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Implementation of Smart Discrimination Training to Improve Discrimination Skills in Autism Spectrum Disorder

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Abstract

Autism is a severe neurobiological developmental disorder appearing before age three, with deficits in communication and social interaction that often persist without intervention. Discrimination Training (DT), vital for children with ASD, involves distinguishing instructions, concepts, and objects. Conventional DT presents multiple stimuli simultaneously, which can confuse children and cause unstable responses. This study introduces Smart Discrimination Training (Smart DT) and tests its effectiveness in two types of children with ASD using a developmental, single-subject experimental design. Data show that both types of children with ASD, who previously had difficulty with discrimination, improved and maintained their skills. Smart DT proves effective as a structured training method for more complex discrimination tasks in children with ASD.

Keywords: applied behavior analysis, autism spectrum disorder (ASD), behavioral intervention, discrimination skills, smart discrimination training

Abstrak

Autisme adalah gangguan perkembangan neurobiologis yang parah dan muncul sebelum usia tiga tahun, dengan kekurangan dalam komunikasi dan interaksi sosial yang sering kali bertahan tanpa intervensi. Pelatihan Diskriminasi (DT)*, yang penting bagi anak-anak dengan ASD, melibatkan kemampuan untuk membedakan instruksi, konsep, dan objek. DT konvensional menyajikan beberapa rangsangan secara bersamaan, yang dapat membingungkan anak-anak dan menyebabkan respons yang tidak stabil. Penelitian ini memperkenalkan Pelatihan Diskriminasi Cerdas* (Smart DT) *dan menguji efektivitasnya pada dua tipe anak dengan ASD menggunakan desain perkembangan dan subjek tunggal dalam sebuah eksperimen. Data menunjukkan bahwa kedua tipe anak berkebutuhan tersebut, yang sebelumnya mengalami kesulitan dalam diskriminasi, mengalami peningkatan dan mampu mempertahankan keterampilan tersebut.* Smart DT *terbukti efektif sebagai metode pelatihan terstruktur untuk tugas diskriminasi yang lebih kompleks pada anak-anak dengan ASD.*

Kata kunci: applied behavior analysis, autism spectrum disorder (ASD), behavioral intervention, discrimination skills, smart discrimination training

Introduction

Discrimination skills are basic skills that greatly determine the success of learning in children with ASD, especially in intervention-based Applied Behavior Analysis (ABA) interventions. However, in the practice of therapy, children with ASD often have difficulty distinguishing various stimuli, instructions, or objects simultaneously. This condition becomes more severe when multiple distractions are presented simultaneously in a learning series, requiring children to process a large amount of information at once. Studies have shown that these high processing demands often exceed the learning readiness of children with ASD, especially in the early stages of intervention, making responses unstable, easily mistaken, and difficult to maintain (Gevarter et al., 2020; Nottingham et al., 2017). Such discrimination difficulties can hinder the learning of advanced skills and prolong therapy duration. Applied behavior analysis (ABA) is an effective intervention approach for teaching various skills to children with ASD (Lovaas et al., 1967). As practice evolved and the need for more measurable interventions evolved, ABA was developed into Smart ABA that emphasizes procedural clarity, systematic behavioral measurement, and empirical data-driven decision-making (Anwar et al., 2022).

Within the framework of Applied Behavior Analysis (ABA), discrimination training (DT) is a fundamental technique for training children to distinguish stimuli and provide appropriate responses (Lovaas & Bondy, 2003; Sutadi, 2018). The mastery of discrimination skills is an important prerequisite for developing more complex academic, communication, and social skills. In practice, classical discrimination training is generally implemented using a procedure developed by Lovaas, which involves gradual learning across nine stages combined with an Errorless Teaching approach. This procedure is carried out through *Mass Trials* with *Full Prompt*, followed by a gradual reduction in aid through *Prompt fading* (Lovaas & Bondy, 2003). Several studies have shown that this approach is effective in establishing stimulus control, but in certain contexts, it can extend the intervention duration if it is not adjusted to the individual's learning characteristics (Bergmann et al., 2017; Breeman et al., 2020; Grow et al., 2011, 2014). In addition, the application of *prompt fading requires* careful monitoring to prevent the dependence of children on prompts and maintain a stable response (Leaf et al., 2019; Perez & Betz, 2020). Mechanistically, the gradual formation of stimulus control requires precise procedural arrangements for the expected response to develop optimally (Perez et al., 2020).

In addition to the procedural aspect, another challenge in the application of classical DT is the simultaneous presentation of multiple distressors in a series of learning trials. Lin and Zhu (2020) Implementing discrimination training by presenting several stimuli simultaneously, where the therapist shows three cards with pictures of apples, blueberries, and bananas, that demand that children choose the target stimulus among several comparisons. The study aims to address this issue. Similar findings have been reported in various studies showing that increasing the number of comparative stimuli can increase distraction and make it difficult to establish stimulus controls, especially when discrimination readiness has not been optimally established (DiSanti et al., 2020; Eldevik et al., 2020; Hannula et al., 2020; LeBlanc et al., 2020). This condition has the potential to confuse the child, produce fluctuating responses, and inhibit learning stability in the early phases of therapy.

A number of previous studies have explored discrimination training through a variety of approaches, including the comparison of procedures *in the discrete trial* (Gutierrez et al., 2009; Vedora & Grandelski, 2015), characteristics of simultaneous discrimination (Eldevik et al., 2020; Lin & Zhu, 2020), the level of complexity of conditional discrimination (Chezan et al., 2016), and the arrangement of the order of presentation of stimuli in discrimination training (Bergmann et al., 2021; Farias et al., 2025). Although these studies make important contributions to the understanding of the mechanisms of discrimination learning, the main focus remains on the procedure's efficiency or the stimulus's characteristics. Few studies have explicitly designed a training framework that controls the number of distractors in a progressive and structured manner from the early stages of learning, especially for children with ASD who are still building basic discrimination readiness.

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This gap underpinned the development of Smart Discrimination Training (Smart DT), a component of the Smart Applied Behavior Analysis (Smart ABA) approach. This approach is a development of Applied Behavior Analysis or ABA (Anwar et al., 2022). Smart DT is designed to be (1) more adaptive and efficient for children with ASD, (2) emphasizes the presentation of activities and distractors in a gradual, structured, and controlled manner, (3) the learning process begins with mastery of one activity at a time through Smart Discrete Trial Training (Smart DT), before the child is introduced to more complex stages of discrimination. This approach aims to minimize unnecessary distractions, reduce confusion, and strengthen stimulus control, especially in the early phases of therapy. Through structured stimulus escalation and proportional prompt support, Smart DT facilitates the development of increasingly stable discrimination skills and provides a foundation for advanced learning in children with ASD.

Unlike Discrimination Training in ABA, which generally presents multiple comparison stimuli simultaneously and does not explicitly regulate the duration of mastery at each stage, Smart DT integrates a clearly structured learning structure with predetermined passing criteria and controlled stimulus escalation. The novelty of this approach lies not only in the gradual management of distractors but also in integrating implementation duration into the training design. By systematically documenting the time required to achieve mastery at each stage, Smart DT provides a measurable temporal benchmark for assessing its efficiency and practical feasibility in real-world therapy settings. Consequently, this study aimed to examine the development and clinical implementation of Smart DT and evaluate its effectiveness in improving and maintaining discrimination skills in children with ASD in a real-life therapy context. This included analyzing the implementation duration required to meet mastery criteria as an important indicator of practical feasibility.

