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Unlocking Social Growth: The Impact of Applied Behavior Analysis on Children with Autism Spectrum Disorder

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Abstract

Autism spectrum disorder (ASD) is significantly known as social interaction impairment that can be reduced through early school-age intervention. The quasi-experimental research design was used to examine the effect of applied behavior analysis treatment on ASD children's interpersonal skills. The researchers used a purposive sampling technique to select 30 participants who have symptoms of ASD, which were divided into two groups (control and experimental) without gender discrimination. The assessment of basic language and learning skills (ABLLS-R) protocol and portage guide of early education was used to develop a questionnaire comprising four factors. The results indicate a statistically significant difference between the experimental and control groups in terms of students' interpersonal skills and the pretest and post-test scores of the experimental group. It is suggested that parents and therapists should develop a sharing ability among children with autism symptoms so they can understand social reinforcement.

Keywords:

Interpersonal Skills, Peer Interaction, Autism, Social Communication, ASD

Introduction

Autism septum disorder (ASD) is a social interaction impairment that affects three types of child development, i.e., behavioral, communicational, and interactional, which leads a child to become socially isolated from a human being(Cihon et al., 2023; Edition, 2013; Mash & Wolfe, 2015). However, some psychologists consider that ASD is a neurodevelopmental disorder that happens due to three types of deficits, i.e., social skills, communication, and stereotypies & rituals (Leung et al., 2010; Lubomirska et al., 2022). Therefore, investigators found that the core symptoms of ASD are impairments in communication, reciprocal social interaction, and restricted and repetitive behaviors that create problems in children's social development. Hence, the Centers for Disease Control reported that ASD affects one in 68 children, as cited by (Roane et al., 2016) and one in 100 adults worldwide, as cited by (Brugha et al., 2011).

Subsequently, families demand insurance coverage for research-based therapies for ASD because the proportion of children with ASD has increased to one in 59 (Zhao et al., 2018). Recently, the Centers for Disease Control (2022) reported that ASD affects children in one in 44 (Lin & Bhatia, 2022). With the dramatic increase of ASD children, the severity of the disorder highlights the importance of practical therapeutic approaches for its treatment through intervention during early school age. Thus, the most successful evidence-based interventions for children with ASD are those based on applied behavior analysis (ABA) treatments (Fein et al., 2013; Zane et al., 2023). A very significant report of autism self-advocacy community before the 1980s, the time when autism was not recognized officially, revealed by Karola, Dillenburger, and Mickey, Keenan (2023) that shares the crisis of discriminatory approach, the concept of ableism followed by medical model advocacy instead of a social model approach. This leads to misinterpretation and the least articulatory concerns regarding providing right-based equitable support services.

Lovaas first implemented the treatment ABA in the 1980s for the UCLA-Young Autism Project, which became very popular because of dramatic improvements in children with ASD (Makrygianni et al., 2018). Since the 1980s, numerous researchers, psychologists, and therapists have conducted various intervention studies to provide additional support to the effectiveness of the ABA method. They concluded that the ABA method improves children's adaptive behavior, language skills, and IQ scores and reduces autism-related symptomatology (Strauss et al., 2012). In comparison, the results of these studies vary due to environmental conditions, measuring parameters, intervention characteristics, subject characteristics, and evaluating parameters that lead to the effectiveness of ABA treatments and their efficacy.

As a result of meta-analytic studies, researchers (Peters-Scheffer et al., 2011, 2013; Virués-Ortega, 2010) defined ABA as treatment approaches that are (a) implemented systematically; (b) applied as early as possible, particularly before school age 3 to 6; (c) based on student-teacher ratio; (d) followed a typical development hierarchy; (e) used in collaboration with parent (Healy & Lydon, 2013). Early diagnosis of impairment of interpersonal skills in ASD children is essential for better language and communication skills of children (Gerhardt et al., 2023; Gillespie-Lynch et al., 2012). Even after six to eight weeks of intervention, children with ASD can develop and improve requesting skills in a spontaneous social context (Azeem, A., Faiz, Z., & Bashir, R., 2022). Julia L. Ferguson and Christine M. Milne (2023) restated the terminology used in 2016 by Leaf and colleagues, as progressive applied behavior analysis as a needed intervention strategy for ASD, followed by a response-friendly and flexibly structured approach for the learner, mainly incorporated with formative analysis of teaching social behaviors. Thus, the influential role of ABA in developing interpersonal skills in ASD children is the core need of the present world. Therefore, this pretest-posttest quasi-experimental research was designed to examine the effect of applied behavior analysis treatment on ASD children's interpersonal skills.

