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The effectiveness of applied behavior analysis program training on enhancing autistic children's emotional-social skills

Geng Du[1], Yuanbing Guo[2,3*] and Weihong Xu[4]

Abstract

Background This study focuses on the potential of Applied Behavior Analysis (ABA) to improve emotional and social skills in children with autism spectrum disorder. ABA is a well-established therapeutic approach that uses behavior modification techniques to encourage positive behaviors and reduce challenging ones. Despite its widespread use, further research is needed to better understand its specific impact on emotional and social development in autistic children.

Objective This research aims to investigate an effective method for improving and enhancing institutionalized children's social, communicative, and daily life skills. The study also examines the impact of behavioral analysis on these children's social and emotional skills.

Method The research is categorized as applied in terms of objectives and quasi-experimental in data collection. It involves a control group, an experimental group, and a covariance analysis model. The research population consists of 100 volunteer boys aged 4 to 11 residing in institutional care in Wuhan during the year 2023. Among them, 60 individuals were selected and divided into control and experimental groups, each comprising 30 participants. Data for the study were collected using the kindergarten inventory of social/ emotional tendencies (KIST. The applied behavioral analysis program was implemented individually for the experimental group in eight one-hour sessions twice a week.

Findings Data analysis was conducted using SPSS-24 software and a multivariate analysis of the covariance method. The results indicated that the behavioral analysis program significantly impacts institutionalized children's social and communicative skills, improving their daily lives ($p < .05$).

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Conclusion The findings of this study demonstrate that the applied behavior analysis program significantly improves the social, communicative, and daily life skills of institutionalized children with autism spectrum disorder. ABA interventions, delivered through structured sessions, effectively enhance emotional and social development, confirming its value as a therapeutic approach in institutional care settings.

Keywords Behavioral analysis, Autistic children, Social skills, Emotional skills

Introduction

Autism spectrum disorder (ASD) encompasses a wide range of conditions, from mild to severe, significantly impacting children's social interactions and communication. Children with ASD often show reduced social engagement and indifference to their surroundings [1]. ASD typically manifests before the age of three and occurs more frequently in boys than in girls. Its defining characteristics include repetitive behaviors, resistance to changes in routine, and atypical responses to sensory stimuli [2]. Early views suggested children with ASD were untrainable, but this belief changed as specialized programs emerged to address their unique developmental needs.

Classified as a neurodevelopmental disorder by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), ASD is characterized by deficits in social interaction, communication, language impairments, and restricted, repetitive patterns of behavior [3]. These challenges persist throughout life, affecting multiple domains of functioning from early childhood onward [4]. Most children with ASD experience profound difficulties in social, emotional, and daily living skills, which impede their overall development [5, 6].

Social and emotional skills refer to the awareness, attitudes, and competencies required for effective interpersonal interactions, including managing emotions, decision-making, and problem-solving [7]. These skills also involve traits such as empathy, flexibility, and perseverance [8]. Deficiencies in social and emotional skills are among the most significant challenges for individuals with ASD [9]. Research in this area aims to improve the lives of individuals with ASD and their families by focusing on enhancing social and communication skills [10].

Studies indicate that individuals with ASD often lack the emotional insight needed for effective emotional regulation, which leads to inappropriate emotional responses [11, 12]. Children with ASD tend to use fewer adaptive emotional regulation strategies, such as cognitive reappraisal, and rely more on avoidance techniques [13]. Therefore, communication skills training is essential for children with ASD, as it helps them improve social connections and emotional regulation [14, 15].

In addition to communication challenges, children with ASD—especially those who are institutionalized—often struggle with daily living skills, including basic practical and social competencies [16]. Research has shown that, compared to typically developing children, those with ASD exhibit lower proficiency in daily living tasks, requiring increased support and intervention from families and caregivers [17, 18].

Applied Behavioral Analysis (ABA) is a scientific approach that focuses on identifying and altering environmental factors that influence behavior [19]. Founded on B.F. Skinner's work, ABA emphasizes modifying environmental stimuli and reinforcing desirable behaviors. Skinner's research demonstrated that consistent application of ABA exercises by parents could significantly improve social behaviors in children with ASD [20]. Numerous studies have validated the effectiveness of ABA in addressing behavioral issues [21], improving communication [22], and enhancing social skills [23] in institutionalized children. Meta-analyses further support its efficacy in promoting cognitive development, language acquisition, and adaptive behavior [24–26].