Autism is the focus of this paper's study is a severe neurobiological developmental disorder that occurs in children, so that it causes problems in communicating and relating (relating) to their environment, starting in the first three years of their life and continuing throughout their life if not intervened. Some experts define autism as a developmental disorder that is genetic, affecting the way we interact with others, as well as affecting cognitive, learning, communicating, and behaving Pickles et al., 2020; Su et al., 2019). This complex disorder, it also has an impact on increasing stress in parents of children with ASD (Porter & Loveland, 2019). Negative stigma from society towards children with ASD contributes to increasing this stress (Song et al., 2022; Tang & Bie, 2016; Yu et al., 2020). Furthermore, some researchers revealed that the stress level of parents who have children with ASD is higher than that of parents who do not have children with ASD (Acharya & Sharma, 2021; Fecteau et al., 2023; Li et al., 2022; Madarevic et al., 2022; Nunnally et al., 2023). A solution must be found so that this stress level does not continue to increase, one of which is the development of a therapy model that accelerates the progress of the development of children with ASD.

In children with Autism Spectrum Disorder (ASD), the ability to discriminate reflects the potential to distinguish and respond appropriately to various types of stimuli, both visual, auditory, and social-emotional, such as differences in color, sound, patterns, and facial expressions. Children with ASD generally have limitations in these skills. According to Lovaas et al. (Lovaas & Bondy, 2003) DT is the distinction between the therapist's instruction and the child's response/ distinguishing elements of the stimulus. DT is a technique used to label or identify to recognize letters, colors, shapes, or people (Holmes et al., 2015; O'Neill et al., 2018).

According to Sutadi (2018), DT is training a person (in this case, ASD) to be able to distinguish between various stimuli from one another, in the form of instructions for various things (models/concepts/objects/etc). Approaches and therapies can help them develop their discrimination abilities, improve their social skills, and improve their overall quality of life. The main constructs in Smart DT include learning-based learning, *Prompt fading*, *Errorless Learning* (Cengher et al., 2020), and the use of staged/gradual stimuli to avoid confusing children. For example, in the study of Moreira et al (2017), the child is given two or more stimuli (stimuli) at the same time, and the child must choose which one is correct. This condition will confuse ASD children. Therefore, new systems and techniques are needed that expand the existing teachings.

Methods

The subjects of the study were two children with a diagnosis of ASD by a pediatrician in Indonesia. Subject A, a 4-year-old girl, showed symptoms of not speaking, avoiding eye contact, hyperactivity, tantrums, frequent crying, and night sleep disturbances. Subject B, a 7-year-old male, also did not speak, had no eye contact, was hyperactive, and exhibited behaviors such as climbing the closet, shouting, biting, playing with fingers, muttering, and sleep disturbances. Prior to Smart ABA therapy at the KID-ABA Autism and NDD Center, both subjects had undergone other therapies. Before therapy begins, an initial assessment is carried out using the Smart ABA pre-verbal program which includes independent sitting, eye contact, obedience to verbal directions, imitation of gross motor movements, execution of simple commands, identification of body parts, imitation of actions against objects, block patterns, identification of cards and objects, and matching of identical cards. The assessment is conducted by therapists, therapist assistants (TAs), and KID-ABA supervisors. The assessment results showed that both subjects gave silent, incorrect, and off-task responses, earning a score of 0%. Therefore, Smart ABA therapy starts with the basic curriculum. Participant A ran 2 therapy sessions per day, whereas Participant B ran 4 per day. Purposively, both participants were selected because they demonstrated consistent difficulties with attending discrimination training commonly used in classical ABA approaches. With these characteristics, participants are considered relevant to test the Smart DT model's implementation and initial response.

The inclusion criteria are as follows: (1) the child has been diagnosed with ASD by a medical professional, (2) is actively participating in a Smart ABA therapy program, (3) can attend structured therapy sessions for a certain duration, and (4) has a relatively stable level of therapy attendance during the implementation period. Children with severe medical conditions, significant sensory or motor impairments, and inconsistent absences were excluded from this study because they could affect the implementation of procedures and observations of the development of discriminatory abilities.

Research is conducted in individual therapy spaces designed to minimize distractions and support structured learning. A Smart ABA therapist, accompanied by a therapist assistant, conducts each therapy session in accordance with standard service procedures. The therapy room is equipped with a closed-circuit television (CCTV) monitoring system that allows parents to observe the entire therapy process from outside, maintaining transparency and the accuracy of implementation. This controlled therapeutic environment is intended to ensure that changes in the child's abilities can be attributed to the application of Smart DT rather than to variations in environmental conditions. This study took place at the KID-ABA Autism Center Indonesia, and during therapy, the subjects also followed dietary management guidance from the KID-ABA team of doctors.

This study uses a development research design, combined with limited implementation and initial observations of effectiveness. The main focus of this research is to develop a model *of smart discrimination training* (Smart DT) as an alternative to discrimination training for children with ASD who have difficulty participating in conventional discrimination training, where distractions are generally given more than one at a time. In contrast to purely experimental research that aims to test effectiveness comparatively and on a large scale, this study places effectiveness as an early indication of the functionality of models developed in the context of real therapeutic practice. This approach is in line with development research that emphasizes the integration of the product design process, implementation feasibility, and initial impact on users (Richey & Klein, 2007).

The research procedure includes the stages of identifying practice problems, designing the Smart DT model, validating and refining procedures through expert discussions, and conducting a limited implementation with the research participants. During the implementation stage, changes in discrimination abilities, speed of skill acquisition, and response stability during therapy sessions were observed. The positive changes that emerged after the implementation of Smart DT were seen as an indication of the model's early effectiveness in real-world therapy. The interpretation of these results follows the principles of reading applied research findings and non-generalizing design, where findings are limited to the subject and conditions of the study and are not intended to be generalized to the wider population (Richey & Klein, 2007; Shadish et al., 2002).

Smart DT was developed in response to the difficulties of children with ASD in participating in classic discrimination training by providing more than one distraction simultaneously. Based on observations of therapy practices and discussions with therapists and parents of children with ASD, the conventional approach often causes confusion in children and slows down the acquisition of discrimination skills. Therefore, Smart DT was developed on the principle of presenting stimuli in a gradual, structured, and measurable manner, so that children can master one activity before being introduced to the next or a distraction, followed by maintenance. The Smart DT development process is conducted through targeted group discussions involving Smart ABA therapists, supervisors, and consultants. The discussion focused on a simpler yet systematic arrangement, including determining the order of activities, the number of activities per block, the graduation criteria for each stage, and *the maintenance* mechanism. The discussion yielded a Smart DT design that groups activities into learning blocks, each consisting of five activities taught in stages through a combination of Smart DTT and Smart DT.

In Smart ABA, each activity is first taught individually using the Smart DTT procedure until the children meet the graduation criteria. After the two activities are mastered separately, Smart DT is carried out by giving instructions or starting the initial activity randomly and gradually. This approach is intended to reduce children's cognitive load and improve the clarity of stimuli during the learning process. Graduation criteria are set quantitatively, so the decision to proceed to the next stage is based on children's performance data rather than subjective assessments. The initial Smart DT design is then given to three therapists who actively work with children with ASD to assess readability, clarity of the procedural flow, and ease of understanding, before experts and practitioners proceed to the assessment stage. This stage ensures the clarity of the procedure flow, consistency of terms, and ease of understanding of the guidance before the model is further implemented. Input from the therapist is used to refine the procedure's redaction and the order of execution so that it is easy to follow during a real therapy session.

