

The Effect of Applied Behavior Analysis (Discrete Trial Training) in Improving Sensory Skills in Mentessori Approach for Children with Autism spectrum disorder (ASD)

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Abstract

The current research aimed at identifying the effect of using some applied behavior analysis techniques (i.e. discrete trial training) in improving sensory skills in Mentessori approach for children with Autism spectrum disorder , and identifying the continuity of the intervention effectiveness after the application and during the follow-up assessment. To achieve this aim, the research sample consisted of (10) children with Autism spectrum disorder (ASD), with age ranges between (4-6) years old. Additionally, the following tools were utilized by the researcher: John Raven's Progressive Colored Matrices Test (prepared and rationed by Hassan, 2016), Autism Diagnostic Observation Schedule – Second Edition (ADOS-2), Sensory Skills Scale for Children with Autism spectrum disorder (ASD) (Prepared by the researcher), and the intervention based on some applied behavior analysis techniques (discrete trial training) prepared by the researcher. It were found statistically significant differences between mean scores of children with Autism spectrum disorder (the experimental sample) in both pre and post measurements of the intervention application on the sensory skills scale in the direction of post measurement. Moreover, no statistically significant differences were found between mean scores of children in the experimental group in both post and follow-up measurement on the sensory skills scale.

- Key Words

Applied Behavior Analysis Techniques (Discrete Trial Training DTT) – Sensory Skills in Mentessori Approach – Children with Autism spectrum disorder (ASD)

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Introduction:

Autism Spectrum Disorder is a comprehensive, complex developmental disorder that appear during early childhood. It is one of the most widespread developmental disorders, affecting all areas of children's life, as it causes dysfunction in many sensory-related skills, and it appears during the first three years of life, and its symptoms are completely clear in the first months of life, as abnormal behaviors, repetitive patterns, and self-absorption begins during early age. Autism spectrum disorder is also one of the most difficult developmental disabilities for children.

Children with autism spectrum syndrome have inappropriate responses to auditory, visual, tactile, taste, and smell stimuli. Also, they may lack to response to sensory reactions at all. Furthermore, they exhibit a lack attention to some stimuli and extreme sensitivity to even the slightest alteration in the sensory input. For instance, children with autism may cover their eyes or ears with their hands to block out stimuli, refuse to be touched and avoid social situations by acts of screaming and turning away.

According to Montessori method, the development of children's sensory skills constitutes the first step toward teaching how to use senses. Moreover, it is an educational system that emphasizes the use of senses because children's sensory skills better develop when they are given the opportunities to interact and explore their surroundings, play with other children, and use sensory materials to create enjoyable and fulfilling experiences. In addition, the Montessori method's use of sensory skills promotes children development and learning across a variety of subject areas while also offering worthwhile and useful educational experiences. Thus, early learning goals can be met through sensory experiences. Children with autism also make progress in many developmental aspects when provided with rich sensory experiences in early childhood education settings.

Applied behavior analysis techniques (Discrete Trial Teaching "DTT") represent a strategy that have proven effective in training children with autism spectrum disorder. It is a planned method within a standardized methodology, through which the sensory skill is trained in simplified and organized steps,

instead of training it all at once. The skill is broken down and reconstructed through separate attempts, each step is taught in each attempt, and it is applied individually (one educator and one child) in an environment free of distractions.

Accordingly, there was a necessity for an intervention that helps develop the sensory skills of children with autism spectrum disorder, so as not to negatively affect their developmental aspects. Thus, the idea of performing the current research was formulated in trying to identify the effect of using applied behavior analysis techniques (discrete trial training DTT) in improving sensory skills in the Montessori curriculum for children with autism spectrum disorder.

Problem of Research:

The problem of the current research arose through the researcher's review of many Arab and foreign research and studies on children with autism spectrum disorder. The researcher noticed that these children have clear deficiencies and weakness in sensory skills compared to their normal peers, as autism spectrum disorder is one of the most important neurodevelopmental disorders; with an impact on sensory aspects. Specifically, the deficiency in sensory skills in these children is evident in the various sensory aspects, whether the general internal senses (the internal organs), the special internal senses (the nerves, muscles, joints, and the inner ear), and the senses that receive external sensory stimuli (sight - hearing - smell - taste - touch). They are represented by delayed response, excessive interaction, or avoidance of response to sensory stimuli, incoherence of sensory input, and the functioning of each sense separately; not only at the level of one sense, but also at the sub-functions of one sense in a way that does not allow for proper sensory perception.

The aforementioned is agreed with Mays and Jolivette (2017) study, that indicated a clear manifestations of deficiency in sensory skills in children with autism spectrum disorder, and showed the deficiency in sensory skills across multiple sensory media over the social skills of children with autism spectrum

disorder. Moreover, Al-Zahrani's study (2018) showed that children with spectrum disorders have difficulties and weaknesses in sensory skills.

This was stressed by the results of the study of Al-Kholy (2017), Al-Desouki (2017), Chein (2018), Greednon and Kelly, (2019), and Korinik and Polloway, (2020), which conformed that children with autism spectrum disorder suffer from deficiency and decline in sensory skills, as it has a negative impact on functional performance that appears in life skills, social skills, play, and recreation. And as a result of deficiency in sensory skills represented in (hearing, sight, touch, taste, and movement) and defects in their interpretation of sensory information, their social interaction with the surrounding environment data decreases.

Hence, the current research highlightd the importance of an intervention based on the use of applied behavior analysis techniques (Discrete Trial Training (DTT)) in improving the sensory skills of children with autism spectrum disorder, which directly contributes to providing a qualitative shift in the field of their training and providing interactive educational settings that exceed in effectiveness and efficiency traditional methods and means that have dominated the educational arena for long periods, and obtaining appropriate educational opportunities to their abilities, so as to achieve the development of those abilities.

The problem of the current research is identified in the effectiveness of an intervention based on the use of applied behavior analysis techniques (Discrete Trials Training (DTT)) in improving the sensory skills of children with autism spectrum disorder.

Accordingly, problem of the current research is stated through answering the following main question:

- What is the effect of using applied behavior analysis techniques (Discrete Trial Training DTT) in improving the sensory skills in mentessori approach for children with autism spectrum disorder, and the continuity of the intervention effectiveness after a period of application?

Research Objectives:

- Improving the sensory skills in mentessori approach for children with autism spectrum disorder through the use of applied behavior analysis techniques (discrete trial training DTT)?
- Verifying the continuity of using applied behavior analysis techniques (discrete trial training DTT) in improving the sensory skills in mentessori approach for children with autism spectrum disorder?

Significance of Research:**(1) Theoretical Significance:****The research theoretical significance can be stated as follow:**

- The research provides a theoretical foundation that explains the concept of sensory skills in the Montessori curriculum, and the impact of using applied behavior analysis techniques (Discrete Trials Training (DTT)) in improving sensory skills in the Montessori curriculum for children with autism spectrum disorder.
- The importance of the group that the research addresses (children with autism spectrum disorder), and hence, the necessity of studying the various related aspects.
- The results of the research may inform specialists and professional about the importance of improving sensory skills in the Montessori approach for children with autism spectrum disorder through the use of applied behavior analysis techniques (Discrete Trial Training (DTT)).

