RESEARCH ARTICLE

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

Smart Shaping to Improve the Clarity of Speech in Children with Autism Spectrum Disorder

Arneliza[1], Rudy Sutadi[1], Irma Bayani[2], Catur Prasetyo[3]

[1] KID-ABA Autism Ndd Center Indonesia.

[2] Faculty of Psychology, Universitas Jayabaya, Jakarta, Indonesia

[3] Faculty of Psychology, Universitas Persada Indonesia-UPI YAI UPI Y.A.I., Jakarta, Indonesia

Abstract

Autism is a neurobiological developmental disorder that emerges in early childhood, typically before the age of three, and is characterized by deficits in eye contact, communication, social interaction, repetitive behaviors, restricted interests, and other associated impairments, without appropriate and timely intervention, these deficits tend to persist over time. One challenge in intervention for children with ASD is difficulty producing clearly intelligible whole words, particularly among children who can imitate syllables but have difficulty combining them into complete target words. This study aimed to develop and examine the use of Smart Shaping, a structured instructional procedure within the Smart Applied Behavior Analysis (Smart ABA) framework, to improve clear word imitation in children with ASD. A single-case case series design with repeated measurement across baseline, intervention, and maintenance phases was implemented with two children with ASD aged 3–7 years who showed marked difficulty producing whole-word vocal imitations at baseline. Smart Shaping was developed through expert discussion and validated using Aiken's V coefficient (V = 0.96). The intervention was implemented intensively, and child responses were recorded trial by trial using the Smart Measurement system (Smart ME), accompanied by treatment integrity monitoring and independent supervisory review of selected sessions. Visual analysis showed improvement in clear word imitation in both participants, with performance maintained over six weeks. These findings provide initial support for the use of Smart Shaping in cases of word imitation difficulty in children with ASD, particularly when individual syllables are already produced clearly but whole-word production remains unclear.

Keywords: Autism Spectrum Disorder, Smart Applied Behavior Analysis, Smart Shaping, clear word imitation, speech clarity

***Correspondence*:** Arneliza
KID-ABA Autism Ndd Center Indonesia
Email: arneliza@kid-aba.com
Pages 25-33/ Received, Jan 26, 2025, Revision Received Feb 18, 2026, Accepted March 12, 2026

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

1. Introduction

The literature in the within the framework of *Applied Behavior Analysis* (ABA) consistently demonstrates that *shaping* and *differential reinforcement* are effective procedures for shaping verbal behavior in children with autism spectrum disorder (ASD). Classical and contemporary studies have reported that gradual learning through differential reinforcement can improve verbal responses without prompts as well as the efficiency of tact and intraverbal skill acquisition (Johnson et al., 2017). The combination of differential reinforcement and prompting can improve verbal responses that are appropriate to the context and social demands (Kuntz et al., 2020). Spinks et al. (2023) extended the scope of ABA interventions to specific speech quality characteristics, e.g., speech volume control through multicomponent interventions. These findings suggest that reinforcement-based gradual teaching procedures can support verbal performance in improving the verbal performance of children with ASD.

Although these findings are important, most ABA studies still evaluate the success of interventions based on the occurrence, frequency, or accuracy of verbal responses, rather than the quality of speech itself. Success is often defined as the achievement of a target verbal response, with no operational specification regarding comprehension or stability of speech production. This approach is in line with the ABA's tradition of prioritizing *correct responses* as an indicator of behavioral mastery (Lovaas, 1977). However, it is relatively less sensitive to the speech quality dimension that determines communication functioning. The literature on speech and communication pathology in ASD shows that the clarity of speech is determined not only by sound production but also by phonological accuracy, cross-trial and cross-session consistency, and the extent to which the listener can understand the speech in a natural context (Paul et al., 2021; Plumb & Plexico, 2013).

Clarity of speech is a fundamental prerequisite for functional communication, as it determines how effectively speech can be understood and used in social interactions. Communication development theory emphasizes speech intelligibility as a central determinant of communicative success (Flipsen, 2015). In children with ASD, low speech intelligibility limits social and academic participation despite emerging communicative intentions (Vogindroukas et al., 2022). Recent intensive language intervention studies demonstrate that improvements in intelligibility are directly associated with better daily functional communication (Moraleda-Sepulveda et al., 2025). Within ABA, complex behaviors are developed through shaping via gradual reinforcement of successive approximations (Cooper et al., 2007; Skinner, 1953). However, empirical evidence indicates that shaping procedures may require additional attention to articulatory stability and consistency of speech production (Bielova et al., 2025; Chenausky et al., 2016; Hodge & Wellman, 2016; Kamenski et al., 2024; Maas et al., 2008).

Speech impediments in children with ASD are often persistent and closely related to phonological processing and speech motor mechanisms. Earlier studies reported that children with ASD frequently show low speech intelligibility despite emerging verbal abilities (Shriberg et al., 2011). Instability in sound patterns and prosody further reduces comprehensibility, even when verbal forms are available (Paul et al., 2005). Acoustic research has shown that atypical phonetic and prosodic features significantly contribute to reduced speech clarity (Diehl et al., 2009). Recent findings indicate that these difficulties are associated with impaired phonological integration and processing, causing challenges in combining sounds into coherent word representations (Vogindroukas et al., 2022; Zuo et al., 2025). Listener perception studies further demonstrate that speech may remain difficult to understand at the word or sentence level even when individual phonemes are produced accurately (Callejo & Boets, 2023; Redford et al., 2018). These findings underscore the need for interventions that explicitly target phonological integration and speech intelligibility in children with ASD.

ABA literature emphasizes data-driven decision-making and precise indicators of response mastery (Leaf et al., 2022). However, most shaping procedures prioritize the emergence of verbal responses without explicitly targeting speech clarity as a functional outcome, creating a conceptual and methodological gap. This study aims to develop and examine Smart Shaping as a structured, measurement-based procedure for teaching clear word imitation in children with ASD. Smart Shaping is a component of Smart Applied Behavior Analysis (Smart ABA) developed within the Smart ABA framework (Anwar et al., 2022). Smart Shaping positions clear word imitation as a measurable and clear word imitation.

Literature Review

Early imitation skills play a critical role in language development and social communication in children with ASD. Longitudinal studies show that early imitation deficits predict later language delays (Pittet, Kojovic, et al., 2022). However, many imitation-based interventions fail to specify targeted linguistic forms or verbal functions, limiting generalizability (Forbes et al., 2019). Reviews also note the dominance of qualitative descriptions and the lack of standardized quantitative measures in imitation programs (Xiao, 2019). Without clearly defined gradual procedures, imitation gains are difficult to replicate and maintain across contexts (Ingersoll & Schreibman, 2006).