Theory of ABA as Treatments

The roots of ABA treatments emerged from the B. F. Skinner research work that suggested and confirmed that human behavior can be modified through a treatment process, parallel to Darwin's process of natural selection (Betz, 2011; Catania et al., 1988). Subsequently, Skinner explained that human behaviors can be modified to produce noteworthy outcomes through an intervention (a function of reinforcement) in a particular situation (Cummings & Carr, 2009). Skinner also illustrates how human behavior could develop or change over time through reinforcement called shaping (Smith & Ladarola, 2015). However, some other operant processes are also used to create new responses through modeling. The first ABA treatment for ASD children was developed by Ivar Lovaas, which is for behavioral intervention conducted 5-7 days per week (Lovaas, 1987).

Initially, ABA treatment was implemented as a one-tone format to develop learning skills and eradicate atypical behavior (S. M. Myers & Johnson, 2007). Subsequently, treatment becomes less structured for children to develop social and complex cognitive skills (Lerman et al., 2011). The ABA is generally applied around children 2 to 25 years old (for a shorter duration) as this age limit is crucial for developing social skills (LeBlanc et al., 2003). Various systematic reviews and meta-analyses support that ABA treatment is more effective for developing social skills than other interventions (Healy & Lydon, 2013; Peters-Scheffer et al., 2013).

Review of Related Literature

Numerous researchers described how applied behavior analysis (ABA) treatment plays a role in the outcome of the special needs of children having autism spectrum disorder (ASD) that are based on the interventions (Foxx, 2008; Lim & Draper, 2011). Thus, few focused on behavioral therapies of ABA treatments to enhance social skills in ASD learners (Matson et al., 2012; Petursdottir et al., 2007; Shukla-Mehta et al., 2010).

The deductive approved methods integrate interpersonal skills among autistic children comprehensively, while individual personality traits influence therapies. Therefore, reliable ABA programs are offered to overcome the special needs of autistic children. Advisors and guardians must be ready to

carry out the projects in various situations, places, and situations involving different people to increase the interpersonal skills that the treatment endeavors successfully. Maladaptive behaviors, such as hatred and self-harm, are not strengthened, whereas explicit, correct elective behaviors are taught or maintained through a supportive environment (Foxx, 1982).

There is overwhelming observational evidence that early and severe conduct mediations require behavior analysis to produce observable and long-lasting practical improvements for autistic children. Parents who choose to use ABA-based intervention for their children are typically left alone with their support and have expressed discontent with the treatment condition. In addition, some experimental studies have been conducted to determine the effectiveness of the ABA program (McPhilemy & Dillenburger, 2013; Olubunmi et al., 2018).

ABA improves and changes socially significant practices within the context of the person's social condition. Adroitly efficient and intelligent, ABA accomplishes quantifiable changes in effective objective practices that last over time and conditions. It is also responsible, open, possible, enabling, and romantic. It is directed inside the logical system. It centers on utilitarian connections and replicable systems. Aversive methods keep a strategic distance from interventions that depend on accurate assessment, utilitarian research, and positive reinforcement (Zachor et al., 2007).

There are two levels of affirmation, guaranteed and directed by the Behavior Analyst Certification Board (BACB, 2007). Before completing a lengthy 4-hour test, Board Certified Conduct Analysts (BCBA) must have at least 1,500 hours of directed free hands-on work experience and a Master's degree level of preparation in conducting investigations. There are currently close to 3,500 BCBAs functional in the world to overcome autistic children's social skills. Board Confirmed Right-Hand Behavior Analysts (BCaBA), which replaced Board Certified Associate Behavior Analysts (BCABA) in January 2009, must have at least Bachelor's degree-level training in conducting the investigation and 1,000 hours of directed free hands-on work experience before taking the test. A BCBA should also manage them shortly after taking the test (Kazemi & Shapiro, 2013). To enhance various social skills, ABA is regarded as a treatment for autistic children in developed nations. To encourage parents, specialized facilities, hospitals, and clinics to adopt this approach and, through these tactics, assist children with autism in leading peaceful, ordinary lives in society, it is necessary to emphasize the value and effectiveness of ABA.

