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THE EFFECTIVENESS OF AN EXPERIMENTAL PROGRAM BASED ON APPLIED BEHAVIOR ANALYSIS TO DEVELOP SOCIAL INTERACTION SKILLS IN A CHILD WITH AUTISM SPECTRUM DISORDER

Guir Keltoum *[1], Nouar Chahrazed [2], Zekri Nardjess [3], Maache Salma [4]

[1,2,4] Neuropsychology and Socio-Emotional Disorders Laboratory

[3] Laboratory for Quality Programs in Special Education and Adapted Education

[1,2,3,4] University of Kasdi Merbah, Ouargla, Algeria

Email : kaltoumguir@gmail.com

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Abstract

The current study aimed to identify the effectiveness of an experimental program based on applied behavior analysis (ABA) to develop social interaction skills. This study utilized a quasi- approach based on a quasi-randomized design for a single group. The tools used were the Childhood Autism Assessment Scale (CARS-2) and the Social Interaction Skills Observation Card. The study was conducted on 20 participants (12 males and 08 females). The clinical and statistical significance of the gain ratios and the significance of the differences (T-test) were calculated using SPSS.V25. The study concluded that the ABA-based program is effective in developing social interaction skills among the study sample.

Keywords: Applied behavior analysis - Social interaction- child with autism spectrum disorder

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder and a neurological growth impairment that causes profound disability and many clinical indicators such as deficits in social interaction and communication, stereotyped behaviors, and self-absorption. In light of the ambiguity surrounding its causes and pathological factors, research intersects with psychological practice in order to identify and select appropriate treatment and intervention programs, whether psychological, behavioral, or educational.

1 - Research Problem

ASD is a neurodevelopmental problem that appears in children between the ages of 18 months and 3 years. It affects communication, social interaction, eye contact, and the formation of relationships

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with others (Asmaa, Waqar, & Zikra, 2020). It affects 1 in every 100 children according to the World Health Organization (WHO, 2022), and this number continues to increase, which requires the preparation of specialized experts and programs to care for this group. Unfortunately, there is insufficient awareness of the disorder, which can appear across a wide spectrum from mild to severe. This makes it difficult for the child to communicate and interact with others, and the child may also engage in routine exercises and become upset by changes in daily schedules.

Many experts view Applied Behavior Analysis (ABA) as one of the most effective programs for children with ASD. It is based on logical standards (Asmaa, Waqar, & Zikra, 2020) and emphasizes the use of techniques that change behavior in measurable ways, focusing on assessment and diagnosis. It includes a large number of strategies that can be used across different groups and a wide range (Leaf, et al., 2016).

Given the importance of ABA, experts emphasize that Board Certified Behavior Analysts (BCBA) must hold graduate degrees. At the master's level, training requires 1500 hours of practical understanding before a comprehensive 4-hour exam. Currently, there are more than 3500 BCBAs worldwide. At the second level, analysts are trained through 1 hour of direct practical training with tests conducted shortly thereafter (Kazemi & Shapiro, 2013). Therefore, in developed countries, ABA is considered a therapeutic program for children with ASD to develop various skills (Asmaa, Waqar, & Zikra, 2020).

Since the research team observed the difficulty of social interaction among children with ASD and the importance of working on developing this aspect, and as studies confirmed the benefits of training children to improve their skills, there is a need to identify problems in communication and social interaction. This requires formulating a training program that equips children with social interaction skills based on techniques and strategies such as the Lovaas program. Several studies have confirmed its effectiveness, including Ameera (2018), which aimed to investigate the impact of training mothers of children with ASD (not enrolled in special education centers) on improving social interaction and communication. Results showed statistically significant differences in all dimensions of the social communication and interaction scale in favor of post-testing.

Reitzel et al. (2013) conducted a study to examine the effectiveness of ABA training in improving social interaction, communication, reducing maladaptive behaviors, and lowering parental stress. Results confirmed the effectiveness of ABA in developing social interaction, communication, and functional behavior among children with ASD. Similarly, Asmaa, Waqar, & Zikra (2020) found ABA effective in enhancing social interaction with peers, social communication, and appropriate purposeful behavior, favoring the experimental group. Mahoney & Perales (2003) demonstrated ABA's effectiveness in significantly improving social interaction among children with ASD and enhancing parental social and emotional performance with their children.

Khalifa (2011) also concluded that ABA was effective in improving social interaction and reducing repetitive behaviors in children with ASD, with results favoring the experimental group in post-testing (Khalifa, 2004).

