Effects of Parent and Teacher Mediated Pivotal Response Treatment and Discrete-Trial Training in Improving Communication Skills of Children with Autism

Dagmawi Alemnh Girma, Belay Hagos Hailu and Abebe Yehualawork Malle

Abstract

The main purpose of this study was to investigate the effects of parent and teacher-mediated pivotal response treatment and discrete-trial teaching in improving the communication skills of children with Autism. The research deployed an ABAB research design. ABAB was divided into 4 phases; A1, B1, A2, and B2. A1 was a baseline, B1 was treatment, A2 was the removal of the treatment, and B2 was the treatment resumed following the break, and at last, a follow-up was conducted. In the study, three children who fulfilled the inclusionary criteria participated. The three children received PRT and DTT from their parents and teachers respectively. The instruments used for assessment were social communication questionnaire-Lifetime, Autism diagnostic interview-revised, and Vineland -3 Adaptive behavioral scale (communication domain). The study result indicated that Parent and Teacher mediated PRT and DTT significantly improved the communication skills of children with ASD.

Keywords: autism spectrum disorder, pivotal response treatment, discrete trial training, parent mediated intervention, teacher-mediated intervention, communication skill
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Introduction

It is important to note that the diverse cultures in Ethiopia have varying beliefs regarding the causes and treatments for ASD in children. Due to these differences, it is crucial to have a culturally sensitive diagnostic process and treatment plan that accommodates the various interpretations of symptoms. Unfortunately, there are limited resources available in Ethiopia, including psycho-education and referrals to specialized schools. Additionally, there is no support system in place for families of children with autism, which compounds the problem. Despite the lack of specialized centers, parents or caregivers often take on the responsibility of managing ASD interventions (Zeleke et al., 2020).

There is very little knowledge and evidence-based services available for children with autism and their families in Africa. In Ethiopia, children with autism are often isolated and hidden from society due to superstitious beliefs, which can lead to health and nutrition problems (Ali & Kumar, 2022). Unfortunately, the government and social stakeholders have not given enough attention to the magnitude of this condition, which affects nearly 500,000 children in Ethiopia alone, according to a study conducted in 2016 by Burton.

In Ethiopia, services for educating and raising awareness for children with autism and their families are primarily located in the capital city. There are four types of service providers in the city, including two psychiatric clinics in government-run hospitals and a private clinic, three autism centers run by parents of children with autism, one government school, and five private schools that offer inclusive education programs for children with autism, and two community-based organizations (Tekola et al., 2016). Access to centers for children with autism, run by parents, is mostly limited to educated and affluent families. However, these centers often have long waiting lists.

In Ethiopia, there are no diagnostic or educational services available in rural areas where 80% of the population resides. Due to limited healthcare, low levels of awareness, and stigma, autism often goes undetected in rural areas (Ali & Kumar, 2022). Moreover, autism-type symptoms are sometimes misinterpreted as a punishment from God, resulting from sin or parental curse. In line with this, Tekola et al., (2016), confirmed that parents hide their children with autism from society due to the fear of social exclusion and negative attitudes/judgments from others, which can be costly.

Autism in Ethiopia still faces challenges related to lack of awareness and stigma, despite recent improvements in public understanding. There is a severe shortage of diagnostic and intervention services for individuals with autism and their families, especially in rural areas. In addition to a need for increased service provision, there is also a clear need for culturally and contextually appropriate autism diagnostic tools. (Borissov et al., 2022)

Autism is a complex condition that demands the constant and careful attention of parents and experts in special needs education and psychology. In Ethiopia, there are only a few non-profit and non-governmental organizations that offer specialized services to children with autism. These organizations play a crucial role in enhancing the physical and psychological conditions of children with ASD (Zeleke et al., 2020). Two such organizations are Nehemiah Autism Center, established in 2010 by a mother of a child with ASD, and Joy Autism Center, established in 2003 by another
mother of a child with ASD. These centers were founded by the mothers because regular schools refused to enroll their children, despite the country's education and training policy of 1994, which aims to teach all learners based on their potential and abilities.

Raising a child with autism comes with many challenges for parents, including managing their behavior, accessing assessment and early intervention services, and effectively interacting with them (Ali & Kumar, 2022). These challenges become even more difficult for families living in poverty. Unfortunately, there is no recent research on the prevalence of autism in Ethiopia, and it has been a neglected issue for far too long, leading to stigma and discrimination against parents of children with autism. Researchers like Ali and Kumar (2022), Merawi (2013) and Helen (2016) have confirmed this unfortunate reality, as many people believe mental problems are caused by curses or sins from the affected family.