Within behavior interventions, ABA offers structured techniques for developing verbal skills through controlled procedures. Shaping vocal skill acquisition compared with prompting methods relying on loosely defined response attempts (Newman, 2009a). Other ABA-based approaches have also been reported to improve early verbal responding in children with ASD (Barnard-Brak et al., 2021). Nevertheless, outcomes are often reported in aggregate, with limited detail on duration, session counts, stability, or efficiency. Overall, the literature reveals a methodological gap in imitation and verbal behavior interventions. Indicators such as acquisition time, required sessions, standardized graduation criteria, and maintenance stability are underreported (Forbes et al., 2019; Xiao, 2019). Methodological guidance emphasizes procedural transparency and data-driven reporting to support replication and evaluation (K. L. Lane & Gast, 2014; Ledford & Gast, 2018). This gap motivates the development of the Smart Shaping approach.

2. Method

2.1 Study Design

This study used a single-case case series design to examine changes in clear word imitation following the implementation of Smart Shaping in children with Autism Spectrum Disorder (ASD). The design involved repeated measurement across baseline, intervention, and maintenance phases, allowing close observation of within-participant performance patterns over time (Egel et al., 2018; Kratochwill et al., 2015). This approach was used to document individual change and to provide initial evidence regarding the applicability of Smart Shaping in specific cases of word imitation difficulty.

2.2 Participants and the Setting

The participants were two children with Autism Spectrum Disorder (ASD), aged 3–7 years (one female and one male), who had been

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

diagnosed by a physician. Based on parental report and pre-intervention Smart ABA assessment, both participants showed marked difficulty in producing clear whole-word vocal imitations at baseline, despite being able to produce certain syllabic forms. The intervention was implemented using the Smart ABA basic curriculum, which included 15 programs and was conducted in four sessions per day, with 90 minutes allocated for therapy and 30 minutes for session reporting, scoring, and graphing, six days per week. The intervention was delivered by three therapists who had demonstrated competence as Smart ABA therapists and alternated a therapist and therapist assistants to reduce bias. All sessions are conducted in an individual therapy room (3×4 m), soundproofed, with stable lighting and temperature. Both parents of the participants provided informed consent and could monitor therapy through a CCTV monitor.

Smart ABA and smart shaping development

Smart Shaping was developed through group discussions involving one expert consultant, one program director, one supervisor, and three therapists. The procedure was intentionally designed to be practical, structured, and standardized to support consistent implementation within the Smart ABA framework. In this study, Smart ABA used a two-on-one instructional format, in which one child was supported by a therapist and a therapist assistant during intervention sessions. This arrangement was intended to support implementation accuracy, trial-by-trial recording, and immediate coordination during instruction (Lovaas, 1987; Saint-Georges et al., 2020; T. Smith, 2001; Yoder et al., 2020). The Smart Shaping procedures for teaching speech to children with ASD were disseminated to seven therapists to assess readability and procedural clarity. Expert validation involved four specialists in education and psychology and three experienced autism therapy practitioners, who evaluated content clarity, usability, and language adequacy. All evaluations were conducted using a five-point Likert scale and analyzed with Aiken's V coefficient to ensure content validity (Aiken, 1985).

In word-imitation instruction, some children with Autism Spectrum Disorder (ASD) are able to produce individual syllables but continue to experience difficulty when combining those syllables into a clear whole-word vocal response. For example, a child may accurately imitate separate syllables such as "mo" and "mi" but still fail to produce the combined target word "momi," instead producing responses such as "omi" or "mimi." This difficulty may limit progress in word imitation even when some prerequisite vocal components have already been acquired. Previous studies have shown that children with ASD may experience motor-articulatory and vocal-processing difficulties that affect speech production and imitation performance (Fadeev et al., 2024; Maffei et al., 2024; Vernay et al., 2014). At the same time, syllable production remains an important foundation for expressive language development in children with ASD (McDaniel et al., 2019).

To address this instructional difficulty, the present study developed Smart Shaping, a structured procedure within the Smart ABA framework designed to improve clear word imitation when children are unable to combine already-produced syllables into an accurate whole-word response. Smart Shaping is based on the shaping principle, in which complex verbal behavior is formed through reinforcement of responses that increasingly approximate the target response. This principle is consistent with research highlighting the value of gradual teaching procedures in supporting vocal imitation and articulation development in children with ASD (Ishizuka et al., 2024; Wang et al., 2021). In the present study, Smart Shaping was designed as a practical, systematic, and measurable teaching procedure for use in highly specific cases of unclear whole-word imitation.

Smart Shaping was implemented only when the child had already mastered the relevant prerequisite vocal units, such as vowel-syllable or syllable-syllable combinations, but still showed difficulty producing the complete target word. When the child was unable to imitate one or both component syllables, Smart Shaping was not introduced; instead, syllable imitation training was conducted until the prerequisite responses were achieved. Word-imitation training was then resumed, and Smart Shaping was introduced when difficulty in whole-word production remained.

The Smart Shaping procedure was used to support progressive improvement toward the correct verbal response through structured and measurable reinforcement stages. The procedure consisted of three stages, which were adjusted according to the child's level of success in imitating the target word. Figure 1 presents the structure of Smart Shaping.

Figure 1: Smart Shaping Structure.

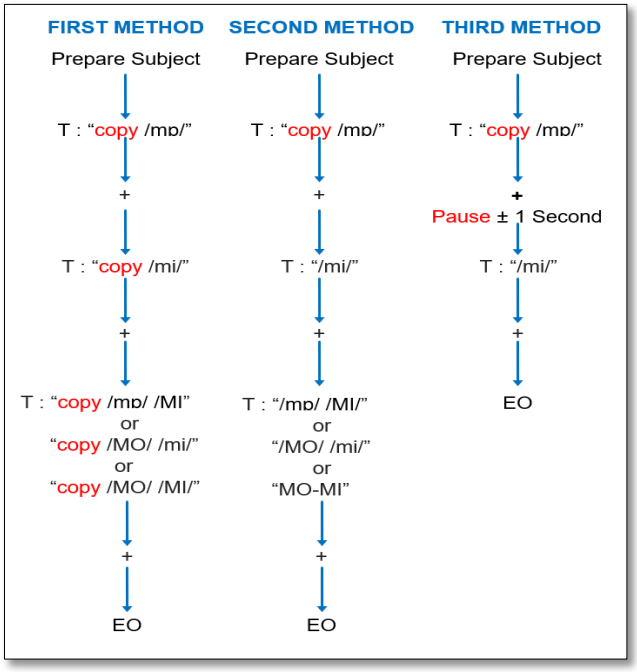


Figure 1 illustrates the implementation of Smart Shaping. The procedure begins with the first method. After the child is ready, sitting, and paying attention, the therapist gives the instruction "imitate /mo/." If the child responds correctly (score +), the therapist immediately, without pause, gives the instruction "imitate /mi/." If the child responds correctly again (score +), the therapist immediately gives the follow-up instruction "imitate /mo/ /MI/" when the problem lies in the pronunciation of /mi/. The syllable "/MI/" is pronounced clearly and expressively if the problem is in the pronunciation of "/mi/," whereas "imitate /MO/ /mi/" is used if the problem is with "/mo/," and "imitate /MO/ /MI/" is used if both are problematic. Rewards or reinforcers are given only if the child responds correctly by saying "momi," then the procedure continues with the Smart EO procedure. Smart EO is a procedure that was also developed by the researchers. It consists of repeating 1–3 times in a non-patterned way, using switching and switchback, to ensure that the child's response is not just a coincidence (Smart EO is outside the scope of this study). If the first method is successful, that is, the child reaches the mastery criteria, then the first method is stopped and the program

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

continues with of words or sentences that were previously problematic, in this case the word "momi."