Several studies point to the effectiveness of ABA-based programs in developing communication and social interaction skills in ASD. Among these is the famous study by Lovaas (1987), which confirmed the effectiveness of intensive behavioral programs in teaching children with ASD. The study was conducted on three groups: the first group received 40 hours of intensive behavioral

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training per week, the second group received 10 hours weekly, while the third group followed traditional teaching methods. Results showed significant behavioral improvements in the first group, with nearly half of these children able to join regular school classrooms (Lutfi, 2015).

For this reason, this study focused on the variable of ABA and its effectiveness in developing social interaction skills among children with ASD by posing the following research questions:

1-1. Research Questions

- Are there statistically significant differences between pre-test and post-test scores of the study sample on the CARS-2 scale?
- Are there statistically significant differences between pre-test and post-test scores on the Social Interaction Skill Observation Card after applying the program?
- Are there clinical differences between pre-test and post-test scores on the Social Interaction Skill Observation Card after applying the program?

1-2. Research Hypotheses

- There are statistically significant differences between pre-test and post-test scores of the study sample on the CARS-2 scale.
- There are statistically significant differences between pre-test and post-test scores on the Social Interaction Skill Observation Card after applying the program.
- There are clinical differences between pre-test and post-test scores on the Social Interaction Skill Observation Card after applying the program.

1-3. Research Objectives

- To identify differences between pre-test and post-test scores of the study sample on the CARS-2 scale.
- To identify differences between pre-test and post-test scores on the Social Interaction Skill Observation Card after applying the program.
- To identify clinical significance between pre-test and post-test scores on the Social Interaction Skill Observation Card after applying the program.

1-4. Significance of the Study

- Scientifically, the study contributes to ASD research and its related theoretical framework.
- Practically, results will benefit specialists working with children with ASD by improving their ability to develop social interaction skills, generalize outcomes, and provide a basis for building ABA-based programs.

1-5. Study Boundaries

1.5.1. Human boundaries: The study sample consisted of 20 children aged between 3 and 8 years diagnosed with ASD.

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1.5.2. Spatial boundaries: The study was conducted at Basma Mental Health Clinic in Ouargla.

1.5.3. Temporal boundaries: The study was conducted from October 18, 2022, to March 18, 2023.

1-6. Definition of Study Concepts

1-6.1. Social Interaction

Abdel Aziz & Al-Shakhs (1997) defined social interaction as a process of mutual influence between people through a series of behaviors including thoughts and feelings to bring about changes in behavior and achieve goals.

Operationally, social interaction is defined as a set of acquired skills by children with ASD to interact with peers, form relationships with others, engage in verbal and non-verbal communication, exchange emotions, practice social play, and regulate social behavior. It involves reciprocal behaviors between two or more individuals, resulting in mutual influence on each other's behavior. It is measured by the total score obtained by a child with ASD on the Social Interaction Skill Observation Card.

1-6.2. Applied Behavior Analysis (ABA)

Due to the great ambiguity in identifying the causes of ASD and the difficulty of defining appropriate care and treatment, researchers and specialists have turned to behavioral and educational training programs to support families of children with ASD. These programs aim to improve communication, social interaction, and adaptive behavior. Among them, ABA is the most widely effective (Ameera, 2018).

ABA is a behavioral training program that helps children acquire new skills to cope with difficulties in communication and social interaction. Given the challenges imposed by the disorder, the program seeks to build new behaviors and develop communication and interaction skills using techniques such as positive reinforcement, chaining, shaping, and prompting (Maria & Claude, 2011). It has more than 40 years of evidence supporting its effectiveness as one of the best interventions for ASD.

The techniques focus on targeting specific behaviors, establishing baselines, designing program plans to achieve goals, implementing interventions, analyzing effectiveness, and maintaining positive target behaviors (Rosenwasser & Axelrod, 2011).

Operationally, ABA is defined as an educational, behavioral activity involving multiple dimensions to develop psychological processes in children with ASD. It aims to improve communication and social interaction and reduce repetitive behaviors through repetition and intensive work, based on strategies and techniques derived from behavioral therapy and conditioned response using reinforcement developed by Lovaas. It includes daily monitoring, evaluation, and sessions averaging 6 hours per day and 30 hours per week.

1-6.3. Autism Spectrum Disorder (ASD)

According to ICD-11, ASD is characterized by persistent deficits in initiating and engaging in reciprocal social interaction and communication, combined with restricted and inflexible patterns

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of behavior, interests, and activities that are clearly excessive for the child, influenced by the social and cultural context (Tracey, Zaldivr, & Ozerk, 2021).

2 - Method and Tools

2-1. Research Method

The present study used the quasi-experimental method based on the one-group design, through which the differences between pre-test and post-test measurements are identified after introducing the experimental variable.

