



- Eliciting Speech in Nonverbal Children with Autism. **Journal of autism and developmental disorders**. 43. 10.1007/s10803-012-1672-z.
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the verbal production of children with ASD in reference to whether they receive music training, speech training or no training at all. Fifty participants who aged between 3 years to 5 years old underwent standard tests of language and level of functioning. Tests measured participants' semantics, phonology, pragmatics, and prosody using Verbal Production Evaluation Scale (VPES) and ASD severity by CARS and Autism Diagnostic Interview Revised (ADI- R) in the three groups pre and post intervention. Results determined that verbal production improved markedly in post- intervention assessment in each of the speech therapy group and Music therapy group. According to Lim (2010), "children with ASD perceive important linguistic information embedded in music stimuli organized by principles of pattern perception, and produce the functional speech". This explanation may be the reason for improvement found in the communicative score in the current work.

O'Loughlin (2001) investigated the effect of combined music and language therapies on pre- linguistic communication behavior. Their study measured eye contact, children's ability to look and point at stimuli, engagement with peers and imitation skills (talking and signing). Their sample consisted of 44 autistic children who aged between two and three years old. Results showed improvement in the eye contact and looking at a stimulus (picture). Their findings found no verbal communication improvement however, advances in passive vocabulary were their major finding.

In accordance to this study, Simpson et.al. (2013) conducted a study measuring the effectiveness of music therapy on receptive labeling tasks on a sample of 22 children who aged 3 years and half to 9 years. It was composed of 22 participants who aged between three and a half years old to nine years old. Findings revealed that the use of musical elements during an intervention to teach language skills has a positive impact on children as it enhances engagement.

This study's third outcome was the total raw score of the auditory processing section in the sensory processing part of the sensory profile questionnaire; before and after 40 sessions of intervention. Results of the questionnaire revealed a significant difference of less than 0.05 between total raw scores of the auditory processing section pre and post intervention.

In line with this study, Al- Ayadhi, Al- Drees and Al- Arfaj (2013) conducted a study in Saudi Arabia to measure the effectiveness of Auditory Integration Therapy (AIT) in autism. 72 participants contributed to the study; 70 of whom were males and their ages ranged from 3 up to 17 years old. Autism was diagnosed by a pediatrician and psychologist using DSM- 4 along with the Childhood Autism Rating Scale (CARS). CARS, Social Responsiveness Scale (SRS) and the Autism Treatment Evaluation Checklist (ATEC) were conducted pre intervention and post intervention as well. The duration of the sessions were 30 minutes long and the frequency ranged from 18 to 20 sessions. Results revealed a significant improvement in some aspects of autism behavior as well as a significant improvement in speech, communication and sociability. This is

in conformity with this study.

In accordance with the results of our study, Hall and Smith (2007) collected pre and post intervention assessment for participants upon completing 12 weeks of training; they combined the diet regimen followed by AIT. They utilized the sensory profile questionnaire and all participants had a definite difference on the Sensory Profile in at least three areas. A significant change occurred between both pretests and posttests proposing that the combination is effective for kids with sensory processing disorders. This is in conformity with this study.

Additionally, a study conducted by Morgan- Brown, Mark (1999), is in line with this study as it confirmed AIT's positive effect on individual's functioning. Despite the very small size of their sample, improvement was measured in regards to various aspects (attention, self- initiation of purposeful activity, arousal and sensory modulation, balance and movement perception, speech and language, social and emotional maturity, praxis and sequencing and eye control). This is in conformity with this study.

Contrary to this study, Sinha et.al., (2011) conducted a systematic review aiming to identify, evaluate and analyze the effectiveness of AIT and other methods of delivering sound therapy to individuals with autism spectrum disorders in regards to improving abnormal sound sensitivity and autistic behaviors. They found that 6 randomized controlled trials were studied, all of which contained auditory integration therapy and one of Tomatis therapy. The study showed that there was no evidence supporting the effectiveness of auditory integration therapy or other sound therapies in treating autism spectrum disorders. However, two studies in Sinha et.al. (2011) found only two that reported a statistically significant effect of the auditory integration therapy group compared to the control group. At the time that their review lowered the importance of auditory training, the method of delivering sound therapy to individuals with autism spectrum disorders may be the point of difference.