Frustrated parents in Ethiopia with children who have Autism Spectrum Disorder (ASD) are facing challenges due to the lack of intervention and support available. Dagmawi’s 2019, report indicates that many children, as many as 2,300 at the Nia Foundation and 810 at the Nehemiah Foundation, are waiting for services. Unfortunately, financial limitations, lack of awareness, and a shortage of assessment and intervention centers have resulted in children with autism staying at home without proper schooling and support. Additionally, some schools have refused to admit children with autism, and schools that do provide services often offer poor-quality care (Tekola et al., 2014). Children with autism who attend regular schools often do not receive the necessary support and intervention due to a lack of expertise on ASD in schools (Tekola et al, 2014). Teachers have limited knowledge and experience in accommodating children with autism, which can make it challenging for them to provide adequate care, research has shown that teachers who work with children with autism may lack the necessary skills and knowledge to provide effective treatment, whether in the classroom or outside of it (Tekola et al., 2014). This poses a significant challenge for both the children and their teachers.

In Ethiopia, there is a shortage of autism therapists in proportion to the number of children with autism. Autism is a disorder that requires lifelong, intensive, and continuous support. While some individuals have opened private autism centers in the country, they are too expensive for many parents to afford. Unfortunately, there is no manual for identifying, assessing, and intervening with children with autism in the country. Parents and teachers lack a guide on how to support children with ASD in home and school settings. As a result, mediation services are highly valued and relevant in Ethiopia context.

The CDC and the Academy of Pediatrics endorse ABA therapy as an evidence-based practice to be used for children with ASD. Both PRT and DTT have their roots in ABA (Vismara, & Bogin, 2009; Borgin, 2008) and are often used in packaged programs designed for use with ASD (Vismara & Bogin, 2009; STAR program, 2016; Autism Speaks: Early Start Denver Model, n.d.).

Pivotal Response Treatment (PRT) is a parent-mediated intervention for children with ASD, using the principles of Applied Behavior Analysis (Koegel & Koegel, 2018). Parents are taught to promote pivotal skills (i.e. self-initiation, motivation for social contact, self-management, and responding to multiple cues).

Discrete trial teaching (DTT) is one of the methods used in teaching children with Autism. In this method, skills are distributed into simple steps, each step is taught by repeated attempts
This strategy consists of five steps which are: (Discriminative Stimulus), (Prompt), (Response), (Consequence) and (Inter-Trial Interval). Thomson et al, 2009 mentions that learning by discrete trial teaching is considered the most significant among intensive training behavior. Teachers, assistants, and parents require this method to teach children with autism. Many researchers such as (Lovaas et al, 1981; Maurice, Green, & Foxx, 2001; Maurice, Green, & Luce, 1996) prepared so many booklets for parents, teachers, and those involved in behavioral remedies. (Lovaas, Schreibman, & Koegel, 1974) emphasized that (DTT) can be implemented in classrooms, at homes, or elsewhere. The implementation of (DTT) in different environments leads to its generalization and use of the skills.

Previous research has documented that parent-implemented PRT is an effective model to improve social and communication skills in children with ASD, and the notion of active parent involvement as interventionists can support the efficacy of targeted pivotal areas such as motivation (Souto-Manning, & Swick, 2006). Further, a meta-analysis conducted by (Barton & Wolery, 2008) indicated that Teachers in the three studies reviewed were able to use the intervention shown to increase the children’s communication skills, and diversity of pretense behaviors.

As discussed above ABA therapy is an evidence-based intervention, and autism intervention services are limited in Ethiopia. As a result, mediation services are highly valued and relevant in the Ethiopia context. To the researcher's knowledge, no study has been conducted on the combined impact of parent and teacher-mediated PRT and DTT on enhancing communication skills in children with autism. This research is a significant step in exploring mediated interventions for children with ASD and provides fresh insights into the combined impact of PRT and DTT.

Having that all in mind, this study attended to answer the following research question: Does teaching parents and teachers on how to effectively use both Pivotal Response Treatment (PRT) and Discrete Trial Training (DTT) respectively, enhance the communication skills of children with Autism Spectrum Disorder (ASD)?