After the readability stage, experts and practitioners assess Smart DT. The assessment involved two experts in psychology and language, as well as two ASD therapy practitioners. The following aspects were evaluated: (1) the relevance and suitability of the Smart DT structure with the learning characteristics of children with ASD, (2) the clarity of the stages and transitions between activities, (3) the ease of implementation in the therapy session, and (4) the accuracy of the use of instructional language. The assessment was conducted using a five-level scale, ranging from very appropriate to very inappropriate. The results of expert and practitioner assessments were then analyzed using Aiken's V coefficient to assess the validity of Smart DT's procedural content (Aiken, 1985). Quantitative and qualitative inputs from the assessment stage form the basis for the final refinement of the Smart DT design. In this study, the measurement at the implementation stage refers to the Smart ABA development framework as a development of ABA (Anwar et al., 2022), as well as the *Smart Measurement and Evaluation* (Smart ME) system developed by Arneliza (2026). At this stage, measurements are focused on indicators of the child's behavioral performance during Smart DT, which are recorded from trial to trial. The data obtained were used to assess the implementation of procedures, the consistency of the Smart DT stages, and the effectiveness of the initial model in supporting the acquisition of discrimination skills among children with ASD in real-world therapy.

In the Smart ABA method, one ASD child is treated by one therapist and one therapist assistant (TA), which we call Smart two on one (Arneliza et al., 2026). The therapists included in this study are therapists and TA who have undergone a training period and a multi-level internship, and have been declared to meet the competence as a therapist by KID-ABA. The training and multi-level internship program as a Smart ABA therapist lasts approximately 3 to 6 months. The therapy room is 3 x 3.5 meters, distraction-free, air-conditioned, and adequately lit, with wall clocks, whiteboards, and other writing equipment available. Tables and chairs for children under eight years old are the same size as those for children in kindergarten schools, while for children over eight years old, tables and chairs are the same size as those for children in elementary schools. It consists of three chairs and two tables.

One chair for the child, one for the therapist, and one for the therapist's assistant; one table for implementing the Smart ABA program; and another table for the assistant therapist to record each child's response. All teaching materials, equipment, and assessment sheets have been prepared before assessment and therapy sessions to ensure they are effective and efficient. There are two shelves on the left and right of the therapist, to place all teaching materials, food/drink rewards, and toys for children. The therapist sits right in front of the child, while the therapist assistant sits on the child's shoulder. The therapist prepares the child before giving instructions, then provides feedback on all of the child's responses. An assistant who sits behind the child, if necessary, to prompt the child, and record each child's response.

The instructions given by the therapist should be neutral, flat, delivered only once, in good, correct Indonesian, with clear articulation, and without additional movements. The social reward given by the therapist must be with the 3 E's technique: energy, excitement, and enthusiasm. The therapist prepares the child's sitting and attention. The child's sitting is prepared with the instruction "sit nice/sweet"; the child's attention is prepared with the instruction to "look" in a neutral, flat manner. If necessary, the therapist's assistant prompts the child to sit and fixes the child's head if it is shaking when the therapist gives the "look" instruction. After the child is ready, the therapist gives instructions. The teaching room is equipped with CCTV and CCTV monitors. Outside the therapy room, the subject's parents/caregivers saw firsthand the implementation of the Smart ABA therapy session as seen in **Figure 1.** below:

Sources: Personal data (2024).

Figure 1. Smart ABA teaching room and parent/caregiver monitor room which is equipped with CCTV and monitor screens

The procedure for implementing Smart ABA therapy sessions is relatively safe for children, therapists, and therapist assistants. After each session, the therapist prepares a session report and posts it in the WhatsApp group for the respective subject. Meanwhile, the therapist's assistant conducts scoring or assessment and graphs on all programs run in the session. WhatsApp groups include: the child's parents, the family appointed to supervise the child (if any), a team of therapists, supervisors, program directors, expert consultants, and administrators. Through WhatsApp groups, all parties involved can monitor the child's development, provide input, and coordinate to support the success of the therapy program. Periodic evaluations are conducted to assess the effectiveness of the therapy program and make necessary adjustments.

Meanwhile smart *DT* was developed in response to the difficulties of children with ASD in participating in classic discrimination training by providing more than one distractor at the same time. Based on observations of therapy practices and discussions with therapists and parents of children with ASD, the classical approach often causes confusion in children. It slows down the acquisition of discrimination skills. Therefore, Smart DT was developed on the principle of presenting stimuli in a gradual, structured, and measurable manner, so that children can master one activity before being introduced to the next or a distraction, followed by maintenance. The Smart DT development process is conducted through targeted group discussions involving Smart ABA therapists, supervisors, and consultants. The discussion focused on a simpler yet systematic arrangement, including determining the order of activities, the number of activities per block, the graduation criteria for each stage, and *the maintenance* mechanism. The discussion yielded a Smart DT design that groups activities into learning blocks, each consisting of five activities taught in stages through a combination of Smart DTT and Smart DT.

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In this development implementation, a program is used to carry out simple commands, with the following activities: 1. Handshake; 2. Toss; 3. Kiss bye; 4. Clap hand; 5. Bye. The instruction is to "shake hands" and then follow the other four activities according to the Smart DT stages. The procedure for implementing Smart DT in Block I (activities 1-5) is carried out in stages as follows: (1) In the daily program, activity 1 is taught using the Smart Discrete Trial Training (Smart DTT) procedure until the mastery criteria are reached, then transferred to the maintenance program. (2) Furthermore, activity 2 is taught using Smart DTT until it reaches the mastery criterion, then transferred to maintenance. (3) In the daily program, Smart DT activities 1 vs 2 are carried out in parallel with the maintenance of activities 1 and 2. After Smart DT activity 1 vs 2 reaches the mastery criterion, Smart DT activity 1 vs 2 is moved to maintenance, and the maintenance of Smart DTT activity 1 and activity 2 is stopped. (4) In the daily program, activity 3 is taught using Smart DTT until the graduation criteria are reached, then transferred to maintenance. (5) Next, Smart DT activities 1 vs 2 and 3 are conducted on the daily program. After the 1 vs 2 vs 3 activity, Smart DT reaches the mastery criterion. The program has been moved to maintenance, and the 1 vs 2 activity in Smart DT maintenance has stopped. (6) In the daily program, activity 4 is taught using Smart DTT until it reaches the mastery criterion. It is transferred to maintenance, and Smart DTT activity 3 maintenance is stopped. (7) Furthermore, Smart DT activities 1, 2, 3, and 4 are carried out in the daily program. After the Smart DT activity 1 vs 2 vs 3 vs 4 reaches the passing criteria, the program is moved to maintenance, and the Smart DT activity 1 vs 2 vs 3 maintenance is stopped. (8) In the daily program, activity 5 is taught using Smart DTT until the mastery criterion is reached, then transferred to maintenance, and the maintenance of Smart DTT activity 4 is stopped. (9) The final stage of Block I is carried out by carrying out Smart DT activities 1 vs 2 vs 3 vs 4 vs 5 (Smart DT Block I) in the daily program. After Smart DT Block, I reached the mastery criterion, the program was moved to maintenance, and all previous maintenance stages were stopped.

After Blocks I and II each reach the mastery criterion, a Smart DT between the blocks (Block I vs. Block II) is conducted in the daily program. After Smart DT Block I vs. Block II reached the mastery criterion, the program was moved to maintenance, and separate maintenance for Block I and Block II was discontinued. The same procedure is gradually applied to the next blocks. If the child has mastered more than two blocks, then 7-12 activities are given in each session of the Smart DT program. For example, if the child has mastered six blocks (30 activities), then learning is divided into several sessions: the first session of 10 activities, the second of the next 10, and the third of the last 10. The number of activities per session is adjusted based on the number of activities being taught and the child's readiness.