#### **Ethical Considerations:**

Ethical consideration according to the research ethics committee of both Ain Shams University and Faculty of postgraduate childhood studies.

#### **Conclusion:**

Based on the results of this study the use of music in intervention programs in children with Autism Spectrum Disorder is considered as an effective therapeutic method in making changes in the PLS- 4 and the auditory component of the Sensory Profile which indicates that there was an improvement in communication skills, as well as perception of auditory stimuli. therapeutic outcomes were significantly more evident in males than in females.

#### **Recommendations:**

This study provides some evidence of partial improvement of children with ASD upon auditory training using music. However, further studies using larger samples for a prolonged period should be implemented to assess the effectiveness of the current program.

test. Results show that there's a non- significant change in ADOS total raw scores between pre and post therapy ( $t= 1.795, P= 0.083$ ). On the other hand, results showed that there's a statistically significant change on the PLS- 4 total raw score ( $t= -4.709, P < 0.05$ ) between pre and post intervention. Similarly, the Sensory Profile questionnaire scores in the auditory processing domain changed significantly ( $t= -4.267, P < 0.05$ ). Thus, the second and third results are accepted as true since  $P < 0.05$  for the PLS- 4 scores and the Sensory Profile questionnaire scores that changed significantly after the intervention.

Scores were also divided among male and female participants in this study to compare the mean scores. Results show that there's a significant difference in all outcome measures (ADOS, APLS- 4, and Sensory Profile Questionnaire (Auditory processing)) among male participants ( $P < 0.05$ ). As for the female sample, the ADOS results could not be assessed as the sample was too small to reveal any difference. On the other hand, there were no significant differences in the PLS- 4 scores, and Sensory Profile Questionnaire (Auditory processing) score for female participants.

Table (2) The Outcome Of The Auditory Based- Music Therapy Rehabilitation Program In The Three Assessed Parameters

The Whole Sample	Range Pre	Range Post	Mean (Standard Deviation)	P Value All	P Value Females	P Value Males
Pls- 4	(34- 127)	(34- 128)	( $\pm 0.504$ )	0.000	0.076	0.000
Ados- 2	(10- 22)	(10- 22)	( $\pm 0.305$ )	0.083	NA	0.043
Sensory Profile Questionnaire	(9- 34)	(10- 33)	( $\pm 0.770$ )	0.000	0.175	0.001

**Discussion:**

This study's first outcome measure was the total score obtained from the Autism Diagnostic Observation Schedule 2 (ADOS- 2). The ADOS- 2 is the latest version and a widely utilized tool that is designed as a diagnostic instrument for ASD. Auditory Training based music therapy rehabilitation program applied did not influence the symptom severity of ASD based on the ADOS- 2.

In comparison with the current work was a study by Bharathi et.al. (2019). They examined the effect of music therapy on social skills' development among autistic children (diagnosis was made by a multidisciplinary team using DMS- V) who aged (6- 12) years. They found that children that were actively interacted with music scored significantly higher on Childhood Autism Rating Scale post- exposure to music therapy than those who were passively exposed to it. Furthermore, they confirmed that children with mild and moderate severity only benefit from the therapy program. The difference between the current work and their findings was related to the older age of their sample and the nature of reaction to music therapy by dancing not only discrimination and imitation of the beats carried in the current work.

Crawford et.al (2017) published a multicentre trial of improvisational music therapy for Children diagnosed with autism whose ages ranged from 4 years old up to 7 years old. The study analyzed the effects of improvisational music therapy (IMT) on social affect and responsiveness of children with ASD. Results of this study revealed that the social ADOS

affect score decreased from baseline after a period of 5 months of music intervention. However, the amount of decrease was statistically of no significant difference. Similar to the current study, Bieleninik and colleagues (year of publication) measured autism using Autism Diagnostic Observation Schedule (ADOS), along with two of the three domains of the Autism Diagnostic Interview- Revised (ADI- R). Findings revealed that there was no change in ASD symptom severity for children after 5 months of receiving IMT along with their treatment. Additionally the secondary outcomes measured were also non- significant; as any improvements shown were minimal and clinically insignificant.