**Research Design**

The study employed Single-Subject Design. The most basic single-subject research design is the reversal design; also called the ABAB design. ABAB research design was implemented for this study. Single-Subject designs can demonstrate clear causal relations between intervention and behavior change with much more efficiency than large-sample designs (Nock, Matthew, Michel, & Photos, 2007). For this research ABAB is divided into 4 phases; A1, B1, A2, and B2 A1 is a baseline, B1 is treatment, A2 is the removal of the treatment, and in phase B2 the treatment resumes following the break. At last, a follow-up assessment was conducted.

**Participants**

| 5 |
Purposive sampling was applied to select the targeted participants who raise/teach children with ASD. Purposive sampling is an acceptable kind of sampling for special situations, It uses the judgment of an expert in selecting cases or it selects cases with a specific purpose in mind (Bernard, 2002). Parents and Teachers who fulfilled the inclusionary criteria were selected from regular schools.

Parents who fulfill the following inclusionary criteria were selected - Parent/Guardian willing to diagnose their children, who never took PRT training before this research, willing to commit to the training and implementation process for up to six months, having children with autism ages between two and eight years old, having children with autism spectrum disorder who sent their children to school, and having children with autism spectrum disorder who completed Grade 12.

Teachers who fulfill the following inclusionary criteria were selected- Teachers who have taught children for a minimum of two years, who never took DTT course/training, express willingness to try new procedures (i.e. DTT), willing to commit to the training and implementation process for up to six months, teaching children with autism ages between two and eight years old. As interventionists, a total of six parents and teachers (three each) who fulfilled the above criteria were recruited and participated in the study.

Settings

The study took place in Ethiopia Addis Ababa where many children with ASD live. Parent and teacher training was delivered in the school. The PRT intervention was given by parents at the participants’ homes and, by teachers in school special education class room.

Research Instruments

The research used standardized tools to assess the children with ASD. Particularly, social communication questionnaire (Life time) was used to identify suspected children with ASD; ADI-R was administered to diagnose the suspected children with ASD, and Vineland - 3 Adaptive Behavioral Scale - third editions administered to assess the children’s communication skills. All tools (SCQ, ADI-R, and Vineland - 3 Adaptive Behavioral Scale (communication domain)) were translated into Amharic due to all the participants' first language is Amharic. Each translation was translated and checked by language experts.

For this study, the Vineland - 3 comprehensive semi-structured interview communication domain was used to assess the children's communication skills before and after the interventions. The communication domain measures how well children exchange information with others. The communication domain is based on scores on three sub-domains: receptive, expressive, and written. The receptive sub-domain assesses attending, understanding, and responding appropriately to information from others. Receptive sub-domain content areas are understanding
nonverbal communication, understanding words, identifying things, following instructions, and entertaining and informational material. An expressive sub-domain reflects the child's use of words and sentences to express his/her verbally. Expressive sub-domain content areas are pre-language, beginning vocabulary, grammar, identifying self, and expressing self. The written sub-domain conveys an individual's use of reading and writing skills. Written sub-domain content areas are pre-reading, developing reading skills, developing writing skills, and applying reading and writing skills.

Within each subdomain, all items are ordered according to increasing developmental sequence, from easiest to most difficult to master. The lowest-numbered items with scores of 0 (never or almost never performed independently) or 1 (sometimes performed independently) indicate the lowest-level behaviors that the child has not fully mastered; these items identified for intervention. The highest item score is 2 (for fully mastered skill). The interviewers did not read the items to the respondents or ask the respondents to provide item scores. The interviewers used open-ended questioning to prompt the respondents to talk about the examinee's behavior in communication skills. The interviewers then used the information to score the items.

In the Vineland - 3 Communication domain, the expressive subdomain has 49 items, the receptive sub-domain has 39 items, and the written sub-domain has 21 items. The communication domain has a total of 109 items. Each child was evaluated on the 109 items.

Research Procedure

Phase 1: Baseline

In the baseline phase, the communication skills of the selected children were measured multiple times by Vineland 3 adaptive scale communication domain. The communication skills of the children were measured by two independent trained data collectors multiple times until the data showed stability.