Data collection during the Smart DT development phase was described in the Development and Measures section. In the implementation phase, Smart DT was applied to two children with ASD in a live therapy session. Data were collected directly during therapy by a therapist assistant, who recorded the child's responses on each trial and plotted them on a progress graph. The collected data included response accuracy, performance stability across sessions, and the time required to meet the passing criteria for each Smart DT stage. The therapy was monitored via CCTV to ensure procedural consistency and allow for parental observation. In addition, supervisors and consultants conducted observations both directly in the therapy room and through recordings. All data was used to evaluate the consistency of Smart DT implementation and the effectiveness of the live therapy session. Data visualization in graphical form also facilitated progress monitoring and the timely decision-making for interventions in the event of performance stagnation or decline.

The internal validity of this study is focused on the implementation credibility and procedural accuracy of Smart DT. Referring to the internal validity framework of Shadish et al. (2002), threat control is achieved by ensuring that changes in the child's performance can be logically attributed to the application of Smart DT procedures that are designed and implemented consistently within the context of real therapy. All Smart DT implementation sessions are conducted in a standardized therapy room free of distractions and are led by Smart ABA therapists and assistant therapists who have undergone training and are deemed competent. The roles of the therapist and the therapist assistant are clearly differentiated to minimize observation bias and recording inconsistencies: the therapist focuses on delivering instruction and reinforcement, while the therapist assistant records all of the child's responses on *a trial-by-trial basis*. This division of roles allows for cross-supervision during sessions and supports consistent implementation of procedures. The use of operationally defined learning stages, explicit graduation criteria, and consistent maintenance mechanisms at each stage also strengthens the procedural reliability of Smart DT. The implementation of therapy sessions is monitored via a CCTV system, allowing supervisors and parents to observe the course of therapy and ensure that the designed procedure aligns with field implementation. With such controls, potential threats to internal validity, such as implementation variations, can be minimized.

Table 1. Smart DT Systematics

Smart DTT	Smart DT	Pass	Maintenance
Activity #1			
		Stop →	Smart DTT #1
Activity #2			
		Stop →	Smart DTT #1 continues
			Smart DTT #2
	1 vs 2		
		Stop →	Smart DTT #1 stop
Activity #3			Smart DTT #2 stop
			Smart DT 1 vs 2
		Stop →	Smart DT 1 vs 2 continue
	1 vs 2 vs 3		Smart DTT #3
		Stop →	Smart DT 1 vs 2 stop
Activity #4			Smart DTT #3 continues
			Smart DT 1 vs 2 vs 3
		Stop →	Smart DTT #3 stop
	1 vs 2 vs 3 vs 4		Smart DT 1 vs 2 vs 3 continue
			Smart DTT #4
		Stop →	Smart DT 1 vs 2 vs 3 continue
Activity #5			Smart DTT #4 stop
			Smart DT 1 vs 2 vs 3 vs 4
		Stop →	Smart DT 1 vs 2 vs 3 stop
	1 vs 2 vs 3 vs 4 vs 5		Smart DT 1 vs 2 vs 3 vs 4 continue
			Smart DTT #5
		Stop →	Smart DT 1 vs 2 vs 3 vs 4 stop
Activity #6-10: Perform the same procedure as Block I.			Smart DTT #5 stop Smart DT 1 vs 2 vs 3 vs 4 vs 5 (DT Block 1)
	Smart DT Block II pass	Stop →	Smart DT Block I continues
			Smart DT Block II continues
Activities	Smart DT Block I vs Block II According to the number of blocks programmed		

The data analysis in this study was conducted after the Smart DT development stage was completed. The data from the assessment of experts and analysts were analyzed using Aiken's V coefficient to assess the validity of the Smart DT procedure content, which includes things that have been explained in the Development and Steps section. The results of the analysis are used as the basis for the final refinement of the Smart DT design. In the implementation stage, data analysis focuses on the clarity and consistency of the Smart DT stages and on the implementation of procedures in each activity and learning block. *After the experiment, data* were analyzed descriptively to assess the consistency of response recording and the stability of performance between sessions. Furthermore, the progress of Smart DT implementation is visualized through graphs to illustrate patterns of progress, stagnation, or changes in children's performance over time (Richards, 2018). These graphs facilitate data interpretation and support the initial assessment of Smart DT's effectiveness in real therapy.

All parents of the subjects have been informed about the procedure of this study, and they can see directly through the CCTV monitor of each child the implementation of this study. All parents of the subjects provided written consent for their participation in this study. Ethical clearance for this study was obtained from the Muslim University of Indonesia (No: 598/A.1).

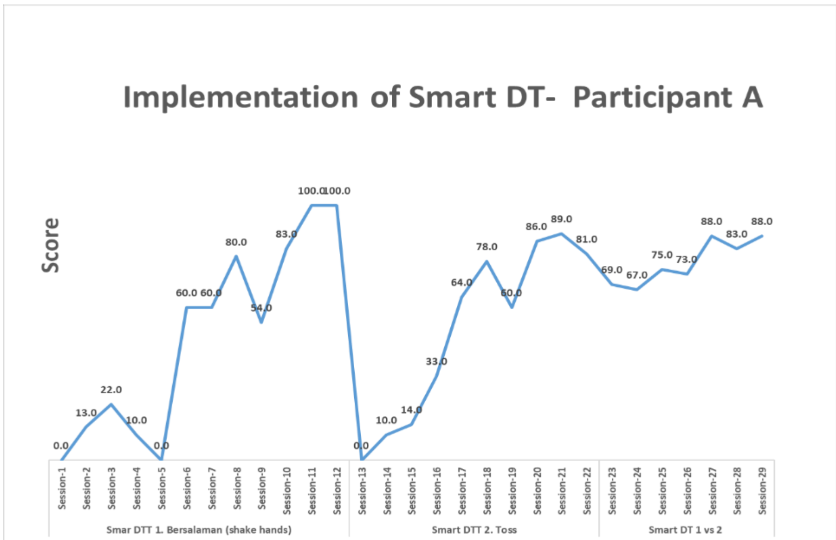
Results and Discussion

Results

At the readability stage, the three therapists who were given Smart DT material stated that the compiled guidelines were easy to understand, with clear implementation flows and stages. The therapist considers that the Smart DT procedure can be systematically followed in daily therapy practice without requiring complex additional explanations. The results of the assessment of the validity of the Smart DT's procedural content by experts and practitioners were analyzed using Aiken's V coefficient, with a total score of .94. These findings suggest that Smart DT is not only conceptually acceptable but also practical for therapists in child therapy services for ASD. After the readability and validation stage, the Smart DT procedure was implemented on two participants who had difficulty distinguishing various instructions, concepts, and objects in the previous therapy program, who did not use Smart DT.