Because of this, the study's most important ABA and autism variable emerged and provided direction to conduct studies with and without treatment. In Pakistan, there are special education government institutes, psychologists, instructors, and doctors for kids with special needs. No qualified specialists appropriately evaluated autistic children or used a systematic instrument. Since ABA is new in Pakistan, many parents and even the directors of the institutions are hesitant to adopt the techniques. For many years, children with autism were enrolled in clinics or centers, and they made some small progress.

This research could be helpful to all behavior therapists, psychologists, government special education department heads, principals, and institution heads to understand how modern, scientific approaches aid in children's right skill development. Scientific methods cannot be the only means of developing robotic talents. These treatments modify people's and parents' minds to accept changes in society and centers. The goal of the current study was to demonstrate how ABA benefits autistic children and how it helps children gain interpersonal skills. With ABA therapy, researchers provide behavior therapists with various tools and procedures to help children develop social interaction skills. The present study answers multiple questions. First, does a post-test on social interaction skills in children with autism yield the same results as the pretest on interpersonal skills? Second, are there any notable differences between an ABA to foster social skills in autistic children? The scope of this study, which aimed to answer the concerns above, was limited by age restrictions, child diagnoses, the severity of autism, the IQ of the subjects, and the use of ABA therapy. All children included in this study were between 3 and 6 years old and had been diagnosed with mild autism. None of the kids were non-verbal.

Research Methodology

Research Design

A research design comprises numerous elements (i.e., research paradigm, research approach, research design, and data collection method that provide guidelines for the study (Creswell & Clark, 2017; M. D. Myers, 2019). Researchers adopted a positivist paradigm (quantitative approach). In contrast, the pretest-posttest design of quasi-experimental research was used to examine the effect of "clinic-based applied behavior analysis treatment on ASD children's interpersonal skills." Hence, a survey method was applied to collect data about participants' interpersonal skills two times (before and after intervention). The independent variable was applied behavior analysis treatment manipulated by the researchers to examine its effect on the dependent variable, interpersonal skills.

Participants

The researchers searched Google to collect information about clinics and centers in the Lahore

district of Pakistan that are working to provide applied behavior analysis (ABA) treatment. It was found that forty (40) centers were providing behavior intervention services to children with autism spectrum disorder. The researchers selected one center to collect information about ABA treatment. At the same time, authorities informed them that they only used behavior and special needs services for children who are suffering from autism symptoms. The decision was made based on enrollment and the many cases in which they dealt with extensive experience and qualified staff. The researchers took permission from one center through a consent form to conduct this experimental study. Initially, researchers selected 36 children who have symptoms of ASD. The center reported that the target sample was already tested for IQ on TONI (Test for Non-verbal Intelligence), and those children had almost the same IQ range (60-75), were aged between 3 to 6 years old, and had mild symptoms of autism.

In contrast, six children were dropped from the experiment because they had comorbid disabilities. Thus, a purposive sampling technique was used to select 30 children who were latterly divided into two groups (i.e., control and experimental) without gender discrimination based on their assessment scores. The inclusion criteria were established and focused on the selected children: i) visit the center from Monday through Friday. ii) can follow a therapist's instructions, iii) speak 4 to 5 phrases, words, and sentences. Before the setup, the researchers followed the approval meeting protocol with parents and the director of that setup, outlining the study's goal and every process step in detail. As a result, both parents and the center director signed the approval letters. In order to determine the children's level, communication and social skills assessment through ABLLS-R and portage guide of early education were performed with each child by the researchers before the beginning of "Clinic-based ABA therapy" and compared with already performed assessment results at the center. After a satisfactory comparison, the intervention took place.