If the first method does not work, the procedure continues to the third method. At this stage, after the child is ready, sitting, and attentive, the therapist instructs the child to "imitate /mo/." If the child responds correctly (score +), the therapist pauses for about one second before giving the next instruction, "/mi/." If the child responds correctly (score +), the therapist immediately gives a reward/reinforcer and proceeds with the Smart EO procedure. If this procedure is successful, the interval between instructions is shortened to about 0.5 seconds in the next session. If the child continues to consistently show the correct response, the pause is further shortened until there is no pause at all. As soon as the child starts saying "mo," the therapist immediately says "mi." If the child reaches the mastery criteria at the final stage of Smart Shaping, then the child has succeeded in imitating words or sentences that were previously problematic in the imitation program. The imitation program is then resumed. However, if the results are still not stable, then the third method is repeated again until the child reaches the mastery criteria. After the mastery criteria are met, the process does not immediately move to imitation of words but continues to the second method to reinforce the response that has been formed.

In the second method, the implementation is similar to the third method, but is conducted without a pause and continues with the therapist's presentation of the complete word/sentence. This example is similar to the first method but without the instruction "imitate," i.e. only "/mo/ /MI/," where "/MI/" is pronounced clearly and expressively if the problem is with the pronunciation of "/mi/," or the instruction "/MO/ /mi/" if the problem is with the pronunciation of "/mo/," or the instruction "/MO/ /MI/" if the problem is with both syllables. The eward/reinforcer is given to the child if the child responds correctly by saying "momi," then the procedure continues with Smart EO. If the child reaches the the child returns to target-word imitation. Smart Shaping is discontinued once the child meets the mastery criteria and continues with repetition of previously problematic words or sentences n this way, Smart Shaping functions as a structured and measurable procedure for supporting clear whole-word imitation in children with ASD.

2.3 Data Collection and Measurement

Child responses were recorded trial by trial using the Smart Measurement system (Smart ME) within the Smart ABA framework (Anwar et al., 2022; Arneliza et al., 2026). In this study, clear word imitation was operationally defined as the child's production of the complete target word in the correct syllable sequence without omission, addition, or substitution of the target syllables during instruction. Through Smart ME, the therapist assistant coded each response during instruction using standardized response categories, including silent (–), incorrect (X), off-task (O), prompt-dependent response (P), approximation (A), and correct (+). At the end of each session, performance was calculated as the percentage of correct responses relative to total response opportunities and plotted in session graphs to monitor progress across baseline, intervention, and maintenance phases. Mastery was defined as a score of ≥80% across three consecutive sessions. If this criterion was not maintained, the count was reset from the subsequent session. Data were reviewed continuously through Smart ME, and programs showing stagnation or decline were discussed in weekly supervisory meetings.

2.4 Internal Validity

This study attempted to support internal validity by maintaining consistent intervention procedures and controlling major sources of variation throughout the study, in line with the internal validity principles described by Shadish et al. (2002). All participants had received an official diagnosis of ASD prior to the intervention, and no additional intervention programs beyond the Smart ABA program were introduced during the study. Under physician supervision, each child followed a controlled medical diet and was restricted from using electronic devices or watching television in order to reduce external influences that might affect attention and learning performance. The intervention was delivered by three qualified Smart ABA therapists, whose competencies were consistent with the therapist qualification framework described by Arneliza et al. (2025). A rotation system involving a therapist and a therapist assistant was used to support procedural consistency across sessions (Hill et al., 2020; Northcott et al., 2018). Child responses were recorded trial by trial, and procedural constraints were reviewed during weekly supervisory meetings to support ongoing treatment integrity. In addition, one Smart ABA practitioner who was not directly involved in the intervention independently reviewed approximately 30% of selected Smart Shaping sessions (five sessions for Participant A and three for Participant B) using a structured observation form focusing on procedural accuracy and response verification.

2.5 Data Analysis

Visual analysis was used as the primary method for interpreting data in this single-case study to identify patterns of behavior change across phases. Smart Shaping served as the independent variable, while clear word imitation in children with ASD was the dependent variable. The analysis focused on changes in level, trend, and stability across baseline, intervention, and maintenance phases, consistent with single-case research approaches for evaluating individual performance change over time (J. D. Lane & Gast, 2014; Wolfe et al., 2019).

2.6 Ethical Considerations

All research procedures followed the applicable ethical standards and institutional regulations and obtained approval from the Research Ethics Committee of the Muslim University of Indonesia (Number: 580/A.1). Before data collection, the parents of all participants gave written informed consent after obtaining a complete explanation of the objectives and procedures of the study. Children's personal identity is strictly guarded in accordance with the principles of confidentiality and data protection that apply in scientific research.

3. Results

Seven therapists who reviewed the systematic design and structure of the Smart Shaping procedure for speech teaching in children with ASD for readability reported that the procedure was easy to understand and could be applied consistently. The results of the content validity test showed that the total Aiken's V coefficient reached 0.96 ($p < 0.01$), indicating a very high level of agreement between the raters, with item values ranging from 0.86 to 0.96. Overall, these results show that the Smart Shaping design has excellent clarity, comprehension, and feasibility in improving the clarity of the pronunciation of words and sentences in children with ASD. Based on the validation results, the Smart Shaping procedure was implemented with two participants.