(2) Applied Significance:

The current research applied significance can be stated as follow:

- 1- The use of Discrete Trials Training (DTT) as an applied behavior analysis technique in improving sensory skills in the Montessori approach for children with autism spectrum disorder, through appropriate set of activities and sensory skills as suitable to the nature and characteristics of the research sample.
- 2- Concluding necessary recommendations and proposals to guide specialists in dealing with children with autism spectrum disorder.
- 3- The provision of activities and sessions based on ABA that suit the nature of children with autism spectrum syndrome.

Research Terminologies:**1- Autism spectrum disorder (ASD):**

Autism spectrum disorder (ASD) was defined by the Diagnostic and Statistical Manual of Mental Disorders – fifth edition (2013), issued by the American Psychiatric Association, as a type of compound (complex) developmental (evolutionary) disorder that appears during early childhood and results in neurological disorders in the form of issues in social interaction and social communication, play activities, responding to objects more than people, distress and boredom with changing environment, repetition of physical movements, and repetition of sounds. Autism spectrum disorder evaluation is based on two criteria: stereotypical physical movements and social interaction. If the deficiency is only in the social interaction and not stereotypical movements, then we have another disorder, which is social interaction disorder and not autism spectrum disorder.

2- Sensory Skills in Montessori Approach:

The researcher adopts the following definition of Montessori (2012, 98): mental activities and skills that require children to organize and classify various sensations (visual, auditory, tactile, kinesthetic, olfactory, and gustatory) in a way that gives them meanings that lead to the formation of the main lines of children's mental life by distinguishing and matching these feelings, through practices carried out by children using tools and materials with specific colors and sizes.

3- Applied Behavior Analysis Techniques (Discrete Trial Training)

It was operationally defined by the researcher as: a set of practices and procedures presented through training sessions, that are applied in an organized and planned manner, with a specific timetable, starting with the presentation of the discriminatory stimulus with help at the same time, then waiting for children response, the presentation of positive outcomes (reinforcers) in case of the right response, and the provision of correction procedures in the case of wrong response, with short time interval between trials.

Research Limitations:

The research is determined by the variables of its, as well as the sample, which consisted of (10) children with Autism spectrum disorder (ASD), with age ranges between (4-6) years old. The sample was matched in (age – IQ – sensory skills – Autism spectrum disorder severity) variables. Accordingly, quasi-experimental method was utilized by the researcher, with the intervention of the current research together with the tools being applied in Beity Center – Mentessori, Madinet Nasr, Cairo – Egypt from February, 2023 to June, 2023.

Theoretical Framework and Previous Studies:

First: Autism spectrum disorder (ASD):

The Concept of Autism spectrum disorder (ASD):

The Fifth Diagnostic and Statistical Manual of Mental Disorders defined autism spectrum disorder as “a disorder characterized by deficits in two basic aspects: deficiencies in social communication and social interaction skills, and the presence of repetitive stereotypical behaviors, limited activities and interests. These symptoms begin to appear in an a relatively early developmental period, causing weakness in social and occupational functioning. (Diagnostic and Statistical Manual Of Mental Disorders, 2013,31)

In addition, Al-Najjar (2016, 396) defined autism spectrum disorder as: “a progressive disorder characterized by a clear deficiency in social interaction and communication; a limited range of activities and interests, and it usually appears before the child’s age of 30 months.”

Symptoms of Autism spectrum disorder (ASD):

- 1- **Social interaction:** There is a clear weakness in social interaction with others, and they are characterized by excessive isolation, withdrawal, and avoidance of social situations. They are unable to communicate with those around them, as if they are in a shell.
- 2- **“Verbal and non-verbal” communication:** They usually develop abnormal forms of language, such as echoing or stereotypical repetition of what others say, inability to visullay communicate, and a strong

attachment to inanimate objects rather than to people. (Al-Saeed, 2016, 17)

3- **Sensory dysfunction:** These individuals often have a very high sensitivity to touch or catch. And sometimes, they do not care about that and are disturbed by some sounds, as is the case with smell and taste. Some of them are accustomed to specific types of food and do not deviate from them.

4- **The emergence of abnormal patterns of behavior,** such as: stereotypical behavior; and moving fingers, hands, or body...etc. Children may also exhibit self-harm, hitting, or sabotage behavior, meaning that children who suffer from autistic disorder lack awareness of their bodies, cognitive control, and motor interaction. (Al-Qamsh, 2017, 98)

Accordingly, Pierce and Schreibman (2017) conducted a study which aimed to monitor the symptoms of autism spectrum disorder in care centers using a list of early indicators of developmental disorders. By describing the symptoms of autism spectrum disorder in care centers through a list of early indicators of developmental disorders, the study relied on developing a new measure for developmental disorders, that can be filled out by child care center workers and is a list of early indicators of developmental disorders (CESDD).

Characteristics of Children with Autism spectrum disorder (ASD):

The Detroit Medical Center has identified a number of characteristics that distinguish children with autism spectrum disorder in a number of areas; all of which are considered basic and distinctive features of this disorder, and therefore their presence in children is greatly relied upon until diagnosis with a Autism spectrum disorder (ASD). Specifically, these characteristics fall into five basic categories:

Social Relationships – Communication (i.e. verbal and non-verbal) – behaviors.

Sensory operations – play (Abd Allah, 2021, 79)

The characteristics related to children with Autism spectrum disorder (ASD) issues include:

(1) Mental (cognitive) characteristics:

Disorders in cognitive aspects are considered the most distinctive features of autism spectrum disorder, as it results in a lack of communication and emotional response to those around them. Many studies stated that about three-quarters of children with autism spectrum disorder have some degree of mental disability, and other studies have shown that some children with autism spectrum disorder have an average level of intelligence. (Suleiman, 2016, 44)

Many children with Autism spectrum disorder (ASD) in the early years of their lives lack many forms of exploratory play; and when one of them takes up one of the surrounding toys or objects, he/she plays with it in an unintended way, without any diversity, creativity, or imagination. For this reason, parents should consider the importance of their role in developing aspects of play in these children. (Al-Najjar, 2016, 164)

(2) Sensory Characteristics:

Some children with Autism spectrum disorder (ASD) may exhibit special characteristics. Many of persons in contact with these children believe that they suffer from deafness, because they do not pay attention to human voices; and sometimes do not show discomfort from loud sounds. Sometimes, these children are provided with hearing aids, although careful medical examination proves the opposite, and that they respond to sounds, especially if this sound is interesting. For example, the rattle made by the wrapping paper of candy or biscuits brings autistic children running even from the farthest corner of the house. (Raslan, 2015, 33)

(3) Behavioral Characteristics:

The majority of children with Autism spectrum disorder (ASD) practice repetitive patterns of behaviour, and have unusual special interests. These behaviors do not occur in response to a specific stimulus; rather, they are often non-purposeful behaviors practiced by children that begin and end suddenly and automatically. Moreover, restricted and repetitive stereotypical behaviors

are among the most common signs and indicators of autism spectrum disorder. Additionally, stereotypical behaviors widely vary among children with autism spectrum disorder, and may begin differently, in terms of their duration and nature. Some of them may be more frequent than others, while some are considered basic rituals for some children with autism spectrum disorder, and others may cause harm to children. However, most of these behaviors do not cause any harm, and others do not cause any harm. (Al-Khouli, 2014, 71-72)

This was indicated by the study by Eberhardt and Nadig (2018), which aimed to determine the nature of relationship between deficiencies in life skills, social interaction, and stereotypical behavior among a group of children with autism spectrum disorder and children with linguistic difficulties; and to determine whether deficiencies in life skills and social interaction may lead to more repetition of stereotypical behavior and the continuation of performing the behavior for a longer time among the group with autism spectrum disorder. The study sample consisted of two groups: the group with autism spectrum disorder, which included 22 children, and the group with language difficulties, which also included 22 children. The two groups were homogeneous in terms of non-verbal IQ and family socioeconomic level. It was found that the lower the performance rate on life skills and social interaction tests, the more likely the recurrence of stereotypical behavior and its continuation among children with autism spectrum disorder. Moreover, no relationship were found between the social level of the family, the chronological age of the child, and the rate of stereotypical behavior.