The outcome of music therapy for children with autism was comparable to other modalities of therapy that has been in the field since decades. This study's findings were in accordance to the study conducted by Itzchak and Zachor (2009). They examined the effects of early behavioral intervention for children with autism on intellectual functioning and autism severity. They utilized the ADOS algorithm for diagnosis and measurement of outcome. Their findings showed that after 1 year of intervention; around 78% of the children's autism diagnosis didn't change. While remaining 22% had a change; 19% got a less severe diagnosis and 3% fell out of the autism criteria.

In contrast to the present study, Kwon and Wang's (2009) introduced an early intervention program for children with autism. Participants' ages varied from 17 months old up to 36 months old. Findings revealed that the intervention had positive effects in regards to both the communication and the social skills for the participants. Specifically the participants showed improvement in the following areas; quality of social overtures, requesting, pointing and vocalizing.

Lastly and contrary to the present study was Kim et.al. (2008) who examined the influence of play and improvisational music therapy on joint attention behaviors in children with autism. Utilizing DMS V and ADOS as an assessment tool, they found a significant improvement in the joint attention behaviors of the participants. The better mental functions and the younger age of their sample could explain the difference between their work and the data implemented in this study.

This study measured the outcome of an auditory training based rehabilitation program on the Preschool Language Scale- 4 Arabic edition (PLS- 4), before and after 40 sessions of intervention. Results determined that there is a significant difference between pre and post intervention scores.

Sandiford et.al (2012) conducted a study comparing the effects of Melodic Based Communication Therapy (MBCT) versus traditional speech therapy in regards to eliciting speech for 12 children with autism aged 5 to 7 years. By utilizing the ADOS and vocabulary repertoire of 10 words or less, both interventions; MBCT and traditional speech therapy showed post intervention improvement. However the MBCT showed faster improvement and better results. This proves the role of music in improving the communicative skills among ASD children.

In line with this study, a study conducted by Lim (2010). He measured

standardized, reliable and valid tool, focuses on sensory responses in daily life. This is a questionnaire for children aged 3- 10 years. It was directed to the caregiver and was composed of 125 items that was grouped into fourteen sections and nine factors. The auditory processing component which is composed of 8 items was the only examined area. Frequency of each response is scored on a 5- point Likert scale. The total raw scores were used to compare both the pre and the post intervention effectiveness of the intervention program. The raw scores are then converted into one of three items to reflect the child sensory processing performance (Typical Performance, Probable difference, definite difference).

2. Phoniatrics Assessment:

- a. A semi- structured interview that included detailed history taking (complaint (onset, course and duration, Parent consanguinity, Similar condition in the family, developmental, and past history regarding the presence of epilepsy, ear disease, nursery attendance, pervious phoniatrics rehabilitation, academic achievement if any).
- b. Assessment of the current communicative abilities which included: determination of the attention stage of the child, the consultant started to elicit a verbal based communication with the child in order to assess the child' passive and active communicative abilities. Further objective assessment was carried on by the Pre-school Language assessment Scale- 4 Arabic edition (PLS- 4). The PLS- 4 is a standardized language screening tool that screens the language development of the Arabic speaking Egyptian children. The test is administered for kids from birth up to 7 years old. It targets both the receptive and expressive language skills in different areas. The response scale is dichotomous; having only two responses yes& now referring to the child's ability to perform the skill. Usually combination of both types the semi- subjective and the subjective one on more than one session with evaluation of home based video tape for the communicative abilities of the child in the home /& /or nursery environment have a synergistic effect on the assessment process.

3. The intervention program: The auditory training based music therapy rehabilitation program is based on training the ability to recognize and repeat similarly the beats played by the therapist using different instruments. Furthermore, different tempo was recognized and repeated by the children. The music beats and tempo was presented by two modalities (auditory and visual) and auditory only. This training addresses different auditory skills including auditory discrimination and temporal ordering and masking. Instrument selection was based on the child's natural environment, and as close as possible to toys used daily by the child, for example, the drum, tambourine, guitar and toy piano. The advanced behavior analysis program recommended the use of objects that is close to objects used in the child's natural environment to facilitate learning and being easily accessible to the parents.