Participant A demonstrated difficulties in pronouncing the word "mata" (eye). When the therapist delivered the instruction "imitate mata," the participant responded with **"**ata." The therapist then provided expressive instructions focusing on the syllable **"**MA**"** (**"**imitate MAta**"**). However, the participant's responses remained **"**ata" across three consecutive sessions. Consequently, the Smart Shaping procedure was implemented to address this word-imitation difficulty. Figure 2 presents the outcomes of the Smart Shaping intervention for Participant

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

Figure 2: Smart Shaping implementation in Participant A

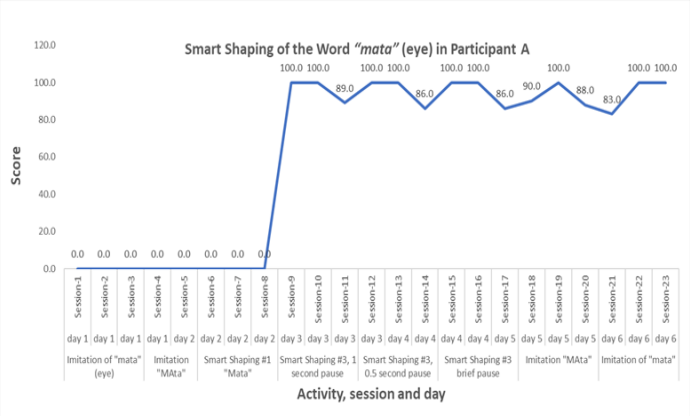
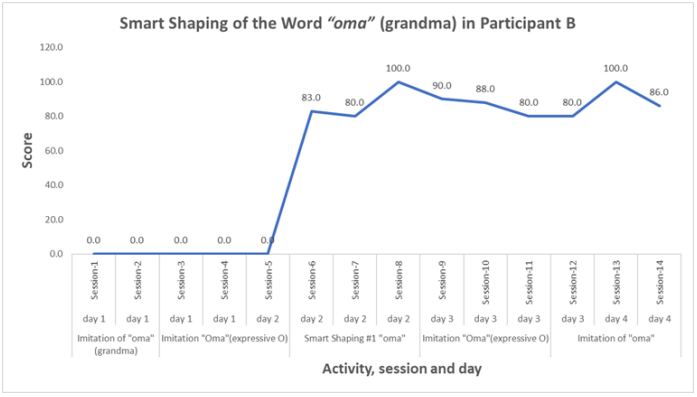


Figure 2 presents the complete implementation of Smart Shaping for Participant A in developing imitation of the word "mata" ("eye"). During the initial word-imitation sessions (Sessions 1–3), the participant was asked to imitate "mata," but the response was incorrect. In the following sessions (Sessions 4-6), the therapist continued word imitation using expressive pronunciation on the problematic syllable, presented as MAta, because the participant's response had been "ata," indicating difficulty in producing the initial syllable "ma." Performance nevertheless remained at 0, showing that the target word had still not been produced correctly despite expressive emphasis on the problematic syllable. Because the participant did not yet produce the target word correctly, Smart Shaping first method was introduced (Sessions 7–8). Performance remained at 0 during this stage, indicating that correct whole-word imitation had not yet emerged. A marked change appeared after the introduction of Smart Shaping third method. Beginning at the 1-second pause stage (Sessions 9–11), the score increased sharply to 100 and remained high across the subsequent 0.5-second pause and brief-pause stages. Across the 1-second pause, 0.5-second pause, and brief-pause stages of Smart Shaping third method, scores ranged from 86 to 100, although some fluctuation was still observed. After successful performance during Smart Shaping third method, the participant returned to word imitation with expressive pronunciation on the problematic syllable, followed by word imitation without expressive pronunciation. Performance remained high across these sessions, indicating continued correct production of the target word.

Participant B exhibited difficulties in pronouncing the word "oma" (grandmother), despite being able to fluently produce the vowel "o" and the syllable "ma." When the therapist delivered the instruction "imitate oma," the participant responded with "mama." Similarly, when the therapist provided expressive instruction emphasizing the vowel "O" ("imitate Oma"), the participant continued to respond with "mama." The Smart Shaping procedure was then conducted with Participant B. Figure 3 shows the results of the implementation of Smart Shaping in Participant B.

Figure 3 presents the complete implementation of Smart Shaping for Participant B in developing imitation of the word "oma" ("grandmother"). During the initial word-imitation sessions (Sessions 1–2), the participant was asked to imitate "oma," but the response was incorrect. In the following sessions (Sessions 3–5), the therapist continued word imitation using expressive pronunciation on the problematic vowel, presented as Oma, because the participant's earlier response to "oma" had been "mama," indicating difficulty in producing the initial vowel "o." Performance nevertheless remained at 0, showing that the target word had still not been produced correctly despite expressive emphasis on the problematic sound. Because the participant did not yet produce the target word correctly, Smart Shaping method 1 was introduced (Sessions 6–8). At this stage, a marked improvement was observed. The score increased to 83 in Session 6, remained high at 80 in Session 7, and reached 100 in Session 8, indicating that correct whole-word imitation emerged during the implementation of Smart Shaping method 1.

Figure 3: Smart Shaping Implementation in Participant B



After successful performance during Smart Shaping, the participant returned to word imitation with expressive pronunciation on the problematic vowel (Sessions 9–12). Performance remained high during this stage, with scores ranging from 80 to 90. The participant then continued to word imitation without expressive pronunciation (Sessions 13–14), and performance remained high, with scores of 100 and 86, respectively. Overall, the data show a clear transition from unsuccessful initial word imitation to high performance following the introduction of Smart Shaping.

Overall, the findings suggest that the Smart Shaping procedure may support improvement in clear word imitation through structured reinforcement and expressive emphasis on problematic syllables, with additional stepwise support when needed. Both participants maintained high performance during the six-week maintenance phase following the intervention. Independent assessment indicated that treatment integrity ranged from 90.0% to 94.4%, suggesting consistent implementation of the Smart Shaping procedure during the intervention.

4. Discussion

This study provides initial support for the use of Smart Shaping in improving clear word imitation in children with ASD who have mastered syllables but continue to experience difficulty integrating them into whole words. The findings indicate that the primary challenge is not mere sound production, but difficulties in phonological integration and articulatory motor coordination during intersound transitions. Mastery of syllables alone does not ensure functional word production without instructional procedures that explicitly target these transitions. This pattern aligns with prior studies documenting articulatory instability, impaired speech motor planning, and difficulties integrating phonological features in children with ASD (Maffei et al., 2024; Medenica & Ivanovic, 2025; Vernay et al., 2014; Zuo et al., 2025). Smart Shaping addresses these challenges through gradual procedures involving adaptive amplification, controlled pauses, and expressive adjustments. The intervention showed flexibility across participants, supporting gradual acquisition in one case and pronunciation

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

stabilization in another, although these findings should be interpreted cautiously given the small-scale design.

ABA research has consistently demonstrated that shaping and successive approximations are effective for establishing new responses, including vocal behavior and verbal imitation, in children with ASD (Grow & LeBlanc, 2013;R. G. Smith & Iwata, 1997). Classical meta-analyses confirm the overall effectiveness of ABA-based interventions but indicate that outcome reporting is often aggregated and emphasizes final performance rather than session-by-session response formation (Makrygianni et al., 2018). Similarly, recent meta-analytic work highlights variability in process transparency, particularly regarding intervention fidelity and supervision (Collins et al., 2025). Reviews of intervention studies further show that outcomes are frequently evaluated across broad time spans without detailing the acquisition of specific verbal units, such as target words or sentences (Choi et al., 2022; García-Gómez et al., 2014; Kasari et al., 2023; Linstead et al., 2017; Meçe & Sherifi, 2022). However, relatively limited attention has been given to single-word formation, response stabilization speed, and instructional strategies addressing sound-combination difficulties. The present study contributes preliminary case-based documentation of word-level intervention processes, which is broadly consistent with calls for more transparent and standardized reporting in verbal intervention research (Bravo et al., 2021; S. M. Peterson, 2024).