(4) Social Characteristics:

Deviation in social development is considered one of the most distinctive features of autism spectrum disorder, as most children with autism have little social interaction; and they are often described as being isolated (separated) from others in their environment. The basic clinical characteristic of autism spectrum disorder is the presence of a profound disorder in social

relationships that appears in the first months of a child's life, and these characteristics appear through many emotional-social problems.

Second: Sensory Skills:

Al-Beblawi (2020, 31) indicated that sensory skills refer to sensory-cognitive processes, where stimulus plays a role in skill development, within the scope of the sense organ. The necessary sensory-cognitive skills are determined in the ability to identify the stimulus, to compare between Stimuli, and to identify a specific stimulus from among several stimuli.

- Fields of Sensory Skills in Children:

1- **Visual sensory skills:** they include distinguishing between objects based on color, shape, size, and distance. The activities of these skills are classified into three categories: the different and the same, sorting and grouping, and sequential and retrieval.

2- **Auditory sensory skills:** they include perceiving and analyzing sounds, correct organization of the obtained auditory information, as well as the understanding of language including ideas and concepts, and determining the space of the sound.

3- **Tactile sensory skills:** they depend on touch, strengthening muscle sensation, and acquisition of sensory experiences to distinguish between objects such as (soft-hard, rough-smooth, wet-dry, cold-hot, Light-heavy), recognizing the shapes of objects, and recognizing different objects as groups. (Saqr, 2019, 31)

4- **Sensorimotor skills:** they include a series of coordinated muscle movements that succeed in performing a specific task. The senses play an important role in teaching motor skills, as sensations are transmitted to the brain to turn into perception, or the organization of information received from various senses and interpreting it for movement. (Fattahi, 2020, 87)

Montessori Approach to Improve Sensory Skills:

Montessori is an educational approach based on an educational philosophy that emphasizes the need for the educational process to be concerned with developing children's integrated personality in psychological, mental, spiritual, physical, and motor aspects; to help them develop creative abilities. The Montessori approach develops and innovates special materials and tools; so that children can learn different experiences. For example, each game in Mrntessori approach has specific goals and skills, such as distinguishing colors, shapes, sizes, sounds and touch. So, all Montessori tools were designed based on children's senses. Moreover, the Montessori approach focuses on the role of parents in the development of their children, which requires their knowledge of children's needs, the appropriate preparation of home environment in terms of beauty and comfort. It also requires that an atmosphere of mutual respect, positive behavior, and discipline prevail between parents and children, because it considers that the role of the parents is complementary to that of school and helps the positive development of children. (Atefi, Kadwani, 2017, 29)

This idea was indicated by Wilcock's study (2017), which aimed to investigate the parents and teachers of children with autism spectrum disorder opinion about the Montessori early childhood educational environment as a supportive environment for children during the early years. Moreover, it aimed to reveal three important main indicators, i.e. social competence, Language and communication, individual interests and sensory development. The sample consisted of (30) parents and (30) teachers of children with Autism spectrum disorder. The results revealed that the Montessori early childhood educational environment supports children with autism spectrum disorder in social competence, language and communication, individual interests and sensory development; and individual learning and sensory development.

In another study, Sobe (2018) aimed to conduct a comprehensive review to compare five main types of empirically supported research interventions based on developing sensory skills for children with autism spectrum disorder

with the Montessori method, for its impact on children with Autism spectrum disorder. It was found the effectiveness of Montessori education in helping children with Autism spectrum disorder in developing sensory skills, and the suitability of the Montessori approach for this group of children. The results also indicated that the program's effect continued even after the follow-up period.

In another study conducted by Antar (2020), it was aimed to enhance attention and reduce behavioral disorders in children with autism spectrum disorder using Montessori tools. The sample consisted of (10) children, and the researcher used the experimental method, with one-group experimental design and repeated measurements (pre-test, post-test and follow-up). The tools consisted of the attention scale, the behavioral disorders scale, and the program based on Montessori activities. It was found that Montessori tools helped improve attention and reduce behavioral disorders in children. And the study by Jamieson (2021), which sought to identify the Montessori method in early childhood education as a supportive environment for children with Autism spectrum disorder in Oakland. The study sample consisted of (6) children in the kindergarten stage, and was found a three main indicators a important, i.e. social competence, language and communication, individual interests and sensory effects.

3- Sensory Skills in Mentessori Approach:

The Montessori approach has many unique features than other curricula. It mixes different ages to allow for a supportive environment for learning by peers. An addition, it emphasizes specific, uninterrupted work times, and a supportive classroom environment in which a full range of Montessori learning tools are available. Also, the tools are arranged in an accessible appropriate way for their ages. Specifically, activities are based on the senses that can develop children's perceptual abilities through direct experience in which a child is put in situations similar to the real world. (Atifi, Kadwani, 2017, 503)

- The Montessori environment of Teaching and Training on Sensory Skills for children with Autism spectrum disorder (ASD)

The sensory skills education and training environment includes a set of materials that focus on one or more senses. Sensory materials are a series of attractive, simple and sequential exercises which children can use these to categorize sensory impressions. These activities can refine the senses, and create a sensory basis for further intellectual development. Montessori theory focused on practical training and sensory experiences as a method for knowledge building, so that children's senses are stimulated especially the touch sense. Moreover, they can provide many spaces for exploration and experimentation, facilitate sensory experiences and development in multiple fields and skills, and encourage cognitive development. In addition, by playing with sensory materials, children learn to understand concepts such as: more/less, full/empty, and sink/float. (Lillard, 2014, 78)

Third: Applied Behavior Analysis Techniques (Discrete Trial Training DTT):

The term Applied Behavior Analysis (ABA) refers to a science based on the use of learning principles to improve socially important behavior, as the practice focuses on assessing environmental influences on behavior, assessment-based intervention, and data-based decision making. It is also used to meet the behavioral needs of clients in multiple areas, including general and private education, organizational behavior management, gerontology, and many others. (BACB, 2018, 409)

Discrete trials (DT) originate in the methods of experimental research, conducted by Thorndike, Watson, and Pavlov in the late 1920s. Discrete trials are the main training method for much of the behavioral input used with children with autism spectrum disorder, which It has proven effective and successful with these children.

Concept of Discrete Trial

It was defined by Al-Feki (2017, 52) as an organized and intensive educational methodology, consisting of several steps, including: signaling, urging, directing, responding, consequence, and the time interval between trials. It is a strategy of applied behavior analysis, as it focuses on children acquisition of the required skill by controlling the sequence of previous and subsequent events.