2-2. Study Sample

Initially, an exploratory sample of 100 cases diagnosed with ASD was selected. Through non-random sampling, 20 cases were chosen, all diagnosed with ASD for at least one year according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), and the CARS test. The participants' ages ranged between 3 and 8 years, and the study was conducted at Basma Mental Health Clinic in Ouargla.

2-3. Measurement Tools

The study relied on the following tools:

2-3-1. Childhood Autism Rating Scale, Second Edition (CARS-2)

The present study adopted the CARS-2 scale for estimating childhood autism, developed by Schopler, Recheler, and Runner (1988). This tool was designed to assist specialists in diagnosing ASD, as its dimensions align with DSM-5 criteria and the definition of the American Autism Society. It serves as a complementary diagnostic tool (Myles, Swanson, Holverstott, & Duncan, 2007).

The scale is used to evaluate children aged 3–13 and consists of 15 dimensions, namely: relating to people, imitation, emotional response, use of objects, adaptation to change, visual response, listening, attending, sensory response, fear, anxiety, verbal communication, non-verbal communication, activity level, intellectual capacity, and general impressions. Each dimension contains 4 items (Marie, 2011).

PSYCHOMETRIC PROPERTIES OF THE CHILDHOOD AUTISM RATING SCALE (CARS-2):

1 - Validity Calculation

1-1. Extreme Group Validity:

Scores were ranked in descending order, and then upper and lower groups were extracted at a rate of 27% of the sample. The significance of differences (T) was then calculated.

The calculated T-value = 2.72 at the significance level of 0.01, which is lower than the significance threshold of 0.05. This indicates the presence of statistically significant differences between the upper and lower extremes, showing that the scale possesses discriminative power and a high degree of validity.

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2 - Reliability Calculation

2-1. Reliability Using Split-Half Coefficient:

To calculate the reliability of the CARS-2 scale, the current study adopted the split-half method, dividing items into odd and even numbers. After calculating the correlation coefficient between the two halves, correction was performed using the Spearman-Brown formula.

The calculated Pearson correlation coefficient (r) before correction was 0.50, while the adjusted value (r′) using the Spearman-Brown equation reached 0.72 at the significance level of 0.01. This shows that the corrected coefficient (r′) is greater than the uncorrected value (r), which indicates that the scale has a high degree of reliability.

2-2. Reliability Using Cronbach's Alpha:

The Cronbach's Alpha reliability coefficient of the CARS-2 scale was 0.90, indicating that the scale demonstrates a high level of reliability.

After conducting the procedures to verify the psychometric efficiency of the CARS-2 scale, it was confirmed that it is suitable for the present study.

2-3. Social Interaction Skills Observation Card:

The observation card was prepared by a group of researchers as a model based on the Lovaas program according to its domains. It was later revised and translated by Nayef bin Abid Ibrahim Al-Zarea (2015). The card allows for observing and evaluating the child's skills through daily monitoring for one week for each targeted skill within the domain of social interaction (Al-Zarea, 2015).

PSYCHOMETRIC PROPERTIES OF THE SOCIAL INTERACTION SKILLS OBSERVATION CARD

1 - Validity Calculation

1-1. Extreme Group Validity:

The calculated T-value = 10.36 at the significance level of 0.01, which is lower than the threshold of 0.05. This indicates that there are statistically significant differences between the upper and lower extremes, showing that the Social Interaction Skills Observation Card possesses discriminative power and a high degree of validity.

2 - Reliability Calculation

2-1. Reliability Using Split-Half Coefficient:

Reliability of the Social Interaction Skills Observation Card was calculated using the split-half method, dividing items into odd and even numbers. After calculating the Pearson correlation coefficient between the two halves, correction was performed using the Spearman-Brown formula.

The calculated Pearson correlation coefficient (r) before correction was 0.70, while the adjusted value (r′) using the Spearman-Brown equation reached 0.82 at the significance level of 0.01. This

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shows that the corrected coefficient (r′) is greater than the uncorrected value (r), which indicates that the scale has a high degree of reliability.

2-2. Reliability Using Cronbach's Alpha:

The Cronbach's Alpha reliability coefficient of the Social Interaction Skills Observation Card was 0.92, which indicates that the scale demonstrates a high level of reliability.