A notable feature of Smart Shaping is that it specifically targets situations in which children with ASD are able to imitate syllables but still fail to produce clear whole-word responses. This approach provides explicit procedural rules by regulating the exercise structure, using controlled pauses, and making expressive adjustments to problematic syllables to reinforce the transition between sounds toward intelligible pronunciation. Thus, the therapist obtains concrete guidance on how verbal learning procedures are conducted when word responses have not yet emerged or are not yet stable. This approach provides explicit procedural rules by regulating the exercise structure, using controlled pauses, and making expressive adjustments to problematic syllables to reinforce the transition between sounds toward intelligible pronunciation. Thus, the therapist obtains concrete guidance on how verbal learning procedures are conducted when word responses have not yet emerged or are not yet stable.

These findings are consistent with the view that verbal learning in children with ASD may involve interaction between behavioral principles and cognitive-auditory-motor processes. This framework is in line with neurocognitive findings suggesting that speech imitation involves the integration of auditory input, attention, and motor outputThis framework is in line with neurocognitive findings suggesting that speech imitation involves the integration of auditory input, attention, and motor output (Hamilton, 2013), and contingency-based imitation interventions can strengthen the stimulus verbal response relationship in children with ASD (Ishizuka & Yamamoto, 2021).

The language development literature also suggests that mastery of canonical syllables does not guarantee progress toward word production without a learning procedure that systematically guides syllable integration (McDaniel et al., 2019). Vocal imitation ability has been shown to predict the next development of language (Pittet, Barker, et al., 2022), correlated with advances in expressive communication (De Giacomo et al., 2009), and becomes a critical factor when it does not develop optimally (Ingersoll, 2008). In addition, early phonological deficits are associated with long-term communication barriers (Jokel et al., 2021; Kover et al., 2016), whereas strengthening behavior increases speech production (Chenausky et al., 2018).

Within such frameworks, Smart Shaping may be viewed as an operational extension of gradual learning principles in ABA by facilitating systematic transitions from syllables to words and by documenting micro-acquisition processes, such as response change across sessions and target words, which have not always been described quantitatively in previous ABA studies (Bekmurat & Autayeva, 2025; Budzińska & Wójcik, 2010; Pitts et al., 2019; Veltmeijer et al., 2014).

From a behavioral science perspective, the findings of this study indicate that speech clarity does not emerge spontaneously but results from a gradual operant learning process shaped through systematic interactions between responses and environmental consequences. Within the operant learning framework, verbal behavior is formed through differential reinforcement and progressive adjustment of response criteria rather than natural linguistic maturation alone (Cooper et al., 2020; Skinner, 1957). These principles were operationalized through the Smart Shaping procedure, which manipulated response demands, controlled pauses, and reinforcement contingent on response quality. The findings also suggest that clear word imitation can be treated as a measurable and shapeable dimension of verbal behavior. The acquisition and maintenance patterns observed in the present study are consistent with the role of structured, contextually grounded practice in supporting stable verbal performance in children with ASD (Ingersoll, 2008);(Slocum et al., 2020).

Practically, Smart Shaping provides structured and measurable operational guidance for therapists and parents in speech clarity training for children with ASD. Many intervention reports provide limited detail regarding the number of cycles, duration of skill achievement, or stability of outcomes (Bedmar-Sanz & González, 2025; da Silva Ferreira, 2025; Yoder et al., 2020). This procedure records each child's response, the number of sessions, and the time it takes to achieve success. In this study, it took 9-15 sessions (3-4 days) to overcome the difficulty of pronouncing words in both participants. Session- and time-based recording supports more consistent decision-making when children experience obstacles in pronouncing whole words.

In addition to increasing the transparency of interventions and facilitating clinical supervision, including treatment *integrity* and consistency between therapists, maintenance over six weeks suggests that the acquired verbal performance was sustained across the observed follow-up period. In line with previous findings that emphasized the role of initial response as a predictor of outcomes without detailing verbal learning procedures (Panganiban et al., 2025), Smart Shaping complements the approach by providing clear operational steps to guide the formation of word responses. This approach is consistent with the literature that emphasizes the importance of imitation learning and structured reinforcement in improving verbal production (Ingersoll, 2008; Kroeger & Nelson, 2006), while responding to the latest calls for standardization and quantification of ABA-based interventions (Esposito et al., 2025) .

Smart Shaping appears relevant as an intervention that directly targets the integration of sound components into whole-word responses while supporting greater evaluation transparency in practice. However, several limitations should be noted. The small number of participants, together with the use of one target word per child, limits replication and broader generalization beyond these highly specific cases. *In addition,* formal interobserver agreement for child vocal responses was not calculated, and the outcome was not evaluated through blinded assessment. *Furthermore,* evaluation focused on stability during a six-week maintenance phase; therefore, further research is needed to examine long-term sustainability of intervention effects across diverse contexts and populations.

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

Conclusion

This study provides initial support for the use of Smart Shaping in improving clear word imitation in children with ASD who have already mastered syllables but continue to have difficulty producing clear whole-word responses. The intervention uses systematic, structured, and measurable stages, with each response quantitatively recorded to ensure precise monitoring of skill acquisition. Both participants reached graduation criteria within 9-15 sessions, equivalent to 3-4 days of intervention, and maintained high performance throughout a six-week maintenance phase. These findings suggest that Smart Shaping may function as a structured and data-based procedure for highly specific cases of word-imitation difficulty The study included independent assessment by one Smart ABA practitioner who was not directly involved in the intervention, along with random supervisory review of selected sessions, to support procedural accuracy, response verification, and treatment integrity during implementation. Nevertheless, further replication across participants, target words, and settings is needed to strengthen the broader applicability of the findings.

Acknowledgements: The authors sincerely thank all participants and their parents for their voluntary participation and cooperation in this study. Their commitment and support were essential to the successful implementation of the research.

Competing interests: The authors declare that they have no competing interests.

Funding: This research received no external funding.

References

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., Rahmawati, S., Sutadi, R., Alsa, A., & Yunanto, K. T. (2025). Experiences and Strategies of Competent Smart ABA Therapists in Treating Children with Autism. Pakistan Journal of Psychological Research, 40(2), 351–372. https://doi.org/10.33824/PJPR.2025.40.2.21

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

Barnard-Brak, L., Watkins, L., & Richman, D. M. (2021). Autocorrelation and estimates of treatment effect size for single-case experimental design data. Behavioral Interventions, 36(3), 595–605. https://doi.org/10.1002/bin.1783

Bedmar-Sanz, C., & González, C. N. (2025). Development Of Prelinguistic Skills In A Child With Asd Through Aba-Vb. A Clinical Case. Journal of Psychological and Educational Research, 33(1), 7–29.