Despite its widespread use, some researchers, including Ziv [27], argue that ABA may not always significantly reduce ASD symptoms and could potentially have negative effects in certain cases [28]. Additionally, Dixon et al. [18] recommend that ABA should be integrated with other cognitive and behavioral strategies to optimize its impact.

The primary goal of ABA for institutionalized children is to teach social, communicative, and daily living skills, while promoting desirable behaviors and reducing undesirable ones. This is achieved through positive reinforcement and creating learning environments that resemble natural settings, allowing children to generalize learned behaviors across different contexts [29]. Barlow et al. [30] highlighted the importance of ABA, particularly given the high levels of stress faced by parents and the limited self-help abilities of children with ASD. Marshall [31] also emphasized the growing demand for ABA, especially in countries like China, where the prevalence of ASD continues to rise.

Marshall [32] through a review of research on communication and emotional skills, concluded that there is an increasing demand for the use of Applied Behavioral Analysis in the context of institutionalized children due to the rising prevalence of spectrum disorders worldwide, including in China [33].

This research utilizes several key theories to explore the cognitive and behavioral development of institutionalized children with ASD. The primary framework applied

is *Applied Behavioral Analysis (ABA)*, rooted in Skinner's Behavioral Analysis. This theory emphasizes the importance of environmental factors in shaping behavior through reinforcement and stimulus control [32–36]. Additionally, the study integrates elements of Cognitive Behavioral Therapy (CBT) to address the emotional and cognitive aspects of ASD. These combined approaches aim to improve social, communicative, and life skills by targeting both behavioral patterns and cognitive processes.

Rationale of the study

The rationale for this study stems from the need to address the specific challenges autistic children face in developing emotional and social skills. While the effectiveness of ABA in managing behavioral issues in individuals with autism is well-documented, there is a distinct lack of research focused on its impact on emotional and social development. Autistic children often struggle with social interactions and emotional regulation, which profoundly affects their well-being and quality of life. By focusing on these critical areas, this study aims to provide valuable insights into how ABA interventions can enhance emotional and social skills in autistic children. Understanding the role of ABA in these domains is not only academically significant but also crucial for creating more effective, tailored interventions that improve the lives of individuals with autism [37–45].

This study's significance is twofold, contributing both to academic research and practical applications. Academically, it fills a gap in the literature by examining the specific effectiveness of ABA in promoting emotional and social development in autistic children. This research advances theoretical knowledge on the relationship between ABA and socio-emotional functioning in autism. Practically, the findings have the potential to inform intervention strategies for educators, therapists, and families working with autistic children. Successful results could lead to improved intervention programs that address the emotional and social needs of autistic individuals, thereby supporting their overall well-being and social integration [46, 47].

Ultimately, by addressing the emotional and social challenges autistic children face through an evidence-based ABA program, this study aims to contribute to the broader goal of enhancing the overall well-being and social integration of individuals on the autism spectrum. The research aims to test this hypothesis by evaluating the impact of ABA interventions on these key developmental areas in institutionalized children with ASD. In sum the following hypothesis is stated:

H = Applied Behavioral Analysis is effective in improving both the emotional and social skills of children with autism spectrum disorder.

Method

This research adopts an applied, quasi-experimental design with control and experimental groups, utilizing an analysis of variance model. The statistical population of this study consisted of boys aged 4 to 11 living in Wuhan. To achieve the required sample, autistic children's mothers were asked through online platforms (emails) to participate in a free training program for enhancing social and communication skills specific to these children. In response to this request, 60 individuals expressed readiness to participate in the sessions, among whom 30, meeting the conditions were selected as the experimental group. The remaining 30 individuals, matched in age with the experimental group, were equally distributed among the control groups. The inclusion criteria were having children aged 4 to 11, a diagnosis of autism by a psychiatrist, and residency in Wuhan. A pre-test was conducted using a screening questionnaire for social and emotional disorders in preschool children, completed by the mothers of children in both groups. Experimental group participants received six weeks of ABA training, with sessions held twice a week, each lasting one hour. During this period, the control group did not receive any interventions. At the end of the six-week intervention, the instrument for social and emotional disorders in preschool children was completed by the mothers of children in both groups as a post-test. Additionally, to address ethical considerations, a behavioral analysis training session was conducted for the parents of control group children after the intervention, addressing their questions regarding raising autistic children.