Examples of music activities that was played by the therapist included: Ask the child's to recognize and repeat two fast beats- pause- one slow beat on the drum, Ask the child to follow four fast beats- pause- then one slow beat on the drum with eyes closed, Ask the child to follow the instructors playing on 3 of the 4 instruments randomly. Improvement was documented if the child responds adequately in 5 tasks for 3 consecutive days.

All children received 40 sessions (2 sessions per week for 20 consecutive weeks), each session is lasting for 45 minutes. The room setting was prepared to be of least distraction; reinforcement was used and parents' attendance depended on the child's performance.

**Statistical Analysis:**

The collected data was organized; tabulated and analyzed using the statistical package for the social science (SPSS) version 20 IBM Corp. (2017). The data were presented as numbers and percentages for the qualitative data, mean, standard deviations and ranges for the quantitative data. T- test was used to compare frequency of qualitative variables pre and post intervention. For all tests a probability ( $p < 0.05$ ) was considered significant.

**Results:**

☒ Descriptive Statistics: The current work was carried on (24 male 6 female) their ages ranged between 3 years and 8 years. The mean age of the current sample was 5.3 years old (male mean age was 5.45 years and female mean age is 4.83 years). Data are presented in Table (1) and Figure (1).

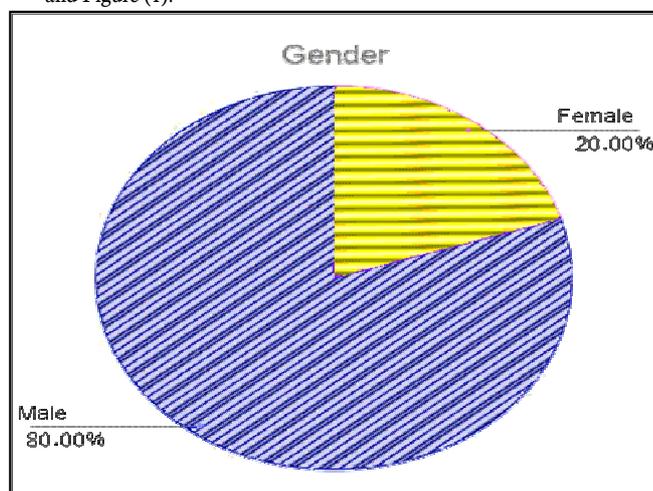


Figure (1) described the female: female ratio.

Table (1): different measures for both sex

	Age (Years)	Pre- ADOS	Post- ADOS	Pre- PLS- 4	Post- PLS- 4	Pre- Sensory	Post- Sensory
Mean Female (No= 4)	4.83	13.5	13.5	103.33	103.83	28.33	28.67
Mean Male (No= 16)	5.45	15.63	15.46	74.54	74.96	20.29	20.96

☒ Comparative Statistics: Data in this study was collected in the form of: Autism Diagnostic Observation Schedule (ADOS- 2), Preschool Language Scale- 4 questionnaire (PLS- 4), and the auditory component of The Sensory Profile. The total raw scores in the pre and post- intervention assessment were compared using paired sample t-

**Background:**

According to the World Health Organization (WHO, 2019) it is estimated that one in 160 children has an ASD. However, other well-controlled studies have reported that the numbers are much higher. The prevalence of ASD in many low- and middle- income countries is so far unknown as data collection is not very well established. El- Alfy and Mohammed (2019) estimated that among a sample of 705 communicatively impaired Egyptian children and found that 1: 20 has ASD. However, Abd el- Fattah et.al. (2019) examined a sample of 3722 preschool children in El- Sharqia Governorate and found that 5.4: 1000 have ASD.

In the past few years, different countries have reported that the rate of the diagnosis of autism spectrum disorder has reached 1%, in both child and adult populations. However, the reason behind this sudden rise is still under investigation. The reason could be attributed to widening of inclusion symptoms in the DSM- V, or by the raise in awareness of the parents and practitioners (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, 2013).