Bekmurat, A. T., & Autayeva, A. N. (2025). The Application of Adapted Applied Behavior Analysis Therapy for Developing Lexical and Semantic Skills in Preschool Children with Autism Spectrum Disorder. European Journal of Educational Research, 14(4), 1047–1062. https://doi.org/10.12973/eu-jer.14.4.1047

Bielova, O. B., Dmytriieva, I. V, Milevska, O. P., Dmitriieva, O. I., Chopik, O. V, & Opaliuk, O. M. (2025). Dysfunction of speech mechanisms in children with autism. Child's Health, 20(6), 449–454. https://doi.org/10.22141/2224-0551.20.6.2025.1904

Blair, B. J., & Ledford, J. R. (2022). Visual Analysis in Single-Subject Designs BT - The SAGE Encyclopedia of Research Design (B. B. Frey (ed.)). SAGE Publications. https://doi.org/10.4135/9781071812082.n669

Bravo, A., Schwartz, I. S., & Gilmour, A. F. (2021). Reporting standards in single-case design intervention research: Implications for transparency and replication. Journal of Behavioral Education, 30(4), 706–728. https://doi.org/10.1007/s10864-020-09401-4

Budzińska, K., & Wójcik, G. (2010). The effectiveness of applied behavior analysis in teaching verbal behavior to children with autism. Polish Psychological Bulletin, 41(2), 75–82.

Callejo, D. R., & Boets, B. (2023). Speech-in-noise perception in autism spectrum disorder: A systematic review. Neuroscience and Biobehavioral Reviews, 151, 105207. https://doi.org/10.1016/j.neubiorev.2023.105207

Chenausky, K., Norton, A., Tager-Flusberg, H., & Schlaug, G. (2016). Auditory-motor mapping training for minimally verbal children with autism: A randomized controlled trial. PLoS ONE, 11(11), e0164930. https://doi.org/10.1371/journal.pone.0164930

Chenausky, K., Norton, A., Tager-Flusberg, H., & Schlaug, G. (2018). Behavioral predictors of improved speech output in minimally verbal children with autism. Autism Research, 11(10), 1356–1365. https://doi.org/10.1002/aur.2006

Choi, K. R., Lotfizadah, A. D., Bhakta, B., Pompa-Craven, P., & Coleman, K. J. (2022). Concordance between patient-centered and adaptive behavior outcome measures after applied behavior analysis for autism. BMC Pediatrics, 22(1), 314. https://doi.org/10.1186/s12887-022-03383-2

Collins, I. M., Halter, F., Schächinger Tenés, L. T., Lieb, R., & Meyer, A. H. (2025). A Meta-Analysis of Applied Behavior Analysis-Based Interventions to Improve Communication, Adaptive, and Cognitive Skills in Children on the Autism Spectrum. Review Journal of Autism and Developmental Disorders, 12(1), 1–23. https://doi.org/10.1007/s40489-025-00506-0

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). Applied Behavior Analysis (2 (ed.)). Pearson Education.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). Applied behavior analysis. Pearson UK.

da Silva Ferreira, T. (2025). Programa ABA para pais e o desenvolvimento verbal de crianças com TEA. Ciencias Psicológicas, 19(1), e4030. https://doi.org/10.22235/cp.v19i1.4030

De Giacomo, A., Portoghese, C., Martinelli, D., Fanizza, I., L'Abate, L., & Margari, L. (2009). Imitation and communication skills development in children with pervasive developmental disorders. Neuropsychiatric Disease and Treatment, 5(1), 355–362.

Diehl, J. J., Watson, D., Bennetto, L., McDonough, J., & Gunlogson, C. (2009). An acoustic analysis of prosody in high-functioning autism. Applied Psycholinguistics, 30(3), 385–404. https://doi.org/10.1017/S0142716409090201

Egel, A. L., Barthold, C. H., Kouo, J. L., & Maajeeny, F. S. (2018). Single-Subject Design and Analysis. In The Reviewer's Guide to Quantitative Methods in the Social Sciences: Second Edition (pp. 417–433). https://doi.org/10.4324/9781315755649-31

Esposito, M., Vivanti, G., Rogers, S. J., & Kasari, C. (2025). Toward standardized and quantifiable outcome reporting in applied behavior analysis interventions for autism. Behavior Analysis in Practice, 18(1), 1–16. https://doi.org/10.1007/s40617-024-00892-1

Fadeev, K. A., Romero Reyes, I. V, Goiaeva, D. E., Obukhova, T. S., Ovsiannikova, T. M., Prokofyev, A. O., Rytikova, A. M., Novikov, A. Y., Kozunov, V. V, Stroganova, T. A., & Orekhova, E. V. (2024). Attenuated processing of vowels in the left temporal cortex predicts speech-in-noise perception deficit in children with autism. Journal of Neurodevelopmental Disorders, 16(1). https://doi.org/10.1186/s11689-024-09585-2

Flipsen, P. (2015). Intelligibility of spontaneous speech in children with autism spectrum disorder. Journal of Communication Disorders, 53, 30–40. https://doi.org/10.1016/j.jcomdis.2014.11.001

Forbes, H. J., Wang, Z., & Bennett, E. (2019). Imitation-based interventions for children with autism spectrum disorder: A systematic review. Review Journal of Autism and Developmental Disorders, 6(4), 282–299. https://doi.org/10.1007/s40489-019-00170-4

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

García-Gómez, A., Risco, L., & Martínez-Rico, G. (2014). Behavioral intervention and language development in children with autism: A longitudinal analysis. Psicothema, 26(1), 49–54.

Grow, L. L., & LeBlanc, L. A. (2013). Teaching receptive language skills: Recommendations for instructors. Behavior Analysis in Practice, 6(1), 56–75. https://doi.org/10.1007/BF03391790

Hamilton, A. F. D. C. (2013). Reflecting on the mirror neuron system in autism: A systematic review of current theories. Developmental Cognitive Neuroscience, 3(1), 91–105. https://doi.org/10.1016/j.dcn.2012.09.008

Hill, D. A., Weiss, M. J., & Nguyen, A. (2020). Treatment integrity and procedural fidelity in applied behavior analysis: Implications for practice and research. Behavior Analysis in Practice, 13(2), 262–274. https://doi.org/10.1007/s40617-019-00395-0

Hodge, M., & Wellman, H. (2016). Speech sound production and intelligibility in children with autism spectrum disorder. American Journal of Speech-Language Pathology, 25(1), 32–47. https://doi.org/10.1044/2015_AJSLP-14-0093

Ingersoll, B. (2008). The effect of context on imitation skills in children with autism. Research in Autism Spectrum Disorders, 2(2), 332–340. https://doi.org/10.1016/j.rasd.2007.08.003