Moreover, Discrete Trials Teaching (DDT) are represented by Cooper, Heron, and Heward (2020, 451) as a series of behavioral learning routines (stimulus-behavior-consequence). It is called discrete, because every trial (stimulus - behavior - consequences) has a clear beginning (the stimulus), a middle (the behavior), and an end (the consequences).

The response on each discrete trial is controlled by a limited opportunity when the stimulus is presented to produce the response.

Discrete Trial Training (DTT) is a formal, evidence-based application for teaching specific behaviors. It is a procedure through which skills are divided into small units and taught according to mastery standards. Research shows that Discrete Trial DTT is an effective educational methodology in applied behavior analysis for autism spectrum disorder.

Discrete Trial Teaching (DDT):

- Assessing skills deficits.
- Create an individual list of goals to present the first, second, etc., starting with simple goals and then gradually working towards more complex ones.
- Benefit from error-free learning.
- Use prompting and indoctrination to gradually fading.

Five components of Discrete Trials:

1- Presenting the discriminatory stimulus:

Discriminative stimuli are brief, clear instructions that alert children to the task at hand. This helps the student associate a specific direction with an appropriate

response. An example could be when the teacher says: "What is this?" Before asking the child to identify something.

Example: Place at least one target/stimulus on the table in front of the client.

Presenting 3 pictures (1. a car; 2. a bowl; 3. a telephone) and presenting a card of the stimulus to be trained on.

2- Induction or indoctrination:

After presenting the image of the stimulus, provide direct assistance, if necessary.

Example: Provide a prompt or aid to help the client respond correctly by placing a picture of the car near the client.

3- Response:

The client's response to the previous two steps can be recorded as follows:

- Correct response (+)
- Incorrect response or no response (-)

4- Consequences

In case of correct response:

Predetermined consequences are provided for correct responses. Offer highly preferred items (usually small edible items) and praise

If you get an incorrect response:

Provide specific corrective feedback (e.g., say, No, that's not the car) and then try again from the first step with more help.

5- Time intervals between attempts: Take a short pause between successive attempts

Example: After Ahmed responds correctly and earns a reinforcer, he gets a short 1-5 minute pause before the next attempt

- Data is collected: data is recorded in a data sheet
- Data for separate attempts are always analyzed and expressed as a percentage
- Mastery standard for separate attempts is between 100% - 80%

However, in discrete trial teaching of Applied Behavior Analysis (ABA), the learning opportunity is designed and structured by the practitioner. This process is as follows:

Acquisition: The child completes the initial lesson

Fluency: The child shows the ability to repeat and master a skill

Maintenance: The student maintains his ability to perform the skill over time

Generalization: The child can apply the skill to a different environment or area

(Cooper, Heron, and Heward, 2020, 473)

Positive Aspects of Discrete Trials Teaching (DDT):

- Ease of application of the interval trials by teachers and specialists.
- Discrete Trial Training (DTT) allows a large number of training attempts to occur in each learning session.
- It is considered a good way to improve the skills of children with autism spectrum disorder.
- The targeted response is measurable and easy to collect data about it.
- It is easy to provide behavioral response consequences, such as food.
- Through discrete trial training, children can learn attention, as they learn that correct response leads to a positive reinforcer, and they also learn to sit quietly in chair.
- The easiness to notice the level of progress if any. (Jennifer, 2018, 273)

Research Hypotheses:

- 1- There are statistically significant differences between mean scores of children in the experimental group in both pre and post measurements on the sensory skills scale in favor of post measurement.
- 2- There are no statistically significant differences between mean scores of children in the experimental group in both post and follow-up measurements on the sensory skills scale.

Research Methodology:

First: Research Method:

Quasi-experimental method was used by the researcher, as the current research aimed to develop sensory skills in the Montessori approach for children with autism spectrum disorder through an intervention based on the

use of applied behavior analysis techniques (Discrete Trial Training (DTT). In addition, the researcher used the quasi-experimental design with one group and pre- and post-measurement. The one-group quasi-experimental design is suitable for the nature and sample of the current research.

Thus, quasi-experimental method with one group based on pre and post measurement design was used for the current research with the following variables:

- **The Independent Variable:** the use of some applied behavior analysis techniques (i.e. discrete trial training).
- **The dependent Variable:** sensory skills.
- **The Extraneous Variables:** the variables that were controlled by the researcher so that no intervention may occur with the results. These variables include: age, IQ, severity of Autism spectrum disorder (ASD), and the pre application of practical life skills in Mentessori scale. Thus, the one-group experimental design was utilized in the current research as suitable to the sample size as could be gathered by the researcher.

Second: Research Sample:

The current research sample was divided into:

A) The Exploratory Research Sample:

The exploratory research aimed to determine the suitability of the used tools to the sample of the main research; ensure the clarity of the tools' instructions, the clarity of the items in the research tools, identify difficulties that may appear during application, working to eliminate and overcome them, in addition to verify the validity and reliability of the research tools. To achieve these goals, the research tools were applied to an exploratory sample, taking into account the availability of most of the characteristics as the main sample of research. Specifically, the exploratory study sample consisted of (22) children with autism spectrum disorder, with age ranges between 4-6 years, with an average of 68.21 months, and a standard deviation of 2.35.

The Final (Basic) Sample: The Experimental Group:

The final research sample consisted of (10) children with autism spectrum disorder, aged between (4-6) years, whom were selected to administer the intervention according to the following bases:

- Bases of Sample Selection:

The researcher relied on several conditions in selecting the research sample, in order to further control the variables of current research as much as possible in accordance with the following conditions:

- In terms of gender: The research sample consisted of males and females; and in terms of age, The researcher took into account that the age group is between (4-6) years from children with autism spectrum disorder.
- In terms of IQ: The Stanford-Binet test - fifth edition was administered, by applying the practical part of the test, due to the availability of conditions for homogeneity of the sample in terms of IQ.
- Children of the sample were selected on the basis of no other disabilities except autism spectrum disorder.
- Regular attendance for the session was a necessity for the sample, and also the researcher ensured that none of the sample members has received any previous training or treatment programs.
- Homogeneity of the experimental group members in terms of Autism spectrum disorder severity, and sensory skills in the Montessori approach before implementing the intervention.
- Verifying the severity of autism for each child according to the medical reports by a specialist physician, after files examination by the researcher.
- The researcher verified that children do not suffer from any other disabilities other than Autism spectrum disorder. This was done through asking their caregivers, careful observation of children by the researcher, and through children's general appearance
- It was verified that the experimental research sample obtained low scores on the sensory skills in the Montessori approach scale.

First: Homogeneity in Demographic Variables:**Homogeneity within the experimental group:**

Achieving homogeneity among the members of the experimental group in the chronological age, IQ, and Autism spectrum disorder severity according to the variables of the current research. Table (1) shows the results of the Chi Square for the differences between group members in age, IQ, and severity of autism spectrum disorder. Also, table (2) shows the results of the Chi Square score on the dimensions of the Sensory Skills Scale according to the Montessori approach.

Homogeneity in demographic variables:

Homogeneity between the (experimental) group before implementing the intervention in chronological age and IQ. Table (1) shows the averages, the sum of the ranks, the value of (Z) and its significance for the experimental group in chronological age, IQ and the severity of autism spectrum disorder.