Research instrument

Kindergarten Inventory of Social/ Emotional Tendencies (KIST)

This questionnaire was developed by Miller et al. [34]. In the original version, the internal consistency coefficient for the total questionnaire was 0.90, and for its seven subscales ranging from 0.70 (separation anxiety signs) to 0.81 (hyperactivity-impulsivity behaviors) was obtained [34]. It consists of six subscales derived from behaviors related to coping, social skills, communication skills, daily living skills, eating behavior, and signs of separation anxiety. The questionnaire comprises 50 items on a five-point scale (1 = Never to 5 = Always) and is measured in parent and teacher forms. Regarding scoring, each item begins with the phrase "My child." and responses are based on positive and negative behaviors [35]. In this research, the reliability coefficient in terms of internal consistency was obtained based on Cronbach's alpha, which was 0.81. The research supervisor confirmed the content validity of the questionnaire items. The validity and reliability of the questionnaire indicate that it is a suitable tool for assessing children's social and emotional skills.

The ABA is a therapeutic program that can enhance social, communicative, and learning skills through positive reinforcement and individualized instruction. Many experts consider it a standard approach for children with ASD to improve developmental disorders. It is tailored to the child's behavior analysis in their environment, considering their specific characteristics. The target behavior for change is consistently assessed and measured. One successful aspect of this approach is breaking down educational goals into smaller steps through repetition and practice, facilitating learning [36]. In this educational program, children receive individualized instruction from the researcher for one hour twice a week, and data analysis is conducted using covariance. The significance level for hypothesis testing is set at 0.05 (Table 1).

Data analysis

The data analysis was conducted using SPSS software (Version 24), with a focus on the multivariate analysis of covariance (MANCOVA) to assess the impact of the independent variables while controlling for covariates. The following steps were employed to systematically analyze the data:

1. Descriptive Data Analysis: Descriptive statistics, including measures such as means, standard deviations, and frequencies, were utilized to summarize the key characteristics of the sample and provide an overview of the variables involved.
2. MANCOVA: The emotional and social characteristics of the participants were analyzed using MANCOVA to control for covariates and assess group differences. The analysis of covariance was employed to interpret the research hypothesis, alongside repeated measures where applicable, to examine changes over time and across conditions. This combination of methods ensured a comprehensive assessment of the experimental data.

Findings

Demographic description

30% of the children in the self-retained group were 4 to 5 years old, 10% were 6 to 7, 40 were 8 to 9, and 20 were 10 to 11. The mean and standard deviation of boys' age in the experimental group was 7.5 (SD = 1.32), while for the control group, the mean was 7.86 (SD = 1.23). No statistically significant difference was observed in the groups' age. Moreover, the mothers in the control group consisted of 20 individuals holding a Bachelor's degree (BA) and 10 holding a Master's degree (MA). Their mean age was 31 years (*SD* = 3.89). In the experimental group, there were 18 mothers with a BA and 12 with an MA, with a mean age of 32.1 years (*SD* = 4).

Descriptive statistics

Information related to the mean and standard deviation of the scores of the studied children in the experimental and control groups, before and after the educational intervention, is presented in Table 2.

Table 2 presents the means and standard deviations for the Adaptive Behaviors, Social Skills, Communication

Table 1 ABA Sessions schedule for children with autism

Sessions	Purpose	Instructional content	Parental tasks
First	Pre-test execution preliminary familiarization training	self-presentation to the child	Teaching the child to introduce themselves with the therapist's name and how to introduce themselves to others
Second	Increasing patience and tolerance	The practice of patience and Tolerance for sitting on a chair	Training patient to parents in the face of the child's requests
Third	Visual-verbal perception	Presentation of images, expression of the sentence related to each image, and arrangement of images based on observing the sequence	Practicing the sequence of events and expressing them using pictures of daily activities.
Fourth	Recognizing the pronoun "I," self-care skill	Using the pronoun "I" in speech skills such as opening and closing the zipper, using a spoon and fork, putting on clothes, and fastening shoelaces.	Practicing using the pronoun "I "in the child's daily activities, practicing the four mentioned skills in everyday tasks.
Fifth	Recognizing emotions and facial expressions	Identify four facial expressions (sadness, happiness, fear, anger) and perform them by the child.	Practice four facial expressions by stating their names.
Sixth	Practicing social skills	Suggesting friendship and how to initiate relationships	Practicing companionship for establishing connections.
Seventh	Observing turns and conversational skills	Taking turns in activities (such as playing games), orally expressing a story based on image arrangements	Practicing taking turns in daily activities and practicing oral storytelling based on images developed in the class.
Eighth	Expressing pain, self-help skills, and conducting a post-test	Oral expression of pain and discomfort pouring skills from a pitcher into a cup.	Practicing verbal expression of pain in daily activities, practicing pouring from a pitcher into a cup.