Phase 2: Parent and Teacher Training-Pre-intervention Phase

Training in PRT and DTT was conducted in one week of group sessions for five days a week for three hours each day; the specific content of group sessions is outlined in the intervention manual. In these group sessions, parents and teachers were introduced to ASD, ABA, and the ABC pattern of behavior. In addition, the parents and teachers got training in the implementation of PRT and DTT respectively. The parent received instruction in antecedent PRT components (gaining the student's attention, presenting clear and appropriate cues, interspersing maintenance and acquisition tasks, sharing control, and using multiple cues), prompting, and consequent PRT components (providing direct and contingent reinforcement and reinforcing attempts) via didactic instruction, video examples, worksheets, and role-plays. In addition, the trainer gave a comprehensive Amharic PRT and DTT intervention manual for parents and teachers respectively.

The PRT and DTT intervention manuals that the current study used were originally
Dagmawi, Hailu and Abebe

developed by the National Professional Development Center on Autism Spectrum Disorders in The M.I.N.D. Institute, The University of California at Davis School of Medicine. The current study adapted the PRT and DTT intervention manuals into the Ethiopian context and translated them into Amharic.

Furthermore, the researcher offered feedback to the parents/teachers, answered questions, and provided suggestions and feedback on worksheets and role-plays. In addition, parents and teachers received a brief introduction to the assessment of the fidelity of PRT and DTT implementation. After each group session, parents instructed and practiced PRT components during instruction to their children and the researchers supervise the intervention delivered by the teachers and parents.

Parents' and teachers' fidelity to the implementation of PRT and DTT respectively were measured. After completing training, parent and teacher deliver PRT and DTT for the targeted children respectively. The Parent's and teacher's fidelity to implementation PRT and DTT respectively, were measured by the implementation checklist for pivotal response treatment developed by National Professional Development Center on Autism Spectrum Disorder.

Parents and teachers were required to meet an implementation criterion of 80% of correct implementation for three consecutive sessions. After completing training, parent and teacher delivered PRT and DTT for the targeted children respectively.

**Phase 3: Parents and Teachers Intervention**

In subsequent sessions, the researcher provided the parents/teachers with the communication system to be implemented in the sessions and let them interact with their children using the teaching procedures. During the sessions, the researcher didn’t coach or model but stayed behind and took notes, within eight weeks parents delivered 20 sessions of PRT, and teachers delivered 20 hours of DTT, 1 hour for each session.

**Phase 4: Removal of the Intervention**

The intervention was removed for four consecutive weeks. In this phase, all parents and teachers in the study did not provide any intervention for the targeted children with ASD.

**Phase 5: Reintroduction of the Intervention**

Parents and teachers reintroduced the intervention after four weeks of break. In this phase parents and teachers continued providing the PRT and DTT intervention respectively for 1 month.

**Phase 6: Follow-up**

Two months following the termination of the intervention, the researcher returned to the participant's homes and schools to evaluate the maintenance of the children’s communication skills. During these visits, two trained data collectors interview the parents and teachers multiple times. Frequent home visits were scheduled for the follow-up phase.
Data Collection

The researcher, along with research assistants, used the Vineland-3 Adaptive Behavioral Scale communication domain to measure the communication skills of each child at various phases - baseline, intervention, withdrawal, re-intervention, and follow-up. The assessment was conducted by interviewing the child's parent using Vineland's extensive semi-structured interview.

Reliability

To determine if scores remain consistent and do not change drastically depending on the interviewer, two independent trained research data collectors independently collect data and assess the inter-interviewers' agreement. The inter-interviewers' agreement was reviewed after the completion of each Vineland-3 communication domain assessment. The inter-interviewer agreement is defined as 90% or higher. This research secured a Certificate of Protocol Approval from the study country. The names that are mentioned in the research document are all pseudo-names.

Data Analysis

To assess the result of the children's communication skills in the pre-, post-, and follow-up phases, results were assessed and compared with line graphs to indicate changes in the performance of children with ASD. The results of the study were reported concerning the child's outcome data. To achieve this goal, graphs coupled with visual inspection techniques were used to determine trends and response levels that distinguish between baseline, intervention, withdrawal, re-intervention phase, and follow-up. As mentioned before due to the nature of the single-subject research design, data analyses proceed for each child separately.

The data was analyzed on individual analysis of the quantitative data in a raw score, v-scale score, and standard score. The subdomains (receptive, expressive, and written) raw scores are average scores of repeated measures, and, the communication domain score is the composite score of the three subdomains. Subdomains have scaled scores called v-scaled scores (mean of 15 and a standard deviation of 3) within the range of scores from 1 to 24. The communication domain score was expressed in standard scores with a mean of 100 and a standard deviation of 15. Communication domain standard scores greater than or equal to 86 are considered adequate or above adequate. Domain scores from 71-85 are considered moderately low, and domain scores <20-70 are considered as low and indicate the student has a significant skill deficit when compared with similarly aged peers. The effect size of the intervention was analyzed for each student.
effect size of the intervention was calculated by Cohen's D Effect Size for Z-Test. Cohen's d is calculated by subtracting the population mean (before treatment) from the sample mean (after treatment), and then dividing the result by the population's standard deviation (15).