2-3. Applied Behavior Analysis Program

Table No. (01): Summary of the Application of the Applied Behavior Analysis (ABA) Program for the Present Study

Program	**Applied Behavior Analysis (ABA) Program for Developing Social Interaction**
Objective	• Developing social interaction for children with Autism Spectrum Disorder. • Interaction with parents. • Verbal and non-verbal communication. • Peer participation. • Sharing emotions with others. • Use of gestures. • Social play. • Regulation of social behavior.
Theoretical Background	Behavioral Theory
Number of Sessions	6 sessions per week, at a rate of one session per day
Duration of Each Session	4 hours at the center and 2 hours at home
Study Sample	20 diagnosed cases of Autism Spectrum Disorder (ASD)
Nature of the Session	Five groups, with four children in each group
Program Duration	6 months
Session Management	Researcher + caregivers
Place of Implementation	Classroom + playground
Evaluation Methods	DSM-5, CARS-2 scale, Social Interaction Skills Observation Card

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Tools and Techniques	Material and social reinforcement + special exercises to develop social interaction skills (hugging and cuddling, interactive play by pulling the blanket, doll play, completing a story, playing with the ball, playing and passing between the legs, cards for implicit groups such as the group of animals). Daily homework task evaluation chart.
Final Session	Post-test evaluation

3 - Presentation of the Study Results

3-1. Presentation of the Results of the First Hypothesis:

The first hypothesis states that there are statistically significant differences between the pre-test and post-test scores on the CARS-2 scale among the study sample after applying the program. The following table presents the obtained results:

Table No. (02): Statistical significance results of the pre-test and post-test measurements on the CARS-2 scale for the study sample.

Statistical Data	Number	Mean	Standard Deviation	(T)	Significance Level
Pre-test	20	37.11	9.55	2.24	0.01
Post-test	20	42.41	3.48		

From Table No. (02), it is evident that the arithmetic mean of the pre-test measurement was (37.11), while the standard deviation of the pre-test was (3.48). The arithmetic mean of the post-test measurement was (42.41), with a standard deviation of (9.55). It is observed that the T-value reached (2.24), which is significant at the level (0.01). Therefore, the study hypothesis is accepted, stating that there are statistically significant differences between the pre-test and post-test scores on the CARS-2 scale for the study sample after applying the program, in favor of the post-test measurement.

3-2. Presentation of the Results of the Second Hypothesis:

The second hypothesis states that there are statistically significant differences between the pre-test and post-test scores on the Social Interaction Skills Observation Card for the study sample after applying the program. The results obtained are as follows:

Equation No. (1) shows the statistical significance results of the gain ratio for the Social Interaction Skills Observation Card after applying the program.

McGugian's Gain Ratio Formula:

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M – pre-test mean,

M – post-test mean,

P – maximum score of the test.

The range of this ratio extends from 0 to 1, and according to McGugian, the minimum acceptable value is (0.5), meaning (50%).

$$75\% = \frac{15-49.15}{15-60} \times 100$$

In other words: 75% > 50%.

By calculating statistical significance through the gain ratio, as explained above, the results of the pre-test and post-test mean scores showed differences between the two measurements in favor of the post-test. Thus, the sample of (20) participants exceeded the McGugian cutoff point of 50%, reaching 75%. This means the second hypothesis is accepted, which states that there are statistically significant differences between the pre-test and post-test scores of the study sample.

3-3. Presentation of the Results of the Third Hypothesis:

The third hypothesis states that there are clinically significant differences between the pre-test and post-test scores on the Social Interaction Skills Observation Card for the study sample after applying the program, in favor of the post-test measurement. The following table presents the obtained results:

Table No. (03): Results of Clinical Significance between the Pre-test and Post-test Scores on the Social Interaction Skills Observation Card for the Study Sample.

Case	Reliable Change Index (RCI)	Response to the Program
01	16.54	Good
02	15.82	Good
03	13.66	Good
04	11.51	Good
05	16.54	Good
06	6.11	Good
07	2.15	Needs more support
08	16.90	Good
09	16.18	Good
10	16.90	Good
11	17.26	Good
12	14.74	Good
13	15.46	Good
14	15.10	Good
15	5.39	Needs support
16	14.38	Good

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17	13.30	Good
18	12.94	Good
19	13.66	Good
20	3.95	Needs more support

From the results obtained and presented in Table No. (03), after applying the Jacobson–Truax (1991) formula to calculate clinical significance, it is clear that all values exceeded the cutoff point (1.96) of the Reliable Change Index (RCI). This indicates confidence in the improvement of cases in developing social interaction skills according to the Jacobson–Truax classification, as well as the positive response of the cases after undergoing the Applied Behavior Analysis (ABA) program. However, cases 7, 15, and 20, despite responding to the program and exceeding the cutoff point, still require additional support and intensive work to further develop their social interaction skills.

4 - Discussion and Interpretation of the Hypotheses Results

From the results presented in Table No. (02), it is clear that the first hypothesis was confirmed, which states that there are statistically significant differences between the pre-test and post-test scores of the study sample on the CARS-2 scale.