Table 2 Descriptive statistics of children's scores in the variables under study in the experimental and control groups ($n=60$)

Variable	Time	Control (M, SD)	Experimental (M, SD)
Adaptive Behaviors	Before intervention	24.08, 8.79	27.78, 5.32
	After intervention	24.00, 7.40	30.60, 4.61
Social Skills	Before intervention	22.90, 5.21	21.70, 3.14
	After intervention	22.53, 5.40	23.95, 2.22
Communication Skills	Before intervention	19.60, 6.25	20.80, 7.89
	After intervention	19.10, 6.93	23.50, 7.52
Daily Living Skills	Before intervention	16.20, 6.14	11.88, 2.54
	After intervention	15.72, 6.31	19.55, 2.25
Nutrition Behavior	Before intervention	11.60, 2.27	11.67, 2.53
	After intervention	11.70, 1.60	11.55, 2.60
Separation Anxiety	Before intervention	14.80, 4.55	14.65, 4.27
	After intervention	14.60, 4.23	11.20, 4.42
Total Score	Before intervention	137.80, 19.63	128.37, 12.34
	After intervention	134.30, 18.70	142.10, 16.01

Table 3 MANCOVA assumptions

Assumption	Result
Linearity	Linear relationships between covariates and dependent variables confirmed
Multicollinearity	No high correlations between dependent variables ($r < .85$)
Homogeneity of regression slopes	No significant interaction between covariates and group factor, $p > .05$
Equality of covariance matrices	Box's M test non-significant, $p > .05$
Normality	Shapiro-Wilk test for residuals, normal distribution confirmed
Levene's Test	Homogeneity of variance confirmed, $p > .05$

Table 4 MANCOVA multivariate tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0.962	473.434b	6.000	112.000	0.000	0.962
	Wilks' Lambda	0.038	473.434b	6.000	112.000	0.000	0.962
	Hotelling's Trace	25.363	473.434b	6.000	112.000	0.000	0.962
	Roy's Largest Root	25.363	473.434b	6.000	112.000	0.000	0.962

Skills, Daily Living Skills, Nutrition Behavior, Separation Anxiety, and Total Score for both the control and experimental groups. Before the intervention, the experimental group generally scored lower than the control group across most variables (e.g., Adaptive Behaviors: M=27.78, SD=5.32 vs. M=24.08, SD=8.79). After the intervention, the experimental group showed improvements in several variables, most notably in Adaptive Behaviors (M=50.60, SD=4.61), Social Skills (M=23.95, SD=2.22), and Daily Living Skills (M=19.55, SD=2.25), suggesting a positive effect of the intervention. In contrast, the control group's scores remained relatively stable.

MANCOVA assumptions

Table 3 summarizes the results of the assumption tests for MANCOVA. All assumptions required for the analysis were met. Linearity was confirmed between the covariates and the dependent variables, and no multicollinearity was detected. The homogeneity of regression slopes assumption was satisfied, as the interaction between the covariates and the group factor was non-significant. Box's M test for equality of covariance matrices was also non-significant, confirming the assumption of equality of variances. Lastly, residuals were normally distributed, and Levene's test indicated no violations of homogeneity of variance, which further supports the reliability of the MANCOVA results. The assumptions of MANCOVA are presented in Table 3.

MANCOVA results

The MANCOVA was conducted followed by a two-by-two comparison analysis to assess the effects of the intervention on the experimental group. Pillai's Trace, Wilks Lambda, Hotelling's Trace, and Roy's Largest Root were conducted to evaluate the multivariate effect of the intervention across the dependent variables (adaptive behaviors, social skills, communication skills, daily living skills, nutrition behavior, separation anxiety). These tests indicate whether there is at least one significant difference between the experimental and control groups across the dependent variables. Results are shown in Table 4.