Table (1): Means, Standard Deviations, Mean Ranks, Sum of Ranks, Z Values and significance between Groups in Chronological Age, IQ, and Autism spectrum disorder (ASD) Severity

Dim.	Group	Mean	Std. Dev.	Mean Ranks	Sum of Ranks	Mann Whitney Value	Z Value	Sig.
Age	Experimental	71.40	6.80	10.30	103.00	48.00	0.152	Insig.
IQ	Experimental	75.20	2.04	10.00	100.00	45.00	0.387	Insig.
Autism spectrum disorder	Experimental	32.30	2.05	10.05	100.50	45.50	0.350	Insig.

It is evident from the previous table that the value of (Z) for identifying differences between the experimental group in age and IQ is not statistically significant, which indicates no differences between the experimental group. Looking at the table, it is also evident that the (experimental) group's average scores are close in terms of chronological age, IQ, and severity of autism spectrum disorder.

Second: Homogeneity in sensory skills in mentessori:

Group homogeneity in sensory skills in mentessori approach for the experimental group as clarified in Table (2).

Table (2) Significance of differences between mean scores of children on the sensory skills scale (N= 10)

Variables	Mean	Std. Dev.	Chi-square	Sign.	Freedom	Sig. Limits	
						0.01	0.05
Auditory Skills	2.70	0.67	2.600	Insign.	6	16.812	12.592
Visual Skills	2.90	0.56	2.00	Insign.	4	9.48	13.2
Tactile Skills	2.80	0.63	2.00	Insign.	5	15.086	11.070
Smell Skills	3.00	0.47	2.00	Insign.	5	15.086	11.070
Motor Skills	3.00	0.47	2.00	Insign.	5	15.086	11.070
Total Score	14.40	2.40	1.200	Insign.	6	16.812	12.592

It is evident from Table (2) that no statistically significant differences were found between the children's averages in terms of the dimensions of sensory skills according to the Montessori approach and the total score, which indicates the homogeneity of these children, as the Chi square values were not statistically significant.

After applying the requirements for the sample selection, the final research sample consisted of (10) children with Autism spectrum disorder (ASD) with age ranges between 4 – 6 years old.

Third: Research Tools:

- 1- John Raven's Progressive Colored Matrices Test (prepared and rationed by Hassan, 2016).
- 2- Autism Diagnostic Observation Schedule – Second Edition (ADOS-2).
- 3- Sensory Skills Scale for Children with Autism spectrum disorder (ASD) (Prepared by the researcher).
- 4- The intervention based on some applied behavior analysis techniques (discrete trial training DTT) prepared by the researcher.

(1) John Raven's Progressive Colored Matrices Test (prepared and rationed by Hassan, 2016):

- Test Standardization:**- Scale Validity and Reliability:**

The test has good validity and reliability, based on many previous studies that utilized the test. Specifically, the reliability coefficients ranged between (0.62 - 0.91). In other studies, they ranged between (0.44 - 0.99), and between (0.55 - 0.82).

- The Scale Psychometric Properties in the Current Research:**First: Validity:**

In the current research, the external test validity was calculated by the correlation coefficient between the performance of a sample of (30) children on the progressive matrices test and the man drawing test (Mohamed Farghaly, Safia Magdy, Mahmoud Abdel Halim, 2004). The validity coefficient was (0.82), which confirms the validity of the test and its suitability for use in the current research.

Second: Reliability:

The reliability coefficient was calculated by the researcher using re-test reliability on (30) children with an interval of three weeks. The re-test reliability coefficient was (0.73), a high reliability coefficient that enhances confidence in the scale.

(2) Autism Diagnostic Observation Schedule – Second Edition (ADOS-2) (Lord, Rutter, DiLavore, & Risi, 2008)**Psychometric properties:**

First: validity calculation: To calculate the validity of the scale, the researcher used the validity test, as he applied the scale to a sample of (20) children from the research community and from outside the main sample. Moreover, the CARS3 scale were administered to the same sample, then the correlation

coefficients were calculated between the sample scores on the two scales to calculate the validity of the test. The correlation coefficient reached (0.82), indicating the validity of the scale.

Second: Reliability:

A- Reliability Calculation Using Alpha Chronbach's:

The reliability coefficients were calculated for the two dimensions of the scale added to the total measurement using alpha chronbach's, as indicated from the following table:

Table (3)

Variable	Alpha Chronbach's
Communication	0.588
Social Interaction	0.717
Total Score	0.806

From Table (3), it is evident that the sub-dimensions of the autism diagnostic observation schedule were reliable, as the reliability according to the Cronbach's alpha method on the communication dimension was 0.588, social dimension was 0.717, and the total score was 0.806.

(3) Sensory Skills in Montessori Approach Scale (Prepared by the researcher):

The researcher prepared a scale of sensory skills in Montessori approach by reviewing the available theoretical framework, previous studies, Arab and foreign research and references, some opinions related to the subject of the research, and a group of measures and tests that dealt with the sensory skills of children with autism spectrum disorder, in order to identify the methods and tools used to measure sensory skills using the Montessori approach and benefiting from them in formulating statements that fit each dimension. The researcher took into account the nature of the research sample. He also tried to make the scale simple in its content and express the true capabilities of the

research group. The number of statements, the length of the scale, and the accuracy of its statements were appropriate to the nature of the sample. The researcher also took care in formulating the statements in their initial form to be easy, clear, and short; with no more than one meaning and measure what it was designed to without ambiguity, and the response should be useful and short.

Psychometric Properties of Scale:

First: Validity: The researcher used several methods to ensure the sensory skills in Montessori approach scale validity, as follow:

- Validity of the external test:

The correlation coefficient was calculated between the sensory skills in Montessori curriculum and the sensory skills scale (Ghaida Jaafar and Atef Abdullah, 2020). The correlation coefficients reached 0.859, which confirms the validity and suitability of the scale use in the current research.

Table (4) Correlation coefficients between each statement and the total score of dimensions (N=30)

Hearing Skills		Visual Skills		Tactile Skills		Tasteful Skills	
N	Correlation Coefficient	N	Correlation Coefficient	N	Correlation Coefficient	N	Correlation Coefficient
1	**0.854	11	**0.742	21	**0.767	31	**0.748
2	**0.844	12	**0.794	22	**0.645	32	**0.685
3	**0.869	13	**0.669	23	**0.765	33	**0.655
4	**0.730	14	**0.666	24	**0.778	34	**0.795
5	**0.759	15	**0.788	25	**0.740	35	**0.620
6	**0.834	16	**0.780	26	**0.742	36	**0.645
7	**0.734	17	**0.820	27	**0.790	37	**0.666
8	**0.840	18	**0.845	28	**0.645	38	**0.780
9	**0.731	19	**0.735	29	**0.649	39	**0.810
10	** 0.859	20	**0.891	30	**0.638	40	**0.725
Motor Skills							
41	**0.620						
42	**0.645						
43	**0.666						
44	**0.788						
45	**0.780						
46	**0.820						
47	**0.666						
48	**0.788						
49	**0.780						
50	**0.640						

From the previous table, it is evident that all correlation coefficients between the score of each item and the score of the scale to which it belongs are statistically significant at (0.01) level, indicating the consistency of the internal structure of the sensory skills scale in Montessori approach. Then, the researcher found the correlation coefficient between the individuals' scores on the total score of the dimension and the total score of the scale.

Reliability:

Reliability of the sensory skills scale was calculated using the following methods:

Kuder-Richardson equation: This was done on a sample of (30) of the subjects, and the results were as summarized in Table (5).