Ingersoll, B., & Schreibman, L. (2006). Teaching imitation to children with autism: A focus on generalized imitation. Journal of Autism and Developmental Disorders, 36(6), 781–793. https://doi.org/10.1007/s10803-006-0126-3

Ishizuka, Y., Fujimoto, N., Uruno, S., Aoki, Y., & Noro, F. (2024). Parent-Therapist Collaborative Intervention Model using Contingent Imitation in a Minimally Verbal School-Aged Child with Autism Spectrum Disorder. Child & Family Behavior Therapy, 46(3), 298–325. https://doi.org/10.1080/07317107.2023.2299919

Ishizuka, Y., & Yamamoto, J. (2021). Research in Autism Spectrum Disorders The effect of contingent imitation intervention on children with autism spectrum disorder and co-occurring intellectual disabilities. Research in Autism Spectrum Disorders, 85(March), 101783. https://doi.org/10.1016/j.rasd.2021.101783

Johnson, C. R., Brown, K. A., & Hightower, K. (2017). Differential reinforcement procedures in the acquisition of verbal behavior. Journal of Applied Behavior Analysis, 50(2), 315–329. https://doi.org/10.1002/jaba.370

Jokel, R., Laird, E., & Phinney, A. (2021). Phonological processing deficits and expressive language development in children with autism. Frontiers in Psychology, 12, 624703. https://doi.org/10.3389/fpsyg.2021.624703

Kamenski, A., Müller, N., & Schaefer, R. (2024). Speech motor control and articulatory consistency in children with autism spectrum disorder. Journal of Speech, Language, and Hearing Research, 67(2), 412–428. https://doi.org/10.1044/2023_JSLHR-23-00318

Kasari, C., Shire, S., Paparella, T., & Chang, Y.-C. (2023). Measuring treatment response in autism intervention research: Challenges and directions. Autism, 27(1), 3–15. https://doi.org/10.1177/13623613221110392

Kover, S. T., Edmunds, S. R., & Ellis Weismer, S. (2016). Brief Report: Ages of Language Milestones as Predictors of Developmental Trajectories in Young Children with Autism Spectrum Disorder. Journal of Autism and Developmental Disorders, 46(7), 2501–2507. https://doi.org/10.1007/s10803-016-2756-y

Kratochwill, T. R., Mission, P., & Hagermoser, E. (2015). Single-Case Experimental Designs. The Encyclopedia of Clinical Psychology, 1–12. https://doi.org/10.1002/9781118625392.wbecp304

Kroeger, K. A., & Nelson, W. M. (2006). A language programme to increase the verbal production of a child dually diagnosed with Down syndrome and autism. Journal of Intellectual Disability Research, 50(2), 101–108. https://doi.org/10.1111/j.1365-2788.2005.00734.x

Kuntz, E. M., Lerman, D. C., & Kelley, M. E. (2020). Effects of prompting and differential reinforcement on socially appropriate verbal responding. Journal of Applied Behavior Analysis, 53(1), 86–101. https://doi.org/10.1002/jaba.618

Lane, J. D., & Gast, D. L. (2014). Visual analysis in single case experimental design studies: brief review and guidelines. Neuropsychological Rehabilitation, 24(3–4), 445–463. https://doi.org/10.1080/09602011.2013.815636

Lane, K. L., & Gast, D. L. (2014). Visual analysis in single-case experimental design studies. Remedial and Special Education, 35(1), 24–34. https://doi.org/10.1177/0741932513519820

Leaf, J. B., Leaf, R., McEachin, J., & Taubman, M. (2022). Data-based decision making in applied behavior analysis: From measurement to instructional change. Behavior Analysis in Practice, 15(4), 1141–1154. https://doi.org/10.1007/s40617-022-00663-6

Ledford, J. R., & Gast, D. L. (2018). Single Case Research Methodology: Applications in Special Education and Behavioral Sciences. Routledge.

Linstead, E., Dixon, D. R., Hong, E., Burns, C. O., French, R., Novack, M. N., & Granpeesheh, D. (2017). An evaluation of the effects of intensity and duration on outcomes across treatment domains for children with autism spectrum disorder. Translational Psychiatry, 7(9). https://doi.org/10.1038/TP.2017.207

Lovaas, O. I. (1977). The autistic child: Language development through behavior modification. Irvington Publishers. https://psycnet.apa.org/record/1978-22353-000

Lovaas, O. I. (1987). Behavioral Treatment and Normal Educational and Intellectual Functioning in Young Autistic Children. Journal of Consulting and Clinical Psychology, 55(1), 3–9. https://doi.org/10.1037/0022-006x.55.1.3

Maas, E., Robin, D. A., Austermann Hula, S. N., Freedman, S. E., Wulf, G., Ballard, K. J., & Schmidt, R. A. (2008). Principles of motor learning in treatment of motor speech disorders. American Journal of Speech-Language Pathology, 17(3), 277–298. https://doi.org/10.1044/1058-0360(2008/025)

Maffei, M. F., Chenausky, K. V, Haenssler, A., Abbiati, C., Tager-Flusberg, H., & Green, J. R. (2024). Exploring Motor Speech Disorders in Low and Minimally Verbal Autistic Individuals: An Auditory-Perceptual Analysis. American Journal of Speech-Language Pathology, 33(3), 1485–1503. https://doi.org/10.1044/2024_AJSLP-23-00237

Makrygianni, M. K., Gena, A., Katoudi, S., & Galanis, P. (2018). The effectiveness of applied behavior analytic interventions for children with Autism Spectrum Disorder: A meta-analytic study. Research in Autism Spectrum Disorders, 51(June 2017), 18–31. https://doi.org/10.1016/j.rasd.2018.03.006

McDaniel, J., Woynaroski, T., Keceli-Kaysili, B., Watson, L. R., & Yoder, P. (2019). Vocal communication with canonical syllables predicts later expressive language skills in preschool-aged children with autism spectrum disorder. Journal of Speech, Language, and Hearing Research, 62(10), 3826–3833. https://doi.org/10.1044/2019_JSLHR-L-19-0162

Meçe, D., & Sherifi, E. (2022). Effectiveness of the ABA Method and Individual Education Programs for the Treatment of Autistic Children: A Case Study. Journal of Educational and Social Research, 12(3), 182–190. https://doi.org/10.36941/jesr-2022-0077

Medenica, V., & Ivanovic, M. (2025). Motor planning and execution in autism spectrum disorder: A systematic review. Human Research in Rehabilitation, 9(2), 1–18. https://doi.org/10.21554/hrr.092505

Moraleda-Sepulveda, E., Pulido-García, N., Loro-Vicente, N., & Santos-Muriel, N. (2025). Effectiveness of Intensive Linguistic Intervention in Autism Spectrum Disorder: A Case Study. Children, 12(2). https://doi.org/10.3390/children12020182