Measures

The researchers developed a pre-assessment and post-assessment tool (questionnaire) by taking help from the assessment of basic language and learning skills (ABLLS-R) protocol and portage guide of early education (main focus was language/communication and social milestones). The ABLLS-R protocol is an evaluation instrument used to measure language, social communication, and social interaction skills among children with autism spectrum disorder. In contrast, the portage guide of early education is used to measure developmental milestones according to infant stimulation, cognition, speech/language, motor, social, and self-help skills of children from birth to 5 years of age. The researchers picked up the goals from the social and language section of the portage guide to early education. Thus, researchers developed a questionnaire that was divided into two sections. In the first section, the Child's demographic information was asked, while the subsequent section consisted of four interpersonal skills sub-constructs (i.e., social group skills, peer interaction, social communication, and interaction, and appropriate behavior). The first sub-factor dealt with social group skills had ten statements. The second sub-factor dealt with peer interaction and had six goal statements. The third sub-factor dealt with social communication and interaction and also had six statements. The fourth sub-factor dealt with a child's appropriate behavior and had eight statements. Both groups completed the questionnaire before and after an intervention. The researchers systematically gave the experimental group "Clinic-based ABA therapy," which consisted of 45 minutes with each student five days a week.

Instrumentation

The assessment of basic language and learning skills (ABBELS-R) protocol of the social interaction domain originally consisted of 34 items. To execute the current research, each item was named "a social goal" for children with autism spectrum disorder. However, in Portage Guide of Early Education, the selected goal statements comprised 83 "peer interaction goals" items. The researchers merged all the goals of both protocols by avoiding duplication and developed a questionnaire comprising 38 items. Each goal was divided into four-point Likert-type percentages (i.e., the child's Master of goal percentage falls between 80 to 100%; the child at a competent level of goal percentage falls between 60 to 80%; the child; the child at a developing level of goal percentage falls between 40 to 60%, and child score less than 40% knows as a child has no social interaction skills. The overall percentage of all goals shows in percentage as (0%-40%, 41%-60%, 61%-80%, and 81%-100%), which means the range of interpersonal skills falls among no improvement, slight improvement, developing improvement, and mastery improvement. Five assessment experts validated the instrument, keeping in view the valuable comments of the experts, eight items/goals were omitted (due the risk of response duplication), and five were modified. Thus, the final questionnaire consisted of four sub-factors and 30 items/goals. However, the instrument's reliability was calculated through Cronbach alpha statistics (0.896), which was acceptable. Before starting the treatment, the researcher made a sheet in which all goal names were mentioned, and the discriminative stimulus (SD), introduced date, and mastered date in a written form. Another sheet was made for every trial recording and percentage. In the end, this percentage helps to know which goal was mastered and which skill was developed in a child's during a marked time duration. The Control group treated with the traditional method used by the center was the experimental group

treated with "Clinic based ABA therapy/treatment," while the environment, time, and therapists were the same for both groups.

Data Collection Procedure

The experimental group was treated through "Clinic based ABA therapy," while the control group was treated with the traditional method. The researchers follow the ABA protocol structure and properly address the rules of measures. Each target receives five trials every day. A score of 20% is equivalent to each trial mark, and 4 levels of prompts were given by examining the child's requirement. Table 1 below contains the Mark sheet, which helps you understand the requirements.

Treatment Duration

The treatment continued for six months (September 2022 to February 2023). A total of 30 children took part in the trial. Five days a week, the researchers offered each child 45 minutes to complete many concurrent goals listed in the instrument. Time and goals for each day's performance during therapy were maintained in a child's portfolio.

Procedure

The researchers taught behavioral therapists and practiced ABA therapy in a private clinic. They completed a registered behavior technician (RBT) program to learn ABA therapy and have complete control over managing autistic children while providing behavior therapy. For participants in the control and experimental groups, five sessions per week were planned for kids with autism. Five sessions comprised a week's five days (Monday through Friday). Each session lasted 45 hours. The same criteria were applied to both groups, but participants in the experimental group received "Clinic-based ABA therapy", while those in the control group received standard, unstructured instruction. Within the same clinic, three therapists treat youngsters. Both groups used the same clinic, measurements, atmosphere, time, and assessment techniques, but the criteria differed. Session description was divided into 4 phases, which were described below:

Phase 1: The two rooms were initially configured by therapists following the needs of the therapy. One room was correctly organized and built, following ABA guidelines. According to the pre-assessment results,

