autistic patients following AIT sessions. Monville and Nelson [6] demonstrated than 63% of parents of children with autism or pervasive developmental disorders reported an increase in attention span and a decrease in sound sensitivity while 30% reported an increase in language.

The improvement noticed in attention following AIT could be related to the modulation of music during AIT listening sessions. Changing the music from low end of frequency at one moment to high level of the spectrum in another moment together with random change in volume may train the listener to tune in to his/her environment. Indeed, random changes cannot be predicted and the patient learn to shift his/her attention more rapidly and more efficiently [7].

Although AIT stimulates essentially the auditory system, the improvement was also found in other senses (smell, taste and touch). This could be explained on the basis that intense sounds stimulates not only stimulate not only the cochlea, but also the vestibular otolith organs which are connected to the brainstem structures, spinal cord and cerebellum [13] .

The cerebellar-vestibular system is the sensory- motor processing center of the brain. It is responsible for the integration and processing of all sensory information (including hearing, vision, taste or smell) Goddard [14-16].

In the present work, eight children reported hypersensitivity to sounds in the form of peaks (n = 6, table 1) or intolerance to loud sounds (n = 2). This hypersensitivity disappeared completely in six of them while one child had consistent peaks and in the other one, a new peak appeared after disappearance of original ones. Such improvement was also reported by Woodward [5] and Monville and Nelson [6]. Research data correlated hypersensitivity to sounds with disturbance in serotonin neurotransmitter in the brain of autistic children. Hergerl and Pechel [17-19] had demonstrated the strong relation between loudness dependence of auditory evoked potentials and low serotonergic function in normal human volunteers and psychiatric patients. Another possible explanation for the disappearance of hypersensitivity to certain frequencies after AIT could be due to lateral inhibition phenomenon proposed by Edelson [7]. Filtering out hypersensitive frequencies and stimulation of non-sensitive adjacent areas would possibly, by lateral inhibition, abolish sensitivity to sounds. The appearance of new peaks after disappearance of original ones was an unexpected findings in one of our patients, we can speculate that the original peaks were so sharp and prominent to the extent that, relatively, the newly detected peak was considered of normal sensitivity in the evaluation prior to AIT.

Hypersensitivity to certain sounds was claimed to be responsible for painful or distorted hearing which in turn lead to delayed language development, both receptive and expressive. In addition, this hypersensitivity could be also responsible for the fear reactions, anger spills, unexplained changes in mood or disturbed sleep rhythm frequently encountered in autistic children. The extensive neural connections between

the auditory cortex in the temporal lobe, the limbic system and amygdale support the relation between hypersensitivity to sounds and the fore mentioned abnormal behavior. Accordingly, improvement in such cases could be viewed, partly, as a consequence of disappearance of such hypersensitivity.

The positive changes noticed in our patients in variable aspects and degrees suggest that after the completion of the listening sessions, the brain reorganized itself in a more natural, structured and functional manner. Indeed, Kirby [20] proposed the 1/f theory suggested by Anderson [21] to explain the changes that occur after AIT.

One over f (1/f) noise waveform patterns represents a distribution pattern found throughout our natural world and may correlate to "normal" brain function. Developmental disorders and autism appear to be associated with chronic alterations in these normally stable bursting (1/f) patterns and the brain regions supporting this activity. European classical music composition contains 1/f distribution of dynamic (as well as pitch) content. It is believed that this pattern may be partly responsible for some of the beneficial effects of Kirby method of AIT applied in this work.

Regardless which of the theories will prove its relation to the improvement following AIT, we can not ignore a very strong fact which is "brain plasticity ". It reflects the ability of the brain to be molded or changed after repeated sensory stimuli. The brain will respond with change when three conditions are met: attention, repetition and intense exposure. These three rules are fulfilled in AIT [22]

An attempt was made to identify the predictors of success of AIT. However, in view of the presence of multiple variables (e.g. age, previous enrollment in rehabilitative programs, severity of autism, family support, enrollment of children in rehabilitation program following AIT, presence/ absence of hypersensitivity, etc.,) and the relatively small number of children examined, statistical analysis could not be

performed to achieve this goal. Yet, thorough observation of our sample highlighted the importance of family support and enrollment of children in a comprehensive rehabilitative program post AIT. It should be mentioned that Rimland and Edelson [23] reported that no significant relationships were found between behavioral improvement and age, degree of sound sensitivity and the amount of variability in the pre AIT audiogram.

In conclusion, 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.

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