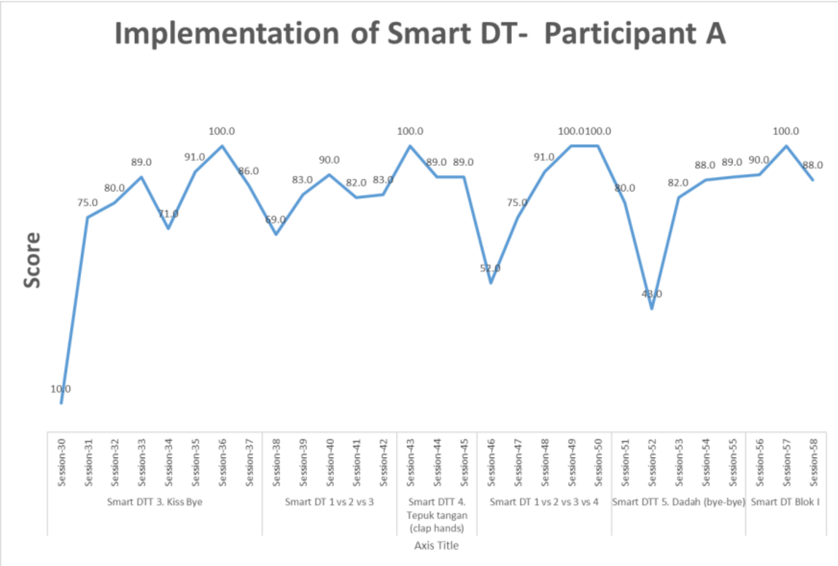
Participant A

To clarify the picture, the results of participant A's implementation are divided into 2 figures: **Figures 2** and **Figures 3**. **Figure 2** shows the results of the implementation on participant A, the number of sessions needed to implement Smart DT for 5 Activities in the First Block. There are five activities (the program carries out simple commands), namely: 1. Shake hands, 2. Toss, 3. Kiss-bye, 4. Clap your hand and 5. Bye-bye. Subject A received Smart ABA therapy two sessions per day, Monday to Friday.



Sources: Personal data (2024).

Figure 2. Smart DT implementation results in participant A



Sources: Personal data (2024).

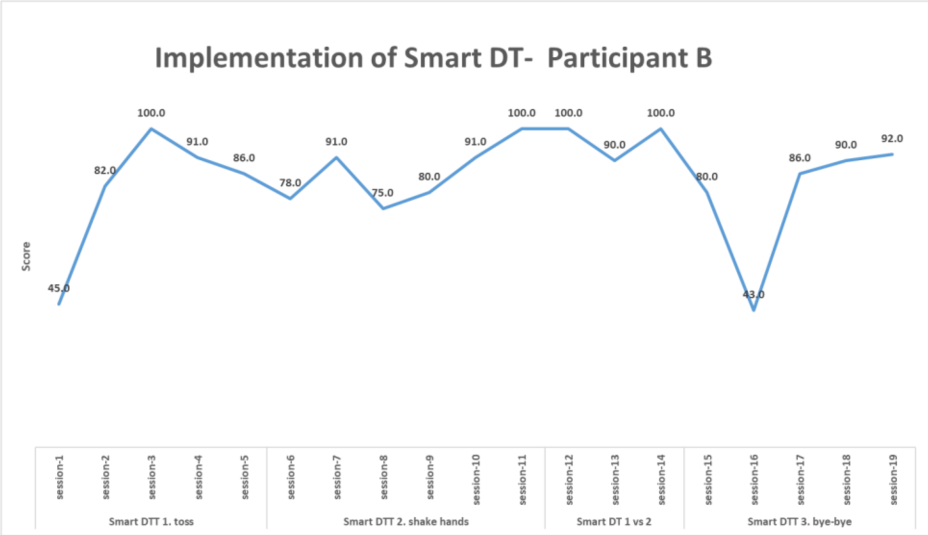
Figure 3. Smart DT implementation results in participant A

Figures 2. and **Figures 3.** illustrate the session-by-session performance of participant A throughout the program's implementation, which began with the Smart DTT (Discrete Trial Training) phase as a prerequisite to entering the discrimination stage in Smart DT. During the initial Smart DTT 1 phase (Shake hands), performance was fluctuating in the early sessions (0-22%), reflecting adaptation to a new response demand. Scores gradually increased and reached 100% in Sessions 11-12, indicating that the first activity had been mastered individually. After mastery of the first activity, training continued with Smart DTT Activity 2 (Toss). During this phase, a significant decline to 0% was observed, indicating adaptation challenges and the need to establish a separate second response repertoire. This finding suggests that mastery of the first activity did not automatically transfer to the new activity. However, after several sessions, performance improved progressively and reached a high range (approximately 78-100%), indicating stable acquisition of the second activity.

Once both single-activity repertoires were established, the participant entered the Smart DT 1 vs 2 discrimination phase. Initial fluctuations were observed, reflecting the integration process of two previously learned response repertoires. Performance then gradually stabilized, demonstrating successful and consistent two-stimulus discrimination. Before progressing to more complex discrimination tasks (1 vs 2 vs 3 and 1 vs 2 vs 3 vs 4), each new activity was first introduced using Smart DTT to build individual repertoire. Subsequently, the participant entered the advanced stages of Smart DT discrimination. Performance remained relatively stable at a high level (75-100%). However, temporary declines were observed in several mid-program sessions, likely associated with the increased number of simultaneously presented stimuli and greater response complexity. Scores later returned to 100% in several final sessions, indicating strengthening generalization. In the subsequent Smart DTT activities (Kiss Bye, Clap Hands, and Bye-bye), each activity was taught individually before being incorporated into the next discrimination stage. Upon entering Smart DT Block I, the final consolidation phase, performance consistently ranged from 88-100%, demonstrating stable discrimination performance and strong skill retention. Overall, Participant A completed the entire program in 58 sessions over 29 days, demonstrating a more gradual acquisition pattern during the early stages, followed by strong stabilization and generalization in the final phase.

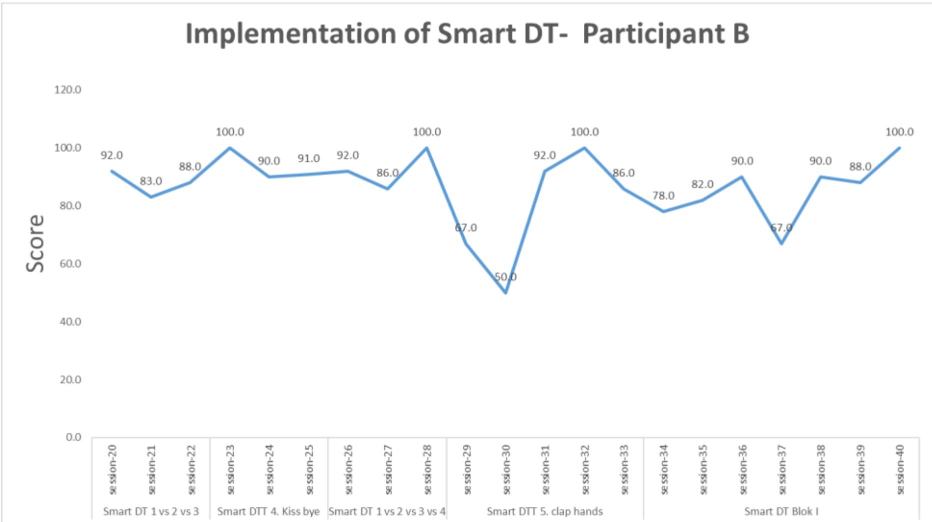
Participant B

Participant B received four sessions of Smart ABA therapy per day, Monday to Friday. Results in participant B are shown in **Figures 4.** and **Figures 5.**:



Sources: Personal data (2024).

Figure 4. Smart DT implementation results in participant B



Sources: Personal data (2024).