Table 1:
Running Goals Record for Every Trial Each Day

Statement #	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Prompt Level	Total Percentage
1	+	+	_	_	_	2	40
2	+	_	_	+	+	1	60
3	+	+	+	+	_	3	80
4	+	+	+	+	_	3	80
5	+	+	+	+	_	3	80
6	+	+	_	_	_	2	40
7	+	+	_	_	_	2	40
8	+	+	+	+	_	1	80
9	_	+	_	+	+	2	60
10	+	+				1	40
11	+	+	+	+	_	1	80
12	+	+	+	+	_	2	80
13	+	+	+	_	_	2	60
14	+	+	+			1	60
15	+	+	+	_	+	3	80
16	+	_	+	_	_	1	40
17	+	+	+	_	_	2	60
18	+	+	+	_	_	2	60
19	+	+	_	_	_	2	40
20	+	+	+	+	_	1	80
21	_	+	_	+	+	2	60
22	+	+				1	40
23	+	+	+	+	_	1	80
24	+	+	+	+	_	2	80
25	+	+	+	_	_	2	60
26	+	+	+			1	60
27	+	+	+	_	+	3	80
28	+	_	+	_	_	1	40
29	+	+	+	_	_	2	60
30	+	+	+	_	_	2	60

the room's tables and chairs were arranged, and each student is given a basket. Researchers used an instrument to pre-assess all the chosen children before beginning treatment, and they then established the baseline for each aim. The amount of work therapists begin depends on where the child falls—pre-assessment results in almost all the kids falling into the same level. Every child in the experimental group also had an objectives chart and a reinforcement plan created by the researchers. A reinforcement schedule was then created and pasted into each child's file by ABA behavior therapy practitioners. Another room had previously been selected to use the conventional session layout. Researchers mapped every child's body when they entered the center, and when they left, parents signed and got their children. Body mapping includes the child's behaviors and shows them to the parents so they may start cooperating during the sessions. The ABC (antecedent, behavior, consequence) model displays all behavioral data. This form, which is only available to members of the experimental group, aids in understanding why this behavior occurs.

Phase 2: In the second phase, therapists separated the group into two sub-groups of 10 youngsters, five in the control group and five in the experimental group. The therapists and researchers remained consistent and met with the child in person. The researcher begins developing pairing or repo building with the youngster in the experimental group. During this process, the researcher offers the child a free hand, lets the youngster choose whatever they want, and continues to play with the child. The primary tenet of the "Clinic-based ABA therapy" ABA is to instill in a child that they are the therapist's employees and must obey all of the therapist's instructions. The establishment of a rapport between children and therapists took two weeks. Therefore, the therapists never made the child sit or work against their will. However, the control group members showed up and engaged in lonesome play. Therapists don't give the child their whole attention and don't interact with them constantly. Therapists run goals side by side while partnering.

Phase 3: Therapists utilized prompt levels when administering "Clinic-based ABA therapy" to experimental group children. There were four steps at the prompt level (complete physical, partial physical, light touch, and independent level). These actions assist in the systematic development of a child's talents. Therapists used those stages to carry out aims during sessions. Therapists used a baseline to create sheets with all goals written out and properly run plans. Therapists never gave the child the same instructions twice. In addition, the child was physically and mentally active for 45 hours. When working with the control group, therapists never used any level of prompting before beginning in an unstructured style and giving the child control. If a youngster makes eye contact, the therapist repeats the instruction/s.

Phase 4: In the last phase, therapists drop the children's level and continue considering the starting level where the child in the experimental group demonstrates no improvement in any goal. The control group attempts all goals inappropriately. Therapists discontinue the objective and move on to the next one if the child doesn't respond. The details of week-wise activities with the treatment and control groups are in Table 2.