Kuder-Richardson's Reliability Coefficients
N= 30

Dimensions	Reliability Coefficients
Auditory Skills	0.757
Visual Skills	0.788
Tactile Skills	0.791
Tateful Skills	0.784
Motor Skills	0.738
Total Scale	0.801

It is evident from the reliability coefficients shown in Table (6) that the scale has good reliability coefficients, as the reliability coefficients ranged from (0.738) to (0.801).

Test-retest Reliability coefficient: Al-Baha calculated the stability of the scale using the test- re-test method with an interval of three weeks, and calculated the correlation coefficient between the two applications. Table (6) shows the correlation coefficient between the two applications.

Reliability Coefficients Using Test – Re-test Method
N= 30

Dimensions	Reliability Coefficients
Auditory Skills	0.784
Visual Skills	0.766
Tactile Skills	0.774
Tasteful Skills	0.728
Motor Skills	0.711
Total Scale	0.753

According to the table, it is shown that the reliability coefficients of the sensory skills scale as a whole and for each of its dimensions separately are at high levels, indicating the possibility of trusting the results of its application to the primary research sample.

[3] **Interpretation of scores:** A low score is explained as a low level of sensory skills in children with autism spectrum disorder, while a high score means a high level of sensory skills.

(4) The intervention based on some applied behavior analysis techniques (discrete trial training DTT) in improving sensory skills in Montessori approach for children with Autism spectrum disorder (ASD) (prepared by the researcher)

- Intervention Description:

A planned and organized program has been prepared based on the use of applied behavior analysis techniques (Discrete Trial Training (DTT)) to improve sensory skills in the Montessori curriculum for children with autism spectrum disorder, according to a set of specific and organized steps based on theories that took into account the education of children with autism spectrum disorder.

Significance of the Intervention:

- The intervention contributes to improving the sensory skills in the Montessori curriculum for children with autism spectrum disorder, including auditory skills - visual skills - tactile skills - tasteful skills - motor skills.

Intervention General Planning:

The general planning process for the intervention includes defining the general and procedural objectives and content, such as the strategies and methods used in its implementation, determining the time span of the intervention, the number of activities, the location of the intervention, and its evaluation.

Procedural and behavioral objectives: At the end of the intervention implementation, children with autism spectrum disorder can:

- Children train on visual-auditory perception, and visual and auditory discrimination.
- Children recognize the differences between touches.
- Children compare colours, sizes and lengths.
- Children can shape with clay and practice pronouncing its names.
- -Children explore different smells and foods through fruit and vegetable basket training.
- Children with autism spectrum disorder explore natural objects, such as stones, pinecones, flowers, and twigs.

Intervention procedures using applied behavior analysis techniques**(Discrete Trial Teaching DTT):**

The current intervention springs from the applied behavior analysis science, and the Discrete Trials Teaching (DTT) method was used in the current research to improve sensory skills according to the Montessori

approach for children with autism spectrum disorder, which include the following main principles:

- 1- The intervention includes educational activities divided into several skills that can be taught to children with autism spectrum disorder by repeating the trial with children when a stimulus is present through training in visual sensory skills: for example, when the researcher asks a child to distinguish between the objects and elements in front of him/her on the basis of color, shape, size, and distance, to identify the different element among the others, the thing or element itself, and for the child to be able to sort, group, sequence, and retrieve. The training also includes the auditory sensory skills: the researcher asks a child to recognize different sounds heard through the auditory display and analyzing them well, then organizing the auditory information obtained in a correct way, and understanding the language and the ideas and concepts it contains, then the researcher asks a child to determine the nature of sound, distinguishing it and determining its direction, as well as determining the distance from which the sound is coming. The intervention also includes training in tactile sensory skills: which depends on touch, strengthening muscular sensation, and gaining sensory experiences to distinguish between objects, such as the researcher asking a child to determine the characteristics of the object by identifying its characteristics (i.e. soft, hard, rough, smooth, wet, dry, cold, hot, light, and heavy), and a child can recognize the shapes of objects and group them together, as well as sensory-motor skills: through a child using a series of coordinated muscle movements that succeed in performing a specific task by children.

- 2- The researcher was keen to pay attention to children's educational environment, by presenting visual, auditory, and kinetic stimuli that attract children with autism spectrum disorder attention to help them develop various sensory skills.
- 3- The researcher was keen to reward the correct response through positive reinforcers: such as smiling, praise, and the provision of favorite types of food and drink to children. Material reinforcers: represented by simple games and symbolic gifts such as preferred colorful books containing picture stories to children, pens, printed pictures of favorite cartoon characters, cards, stars, and luminous badges, reinforced through social activities such as trips and sports games.
- 4- As for the incorrect response, it was represented by the researcher not giving the reinforcer to children. This is called the error correction strategy. The researcher asks a child to try again. However, if a child continues to respond incorrectly, the researcher increases the level of indoctrination. But, if a child does not succeed in giving any correct response, we then increase the level of indoctrination again and re-evaluate the effectiveness of the used reinforcers, or wait for a short time interval to begin another separate attempt. The interval between attempts is between (3-10) seconds, which is a short pause between successive attempts to give children the opportunity to realize that one attempt has ended, and to allow them to prepare for the next attempt. Additionally, the time between attempts allows interaction with the reinforcement provided to children, and training continues through multiple attempts over several sessions, and the number of attempts ranges between (5-9) attempts.

Procedural fidelity

The current intervention procedures were carried out by the researcher through the use of self-observation, and the observers agreement on the accuracy of the intervention used in some techniques of applied behavior analysis (discrete teaching trials DDT) to improve sensory skills in children with autism spectrum disorder.

1- The Use of Self-observation: through the behavior evaluation form that was applied by the researcher at the end of each session or training activity to determine the extent of child's mastery of the required skill or to identify deficiencies in implementing the skill to confirm its development through the next session of the intervention.

2- Interobserver Agreement (IOA): This procedure was done by following up with children's teacher or the specialist in the center who cares, educates and trains children; so that the second observer takes notes or records the extent of children's performance in implementing the skill, as compared to children's scores on pre-application of the practical life skills scale.

The researcher also used some IOA procedures, including:

Total Count IOA

It is a method that includes concluding the percentage of approval of the total number of responses through a mathematical equation: $\frac{\text{smallest/largest}}{\text{total}} \times 100\%$.

Exact Count-per-Interval IOA:

It is one of the most important and accurate methods in IOA, and includes reaching a consensus through the number of periods with 100% IOA agreement/ $\frac{\text{Total number of periods with 100\% IOA}}{\text{Total number of periods}} \times 100\%$

Table (7)

Number of Intervention Sessions (48 sessions), Topics, Procedural Objectives, Techniques and Time of Session (35 Min.) and Total Application Time (3 months from the intervention application start-up)

Skill	Number of Sessions	Objectives	Strategies	Session Time
Vision Skill	20	(Dimensions - shapes - colors) Cylinders with handles (large, small) Cylinders without handles (large, small) The pink tower Brown stairs Red Sticks Colors Mixing colors 3D three-dimensional shapes Geometric shapes	Discrete Trials – Modelling – Reinforcement – Role Playing	35 Min.
Touching and Hearing Skills	17	- Touch (sense of leather and cloth texture - sensation of temperature - sensation of weight - bag of touch) - Hearing (sound cylinders - matching the sounds of musical instruments)	Discrete Trials – Modelling – Reinforcement – Role Playing	35 Min.
Smelling Sense Taste Sense	10	- Olfaction (naming different odors after smelling them) - Taste (naming different flavors after tasting them)	Discrete Trials – Modelling – Reinforcement – Role Playing	35 Min.
Final Session	1	-A child gains many educational experiences that help learn the skills of dealing and interacting with others. - A child is trained to increase linguistic vocabulary and linguistic and motor skills.	Reinforcement - Play	35 Min.