Figure 5. Smart DT implementation results in participant B

Figures 4. and **Figures 5.** illustrate the session-by-session performance of Participant B throughout the program's implementation, which began with a single activity in the Smart DTT (Discrete Trial Training) phase as a prerequisite for entering the discrimination stage in Smart DT. During the initial Smart DTT 1 phase (Toss), performance increased from 45% to 100% within three sessions, indicating learning readiness and a rapid response to structured single-activity instruction. This phase was followed by Smart DTT 2 (Shake hands) as the introduction and teaching of a new activity (the second activity) within Block I. Thus, the participant established two separate response repertoires before entering the discrimination stage.

Subsequently, the participant entered the Smart DT discrimination phase, beginning with 1 vs 2 and progressing to more complex combinations. In the early Smart DT 1 vs 2 phase, performance remained relatively stable within the 75-100% range, demonstrating adequate mastery of two-stimulus discrimination. A notable decline occurred in Session 16 (43%) when Smart DTT 3 (Bye-bye) was introduced as an additional new activity, indicating adaptation challenges due to stimulus change and increased response complexity. However, recovery was immediate, and performance stabilized above 85% in subsequent sessions. The participant then progressed to more complex discrimination tasks in Smart DT (1 vs 2 vs 3 and 1 vs 2 vs 3 vs 4). Performance remained predominantly high (80-100%), although temporary fluctuations were observed in Sessions 29–30 (67% and 50%), likely associated with the increased number of stimuli presented simultaneously. Scores subsequently improved again to 92-100%, reflecting strengthening generalization.

In the subsequent Smart DTT activities (Kiss bye and Clap hands), each new activity was taught individually before being incorporated into the next discrimination stage. Performance remained above 85% before entering Smart DT Block I, the final consolidation phase. In this stage, scores consistently ranged from 88% to 100%, indicating stable discrimination performance and strong skill retention. Overall, Participant B completed the entire program in 40 sessions over 10 days, demonstrating rapid acquisition of a single activity and relatively efficient, stable patterns of discrimination and generalization. A comparison of the success of Participant A and Participant B is shown in **Table 2.** below.

Table 2. Comparison of Participant A vs Subject B

Criterion	Participant A	Participant B
Age	5 years (girl)	7 years (boy)
Therapeutic dosage	2 sessions per day	4 sessions per day
Number of activities	5 Activities	5 Activities
Therapist	Have competence	Have competence
Success	58 sessions = 29 days	40 sessions = 10 days

Table 1. shows that participant A received two 120-minute sessions per day (120 minutes each), five days a week, and completed five activity programs in 58 sessions (29 days). Meanwhile, Participant B received four sessions per day and mastered the same five activities in 40 sessions (10 days). Both followed a structured program, and a competent Smart ABA therapist conducted all therapy sessions. A striking difference was observed in the time required to reach the passing criteria for the five activities. Participant A, with a lower daily therapy dose, showed slower progress than Participant B, who received higher-intensity sessions and achieved mastery more quickly. These findings suggest a trend toward a proportional relationship between therapy dose and the speed of skill acquisition in Smart DT. Although there were differences in age and gender between the two subjects, these factors did not appear to influence the success of skill discrimination significantly.

Discussions

The findings of this study indicate that the development of Smart Discrimination Training (Smart DT) from conventional Discrimination Training has a meaningful impact on improving discrimination skills in children with ASD. Smart DT not only retains the fundamental principles of stimulus control formation within the ABA framework but also refines its implementation through more systematic learning stages, greater procedural transparency, and clearer estimates of the duration of skill mastery. In ABA practice, the effectiveness of an intervention is often reported in terms of increased scores or response accuracy; however, the sequencing of learning stages and the stability of mastery duration are less frequently discussed comprehensively. In the present study, both participants completed the first block, consisting of five activities, within 10-29 days. This achievement did not occur immediately but emerged through a gradual process, beginning with individual mastery of each activity using Smart DTT before combining them in the Smart DT discrimination stage. Each activity was taught until clearly defined mastery criteria were met, allowing the child to establish a stable response foundation before encountering more complex stimulus comparisons. This pattern suggests that robust discrimination learning requires well-established foundational response readiness.

From a theoretical perspective, Discrimination Training (DT) is understood as a process in which an individual responds correctly to a target stimulus when it is presented alongside one or more comparison stimuli. Lovaas et al. (1967) explained that behavioral learning within ABA often begins with the introduction of a single stimulus before the child is required to discriminate among multiple alternatives. Subsequent research has demonstrated that discrimination can also be trained by presenting multiple stimuli from the outset. (Grow et al., 2011). However, core ABA principles emphasize that stimuli should be arranged systematically to ensure effective formation of stimulus control and to avoid overburdening the child's learning process (Tarbox & Granpeesheh, 2014). Moreover, response consistency established through conditioned reinforcement plays a critical role when comparison stimuli are gradually introduced (Taylor-Santa et al., 2014).

In Discrimination Training (DT) practice, the ABA approach is used; several studies have reported that comparison stimuli are often presented simultaneously from the early stages of learning. For example, Lin and Zhu (2020) described procedures in which children with ASD were exposed to multiple visual stimuli within a single session to accelerate accurate response selection. Similar approaches have been reported by DiSanti et al. (2020), Eldevik et al. (2020), Hannula et al. (2020), and LeBlanc et al. (2020). Although this method aims to facilitate the rapid establishment of stimulus control, detailed explanations of children's readiness before increasing stimulus complexity are often lacking.

Several studies have also indicated that rapid increases in stimulus complexity may lead to response instability in some children with ASD. Grow et al. (2014) found that stimulus control formation can become inconsistent when discrimination demands are escalated too abruptly. Leaf et al. (2019) reported that although certain prompting strategies improve response accuracy, mastery stability is not always guaranteed when comparison stimuli are presented simultaneously; furthermore, Eldevik et al (2020) demonstrated that not all children show improvements in discrimination skills despite intensive DT procedures. Collectively, these findings suggest that the effectiveness of DT is highly dependent on how stimulus complexity is arranged, highlighting the need to extend beyond commonly used approaches in current practice.

Smart DT was developed to address these challenges. In contrast to Discrimination Training, which often introduces multiple comparison stimuli simultaneously, Smart DT regulates the learning process gradually and systematically. Each activity is first established individually through Smart DTT until stable performance is achieved, and only then is it progressively combined within the discrimination phase. Comparison stimuli are introduced one at a time, guided by clearly defined escalation criteria. This structured progression enables children to develop stimulus control more deliberately and reduces the likelihood of guess-based responding.

This gradual approach is consistent with research indicating that the simultaneous presentation of multiple stimuli may increase cognitive load in some children with ASD (Lambert et al., 2021). Chavez-Brown et al. (2005) and DeQuinzio et al. (2018) emphasized that rapid increases in antecedent complexity without systematic adjustment may result in discrimination failure. Gutierrez et al. (2009) also reported considerable individual variability when DT was implemented without a structured progression of stimulus demands. Therefore, Smart DT can be understood as an effort to integrate the principles of stimulus control with the need to carefully regulate the complexity of learning.

From a practical standpoint, this model provides clearer guidance for therapists on when an activity can be considered fully mastered and when comparison stimuli may be introduced. The clarity of mastery criteria and the estimation of acquisition time offer an objective basis for program decision-making. In this study, differences in mastery duration among participants appeared associated with variations in daily therapy intensity; however, these findings are presented descriptively and are not intended as causal conclusions. This suggests that a consistent instructional structure can be flexibly combined with varying therapy intensities according to individual needs.