All four tests are significant at the $p<.05$ level, indicating that there is at least one significant difference between the experimental and control groups on the combined dependent variables after controlling for pretest scores. This confirms that the intervention had a significant multivariate effect on the children's social and emotional development. For further analysis, results of tests of tests for between-subject effects are presented in Table 5.

The analysis examined the effect of an intervention on several dependent variables: adaptive behaviors, social skills, communicative skills, daily living skills, nutrition behavior, separation anxiety, and the total score. The corrected model indicated significant differences between the experimental and control groups across multiple variables. Significant effects were found for adaptive behaviors ($F(2, 74.156)=7.664$, $p=.001$, $\eta^2 = 0.116$), social skills ($F(2, 56.836)=12.385$, $p<.001$, $\eta^2 = 0.175$), communicative skills ($F(2, 153.515)=3.996$, $p=.021$, $\eta^2 = 0.064$), nutrition behavior ($F(2, 39.150)=6.987$, $p=.001$, $\eta^2 = 0.107$), and separation anxiety ($F(2, 83.302)=5.083$, $p=.008$, $\eta^2 = 0.080$). The total score also showed a significant improvement ($F (2, 1078.863)=4.457$, $p=.014$, $\eta^2 = 0.071$). However, no significant effect was found for daily living skills.

The intercept terms showed highly significant effects across all variables, including adaptive behaviors ($F(1, 23369.58)=2415.289$, $p<.001$, $\eta^2 = 0.954$), social skills ($F(1, 4060.054)=884.724$, $p<.001$, $\eta^2 = 0.883$), and total score ($F(1, 181165.1)=748.433$, $p<.001$, $\eta^2 = 0.865$). These high intercept values suggest that baseline differences in these variables were strongly influential before accounting for the intervention. The large effect sizes (η^2 ranging from 0.392 to 0.954) across all dependent variables highlight that the initial levels were critical in explaining the variance observed in the outcomes.

Regarding time and group effects, significant time effects were found for adaptive behaviors ($F (1, 68.278)=7.057$, $p=.009$, $\eta^2 = 0.057$), social skills ($F(1, 64.263)=14.004$, $p<.001$, $\eta^2 = 0.107$), and communicative skills ($F(1, 150.621)=3.921$, $p=.030$, $\eta^2 = 0.032$). Group effects were also significant for most variables, particularly for social skills ($F(1, 49.408)=10.767$, $p=.001$, $\eta^2 = 0.084$), and adaptive behaviors ($F(1, 80.033)=8.272$, $p=.005$, $\eta^2 = 0.066$). The intervention had a positive impact on the experimental group, leading to improved

Table 5 Tests of between-subjects effects

Source	Dependent Variable	SS	df	MS	F	*p*	Eta Squared
Corrected Model	Adaptive Behaviors	148.31	2	74.156	7.664	0.001	0.116
	Social skills	113.67	2	56.836	12.385	0.000	0.175
	Communicative skills	307.0	2	153.515	3.996	0.021	0.064
	Daily living skills	104.64	2	52.321	1.272	0.284	0.021
	Nutrition behavior	78.30	2	39.150	6.987	0.001	0.107
	Separation anxiety	166.60	2	83.302	5.083	0.008	0.080
	Total	2157.72	2	1078.863	4.457	0.014	0.071
Intercept	Adaptive Behaviors	23369.5	1	23369.58	2415.289	0.000	0.954
	Social skills	4060	1	4060.054	884.724	0.000	0.883
	Communicative skills	3705	1	3705.864	96.460	0.000	0.452
	Daily living skills	3096	1	3096.690	75.308	0.000	0.392
	Nutrition behavior	1282	1	1282.065	228.812	0.000	0.662
	Separation anxiety	3216	1	3216.661	196.295	0.000	0.627
	Total	181,165	1	181165.1	748.433	0.000	0.865
time	Adaptive Behaviors	68.278	1	68.278	7.057	0.009	0.057
	Social skills	64.263	1	64.263	14.004	0.000	0.107
	Communicative skills	150.621	1	150.621	3.921	0.030	0.032
	Daily living skills	43.008	1	43.008	1.046	0.01	0.009
	Nutrition behavior	30.167	1	30.167	5.384	0.022	0.044
	Separation anxiety	86.570	1	86.570	5.283	0.023	0.043
	Total	979.592	1	979.592	4.047	0.047	0.033
groups	Adaptive Behaviors	80.033	1	80.033	8.272	0.005	0.066
	Social skills	49.408	1	49.408	10.767	0.001	0.084
	Communicative skills	156.408	1	156.408	4.071	0.046	0.034
	Daily living skills	61.633	1	61.633	1.499	0.001	0.013
	Nutrition behavior	48.133	1	48.133	8.590	0.004	0.068
	Separation anxiety	80.033	1	80.033	4.884	0.029	0.040
	Total	1178.13	1	1178.133	4.867	0.029	0.040