Newman, B. (2009a). Shaping vocal behavior in children with autism spectrum disorder. Journal of Applied Behavior Analysis, 42(3), 671–676. https://doi.org/10.1901/jaba.2009.42-671

Newman, B. (2009b). The effects of successive approximations on vocal acquisition in children with autism. Journal of Applied Behavior Analysis, 42(1), 125–130. https://doi.org/10.1901/jaba.2009.42-125

Northcott, S., Simpson, A., Moss, B., Ahmed, N., & Hilari, K. (2018). Supporting people with aphasia to 'settle into a new way to be': speech and language therapists' views on providing psychosocial support. International Journal of Language & Communication Disorders, 53(1), 16–29. https://doi.org/10.1111/1460-6984.12323

Journal of Psychology, Health and Social Challenges
Journal homepage: www.jphasc.com
ISSN ONLINE: 3006-8800/PRINT: 3006-8797

Panganiban, K., Kasari, C., & Bishop, S. L. (2025). Meaningful Determinants of Early Response: Predicting and Characterizing Behavioral Change in Autism Interventions. Autism Research, 18(2), 321–334. https://doi.org/10.1002/aur.3199

Paul, R., Norbury, C. F., & Gosse, C. (2021). Speech intelligibility and functional communication in autism spectrum disorder. Autism Research, 14(5), 927–939. https://doi.org/10.1002/aur.2489

Paul, R., Shriberg, L. D., McSweeny, J. L., Cicchetti, D., Klin, A., & Volkmar, F. R. (2005). Relations between prosodic performance and communication functioning in children with autism spectrum disorders. Journal of Autism and Developmental Disorders, 35(6), 861–869. https://doi.org/10.1007/s10803-005-0021-4

Peterson, S. M. (2024). Improving transparency and accountability in applied behavior analysis intervention research. Behavior Analysis in Practice, 17(1), 1–15. https://doi.org/10.1007/s40617-023-00840-3

Pittet, I., Barker, E. D., & Pasco Fearon, R. M. (2022). Early imitation predicts language development in children with autism spectrum disorder. Autism Research, 15(6), 1176–1188. https://doi.org/10.1002/aur.2701

Pittet, I., Kojovic, N., Franchini, M., & Schaer, M. (2022). Trajectories of imitation skills in preschoolers with autism spectrum disorders. Journal of Neurodevelopmental Disorders, 14(1). https://doi.org/10.1186/s11689-021-09412-y

Pitts, L., Valentino, A. L., & LeBlanc, L. A. (2019). Effects of prompting and reinforcement procedures on vocal verbal behavior. Journal of Applied Behavior Analysis, 52(3), 748–761. https://doi.org/10.1002/jaba.560

Plumb, A. M., & Plexico, L. W. (2013). Autism spectrum disorders and speech intelligibility: A review of the literature. American Journal of Speech-Language Pathology, 22(3), 368–381. https://doi.org/10.1044/1058-0360(2013/12-0098)

Redford, M. A., Kapatsinski, V., & Cornell-Fabiano, J. (2018). Lay Listener Classification and Evaluation of Typical and Atypical Children's Speech. Language and Speech, 61(2), 277–302. https://doi.org/10.1177/0023830917717758

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). Experimental and Quasi-experimental Designs for Generalized Causal Inference. Houghton Mifflin.

Skinner, B. F. (1953). Operant Behavior, Reinforcement, Shaping, Stimulus Control, and Extinction. In Science and Human Behavior (pp. 59–130). Macmillan.

Skinner, B. F. (1957). Echoic Behavior. In Verbal Behavior (1st ed., pp. 55–81). Appleton-Century-Crofts. https://psycnet.apa.org/record/1958-05915-000

Slocum, T. A., Detrich, R., Wilczynski, S. M., Spencer, T. D., & Lewis, T. (2020). Standards of Evidence and Measurement in Behavior-Analytic Intervention Research. Behavior Analysis in Practice, 13(2), 448–464. https://doi.org/10.1007/s40617-020-00430-0

Smith, R. G., & Iwata, B. A. (1997). Use of shaping to establish stimulus control in the treatment of behavior disorders. Journal of Applied Behavior Analysis, 30(1), 103–118. https://doi.org/10.1901/jaba.1997.30-103

Smith, T. (2001). Discrete Trial Training in the Treatment of Autism. Focus on Autism and Other Developmental Disabilities, 16(2), 86–92. https://doi.org/10.1177/108835760101600204

Spinks, H. M., Falcomata, T. S., & Spinks, E. M. (2023). An evaluation of a multi-component intervention for loud speech among children with autism spectrum disorder. Behavioral Interventions, 38(2), 1–15. https://doi.org/10.1002/bin.1931

Veltmeijer, M., Hendriks, P., & Krahmer, E. (2014). The role of assessment-based intervention in early language development of children with autism. Research in Developmental Disabilities, 35(9), 2081–2092. https://doi.org/10.1016/j.ridd.2014.05.019

Vernay, F., Marrone, T., & Roussey, J.-Y. (2014). Facilitate speech in non-verbal children with autism. ANAE - Approche Neuropsychologique Des Apprentissages Chez l'Enfant, 26(129), 169–177. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84904638830&partnerID=40&md5=79351258febe2103a0517942e0edce10

Vogindroukas, I., Stankova, M., Chelas, E.-N., & Proedrou, A. (2022). Language and Speech Characteristics in Autism. Neuropsychiatric Disease and Treatment, 18, 2367–2377. https://doi.org/10.2147/NDT.S331987

Wang, L., Pfordresher, P. Q., Jiang, C., & Liu, F. (2021). Individuals with autism spectrum disorder are impaired in absolute but not relative pitch and duration matching in speech and song imitation. Autism Research, 14(5), 942–954. https://doi.org/10.1002/aur.2569

Wolfe, K., Barton, E. E., & Meadan, H. (2019). Systematic Protocols for the Visual Analysis of Single-Case Research Data. Behavior Analysis in Practice, 12(2), 491–502. https://doi.org/10.1007/s40617-019-00336-7

Xiao, B. (2019). Imitation and language development in children with autism spectrum disorder: A review. Journal of Autism and Developmental Disorders, 49(2), 640–656. https://doi.org/10.1007/s10803-018-3738-7

Yoder, P. J., Bottema-Beutel, K., & Woynaroski, T. (2020). One-on-one interventions for minimally verbal children with autism: A systematic review. Journal of Speech, Language, and Hearing Research, 63(3), 889–905. https://doi.org/10.1044/2019_JSLHR-19-00225

Zuo, M., Zhang, Y., Wang, R., Huang, D., Yu, L., & Wang, S. (2025). Discrimination and Integration of Phonological Features in Children with Autism Spectrum Disorder: An Exploratory Multi-Feature Oddball Protocol. Brain Sciences, 15(9). https://doi.org/10.3390/brainsci15090905