Fourth: Research Steps:

The research was conducted according to the following steps:

- Reviewing the theoretical framework and previous studies, determining the basic hypotheses for the research and methods for collecting appropriate data.
- Preparing the research tools, by reviewing the tools and previous arabic and foreign studies about sensory skills in the Montessori approach; and based on this review, the researcher built a scale of sensory skills for children with autism spectrum disorder.
- Building the intervention based on the use of applied behavior analysis techniques (Discrete Trial Training (DTT)) according to the theoretical framework and previous studies and reviewing a number of interventions that were designed for this category.
- The psychometric properties of the tools were calculated in terms of validity and reliability on the exploratory research sample, which is similar to the basic sample.
- After ensuring the psychometric properties of the tools and the suitability of the intervention to achieve its goals, the application was carried out on the experimental group.
- Appropriate statistical methods were used to test the research hypotheses.
- The results were presented according to the research hypotheses, and were interpreted according to the theoretical framework and previous studies.

Fifth: Statistical Methodology:

Statistical methods were used to calculate psychometric properties and prepare research tools, in addition to prove the validity or invalidity of the research hypotheses, and to find the stability and validity of the measures and the research results using the SPSS statistical package programs used in the social sciences. The most important of these statistical methods used are:

- Wilcoxon on Signed Ranks Test, to calculate the difference between the average ranks of pairs of related scores.
- Averages and standard deviations.
- Correlation coefficients.
- Cronbach's alpha reliability coefficient.

Results and Discussion:**Results and Discussion of the first hypothesis:**

The first hypothesis states that: “There are statistically significant differences between the mean scores of children in the experimental group in pre- and post-measurements on the sensory skills at the Montessori approach scale in the direction of the post-measurement.” To verify this hypothesis, the Wilcoxon test was used to reveal the significance and direction of the differences between the mean scores of the pre- and post-measurements of the experimental group on the sensory skills at the Montessori approach scale. The Z value was calculated to determine the differences between the pre- and post-measurements of the dimensions by applying the sensory skills in the Montessori approach scale, which the experimental group was trained on during the intervention sessions. The following table shows the results of this.

Table (8): Z value to identify the differences between pre and post measurements for the sensory skills in Mentessori approach scale and the total score using Wilcoxon formula

Dimensions	Ranks	Number	Ranks Average	Ranks Sum	Z Value	Sig.
Auditory Skills	Positive Ranks	10	5.50	55.00	-2.840	0.01
	Negative Ranks	0	0.00	0.00		
	Equality	.				
	Sum	10				
Visual Skills	Positive Ranks	10	5.50	55.00	-2.859	0.01
	Negative Ranks	0	0.00	0.00		
	Equality	0				
	Sum	10				
Tactile Skills	Positive Ranks	10	5.50	55.00	-2.842	0.01
	Negative Ranks	0	0.00	0.00		
	Equality	0				
	Sum	10				
Tasteful Skills	Positive Ranks	10	5.50	55.00	-2.871	0.01
	Negative Ranks	0	0.00	0.00		
	Equality	0				
	Sum	10				
Motor Skills	Positive Ranks	10	5.50	55.00	-2.848	0.01
	Negative Ranks	0	0.00	0.00		
	Equality	0				
	Sum	10				
Total Score	Positive Ranks	10	5.50	55.00	-2.812	0.01
	Negative Ranks	0	0.00	0.00		
	Equality	0				
	Sum	10				

According to the table, the values of (Z) that determine the differences between the pre- and post-measurements of the dimensions are respectively (-2.820, -2.827, -2.831, 2.831 - 2.812), which are significant values at the level (0.01), indicating the presence of differences between The pre and post measurements in favor of the post measurement, as the average positive ranks were greater than the average negative ones, and this is an indication of the effectiveness of the program used in improving sensory skills in the Montessori approach for children with autism spectrum disorder in the experimental sample.

To determine the amount of improvement in the dimensions of the sensory skills scale in the Montessori approach, the arithmetic mean and standard deviation were calculated for the pre- and post-measurements of the experimental group, and the effect size was calculated using the equation provided by Field (2018, 520), in which the effect size is calculated from the following equation:

$$r = \frac{Z}{\sqrt{N}}$$

Z= the calculated z value and N= the sample size

Discussion and Interpretation for the First Hypothesis Results:

The results of the first hypothesis indicate that there are statistically significant differences between the mean scores of children with autism spectrum disorder, the experimental group, in the pre- and post-application on the scale (i.e. sensory skills in the Montessori approach scale) used in the current research, in favor of the post-application, and thus the first hypothesis is verified. It is also clear the first hypothesis was verified, as the value of (z) indicates that the differences between the mean scores of children with autism spectrum disorder (i.e. the experimental sample) in the pre- and post-application on the sensory skills in the Montessori approach scale was in the direction of the post-measurement, confirming the effectiveness of using some techniques of applied behavior analysis (i.e. Discrete Trials Teaching (DTT)) in the current research.

The results of the first hypothesis also indicated that the Discrete Trial Training (DTT) was effective to the extent that it led to an increase in the averages of all ranks, and this is an indication of the increase and improvement that occurred for children with autism spectrum disorder after implementing the program. The researcher attributes this result to a group of reasons. Including the techniques used in the program.

The researcher attributes this result to the nature and quality of applied behavior analysis techniques, as they include a set of exercises and activities that are appropriate to the abilities of children with autism spectrum disorder. The result of this hypothesis also supports the effectiveness of using some applied behavior analysis techniques (i.e. Discrete Trials Training (DTT)) in achieving the research objectives and developing sensory skills in the Montessori approach for children with autism spectrum disorder.

These results can be explained by the set of techniques included in the program, which contributed to the effectiveness of the program in achieving its intended goals. The current research, in implementing the intervention, relied on behavior modification techniques (discrete trial training or DTT), which led to improving sensory skills. This was evident in the children's performance, as was reflected in the result of the current research, with a difference in favor of the post-measurement. This means that the techniques (discrete trial training) (DTT) was effective to the extent that it led to high rates of improvement between the pre- and post-measurements on the sensory skills in the Montessori approach scale.

This result is consistent with the results of many studies, including the study by Amy (2018), Muneeb and Nafi (2016), Saud (2016), Al-Faqi (2017), Al-Shakhs (2017), Orinna and Rementon (2018), Sandra and Lara (2018); and the study by Smith (2019), Eldevik, et al, (2020), Cummings (2021), Holding et al, (2021), which all aimed to use training programs that are based on (Discrete Trial training (DTT), To develop auditory, visual, and motor skills, attention, and cognition in children with autism spectrum disorder.