Table 2

Work of Control and Experimental Group

Work according to weeks	Control Group	Experimental Group
Month of September	start with pairing	start with pairing
Last week of September and the Start of November	Start run goals without developing reinforcement Schedule	pairing also takes a preferred assessment of reinforcement
The third week of the November	session, run anywhere, not sit in a table chair. also, start with the 15 goals	Compulsory to sit in a table chair that increases the compliance level of a child and start running goals. Select 2 to 3 goals from each domain
Month of December	start with the 15 goals	start with goals with a preferred item of a child Reinforcement schedule
The first week of January	all goals run side by side	after achieving seven primary goals, Add more goals
Third week of January	use reinforcement, not proper schedule design, and work on all 30 goals	runs all goals according to the data results entered in a file
The second week of February	achieved goals closed run non achieved goals run	Achieved goals added as a maintenance goal also run other goals as acquisition goals
Fourth week of the February	post-assessment	post-assessment

Data Analysis

The statistical package for social sciences (SPSS version 24) software was used to apply inferential statistics to collect data for analysis. The researchers applied independent samples t-test, paired samples t-test, and Univariate Analysis of Variance test to find out the difference between the control and experimental groups and to examine the effect of applied behavior analysis treatment on ASD children's interpersonal skills.

Ethical Considerations

All ethical norms were observed in this study, ensuring respondents' anonymity. The University of Management and Technology Lahore granted Ethical approval to conduct the study (Approval No: 236-06-09-2022).

Results

Table 3:
Pre-Assessment Scores of Children Regarding Interpersonal Skills

Factor	*M*	*SD*
Social Group Skills	2.71	1.021
Peer Interaction	2.63	1.624
Social Communication & Interaction	2.21	1.352
Appropriate Behaviors	2.81	1.873
Overall Interpersonal Skills	2.74	1.406

Note: N=30.

Table 3 shows the results of children's pre-assessment scores of their interpersonal skills and their sub-factors. It is depicted that children develop level-appropriate behaviors that were higher than social group skills, peer interaction, and communication & interactive skills as the *M= 2.81; SD=1.873>* than *M=2.71; SD=1.021; M=2.62; SD= 1.624;* and *M=2.21; SD=1.352*, respectively. However, the least contributing factor was social communication and interaction among children. Moreover, the mean score of overall interpersonal skills indicated that children have developing level interpersonal skills as *M=2.74; SD=1.406.*

Table 4:
Comparison of Control Group of Children Pretest and Post-test Scores of Interpersonal Skills

	Pretest		Posttest		*t*	*df*	*p*	*g*
	M	*SD*	*M*	*SD*				
SGS	2.43	.652	2.61	1.004	1.331	28	0.249	0.187
PI	2.92	.946	3.07	.974	1.526	28	0.846	0.284
SCI	2.99	.639	3.23	1.045	.939	28	0.987	0.235
AP	2.87	.474	3.01	1.235	1.427	28	0.496	0.139
OIS	2.68	.737	2.94	.934	-1.430	28	0.167	0.273

Note: N= 15; SGS: Social Group Skills; PI: Peer Interaction; SCI: Social Communication and Interaction; AB: Appropriate Behaviors; OIP: Overall Interpersonal Skills; g= Hedge's g; and * = p < 0.05.

To compare the difference between the pretest and post-test scores of the control group regarding their interpersonal skills, a paired sampled t-test (Table 4) was applied. The results showed no statistically significant difference between pretest and post-test scores of children's overall interpersonal skills, and all the four sub-factors as *t* (28) = -1.430, *p* (0.167); *t* (28) = 1.331, *p* (0.249); *t* (28) = 1.1526, *p* (0.846); *t* (28) = .939, *p* (0.987); *t* (28) = 1.427, *p* (0.496) respectively. In contrast, the values of Hedge's *g* indicated a small (0.1 to 0.2) effect size (Albers, 2017; Fallon, 2016) as *g* = 0.273, 0.187, 0.284, 0.235, and 0.139. Thus, the null hypothesis, "There is no significant difference between the pretest and a post-test score of a control group of children's interpersonal skills," is accepted.

Table 5:
Comparison of Experimental Group of Children Pretest and Post-test Scores of Interpersonal Skills

	Pretest		Posttest		*t*	*df*	*p*	*g*
	M	*SD*	*M*	*SD*				
SGS	2.43	1.271	3.75	2.982	3.743	23.673	0.001*	0.576
PI	2.92	1.843	3.87	2.964	-4.765	24.984	0.000*	0.563
SCI	2.99	1.759	3.83	1.834	-3.652	24.733	0.001*	0.706
AP	2.87	1.834	3.79	1.851	2.934	27.634	0.003*	0.687
OIS	2.68	1.807	3.69	2.863	-8.981	25.097	0.000*	0.609

Note: N= 15; SGS: Social Group Skills; PI: Peer Interaction; SCI: Social Communication and Interaction; AB: Appropriate Behaviors; OIP: Overall Interpersonal Skills; g= Hedge's g; and * = p < 0.05.