**Results**

Three parents and three teachers participated in supporting their respective children and students. Three mothers were trained to implement PRT, while three teachers between the ages of 26 and 38 were trained to support their students using DTT strategies. The participants' education qualifications ranged from a diploma to a Master's degree.

**Ekram’s Communication Skills**

The scores for communication were based on three subdomains: Receptive, Expressive, and Written. These are calculated to give a raw score, v-scale score, and standard score. In Ekram's baseline sessions, her average raw score was 65.8 which fall within the range of 63-67. Her standard score was 22.

Ekram's communication skills greatly improved after receiving help from both her teacher and parents at school and home, as shown in Figure 1. During the Intervention phase, her average raw score was 110.8 with a range of 75-149 and a standard score of 38. However, when the intervention was removed during the withdrawal phase, as seen in Figure 1, her communication skills declined. During this phase, she scored an average raw score of 109.6 with a range of 96-130 and a standard score of 37. But during the Re-intervention phase, when Ekram took PRT and DTT interventions, her skills improved once again. Her average raw score during this phase was 129.5 with a range of 110-145, and she received a standard score of 44.

Two months after the re-intervention sessions, follow-up sessions were held at the participant's home and school using the same procedures as before. The results showed that Ekram maintained benefit of the intervention, scoring an average raw score of 107.5 with a range of 105-110 and a standard score of 37. This confirmed the success of the intervention, which had an effect size of 1 when compared to Ekram's baseline standard score.

**Yonas's Communication Skills**

Yonas' communication skills were evaluated based on his scores on three subdomains: Receptive, Expressive, and Written. These scores were used to calculate his communication raw score, v-scale score, and standard score. During the baseline sessions, Yonas had an average raw score of 74, with a range of 73-75, and a standard score of 25, as shown in Figure 2. However,
after receiving intervention from both his teacher and parent, Yonas' communication skills significantly improved. In fact, during the Intervention phase, Yonas' average raw score was 106.1, with a range of 80-127, and he achieved a standard score of 36.

As shown in Figure 2, Yonas experienced a decline in his communication skills when both PRT and DTT interventions were removed. His average raw score was 96.8 with a range of 89-115 and a standard score of 33. However, during the Re-intervention phase, Yonas's parents and teachers worked together to improve his communication skills, resulting in a significant improvement. Yonas's average raw score increased to 121 with a range of 95-138, and he achieved a standard score of 42 in the re-intervention phase. In the re-treatment phase, Yonas achieved the highest score out of all the phases.

The participants' home and school were used for follow-up sessions, which were conducted two months after the end of re-intervention sessions. The same procedures were used for the baseline, intervention, withdrawal, and re-intervention sessions. Yonas successfully maintained the parent and teacher-mediated intervention. During the follow-up phase, Yonas scored an average raw score of 104 (range: 102-106) and had a standard score of 35, indicating the intervention was successful. Comparing Yonas's initial and follow-up standard scores, the intervention had an effect size of 0.66.

*Biruk’s Communication Skill*

The scores for communication are based on three subdomains: Receptive, Expressive, and Written. These scores include the raw score, v-scale score, and standard score. In the baseline sessions, Biruk had an average raw score of 76.5, with a range of 75-78. His standard score was 26. As shown in Figure 3, Biruk's communication skills showed gradual improvement following the PRT and DTT intervention initiated by the parent and teacher. During the Intervention phase, Biruk's average raw score was 123.6, with a range of 90-143. He achieved a standard score of 42, which was almost twice his baseline score.

As Figure 3 shows, Biruk's communication skills decreased during the withdrawal phase, with an average raw score of 109.6 and a range of 92-132. His standard score was 37. However, during the re-intervention phase, his score indicated an improvement in his communication skills, with an average raw score of 134.8 and a range of 112-150. His standard score was 46, which was the highest of all phases.