A lot of children with ASDs have some form of sensory deficit (Robertson& Baron- Cohen, 2017). This may be connected to auditory processing disorder, visual, vestibular, and/ or tactile perception. Central auditory processing disorders in ASD (CAPDs) were considered by Miron, Beam& Kohane (2018) as the greatest perception afflicted.

Music is considered in literature as a form of language. Therefore, it can convey concepts, intent, emotion and meaning between two partners. Furthermore, it can stimulate different sensory systems in people whether they listen to it or play it. Therefore, language and music have a common ground in that they both are a form of communicating emotions and feelings within (Ockelford, 2013).

The unique abilities of ASD children to perceive and play music are dated back to Kanner (1943). Since this date, several studies have provided strong evidence in the relation between music perception and expression and of the clinical presentation of ASD (Heaton, 2009). This encourages researchers to study the effect of music therapy in children with ASD.

The brain is a highly dynamically organized structure that changes and adapts as a result of activities and demands imposed upon it by the environment. This fact was proved on many levels: the first is the Functional MRI studies which provided strong evidence of the role played by music in stimulating different brain areas. It is not limited to sensory areas only but motor areas, frontal lobe, multisensory integration areas of the parietal lobe and temporo- occipital junction and the cerebellum all were invented in reaction to music perception and expression. Moreover, cognitive tasks that are time dependent, brain adaptation and brain plasticity all were strongly influenced by music activity (Wan and Schlaug, 2010). Furthermore, the role played by music in improving different auditory tasks (i.e. frequency discrimination, perception of pitch in spoken language and detection of minor changes of pitch in familiar and

unfamiliar melodies (Habibi et.al., 2013) was the encouraging factors to carry on the current study.

The current work was aiming at development of an Auditory training based music rehabilitation program in order to evaluate the effect of the use of music in therapy on the overall outcome in children with ASD.

**Patients And Methods****Patients:**

The present study is an interventional and follow up study which has been conducted on 30 ASD children that was recruited from the Phoniatrics and Psychiatric Outpatient clinic of Special Needs Center for Children at the Faculty of Post- Graduate Childhood Studies at Ain-Shams University in the period between January 2019 and January 2020.

## 1. Inclusion Criteria Included:

- a. Children, aged between 3 years and 8 years of both genders, seeking medical advice for their Delayed Language development.
- b. Children who received the diagnosis of ASD according to the DMS- V criteria.
- c. Children with severity index (mild- moderate) severity.

## 2. Exclusion Criteria Included:

- a. Children with comorbidity of other moderate mental disability, sensory, motoric disability and other psychiatric disability.
- b. Children who were enrolled in language session therapy.
- c. Children with ASD who received medication to control their condition.
- d. Children with motor speech disorder.

**Method:**

The current study was tri- phasic study. The first phase included implementation of an assessment protocol. The second phase was an intervention program and the third phase was application of the assessment protocol in the first phase. The interval between the first and the 2<sup>nd</sup> assessment was 1 year.

1. Clinical Psychiatric Interview based on Diagnostic and Statistical Manual of Mental disorders, fifth edition (DSM- V) (American Psychiatric Association, 2013). Furthermore, the psychometric assessment was done for children to indicate severity index of Autism Spectrum Disorder by Autism Diagnostic Observation Schedule (ADOS- 2) and Auditory part of the sensory assessment.

- a. The ADOS- 2 is a semi- structured, standardized assessment of communication, social interaction, play, and restricted and repetitive behaviors. It provides information that confirms diagnosis, and helps in drawing an appropriate intervention program. ADOS- 2 includes five modules that could be administered in 40 to 60 minutes to administer. Due to the expressive language age range in the current sample, only module 1 was used. It is composed of 28 to 31 items. The range of each item scores was from 0 to 3 (0 indicated not acquired yet and 3 indicated that it is fully acquired). (ADOS- 2; Lord et.al 2012).
- b. Sensory Profile (Dunn, W. 1999). The Sensory Profile, a

The Effect of auditory skills training on the overall outcome of children with Autism spectrum disorder

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Abstract

**Background:** Sensory abnormalities in children with Autism Spectrum Disorder (ASD) were and still are the accused process in the pathogenesis of this disorder. Auditory sensory processing abnormalities are considered the most common presenting sensory abnormality and play an important role in understanding the clinical presentation of the disorder. Therefore, it should be targeted during rehabilitation programs.