To compare the difference between the pretest and post-test scores of the experimental group regarding their interpersonal skills, a paired sampled t-test (Table 5) was applied. The results showed a statistically significant difference between pretest and post-test scores of children's overall interpersonal skills and all the four sub-factors as *t* (25.097) = -8.981, *p* (0.000); *t* (23.673) = 3.743, *p* (0.001); *t* (24.984) = -4.765, *p* (0.000); *t* (24.733) = -3.652, *p* (0.001); *t* (27.634) = 2.934, *p* (0.003) respectively. In comparison, the values of Hedge's *g* indicated medium to large (0.5 to 0.7) effect size (Albers, 2017; Fallon, 2016) as *g* = 0.609, 0.576, 0.563, 0.706, and 0.687. Thus, it is concluded that applied behavior analysis treatment significantly affected the experimental group of children's interpersonal skills. Therefore, the null hypothesis, "There is no significant difference between the pretest and post-test score of the experimental group of interpersonal skills," is rejected.

Table 6:
Comparison of Control and Experimental Group Children Post-test Scores of Interpersonal Skills

	Control Group (15)		Experimental (15)		*t*	*df*	*p*	*g*
	M	*SD*	*M*	*SD*				
SGS	2.93	1.221	3.86	2.083	-2.812	26.156	0.041*	0.544
PI	3.21	1.743	3.78	2.093	-2.035	25.987	0.039*	0.487
SCI	3.17	1.604	3.81	1.934	2.412	26.593	0.016*	0.512
AP	3.26	1.935	3.73	1.957	1.452	28	0.082	0.134
OIS	3.08	1.203	3.76	2.004	-3.074	25.073	0.001*	0.629

Note: N= 30; SGS: Social Group Skills; PI: Peer Interaction; SCI: Social Communication and Interaction; AB: Appropriate Behaviors; OIP: Overall Interpersonal Skills; g= Hedge's g; and * = p < 0.05.

To compare the difference between the post-test scores of the control group and experimental group regarding their interpersonal skills, an independent sampled t-test (Table 6) was applied. The results showed a statistically significant difference between the control and experiment group children's interpersonal skills as *t* (25.073) = -3.074, *p* (0.001). At the same time, the values of Hedge's *g* indicated a large (0.6) effect size as *g* = 0.629. Thus, it is concluded that applied behavior analysis treatment significantly affected autism spectrum disorder children's overall interpersonal skills. Thus, the null hypothesis "There is no significant effect of applied behavior analysis treatment on autism spectrum disorder children interpersonal skills" is rejected.

Moreover, there was a significant difference in the control group of children's social group skills, peer interaction, and social communication & interaction as compared to experimental groups as *t* (26.156) = -2.812, *p* (0.041); *t* (25.987) = -2.035, *p* (0.039); *t* (26.593) = 2.412, *p* (0.016), respectively, whereas the values of Hedge's *g* showed medium (0.4 to 0.5) effect size. However, there was no significant difference between the control and experimental groups of children's appropriate behaviors as *t* (28) = 1.452, *p* (0.082).

Table 7:
Univariate Analysis of Variance among Two Groups

	N	*M*	*SD*	*f*	*df1*	*df2*	*p*	r^2
Control Group	15	34.67	19.223	.206	1	28	.653	.156
Experimental Group	15	52.00	22.424					

Table 7 (control and experimental) displays the variance analysis between the two groups. The findings indicate that the experimental group exhibits greater progress than the control group *M* = 34.67, *SD* = 19.223; *M* = 52.00, *SD* = 22.424; *p* = .653).