Follow-up sessions were conducted at Biruk's home and school two months after the re-intervention sessions. These sessions were identical to the previous ones - baseline, intervention, withdrawal, and re-intervention. The follow-up score showed that Biruk had maintained the intervention. During this phase, Biruk had an average raw score of 114.8 with a range of 112-118. His standard score was 39 in the follow-up phase. According to the results, there is a noticeable improvement in Biruk's communication skills between the initial assessment and the follow-up evaluation. The intervention had a considerable impact, as evidenced by an effect size of 0.86 when comparing Biruk's standard scores from the two assessments.
Discussion and Conclusion

The study involved only mothers as participating parents, which is a common practice in early interventions. Marcu et al. (2009) conducted a study on factors that could improve social interaction and communication in individuals with ASD. They found that frequent and organized attachment from mothers has a positive impact on these factors. Johnson (1978) also discovered that communication between mothers and their children is essential for communication and play development.

According to the study, children with ASD who underwent PRT and DTT therapies showed an improvement in their communication skills. Intensive interventions are crucial when working with children who have ASD, as research suggests. The CDC and the Academy of Pediatrics, 2016 endorse ABA therapy as an evidence-based practice for children with ASD. PRT and DTT originated from ABA according to Vismara and Bogin (2009) and Borgin (2008). These methods are commonly included in pre-designed programs for people with ASD such as the STAR program (2016) and Autism Speaks' Early Start Denver Model (n.d.).

The study demonstrated that parents and teachers effectively learned the PRT and DTT training methods, respectively, and utilized them to enhance children's communication abilities. The results emphasized the importance of proper training and feedback for parents and teachers to effectively teach children how to communicate with those in their surroundings. Research has shown that parent-implemented PRT is a successful method for enhancing social and communication abilities in children with ASD (Levy et al., 2006). By involving parents as interventionists, the strategy of active parent engagement can enhance the effectiveness of targeted pivotal areas such as motivation. This approach provides a "goodness of fit intervention" that fits seamlessly into the sociocultural system of the family, benefiting them.

The study found that involving parents and teachers in setting goals, planning instructions, and implementing strategies is a powerful tool that enhances the sustainability and generalizability of skills across different settings. Research has shown that family involvement is essential in effectively intervening with children with disabilities (Schopler & Reichler, 1971). Involving families has several benefits, including increasing spontaneity, generalization, and maintenance of the intervention, boosting parents' self-efficacy, and ensuring consistency (Lovaas et al., 1973).

This study emphasized the significance of incorporating family sociocultural environments and daily routines into intervention planning to achieve effectiveness. Integrating the intervention into family activities and routines can offer ample opportunities for social communication and behavioral learning, while also fostering positive interaction among family members.

The study suggests that involving parents and teachers in a child's development can improve their communication skills, which is often deficient in children with autism. Siller and Sigman (2002) conducted research to determine the effect of parent involvement on communication and interaction in children with ASD. The study found that when parents and teachers work together to improve a child's communication and interaction, it leads to better social communication skills, which are essential for effective communication.
Implications

The shortage of skilled teachers and therapists is not expected to be resolved soon, and the number of students with autism spectrum disorder is increasing. Therefore, all classroom professionals and paraprofessionals require specialized levels of instruction and supervision.

This research shows that when DTT or PRT interventions are found important for a student with autism, the parents and teacher obtain intensive training to learn techniques and deliver interventions with fidelity, to improve the communication skills of children with ASD. Training further allows parents and teachers to improve the skills of children with ASD. The availability of effective training in ABA can improve the equality of access to evidence-based interventions for students with autism across geographic and socioeconomic boundaries. Based on the finding of the study, the following recommendations have been made:

- To better support children with ASD, their parents and teacher; it would be beneficial for the government to work with NGOs and universities in creating an autism-specific policy.
- It is important for the government to create intervention manuals in various local languages for parents and teachers of children with autism. These manuals would help raise awareness and teach parents and teacher how to enhance the skills of children with ASD. This would be beneficial on a nationwide level.
- We strongly suggest that parents of children who took part in this study continue to apply the knowledge and skills they acquired to support their children with ASD.
- It is advised that teachers who instructed children in this study continue to utilize the knowledge and skills they acquired to assist students with ASD.
- We suggest that parents who haven't participated in the study use the intervention manual provided to get acquainted with the PRT procedure and apply it to improve their children's ASD skills.
- We recommend that teachers and school psychologists, especially those who specialize in special education, utilize our research protocol and DTT intervention manual. This will help them to understand and implement DTT procedures, which can enhance the abilities of students with ASD.
- Future research is warranted for further examination of this intervention protocol with a larger sample size.
References