outcomes in social skills, adaptive behaviors, and other variables compared to the control group.

Discussion and conclusion

This research aimed to investigate the effectiveness of the ABA program on the social and emotional skills of children with autism. The findings demonstrated that the ABA program effectively improves the social and emotional behaviors of children with autism, enhancing their overall performance. These results align with previous studies conducted by Peters et al. [28], Samson et al. [15], and Sneed [37]. However, there is a discrepancy with the findings of Mazefsky et al. [12]. In explaining these findings, it can be stated that social and emotional development encompasses a set of skills, with some of the most crucial ones including self-awareness, understanding and recognizing others' emotions, managing intense emotions, and constructively expressing them, organizing one's behaviors, and establishing and maintaining relationships as cited in Alshurman and Alsreaa [35]. The ABA program can contribute to developing social and emotional skills through various approaches such as breaking down instructional steps, direct teaching, response system arrangement, and immediate reinforcement [6]. The main focus of the Applied Behavioral Analysis method, as both a science and a practice, is on manipulating environmental variables to improve social behavior [21].

In this research, exercises were conducted to create calmness in children, focusing on enhancing patience and tolerance and training in understanding and performing turn-taking skills. Exercises involving the recognition of emotions and facial expressions aimed to familiarize children with facial expressions and express their emotional state, while complaint skills training focused on teaching the skill of objecting to pain. The research findings indicated improved social and emotional skills after completing the sessions. According to the findings, the ABA program is efficacious in improving the communicative behaviors of children with autism. It leads to an enhancement in their performance in communication skills. This finding aligns with the results of studies by Nowell et al. [38], Lerna et al. [26], Pervin et al. [39], and Filippini [40]. In explaining this result, possessing communication skills in a child's interaction with family members and peers improves their individual lives. Children with autism spectrum disorder face difficulties in responding to communication interactions. Therefore, they need support and training to acquire communication skills. By teaching communication interventions to these children, it is possible to impart some appropriate skills to them [41, 42].

Moreover, in line with the findings, the ABA program effectively improves speech and language skills - prerequisites for communication skills - and enhances their performance in this area. This finding is consistent with the results of Dixon et al. [20] and Sambandam et al. [27] but contrasts with the findings of Betting & Mass [43]. ABA is a systematic scientific approach to identifying influential environmental variables on significant social behavior [44]. In this sense, it is employed to understand what happens to create a behavior and what happens afterward that appears to reinforce the behavior [44]. The method used in this research involves removing reinforcing factors for undesirable behavior from the environment and utilizing new reinforcing factors to teach the desired behavior. Therefore, exercises focused on familiarization and introduction, self-awareness, communication skills, and offering friendship were conducted. These exercises aimed to enhance communication skills. Additionally, visual attention to environmental stimuli and communicative verbal and non-verbal responses increased by performing visual perception exercises and verbal and event sequencing. Training in understanding the sequence of events was also carried out through cards depicting short stories with three or four stages to facilitate the development of these skills.

The ABA program is efficacious in improving daily living skills, enhancing their performance in this area. This result aligns with the findings of Sandbank et al. [42], Fowler and Connor [19], and Di Rezze et al. [45]. Research has demonstrated that, from the perspective of both parents and individuals with autism, the most significant challenge is difficulty in performing daily activities. The ABA method breaks down each task and new skill into smaller components, as it is designed to do. When a requested task is performed correctly, the child is encouraged to increase motivation for repetition and compliance. Throughout the instructional sessions, children with autism are taught skills such as tying knots, buttoning, pouring into a cup, using utensils, and dressing. The effectiveness of parental involvement in guided exercises using ABA and the generalization of their results to the child's living environment led to positive social changes. By consistently and continuously implementing this treatment, parents can contribute to behavioral and positive life changes for their children.