Discussion

Researchers examine the effect of "Clinic-based ABA therapy" (ABA) on interpersonal skills of autism spectrum disorder (ASD). They used the pretest-posttest design of quasi-experimental research while a survey method was applied to collect data two times (before and after intervention). The researchers selected 30 participants from the 3 to 6 age group of children divided into two groups (experimental and control). The children have mild symptoms of autism that were already diagnosed by the center where they enrolled. The selected children can speak 4 to 5 phrases, words, and sentences by following the command of the therapist. The researchers gave ABA treatment to the children chosen, which lasted six weeks. The researchers developed a pre-assessment and post-assessment tool comprising four interpersonal skill sub-factors. Descriptive and inferential statistical techniques were applied to examine the effect of ABA treatment on ASD children's interpersonal skills. The pre-experimental results showed that children have no proper eye contact and no proper response when called names.

Moreover, they are less able to communicate easily with others and prefer to play individually. Children cannot share toys with peers, whereas throwing and hitting behaviors exist. It is also depicted that children must develop level-appropriate behaviors compared to social group skills, peer interaction, and communication & interactive skills. At the same time, the least contributing factors were social communication and interaction among children. Numerous researchers found similar results before the treatment of ABA; children develop interpersonal skills (Eldevik et al., 2010; Virués-Ortega, 2010).

After the pre-assessment results, researchers formed two groups and started giving treatment: the control group, using the traditional method, and the experimental group, using the ABA treatment. Afterward, researchers compared the pretest and post-test scores of the control group regarding their interpersonal skills and found no statistically significant difference between pretest and post-test scores of children's overall interpersonal skills and all four sub-factors; these findings support the findings of (Abid et al., 2022; Aslam et al., 2022; Eldevik et al., 2010) and inconsistent with the results of (Gillespie-Lynch et al., 2012; Kasari et al., 2010). Moreover, researchers also compared the difference between the pretest and post-test scores of the experimental group regarding their interpersonal skills. They found a statistically significant difference between pretest and post-test scores of children's overall interpersonal skills and all four sub-factors (i.e., social group skills, peer interaction, social communication & interaction, and appropriate behaviors). These results have supported the findings of (Dillenburger & Keenan, 2023; Matson et al., 2012; Özerk, 2016, 2018; Petursdottir et al., 2007; Shukla-Mehta et al., 2010), who found a significant difference between pretest and post-test scores of children before and after the ABA treatment regarding

complex cognitive abilities and communication skills.

Furthermore, the researchers found a significant difference between the control and experiment groups of children's interpersonal skills, concluding that applied behavior analysis treatment significantly affected autism spectrum disorder children's overall interpersonal skills and sub-scales. Numerous studies concluded the significant effect of ABA on ASD children's communication skills, supporting the study findings (Gunadi, 2019; Leaf et al., 2016; Mohammadzaheri et al., 2014; Strain & Schwartz, 2001). Previous research indicates that ABA therapy benefits the development and requesting relationships of children with autism via various strategies (Strain, Schwartz, & Disabilities, 2001). There is ample empirical evidence in the literature that early and severe behavior mediations based on behavior analysis result in visible and long-lasting practical benefits for the enhancement/development of different dimensions of social skills in children with autism (Azeem.A., Faiz & Bashir, R., 2022).

Limitations and Direction for Future Researchers

The researchers faced some difficulties while conducting this study, i.e., unavailability of early assessment centers for ASD, especially at the state level (Public sector schools/centers/clinics), unavailability of many centers that provide authentic ABA treatment by licensed practitioners, less enrollment of autistic children in public and private sector institutes, no proper facilitation for children, and researchers. Future researchers may use other variables (i.e., enablers, psychologists' characteristics, cognitive and non-cognitive variables) that significantly develop interpersonal skills. They may also plan intervention studies to seek the role of other therapies in developing social skills in children with an autism spectrum disorder. The current research findings reflect that after authentic assessment, the children with autism are consistently provided with authentic applied behavior analysis therapeutic intervention, resulting in a desirable change in all aspects of social behavior: language skills, social and interpersonal skills, and a clear understanding of the contextual obligations. Likewise, the study aimed to examine the effect of applied behavior analysis (ABA) treatment on interpersonal skills in children with autism spectrum disorder (ASD), which was achieved through the experimental study conducted in the Pakistani context. At the same time, future researchers can select ASD children for intervention studies from other countries to share the possibilities to increase the generalizability of all types of ABA therapy through the findings of their research. Moreover, future researchers may design longitudinal studies to examine variations in ASD children's behaviors over time through the changes in conditions.

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