Table 1: Parents and Teachers’ Demographic Characteristics

<table>
<thead>
<tr>
<th>INTERVENTIONIST</th>
<th>EKRAM MOTHER</th>
<th>YONAS MOTHER</th>
<th>BIRUK MOTHER</th>
<th>EKRAM TEACHER</th>
<th>YONAS TEACHER</th>
<th>BIRUK TEACHER</th>
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<tr>
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<td>28</td>
<td>38</td>
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<td>BA Degree</td>
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<td>Unemployed Own business</td>
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<td>3</td>
<td>4</td>
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<td>Biological Mother</td>
<td>Biological Mother</td>
<td>Self-contained teacher</td>
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Table 2: Student Demographic Characteristics

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<th>AGE YEAR AND MONTH</th>
<th>SEX</th>
<th>SCHOOL</th>
<th>DIAGNOSIS</th>
<th>INTERVENTION SETTING</th>
<th>INTERVENTIONIST</th>
<th>ANY OTHER MEDICAL DIAGNOSIS</th>
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<td>ASD</td>
<td>Home School and Mother Teacher</td>
<td>and Asthma</td>
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<tr>
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<td>ASD</td>
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<td>and None</td>
<td></td>
</tr>
</tbody>
</table>
Table 3: Ekram’s Communication Skill Score Summary

<table>
<thead>
<tr>
<th>COMMUNICATION SUBDOMAINS</th>
<th>BASELINE RAW SCORE</th>
<th>BASELINE v-SCALE SCORE</th>
<th>INTERVENTION RAW SCORE</th>
<th>INTERVENTION v-SCALE SCORE</th>
<th>WITHDRAWAL RAW SCORE</th>
<th>WITHDRAWAL v-SCALE SCORE</th>
<th>RE-INTERVENTION RAW SCORE</th>
<th>RE-INTERVENTION v-SCALE SCORE</th>
<th>FOLLOW-UP RAW SCORE</th>
<th>FOLLOW-UP v-SCALE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptive</td>
<td>40.3</td>
<td>7</td>
<td>65.5</td>
<td>13</td>
<td>65.1</td>
<td>13</td>
<td>74.2</td>
<td>10</td>
<td>63</td>
<td>12</td>
</tr>
<tr>
<td>Expressive</td>
<td>19.4</td>
<td>1</td>
<td>34</td>
<td>1</td>
<td>33.2</td>
<td>1</td>
<td>39.1</td>
<td>2</td>
<td>32.1</td>
<td>1</td>
</tr>
<tr>
<td>Written</td>
<td>6.1</td>
<td>7</td>
<td>11.3</td>
<td>10</td>
<td>11.3</td>
<td>10</td>
<td>16.2</td>
<td>13</td>
<td>12.4</td>
<td>11</td>
</tr>
<tr>
<td>Overall composite</td>
<td>65.8</td>
<td>110.8</td>
<td>109.6</td>
<td>129.5</td>
<td>107.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw Score</td>
<td>22</td>
<td>38</td>
<td>37</td>
<td>44</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The subdomains (receptive, expressive, and written) raw scores are average scores of repeated measures. Subdomains have scaled scores called v-scaled scores (mean of 15 and a standard deviation of 3). The communication domain score was expressed in standard scores with a mean of 100 and a standard deviation of 15.