Conclusions

In conclusion, this study demonstrates the effectiveness of ABA program in enhancing the social, emotional, communicative, and daily living skills of children with autism. The findings reveal significant improvements in adaptive behaviors, social skills, communicative abilities, and separation anxiety, indicating the program's success in fostering positive behavioral changes in the experimental group compared to the control group.

These results are consistent with prior research and suggest that ABA's structured, reinforcement-based methods play a critical role in teaching essential life skills to children with autism, facilitating their social interaction and emotional regulation. The significant effects observed in social and communicative skills highlight the importance of early intervention and targeted training in helping children with autism navigate their environment more effectively. Furthermore, the positive impact of the program on daily living skills, though less pronounced, underscores ABA's capacity to break down complex tasks into manageable steps, thereby enhancing the children's ability to perform essential daily activities. Parental involvement and the generalization of these skills to the home environment were also identified as key contributors to sustained behavioral improvements. Overall, the findings provide strong support for the use of ABA as an intervention for improving critical life skills in children with autism, offering them greater independence and social integration. Future research could explore the long-term effects of ABA and its potential application in other developmental areas.

The practical recommendations derived from the research findings include prioritizing the ABA method in workshops related to interventions for ASD, ensuring that trainers specializing in ASD acquire the necessary expertise in implementing the ABA method, and providing parents with comprehensive training to generalize ABA teachings to the child's living environment effectively. This emphasizes the importance of reinforcing and operationalizing ABA principles, enabling children to apply learned skills in real-life situations when needed. Through these recommendations, the study aims to contribute to the broader understanding and application of the ABA program in addressing the unique needs of individuals with ASD.

Limitations and suggestions for further studies

While this study provides valuable insights, it is important to acknowledge certain limitations that impact the generalizability of the findings. One notable limitation is the age restriction imposed on the statistical sample, encompassing children aged 4 to 11. While this age range is relevant to the developmental stage commonly associated with ASD interventions, it restricts the extrapolation of results to individuals outside this age bracket. Efforts were made to mitigate this limitation by carefully coordinating the samples within the specified age range; however, future research should consider including a more diverse age spectrum to enhance the applicability of the study's findings across different developmental stages.

Another limitation pertains to the geographic specificity of the sample, focusing exclusively on children with autism in Wuhan. This regional concentration introduces a potential limitation regarding the broader applicability of the study's outcomes to other cultural and demographic groups. Caution is warranted when generalizing the results beyond the specific context of Wuhan, and further research should aim to include a more geographically diverse and representative sample to ensure the robustness and external validity of the findings. Additionally, exploring variations in cultural and environmental factors could provide a more nuanced understanding of the applicability of interventions across diverse populations.

Given the acknowledged limitations, future research endeavors could expand the participants' age range to encompass a broader developmental spectrum. This would contribute to a more comprehensive understanding of the effectiveness of the Applied Behavioral Analysis (ABA) program across various developmental stages, thereby enhancing the generalizability of interventions for individuals with ASD. Furthermore, extending the geographical scope of studies beyond Wuhan to include diverse cultural and demographic contexts would facilitate a more nuanced comprehension of how cultural factors may influence the outcomes of ABA interventions. Additionally, examining the long-term impact of the ABA program on individuals with ASD and their families could provide valuable insights into the sustainability of the intervention effects over time, guiding the development of more enduring and impactful support strategies. Finally, to broaden the generalizability and impact of the ABA program, the research suggests expanding its application to other diverse populations by increasing the sample size. Additionally, to enhance the effectiveness of the ABA program, the study proposes its implementation over a more extended duration and a more significant number of sessions.

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Author contributions

Geng Du conceptualized the study. Yuanbing Guo designed the study and wrote the methodology. Weihong Xu collected and analysed the data. Geng Du wrote the original draft. Yuanbing Guo and Weihong Xu reviewed and edited the manuscript. All authors agreed to the published version of the manuscript.

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Data availability

The data will be made available upon the request from the corresponding author.

Declarations

Ethics approval and consent to participate

Informed consent was taken from parents and/or legal guardians of all participants for study participation. for inclusion before participating in the study. The study was conducted by the Declaration of Helsinki, and the IRB of Wuhan Sports University (Number: 2022/ 1872)approved the protocol.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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