Overall, the implementation of Smart DT by the two participants demonstrated that discrimination skills not only improved but were also maintained and successfully progressed to subsequent learning stages without a significant decline in performance. Although the present study involved a limited number of participants, the findings provide preliminary support for the potential of Smart DT developed from conventional Discrimination Training to serve as a more structured, measurable, and adaptive model within ABA practice. Further research with larger, more diverse samples is recommended to strengthen the external validity of this model.

Conclusion

This study demonstrates that Smart Discrimination Training (Smart DT) has been successfully developed into a structured, practical, and effective discrimination-learning model for children with ASD. The development process included therapist-readability evaluation as well as expert and practitioner reviews to ensure procedural clarity, stage consistency, and feasibility in real therapy settings. During implementation, both participants successfully mastered the first block of five activities within 10-29 days through systematic learning stages, gradual addition of stimuli, and clearly defined mastery criteria. The findings highlight the importance of structured and gradual learning in preventing confusion and supporting stable skill acquisition. The clarity of mastery duration also provides meaningful benchmarks for evaluating therapeutic progress, which may increase parents' confidence and reduce their stress. The study further suggests that therapy intensity and therapist competence play important roles in facilitating effective outcomes. Although developed with two children in Indonesia, Smart DT offers a promising, implementable framework within ABA practice and warrants further investigation in larger, more diverse populations.

References

Acharya, S., & Sharma, K. (2021). Lived Experiences of mothers raising children with autism in Chitwan District, Nepal. *Autism Research and Treatment*, *2021*, 1–12. https://doi.org/10.1155/2021/6614490

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and Psychological Measurement*, *45*(1), 131–142. https://doi.org/10.1177/0013164485451012

Anwar, A., Sutadi, R., & Miranda, C. (2022). Development of Discrete Trial Training (DTT) Procedure in Smart Applied Behavior Analysis (Smart ABA) for Autism. *Journal of Psychology and Behavior Studies*, *2*(1), 44–63. https://doi.org/10.32996/jpbs.2022.2.1.7

Arneliza, A., Sutadi, R., Alsa, A., & Yunanto, K. T. (2026). Development and implementation of Smart Measurement and Evaluation (Smart ME): A Trial-by-Trial Monitoring System for Autism Therapy. *Journal of Culture and Values in Education*, *9*(1), 106–124. https://doi.org/10.46303/jcve.2026.5

Bergmann, S. C., Kodak, T. M., & LeBlanc, B. A. (2017). Effects of programmed errors of omission and commission during auditory-visual conditional discrimination training with typically developing children. *Psychological Record*, *67*(1), 109–119. https://doi.org/10.1007/s40732-016-0211-2

Bergmann, S., Turner, M., Kodak, T., Grow, L. L., Meyerhofer, C., Niland, H. S., & Edmonds, K. (2021). Replicating stimulus-presentation orders in discrimination training. *Journal of Applied*

Behavior Analysis, *54*(2), 793–812. https://doi.org/10.1002/jaba.797

Bitsika, V., & Sharpley, C. F. (2023). “They don’t understand how bad I feel”: Inconsistencies between mother-rated and self-rated symptoms of depression in autistic girls. *Research in Autism Spectrum Disorders*, *104*, 102145. https://doi.org/https://doi.org/10.1016/j.rasd.2023.102145

Breeman, S. L., Vladescu, J. C., DeBar, R. M., Grow, L. L., & Marano, K. E. (2020). The effects of procedural integrity errors during auditory–visual conditional discrimination training: A preliminary investigation. *Behavioral Interventions*, *35*(2), 203–216. https://doi.org/10.1002/bin.1710

Cengher, M., Kim, J. Y., & Fienup, D. M. (2020). A review of prompt-fading procedures, part ii: parameters and components. *Journal of Developmental and Physical Disabilities*, *32*(4), 553–574. https://doi.org/10.1007/s10882-019-09711-2

Chavez-Brown, M., Scott, J., & Ross, D. E. (2005). Antecedent selection: Comparing simplified and typical verbal antecedents for children with autism. *Journal of Behavioral Education*, *14*(3), 153–165. https://doi.org/10.1007/s10864-005-6295-4

Chezan, L., Drasgow, E., Legg, J., & Hollborn, A. (2016). Effects of conditional discrimination training and choice opportunities on manding for two young children with autism spectrum disorder and language delays. *Journal of Developmental and Physical Disabilities*, *28*(4), 557–579. https://doi.org/10.1007/s10882-016-9493-1

DeQuinzio, J. A., Taylor, B. A., & Tomasi, B. J. (2018). Observational learning and children with autism: discrimination training of known and unknown stimuli. *Journal of Applied Behavior Analysis*, *51*(4), 802–818. https://doi.org/10.1002/jaba.481

DiSanti, B. M., Eikeseth, S., Eldevik, S., Conrad, J. M., & Cotter-Fisher, K. L. (2020). Comparing structured mix and random rotation procedures to teach receptive labeling to children with autism. *Behavioral Interventions*, *35*(1), 38–56. https://doi.org/10.1002/bin.1694

Eldevik, S., Aarlie, H., Titlestad, K. B., Kazemi, E., & Elsky, G. (2020). Effects of functional discrimination training on initial receptive language in individuals with autism spectrum disorder. *Behavior Modification*, *44*(5), 670–697. https://doi.org/10.1177/0145445519841052

Farias, R. H. C., Bernardy, J. L., & Tomanari, G. Y. (2025). Simultaneous vs. successive discrimination processes. *Acta Comportamentalia*. https://doi.org/10.32870/ac.v33i2.88580

Fecteau, S. M., Trudel, M., Champagne, N., & Picard, F. (2023). Are all parental experiences equal?: Cluster analysis of salivary cortisol and perception of parental stress in mothers of children with autism spectrum disorder. *Research in Developmental Disabilities*, *139*, 104550. https://doi.org/https://doi.org/10.1016/j.ridd.2023.104550

Gevarter, C., Groll, M., & Stone, E. (2020). Dynamic assessment of augmentative and alternative communication application grid formats and communicative targets for children with autism spectrum disorder. *Augmentative and Alternative Communication*, *36*(4), 243–255. https://doi.org/10.1080/07434618.2020.1845236

Grow, L. L., Carr, J. E., Kodak, T., & LeBlanc, L. A. (2014). Instructional design considerations for teaching receptive discrimination skills to learners with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *8*(11), 1473–1486. https://doi.org/10.1016/j.rasd.2014.07.012

Grow, L. L., Carr, J. E., Kodak, T. M., Jostad, C. M., & Kisamore, A. N. (2011a). A comparison of methods for teaching receptive labeling to children with autism spectrum disorders. *Journal of Applied Behavior Analysis*, *44*(3), 475–498. https://doi.org/10.1901/jaba.2011.44-475

Gutierrez, A., Hale, M. N., O’Brien, H. A., Fischer, A. J., Durocher, J. S., & Alessandri, M. (2009). Evaluating the effectiveness of two commonly used discrete trial procedures for teaching receptive discrimination to young children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *3*(3), 630–638. https://doi.org/10.1016/j.rasd.2008.12.005

Hannula, C., Jimenez-Gomez, C., Wu, W., Brewer, A. T., Kodak, T., Gilroy, S. P., Hutsell, B. A., Alsop, B., & Podlesnik, C. A. (2020). Quantifying errors of bias and discriminability in conditional-discrimination performance in children diagnosed with autism spectrum disorder. *Learning and Motivation*, *71*. https://doi.org/10.1016/j.lmot.2020.101659

Holmes, E. J., Eikeseth, S., & Schulze, K. A. (2015). Teaching individuals with autism receptive labeling skills involving conditional discriminations: A comparison of mass trial and intermixing before random rotation, random rotation only, and combined blocking. *Research in Autism Spectrum Disorders*, *11*, 1–12. https://doi.org/10.1016/j.rasd.2014.11.013

Lambert, J. M., Lamers, M. E., Copeland, B. A., & Banerjee, I. (2021). Multiple operant discrimination training to increase the precision of stimulus deltas following treatment of challenging behavior. *Behavioral Interventions*, *36*(3), 606–619. https://doi.org/10.1002/bin.1788

Leaf, J. B., Cihon, J. H., Ferguson, J. L., Leaf, R., & McEachin, J. (2019). Comparing no-no prompt to flexible prompt fading to teach expressive labels to individuals diagnosed with autism spectrum disorder. *Education and Training in Autism and Developmental Disabilities*, *54*(3), 274–287.