Table 4: Yonas’s Communication Skill Score Summary

<table>
<thead>
<tr>
<th>COMMUNICATION SUBDOMAINS</th>
<th>BASELINE RAW SCORE</th>
<th>BASELINE v-SCALE SCORE</th>
<th>INTERVENTION RAW SCORE</th>
<th>INTERVENTION v-SCALE SCORE</th>
<th>WITHDRAWAL RAW SCORE</th>
<th>WITHDRAWAL v-SCALE SCORE</th>
<th>RE-INTERVENTION RAW SCORE</th>
<th>RE-INTERVENTION v-SCALE SCORE</th>
<th>FOLLOW-UP RAW SCORE</th>
<th>FOLLOW-UP v-SCALE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptive</td>
<td>34</td>
<td>6</td>
<td>61.8</td>
<td>12</td>
<td>56.5</td>
<td>11</td>
<td>67.3</td>
<td>14</td>
<td>63.1</td>
<td>13</td>
</tr>
<tr>
<td>Expressive</td>
<td>18.7</td>
<td>1</td>
<td>28</td>
<td>1</td>
<td>25.2</td>
<td>1</td>
<td>35</td>
<td>2</td>
<td>24.4</td>
<td>1</td>
</tr>
<tr>
<td>Written</td>
<td>11.3</td>
<td>12</td>
<td>16.3</td>
<td>15</td>
<td>15.1</td>
<td>14</td>
<td>18.7</td>
<td>15</td>
<td>16.5</td>
<td>15</td>
</tr>
<tr>
<td>Overall composite</td>
<td>74</td>
<td>106.1</td>
<td>96.8</td>
<td>121</td>
<td>104</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw Score</td>
<td>25</td>
<td>36</td>
<td>33</td>
<td>42</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The subdomains (receptive, expressive, and written) raw scores are average scores of repeated measures. Subdomains have scaled scores called v-scaled scores (mean of 15 and a standard deviation of 3). The communication domain score was expressed in standard scores with a mean of 100 and a standard deviation of 15.

18
Table 5: Biruk’s Communication Skill Score Summary

<table>
<thead>
<tr>
<th>COMMUNICATION SUBDOMAINS</th>
<th>BASELINE RAW SCORE</th>
<th>BASELINE v-SCALE SCORE</th>
<th>INTERVENTION RAW SCORE</th>
<th>INTERVENTION v-SCALE SCORE</th>
<th>WITHDRAWAL RAW SCORE</th>
<th>WITHDRAWAL v-SCALE SCORE</th>
<th>RE-INTERVENTION RAW SCORE</th>
<th>RE-INTERVENTION v-SCALE SCORE</th>
<th>FOLLOW-UP RAW SCORE</th>
<th>FOLLOW-UP v-SCALE SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptive</td>
<td>39.4</td>
<td>8</td>
<td>58.2</td>
<td>12</td>
<td>52.1</td>
<td>11</td>
<td>62.3</td>
<td>13</td>
<td>56.5</td>
<td>12</td>
</tr>
<tr>
<td>Expressive</td>
<td>35.8</td>
<td>4</td>
<td>55.1</td>
<td>8</td>
<td>45.5</td>
<td>6</td>
<td>54.4</td>
<td>8</td>
<td>44.2</td>
<td>6</td>
</tr>
<tr>
<td>Written</td>
<td>1.3</td>
<td>7</td>
<td>10.3</td>
<td>13</td>
<td>12</td>
<td>14</td>
<td>18.1</td>
<td>17</td>
<td>14.1</td>
<td>15</td>
</tr>
<tr>
<td>Overall composite</td>
<td>76.5</td>
<td></td>
<td>123.6</td>
<td></td>
<td>109.6</td>
<td></td>
<td>134.8</td>
<td></td>
<td>114.8</td>
<td></td>
</tr>
</tbody>
</table>

Note: The subdomains (receptive, expressive, and written) raw scores are average scores of repeated measures. Subdomains have scaled scores called v-scaled scores (mean of 15 and a standard deviation of 3). The communication domain score was expressed in standard scores with a mean of 100 and a standard deviation of 15.

Figure 1: Ekram Vinland Adaptive Behavior Scale Communication Domain Raw Score

Note: This figure demonstrates Ekram’s scores on different sessions and phases. The baseline phase was conducted from sessions one to six; the intervention phase began in session seven and ended in session 42; the withdrawal phase started in session 43, and ended in session 48; the re-intervention was introduced in session 49 and ended in session 66 and the follow-up session was conducted from session 67 to 72.
Figure 2: Yonas Vinland Adaptive Behavior Scale Communication Domain Raw Score

Note: This figure demonstrates Yonas’s scores on different sessions and phases. The baseline phase was conducted from sessions one to six; the intervention phase began in session seven and ended in session 42; the withdrawal phase started in session 43, and ended in session 48; the re-intervention was introduced in session 49 and ended in session 66 and the follow-up session was conducted from session 67 to 72.
**Figure 3: Biruk Vinland Adaptive Behavior Scale Communication Domain Raw Score**

Note: This figure demonstrates Biruk’s scores on different sessions and phases. The baseline phase was conducted from sessions one to six; the intervention phase began in session seven and ended in session 42; the withdrawal phase started in session 43, and ended in session 48; the re-intervention was introduced in session 49 and ended in session 66 and the follow-up session was conducted from session 67 to 72.