**Aim:** This study is aiming to determine the effectiveness of a music therapy as a modality of auditory rehabilitation program on both the communicative as well as behavioral outcome of children with ASD.

**Patients& Methods:** An Intervention prospective study carried on a sample of randomly selected Egyptian ASD children from the Phoniatics and Psychiatric clinic seeking the medical advice at the Special Needs Center at Ain Shams University in the period between January 2019 and January 2020. Children were subjected to the following assessment protocol twice (pre and post intervention): Semi- structured Clinical Psychiatric Interview (included Diagnostic Observation Schedule- 2 (ADOS- 2), Communicative Assessment (included PLS- 4 Arabic edition) and the auditory processing component in the Sensory Profile Caregiver Questionnaire.

**Results:** There is a significant statistical difference on the Total Language age and Auditory sensory profile score in children with ASD following the auditory training based music therapy program.

**Conclusion:** the usage of music therapy as an auditory rehabilitation intervention program in children with ASD is considered an effective therapeutic method in making changes in the communicative aptitude as well as the auditory component of the Sensory Profile. Such a significant outcome was more evident in males than in females.

**Keywords:** Auditory training, Sensory Profile of ASD Children, Auditory Comprehension among ASD children, Music therapy.

تأثير إعادة تأهيل المهارات السمعية على النتيجة الاجمالية

لدى الاطفال الذي يعانون من اضطرابات طيف التوحد

**الخلفية:** الاضطرابات الحسية لدى الأطفال المصابين باضطراب طيف التوحد (ASD) كانت ولا تزال هي العملية المتهمة في التسبب في هذا الاضطراب. تعتبر اضطرابات المعالجة الحسية السمعية من أكثر الاضطرابات الحسية شيوعاً وتلعب دوراً مهماً في فهم الاعراض لاضطراب التوحد. لذلك، يجب أن تكون مستهدفة خلال برامج إعادة التأهيل.

**الهدف:** تهدف هذه الدراسة إلى تحديد مدى فعالية العلاج بالموسيقى كجزء من برنامج لإعادة التأهيل السمعي على كل من النتائج في مهارات التواصل والسلوك للأطفال المصابين بالتوحد.

**المرضى والطرق:** دراسة تدخلية مستقبلية أجريت على عينة من الأطفال المصريين الذين تم اختيارهم عشوائياً من عيادات التخاطب والطب النفسي للحصول على المشورة الطبية في مركز ذوي الاحتياجات الخاصة بجامعة عين شمس في الفترة ما بين يناير ٢٠١٩ ويناير ٢٠٢٠. تم تقييم الاطفال مرتين (قبل وبعد التدخل): مقابلة نفسية شبه منظمة (متضمنة جدول المراقبة التشخيصية- ٢ (ADOS- 2)، التقييم اللغة والتخاطب (PLS- 4) بما في ذلك الإصدار العربي واستبيان المعالجة الحسية (الجزء السمعي فقط) لمقدم الرعاية.

**النتائج:** توجد فروق ذات دلالة إحصائية في إجمالي درجة اللغة ودرجة الملف الحسي السمعي لدى الأطفال المصابين باضطراب طيف التوحد بعد برنامج العلاج بالموسيقى القائم على التدريب السمعي.

**الخلاصة:** يعتبر استخدام العلاج بالموسيقى كبرنامج تدخل لإعادة التأهيل السمعي للأطفال المصابين بالتوحد طريقة علاجية فعالة في إحداث تغييرات في مهارات التواصل وكذلك المكون السمعي للملف الحسي. كانت هذه النتيجة المهمة أكثر وضوحاً في الذكور منها في الإناث.

**الكلمات المفاتيح:** تدريب سمعي، لمحة حسية لأطفال ASD، فهم سمعي لدى أطفال ASD، علاج بالموسيقى.