LeBlanc, L. A., Sump, L. A., Leaf, J. B., & Cihon, J. (2020). The effects of standard and enhanced data sheets and brief video training on implementation of conditional discrimination training. *Behavior Analysis in Practice*, *13*(1), 53–62. https://doi.org/10.1007/s40617-019-00338-5

Li, F., Tang, Y., Li, F., Fang, S., Liu, X., Tao, M., Wu, D., & Jiang, L. (2022). Psychological distress in parents of children with autism spectrum disorder: A cross-sectional study based on 683 mother-father dyads. *Journal of Pediatric Nursing*, *65*, e49–e55. https://doi.org/https://doi.org/10.1016/j.pedn.2022.02.006

Lin, F. Y., & Zhu, J. (2020). Comparison of two discrimination methods in teaching Chinese children with autism. *Journal of Applied Behavior Analysis*, *53*(2), 1145–1152. https://doi.org/10.1002/jaba.652

Lovaas, O. I., & Bondy, A. B. G. (2003). *Teaching individuals with developmental delays: Basic intervention techniques* (First Edit). Pro-Ed.

Lovaas, O. I., & Bondy, A. B. G. (2003). *Teaching Developmentally Disabled Children: The Me Book*. Pro-Ed.

Lovaas, O. I., Freitas, L., Nelson, K., & Whalen, C. (1967). The establishment of imitation and its use for the development of complex behavior in schizophrenic children. *Behaviour Research and Therapy*, *5*(3), 171–181. https://doi.org/10.1016/0005-7967(67)90032-0

Madarevic, M., van Esch, L., Lambrechts, G., Ceulemans, E., Van Leeuwen, K., & Noens, I. (2022). Parenting behaviours among mothers of pre-schoolers on the autism spectrum: Associations with parenting stress and children's externalising behaviour problems. *Research in Autism Spectrum Disorders*, *90*, 101901. https://doi.org/https://doi.org/10.1016/j.rasd.2021.101901

Moreira, M. B., Oliveira, A., & Hanna, E. S. (2017). Stimulus arrangement in simple discriminative training with compound and emergence of stimulus equivalence classes. *Temas Em Psicologia*. https://doi.org/10.9788/TP2017.1-19En

Nottingham, C. L., Vladescu, J. C., Kodak, T., & Kisamore, A. N. (2017). Incorporating multiple secondary targets into learning trials for individuals with autism spectrum disorder. *Journal of Applied Behavior Analysis*, *50*(3), 653–661. https://doi.org/10.1002/jaba.396

Nunnally, A. D., Factor, R. S., Sturm, A., Soorya, L. V., Wainer, A., Taylor, S., Ponzini, M., Abbeduto, L., Gulsrud, A. C., & Northrup, J. (2023). *Examining indicators of psychosocial risk and resilience in parents of autistic children*. *May*. https://doi.org/10.3389/fnbeh.2023.1102516

O'Neill, S. J., McDowell, C., & Leslie, J. C. (2018). A Comparison of prompt delays with trial-and-error instruction in conditional discrimination training. *Behavior Analysis in Practice*, *11*(4), 370–380. https://doi.org/10.1007/s40617-018-0261-9

Perez, A., & Betz, A. (2020). Stimulus control and discrimination learning in autism. *Journal of Behavioral Education*. https://doi.org/10.1007/s10864-020-09374-7

Perez, W. F., Huziwara, E. M., Rodrigues, R. M., Vilela, E. C., Tomanari, G. Y., & Vaidya, M. (2020). Effect of observing response requirements to sample and comparison stimuli on the establishment of reject control (sample/S- relations). *Journal of the Experimental Analysis of Behavior*, *114*(1), 60–71. https://doi.org/10.1002/jeab.602

Pickles, A., McCauley, J. B., Pepa, L. A., Huerta, M., & Lord, C. (2020). The adult outcome of children referred for autism: typology and prediction from childhood. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *61*(7), 760–767. https://doi.org/10.1111/jcpp.13180

Porter, N., & Loveland, K. A. (2019). An Integrative review of parenting stress in mothers of children with autism in Japan An integrative review of parenting stress in mothers of children with autism in Japan. *International Journal of Disability, Development and Education*, 1–24. https://doi.org/10.1080/1034912X.2018.1439159

Richards, S. B. (2018). *Single subject research: Applications in educational settings*. Cengage Learning.

Richey, R. C., & Klein, J. D. (2007). *Design and development research: Methods, strategies, and issues*. Lawrence Erlbaum Associates.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Houghton Mifflin.

Song, C., Wu, L., Hong, Y., Chen, X., & Zhu, Z. (2022). Factors affecting knowledge of autism spectrum disorder among pediatric residents in eastern China: a cross-sectional study. *BMC Medical Education*, *22*(1), 699. https://doi.org/10.1186/s12909-022-03770-4

Su, P. L., Castle, G., & Camarata, S. (2019). Cross-modal generalization of receptive and expressive vocabulary in children with autism spectrum disorder. *Autism and Developmental Language Impairments*, *4*. https://doi.org/10.1177/2396941518824495

Sutadi, R. (2018). *Teaching and training speech and various abilities in people with autism with Smart ABA*. PT Smart Medika Pro.

Sutadi, R., & Arneliza. (2018). *Mengajar dan melatih bicara pada autisi dengan smart ABA*. Smart Medika Pro.

Tang, L., & Bie, B. (2016). The stigma of autism in China: an analysis of newspaper portrayals of autism between 2003 and 2012. *Health Communication*, *31*(4), 445–452. https://doi.org/10.1080/10410236.2014.965381

Tarbox, J., & Granpeesheh, D. (2014). Principles and procedures of acquisition. In *Evidence-Based Treatment for Children with Autism* (pp. 31–74). Elsevier. https://doi.org/10.1016/B978-0-12-411603-0.00004-5

Taylor-Santa, C., Sidener, T. M., Carr, J. E., & Reeve, K. F. (2014). A discrimination training procedure to establish conditioned reinforcers for children with autism. *Behavioral Interventions*, *29*(2), 157–176. https://doi.org/10.1002/bin.1384

Vedora, J., & Grandelski, K. (2015). A comparison of methods for teaching receptive language to toddlers with autism. *Journal of Applied Behavior Analysis*. https://doi.org/10.1002/jaba.167

Yu, L., Stronach, S., & Harrison, A. J. (2020). Public knowledge and stigma of autism spectrum disorder: Comparing China with the United States. *Autism*, *24*(6), 1531–1545. https://doi.org/10.1177/1362361319900839