The current result is consistent with the study of Al-Shamqani (2013), whose findings demonstrated the effectiveness of the Applied Behavior Analysis (ABA) program in developing social interaction and reducing stereotyped behaviors, using the CARS-2 scale on a sample of 10 cases aged between 2 and 6 years.

The result of this study also agrees with the findings of Al-Ghamdi (2003), which confirmed the effectiveness of ABA in favor of the experimental sample in developing communication and social interaction in children with ASD, conducted on 10 children aged between 4 and 9 years. Similarly, the findings align with the study of Rubinalal (2010), conducted on 8 children with ASD aged between 9 and 12 years, which demonstrated the effectiveness of ABA in developing communication, social interaction, and expressive language. The results also agreed with those of Ingersoll and Dvortcsak (2006), which showed the effectiveness of ABA in developing communication and social interaction skills for children with ASD through natural environment interventions and parent training using specialized learning programs.

Regarding the second hypothesis, which was confirmed after applying McGugian's statistical significance equation for gain ratios, results indicated statistically significant differences between the pre-test and post-test scores on the Social Interaction Skills Observation Card for the study sample, in favor of the post-test. By calculating gain ratios and comparing them with McGugian's minimum acceptance threshold (0.5), the cutoff value for the 20 participating children was found to be $0.75 > 0.5$, thus meeting the required standards.

These results are consistent with the study of Sadeeq (2006), which reported improvements in attention, imitation, and eye contact through a proposed program for developing social interaction among 38 children with ASD aged 4–6 years, in favor of the experimental group. The findings also align with those of Bibi et al. (2001), which highlighted linguistic progress, development of adaptive behavior, and enhanced social interaction in a sample of 66 children who received services through intensive ABA programs implemented by mothers.

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From the results presented in Table No. (03), the third hypothesis was also confirmed, stating that there are clinically significant differences between pre-test and post-test scores on the Social Interaction Skills Observation Card for the study sample after applying the program. This can be explained by the outcomes obtained, which clearly demonstrate the effect and change brought about by ABA after calculating clinical significance. Results showed improvements and progress in all cases, with 17 children exhibiting significant development in social interaction skills, while 3 cases (7, 15, and 20) still required intensive support, despite showing slower improvement.

These results, with their varying effects, are consistent with the gain ratios presented earlier, demonstrating the effectiveness of ABA. They also align with the findings of James & Adkins (2020), which confirmed the effectiveness of ABA, highlighting differences between the first and second evaluations of cases and, more importantly, showing that ABA contributed to the development of social interaction skills and the reduction of maladaptive behaviors in children with ASD.

In contrast, the current study's findings differ from those of Randa (2011), which reported no significant differences between pre-test and post-test scores in both the control and experimental groups, attributing no effect to the use of symbolic reinforcement in ABA for developing communication and social interaction skills in a sample of 48 children with ASD aged 5–9 years.

This discrepancy may be attributed to differences in program duration and intensity. The current study applied ABA for 6 months at a rate of 30 hours per week and 6 hours per day, whereas Randa's study relied on symbolic reinforcement within ABA for only 2 months, with 6 hours per week at 1 hour per day. In the researcher's view, this difference in intensity explains the contrasting results, given that children with ASD require intensive intervention ranging between 30 and 40 hours (Randa, 2011).

CONCLUSION

The results of the present study showed progress in developing social interaction skills at the level of gestures, understanding signals, emotional sharing, and improvements in the emotional interactive relationship between mother and child. The study also demonstrated positive changes in the child's behavior, responsiveness to requests, and both verbal and non-verbal communication. Mothers reported noticeable behavioral changes in their children, such as increased attention, responding when called, and joining their mothers in play with the blanket.

The intensive intervention using Applied Behavior Analysis (ABA) contributed significantly to the development of social interaction skills in children with ASD, reduced stereotyped behaviors, and enhanced interactive emotional relationships with specialists and caregivers during skill training. The diversity of strategies and techniques used to develop social interaction skills such as material reinforcement, social support, play, and hugging had a positive impact in helping mothers accept their children, participate in the program, and build stronger emotional interactive mother child relationships during homework exercises, as revealed in this study.

Based on the findings, the following suggestions are proposed:

- Encourage and support specialists to use ABA in the care of children with ASD.

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- Establish specialized institutions and pedagogical centers to provide care and rehabilitation for individuals with ASD using ABA and to train mothers.
- Support students and researchers to investigate this topic further, given the scarcity of Arabic studies on the variable of Applied Behavior Analysis programs.

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