Results and Discussion of the second hypothesis:

The second hypothesis states that “**there are no statistically significant differences between the average scores of the children in the experimental group on the sensory skills in mentessori approach scale in the post and follow-up measurements.**” To verify this hypothesis, the Wilcoxon test was used and the value of (Z) was calculated to find differences between the average scores of the children of the experimental group’s scores in the post- and follow-up measurements of the dimensions by applying the sensory skills in mentessori approach Scale, which the children of the experimental group were trained on during the intervention sessions, after a month. The following table shows this.

Table (9)

Z value to identify the differences between the post and follow-up measurements of the sensory skills in mentessori approach scale and the total score using Wilcoxon Formula

Dimensions	Ranks	N.	Rank Means	Rank Sum	Z Value	Sig.
Auditory Skills	Positive Ranks	1	1.00	1.00	-1.000	Insig.
	Negative Ranks	0	0.00	0.00		
	Equality	9				
	Sum	10				
Visual Skills	Positive Ranks	1	1.00	1.00	-1.000	Insig.
	Negative Ranks	0	0.00	0.00		
	Equality	9				
	Sum	10				
Tactile Skills	Positive Ranks	1	1.00	1.00	-1.000	Insig.
	Negative Ranks	0	0.00	0.00		
	Equality	9				
	Sum	10				
Tasteful Skills	Positive Ranks	1	1.00	1.00	-1.000	Insig.
	Negative Ranks	0	0.00	0.00		
	Equality	9				
	Sum	10				
Motor Skills	Positive Ranks	1	1.00	1.00	-1.000	Insig.
	Negative Ranks	0	0.00	0.00		
	Equality	9				
	Sum	10				
Total Score	Positive Ranks	1	1.00	1.00	-1.633	Insig.
	Negative Ranks	0	0.00	0.00		
	Equality	9				
	Sum	10				

From the previous table, it is evident that the Z values for determining the differences between the post and follow-up measurements of the dimensions are not statistically significant values, indicating no differences between the post and follow-up measurements. The average positive ranks converged with the average negative ones, and this is an indication of the persistence of the effect of using applied behavior analysis techniques (i.e. Discrete Trial Training (DTT)) in improving sensory skills in the Montessori curriculum through the intervention used among the children of the experimental sample. To identify the amount of difference in the scale dimensions, the arithmetic mean and standard deviation were calculated for the post and follow-up measurements for the experimental group, and the following table shows this.

Table (10) Arithmetic mean and standard deviation for the sensory skills in mentessori approach scale and the total score of the experimental group in post and follow-up measurements

Dimension	Post		Follow-up	
	Mean	Stand. Dev.	Mean	Stand. Dev.
Auditory Skills	19.10	0.87	19.20	0.87
Visual Skills	19.40	0.84	19.60	0.84
Tactile Skills	18.80	0.91	18.90	0.91
Tasteful Skills	17.40	0.67	17.40	0.67
Motor Skills	17.60	0.69	17.60	0.69
Total Score	92.20	2.52	92.60	2.17

It is evident, from the table, that the arithmetic mean of the post-measurement is close to the arithmetic mean of the follow-up measurement in the dimensions, indicating that the effect of using applied behavior analysis techniques (Discrete Trial Training (DTT)) in improving sensory skills in the Montessori approach among the experimental group remains, and so is the

effectiveness of the training within the intervention sessions to improve sensory skills in the Montessori approach for children with autism spectrum disorder.

Discussion and Interpretation for the First Hypothesis Results:

According to table (13), there are no statistically significant differences between the mean ranks of children with autism disorder in the experimental research sample, in the post and follow-up applications after a month of implementing the intervention on the sensory skills in the Montessori approach scale for children with autism spectrum disorder, which verifying the validity of this hypothesis.

Therefore, the results of this second hypothesis confirm that the effect of the intervention based on the use of applied behavior analysis techniques (Discrete Trial Training (DTT)) was continuous and not temporary, but rather its effectiveness continued even after a period of time had passed since the intervention was implemented. This can be attributed to what children with autism spectrum disorder achieved within the intervention sessions and that the sensory activities that were presented to the children in the sessions were largely appropriate to their abilities, and their impact continued beyond the implementation. This is also due to the use of the Discrete Trial Teaching (DTT) technique that helped children improve the sensory skills or experiences. This result agreed with the studies of Murdock et al, (2015), Bakhsh (2016), Amara (2017), Khattab (2018), Samir (2018), Moussa (2019), Reginald and Bryson (2020), Mayes and Calhoun (2020), and Spalovida and Jasmin (2021), which all emphasized the acquisition of sensory skills, which is considered a real indicator for measuring the level of development in children with autism spectrum disorder, as sensory skills need to be practiced until the autistic child reaches mastery. Through its performance, children move from an introverted state to the shared grouplevel. The results of the research resulted in the absence of statistically significant differences between the mean ranks of the scores of children with autism spectrum disorder in the experimental research sample, in the post- and follow-up application after a month. Thus, the results of the second hypothesis also showed that there were no statistically

significant differences between the post and follow-up measurements in each of the dimensions of the sensory skills in the Montessori approach scale, proving that the Discrete Trials Training (DTT), as an applied behavior analysis technique, have achieved a noticeable improvement in children with spectrum disorders.

The results can be attributed to the progress the children achieved within the intervention sessions, which led to the continued impact after a period of its implementation, and also to the encouragement and reinforcement the children received that made them desire to continue and progress, as the child found support from the researcher and family at home. In addition the intervention contributed to children's feeling with improved abilities among the peer group, helped educate parents about the importance of acquiring and improving sensory skills in children, which supported the child's position, through participation between the parents and children in performing household activities, and the parents' observation of their children's progress.

The result of the current research also agreed with the results of Sharaf (2016), Masan and Misty (2017), Goodwin (2018), Larocci and McDonald (2019), and Mckenney and Ryanm (2020), who all emphasized the continuity of the intervention effectiveness during the follow-up period in developing the sensory skills of children with autism spectrum disorder. They also pointed out the effectiveness of the programs that relied on applied behavior analysis techniques in developing many skills and experiences, including sensory skills, and the effect of these programs appears to extend even after they end. It is clear from the above that the result of the second hypothesis is verified. Indeed, despite the end of the application of the intervention, its effectiveness extended and continued even after a period of one month, which led to the absence of statistically significant differences between the average scores of the children of the experimental group in the post- and follow-up measurements, the continued impact and effectiveness of the program, which included the use of applied behavior analysis techniques (i.e. Discrete Trials Training (DTT)) in

improving sensory skills in the Montessori curriculum for children with autism spectrum disorder.

Second: Research Recommendations:

- Preparing appropriate programs and strategies to improve the sensory skills of children with autism spectrum disorder through the use of applied behavior analysis techniques (i.e. Discrete Trial Training (DTT)).
- The need to guide teachers and parents to diversify the means and tools used in education and to make them interesting and attention-attractive, in addition to being available in children surrounding environment, in addition to using means and tools that feed more than one sensory input through the techniques of applied behavior analysis.
- Paying attention to the nature of sensory activities and exercises that rely on multi-sensory learning that are provided to children through the discrete trial training (DTT).
- It is necessary to provide the required tools in children's environment to help them improve sensory skills, diversify activities and use of modern strategies, including applied behavior analysis techniques (i.e. Discrete Trial Teaching (DTT)) that are provided to children rather than relying on one activity.
- The need for familial participation in interventions based on applied behavior analysis (Discrete Trial Teaching) designed to improve the sensory skills of children with autism spectrum disorder.

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